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PALEONTOLOGICAL MONITORING COMPLIANCE REPORT FOR THE METRO

PURPLE LINE EXTENSION EXPLORATORY SHAFT PROJECT

LOS ANGELES, LOS ANGELES COUNTY, CALIFORNIA

Submitted to:

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ABSTRACT

This Paleontological Monitoring Report (PMR) reviews the results of the paleontological monitoring of the Los Angeles County Metropolitan Transportation Authority (Metro) Purple Line Subway Extension (PLE) Wilshire and Fairfax Exploratory Shaft (Project). Monitoring of drilling activities and shaft excavation occurred from April 15, 2013 to March 22, 2014. Monitoring occurred for all excavations from 5 ft. below surface through to the base of the shaft. Personnel documented monitoring and fossil recoveries on the appropriate paperwork; all of which is included in the administrative record for the project.

Fossils and field number locations were documented according to the Paleontological Mitigation Plan. A total of 4479 invertebrate, vertebrate, plant, pollen, foraminifera, and nannofossils specimens were identified and assigned to 32 field numbers. These field numbers were later grouped into 11 project localities based on elevation. All but one fossil were collected from the mid to late Pleistocene (~330,000 year old) San Pedro Formation and mostly from unit 16U. A single freshwater clam (*Anodonta californiensis*) was collected from the late Pleistocene (10,000-~45,000 year old) Quaternary older alluvium.

Foraminifera were recovered from 3 samples and only the one collected at 49.5-50.3 ft. deep (116-115.3 ft. elev.) produced 174 specimens. Although the taxa recovered indicate an age of early Pliocene to early Pleistocene (2.25-5 million years old) the numerous environments represented by the taxa (shallow marine to basinal) suggested to Zippi (2014 p. 5) that the sediments were from an offshore basin with channelized turbiditic sediments. During field observations, these sediments (Level 12, unit 1) were assigned a near-shore marine environment with rip up clasts (chunks of finer grained sediments pulled from older deposits). Finer grained sediments typify deeper marine environments and southern California's history at the time included local uplift and the infilling of our marine basins. The only deeper marine macrofossil, the trench tusk shell (*Dentalium vallicolens*) was also recovered from this deposit.

The types of pollen recovered were not useful for determining the age of the sediments. The largest component of the pollen was pine with 116 specimens. Cypress (62 specimens) and oak (39 specimens) were the next most abundant. Only Mormon tea indicated a specific environment which was creosote bush scrub <3,600 ft. in elevation. The rest of the taxa recovered are common in many of California's ecosystems.

The presence of hickory (*Carya* spp.) which went extinct in California by the end of the Miocene (5 million years ago) suggests contamination of the 40.3-41 ft. deep (124.0-124.7 ft. elev.) and the 49.5-50.3 ft. deep (116-115.3 ft. elev.) samples by older sediments. Both samples had frags of Monterey Formation shale which was deposited between 17 and 5 million years ago and could have been the source of the hickory pollen.

The conifers identified from larger specimens occur only in coastal California as relict (last remaining) populations due to specific environmental needs. Today the most restricted conifers (Monterey cypress and Torrey pine), only inhabit locations on coasts with cool summers with a mean summer high temperature of 70-83ºF (21.1-28.3ºC), average precipitation of 10.59-32.41" (26.90-82.32cm). These sites all receive significant summer fog and cold water upwellings due to submarine canyons adjacent to the shore.

Invertebrates recovered are typical of the San Pedro Formation. Aside from one specimen of a Princep's slipper snail (*Crepidula princeps*) all taxa recovered are alive today. Additionally all taxa were present from at least 5 million years ago on, making an earliest age for these sediments indeterminate. Using the

modern ranges of the invertebrates recovered, the environmental analysis indicates shallow marine conditions, primarily between intertidal and 50 m deep. Of the fauna that had temperature information, temperatures correspond well to those found along the coast of California today with 62% requiring ocean temperatures of at least 12.0ºC to survive, classifying this as a temperate marine fauna.

Vertebrates recovered were limited to bat ray tooth plates, a marine mammal rib, and an as yet unidentified large terrestrial mammal pelvic fragment.

Detailed stratigraphic columns were recorded for all four walls of the Exploratory Shaft. Sediments are attributed to recent (<100 years old) artificial fill, Quaternary alluvium (Holocene; <10,000 years old), Quaternary older alluvium (late Pleistocene; ~10,000 to 45,000 years old), and mid to late Pleistocene (45,000 - 330,000 years old) San Pedro Formation. Quaternary alluvial sediments were deposited in stream and lake paleoenvironments and were present in the upper 20 ft. or so of the exploratory shaft. A poorly developed ancient soil at ~147 to145 elevation (~19-21 ft. depth) marked the boundary between the alluvium and the San Pedro Formation. The depositional environment of the San Pedro Formation generally transitioned from nearshore marine to intertidal/beach environment with depth. The lower 20 ft. of the shaft had more invertebrate fossils and wood than above. A highly fossiliferous bed containing the uppermost occurrence of Pacific gaper clams in the shaft and evidence that the sediments were washed out of an estuary during a flash flood was used as the upper marker bed for this primarily nearshore marine unit. Near the base of the cut, terrestrial mud with preserved roots was present between layers of intertidal sediments. Brownish black and black coloration of the sediments at depth is due to asphalt contamination.

Interpretations. All except one of the fossils recovered came from the near-shore marine San Pedro Formation. The majority of fossils recovered were invertebrates, primarily clams, snails and tusk shells. Vertebrate remains were rare and consisted of ray teeth, a large marine mammal rib fragment, and a terrestrial mammal pelvis fragment.

Although samples were collected for dating analysis using first and last appearances of taxa, the results were unhelpful as the majority of pollen, foraminifera and nannoplankton seem to have been washed in from older, deeper marine sediments. We know this because some of the taxa were from deeper marine environments and the marine sediments of the shaft were all nearshore, and we never encountered either the 665,000 year old Lava Creek Ash or the 760,000 year old Bishop Ash that had been seen in cores of Hancock Park (Figure 3; Quinn et. al, 2000). This puts an age of less than 665,000 years on all of the material recovered from the shaft.

Some of the most unique fossils recovered were the plants. The presence of Monterey cypress, Monterey Pine, and Torrey pine allows for a climactic interpretation of the area. Climate where relict populations persist are characterized by cool, moist summers with abundant sea fog and cool, damp winters with good rainfall. In California this is within a coastal montane chaparral and woodlands ecoregion. The specimens of Monterey cypress from the shaft are only the third fossil record of this species, although the other two are from Rancho la Brea in Los Angeles and mid to late Pleistocene deposits in Costa Mesa, California. These fossils were recovered from 560 miles south of the current stands of Monterey cypress. For other plants, manzanita and oak were recovered as seeds and leaf imprints.

Invertebrates recovered included cniderians, annelid worm tubes, barnacles, crabs, snails, bivalves, tusk shells, sand dollars and bryozoans. Using the modern ranges of the invertebrates recovered, the environmental analysis indicates shallow marine conditions, primarily between intertidal and 50 m deep. Of the fauna that had temperature information, temperatures correspond well to those found along the coast of California today with 62% requiring ocean temperatures of at least 12.0ºC to survive, classifying this as a temperate marine fauna.

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LIST OF ABBREVIATIONS

B.A. - Bachelors of Arts
B.S. - Bachelors of Science
elev. - elevation
Fm. - Formation
FPL - Forest Products Laboratory United States Department of Agriculture
ft. – foot
GPS - Global Positioning System
M.A. - Masters of Arts
Metro - Los Angeles Metropolitan Transit District
MOU - Memorandum of Understanding
M.S. - Masters of Science
NHMLA - Natural History Museum of Los Angeles County
PLE - Los Angeles County Metropolitan Transportation Authority Purple Line Subway Extension
PMR - Paleontological Monitoring Report
PRMMP - Paleontological Resources Monitoring and Mitigation Plan
Project - Metropolitan Transportation Authority Purple Line Subway Extension Project, Wilshire and Ogden Exploratory Shaft
RLB - Rancho la Brea
spp. - one of multiple potential species
UCMP - University of California Museum of Paleontology
UCR - University of California at Riverside Herbarium Collections

^{0}C - degrees Celsius
^{0}F - degrees Fahrenheit

cm – centimeter(s)
elev. - elevation
m – meter(s)
mm – millimeter(s)

Jan - January
Feb - February
Mar - March
Apr - April
Jun - June
Jul - July
Aug - August
Sept - September
Oct - October
Nov - November
Dec - December

INTRODUCTION

PURPOSE OF DOCUMENT

This Paleontological Monitoring Report (PMR) reviews the results of the paleontological monitoring of the Los Angeles County Metropolitan Transportation Authority (Metro) Purple Line Subway Extension (PLE) Wilshire and Fairfax Exploratory Shaft (Project).

PROJECT LOCATION AND DESCRIPTION

The Project is located at the south western corner of Wilshire and Ogden in the Miracle Mile District of Los Angeles, California (Figure 1, 2). Excavations of an 18 ft. by 36 foot (ft.) shaft extended from the surface to 75 feet (ft.) down. This shaft was excavated in order to determine the characteristics of the asphalt-rich sediments at depth to assist in planning and executing the construction of the main station.

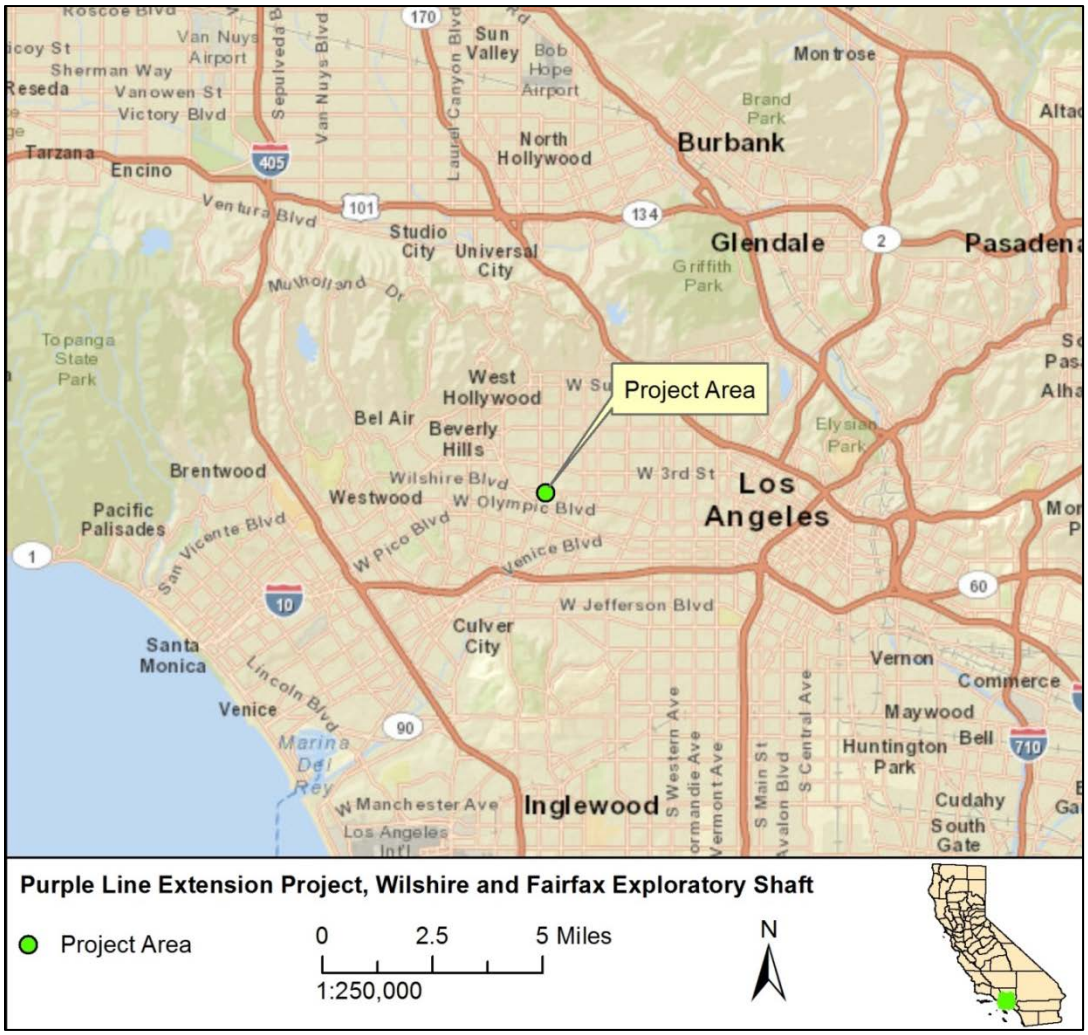


Figure 1. Project Vicinity

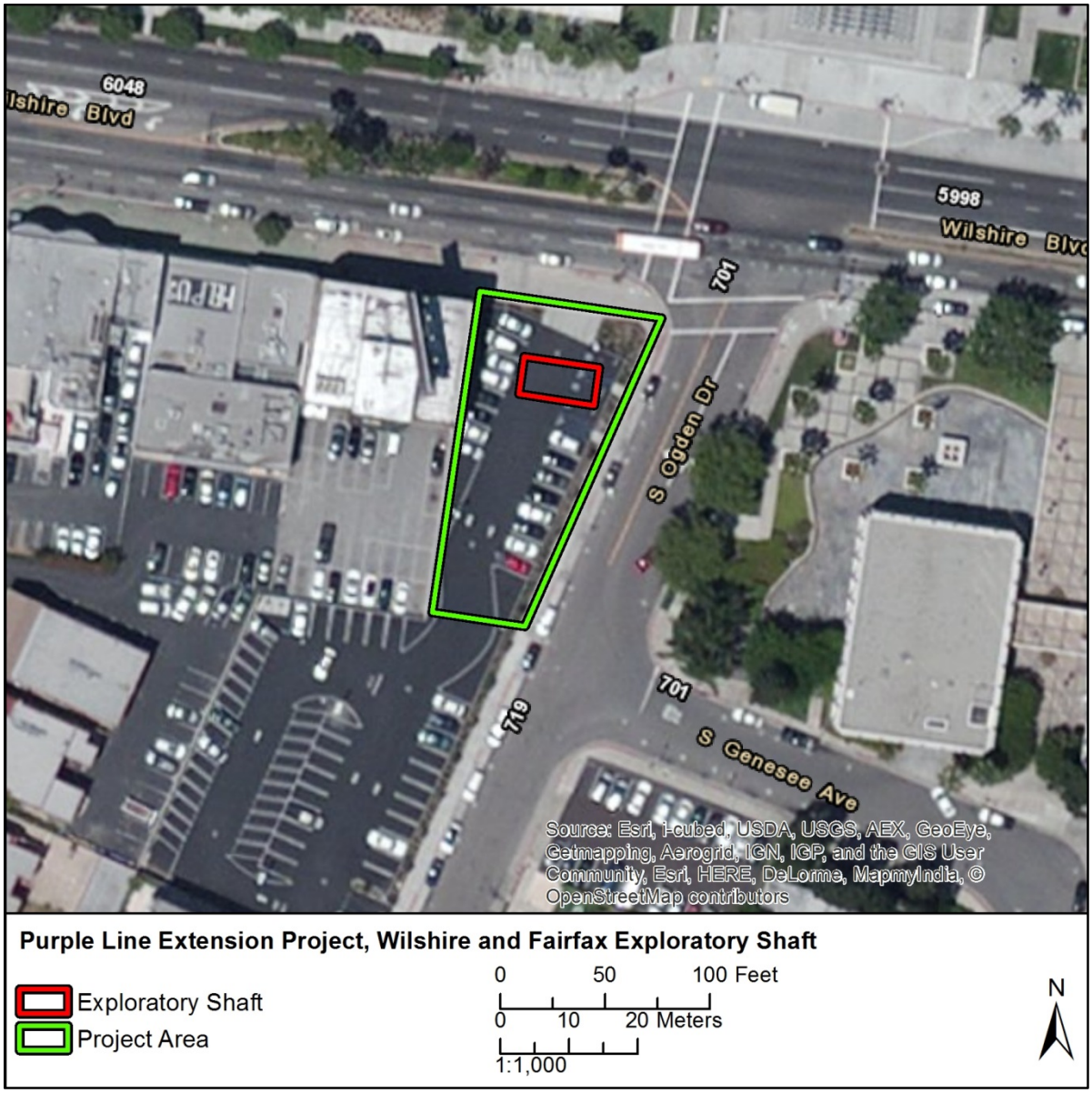


Figure 2. Location Map

PALEONTOLOGICAL RESOURCES MONITORING AND MITIGATION PLAN

Specifications for monitoring, fossil treatment and data recovery as described in the Paleontological Resources Monitoring and Mitigation Plan (PRMMP; Gust 2012, 2014) were followed for all recovered materials from this Project (see Methods Section 3).

PROJECT PERSONNEL

Cogstone Resource Management Inc. performed the paleontological services for the Project in 2013 and 2014 (Table 1). Sherri Gust, M.S., prepared portions of this report and supervised the project. Gust is a Qualified Principal Paleontologist with more than 35 years of experience in cultural resources management and consulting in California. She earned a Bachelor's degree in Anthropology (Physical) from the University of California at Davis and Master's in Anatomy (Evolutionary Morphology) from University of Southern California. Gust is Metro's principal paleontologist for the PLE.

Table 1. Cogstone Staff and Roles

Last	First	Position	Field Crew	Lab Crew	Initials used in Field Numbers	Degree	Years' Experience
Ader	Bethany	Technician	x	x	BRA	B.S.	5
Duke	Holly	Technician	x	---	---	B.A.	3
Gust	Sherri	Principal Investigator	PI	PI	---	M.S.	35
Porras	Lindsay	Technician	---	x	---	B.A.	5
Richards	Courtney	Assistant Director	x	x	CDR	M.S.	3
Scott	Kim	Director	x	x	KMS	M.S.	19
Simmons	Andre	GIS Technician	---	x	---	B.A.	3
Tabencki	Michelle	Technician	x	---	MUT	B.A.	2
Valle	Trevor	Technician	x	---	TSV	B.S.	8
Valasik	Molly	GIS Supervisor	---	x	---	M.A.	8

Kim Scott, M.S., served as senior field supervisor, lab supervisor, monitor, recorded and prepared portions of the stratigraphic columns, and wrote portions of this report. She has a Master's in Biology with an emphasis in Paleontology from the California State University at San Bernardino, and a Bachelor's degree in Geology with an emphasis in Paleontology from the University of California, Los Angeles. Additionally Ms. Scott has over 19 years of experience in California paleontology and geology.

Courtney Richards, M.S., served as assistant field supervisor, monitor, recorded and prepared portions of the stratigraphic columns and wrote portions of this report. She has a Master's in Biological Sciences with a paleontology focus at Marshall University, and a Bachelor's degree in Earth and Space Science at the University of Washington and over 3 years of experience in California paleontology and geology.

Bethany Ader, Holly Duke, Michelle Tabencki, and Trevor Valle also served as paleontological monitors. Additionally Bethany Ader and Lindsay Porras prepared the fossils recovered. All Cogstone field personnel used for this project have degrees and experience in paleontology or degrees in archaeology or anthropology and a minimum of 16 hours of cross-training in paleontology. Short resumes of Cogstone senior staff appended (Appendix A).

Fossil identifications were done by experts for each group. Lindsey Groves of the Natural History Museum of Los Angeles County (NHMLA) identified the invertebrates, while Dr. Larry Barnes and Dr. Sam McLeod (NHMLA), Chris Shaw, Gary Takeuchi and Shelly Cox of Rancho la Brea (RLB), identified the vertebrates. Cones and seeds were identified at the University of California at Riverside Herbarium Collections (UCR) by Andrew Sanders of UCR and Kim Scott of Cogstone. Wood samples

were identified by the Forest Products Laboratory United States Department of Agriculture (FPL) in Madison, Wisconsin. Pollen and marine plankton identifications were made by the staff of Biostratigraphy.com in Garland, Texas.

FIELD AND LABORATORY METHODS

FIELDWORK DATES AND MONITORING

Monitoring of drilling activities and shaft excavation occurred from April 15, 2013 to March 22, 2014 (Appendix B). Monitoring occurred for all excavations from 5 ft. below surface through to the base of the shaft. Although the excavation began as a single shift, the schedule required a second shift as the project progressed to 16 hour days from 6 am to 10 pm. A supervisor was present as a part-time monitor and to record the stratigraphy of the shaft. Personnel documented monitoring and fossil recoveries on the appropriate paperwork; all of which is included in the administrative record for the project. No monitoring was required on days where no excavation occurred, however occasionally stratigraphy recording would take place on those days.

FOSSIL RECOVERY

As the fossils present were typically in good condition, most fossils were just recovered without any special procedures other than the occasional gluing. One 10 ft. long tree branch required a wood plank, Tyvek, and tape for support for removal and transport.

Matrix samples were collected from every 5 ft. level of the San Pedro Formation for chronostratigraphy using the pollen and ancient marine plankton present. All fossils and sediment samples were accompanied by a field tag with project and site information including a unique field number. Cogstone field numbers have the following format: year, person's initials, month, date, period and discovery number for that day. For example 2014_02_19.4KMS was discovered in 2014 by Kim Scott on February 19th and was the fourth discovery of the day. Heavy equipment and additional personnel were provided by the contractor ICS to assist in moving heavy samples and in excavating large pieces of wood.

FIELD DOCUMENTATION

Due to the tight conditions of the 18 ft. x 36 ft. excavation, it was not always possible to monitor the cut and instead the monitor watched the material being dumped in the hopper for haul out. Because the exact location was unknown for many fossils, the fact that many fossils occurred in concentrations of a bed or beds, and the lack of global positioning system unit (GPS) in the shaft (the unit was not intrinsically safe and the amount of satellite bounce from the local topography would have made any data worthless) exact placement of most fossils were not recorded for the thousands of invertebrate and plant fossils recovered. Instead the entire bed(s) were given a single field number over the entire shaft and when more specific data was taken for a fossil it was recorded separately.

Due to the limit on non-intrinsically safe equipment and the local topography causing errors in the GPS readings, x and y data of special fossils were taken using a Brunton compass and tape from at least 2 of the pilings. Elevations were recorded using a sight level and rod from elevations placed on the wall by ICS. Detailed lithologies using Munsell Soil Color charts and standard sediment grain size measurements were recorded and paleoenvironmental interpretations were made for the entire shaft as part of the stratigraphy for every level (Appendix C). The data was recorded both on a fossil recovery sheet and a tag to stay with the fossil.

As part of the stratigraphy, every level was also photographed in detail. Each bay between pilings was mapped on graph paper. Elevation of bed contacts were determined using the information provided from ICS along with a sight level and measuring rod. Detailed lithologies were taken as described above and paleoenvironments were determined for each bed. Columns were digitized in Adobe Acrobat Elements. When beds were cut by pilings, an attempt was made to track each bed from one bay to the next and document this in the digitized version (Appendix C).

In compliance with the Memorandum of Understanding with the Natural History Museum of Los Angeles County including the Page Museum at the La Brea Tar Pits (Museum) as outlined in Gust (2012), all field notes were recorded as fillable PDF format documents and transferred to the Museum and Metro for their records on a monthly basis. A copy of this report shall accompany the fossils with the Deed of Gift to the Museum.

FOSSIL PREPARATION

The fossils recovered were all saturated in asphalt and required cleaning in the same degreaser (n, propyl bromide "Gentech") as is used for fossils at Rancho la Brea. Sometimes asphalt removal involved using dental tools and a toothbrush, while other times the fossils were placed in a wire mesh screen in the degreaser and removed once the fossils were clean. Some fossils also required gluing using a thin cyanoacrylate (superglue). Harder sediments necessitated use of a miniature jackhammer, called a zip-scribe. A 0.5 – 3 mm sized tool of carbide steel is used as the tip of the zip-scribe to remove sediment hardened on delicate fossils.

IDENTIFICATION

Specialists were used to identify the fossils recovered. Lindsey Groves of the Natural History Museum of Los Angeles County (NHMLA) identified the invertebrates, while Dr. Larry Barnes and Dr. Sam McLeod (NHMLA), Chris Shaw, Gary Takeuchi and Shelly Cox (RLB), and Sherri Gust (Cogstone) identified the vertebrates. Cones and seeds were identified at the University of California at Riverside Herbarium Collections (UCR) by Andrew Sanders of UCR and Kim Scott of Cogstone. Wood samples were identified the Forest Products Laboratory United States Department of Agriculture (FPL) in Madison, Wisconsin. Pollen and marine plankton identifications were made by Dr. Pierre Zippi of Biostratigraphy.com in Garland, Texas.

PHOTOGRAPHY AND CATALOGING

A representative selection of every species of large fossil recovered was photographed after the fossils were identified. A catalog of the data for the fossils was prepared once they had been identified (Appendix D).

PALEONTOLOGICAL SETTING

The paleontological context prepared for the present study is based on information from Gust (2012, 2014), Harris and Jefferson (1985), Powell and Stevens (2000), Quinn et al (2000), and tarpits.org as well as stratigraphic columns recorded from the excavation (Appendix B).

GEOLOGY

Site geology consisted of recent artificial fill overlying Quaternary younger alluvium, Quaternary older alluvium (unit "W"), and finally the San Pedro Formation (units "BU" and "16U") sediments. Quinn et al. (2000) chronostratigraphy units were assigned to formations as they best fit based on their age and geologic framework (Figure 3).

ARTIFICIAL FILL

Discontinuous deposits of artificial fill were present at the surface ranging from 6 to 8 ft. thick. These sediments were imported from other locations for past construction purposes. It generally consisted of silty sand, silt, clay and gravel of varying colors. Trash in the form of metal and occasionally pavement asphalt were also present.

QUATERNARY YOUNGER ALLUVIUM AND FAN DEPOSITS

These sediments are Holocene in age (less than 11,000 years old) and were deposited by streams flowing over the project area. Sediments were typically greyish to yellowish brown sand, silt and clay and ranged from the base of the artificial fill to approximately 11 ft. deep. Much of the unit was saturated with asphalt from the nearby oil field. Paleoenvironments present included stream, overbank, and debris flow deposits with a marsh or lake.

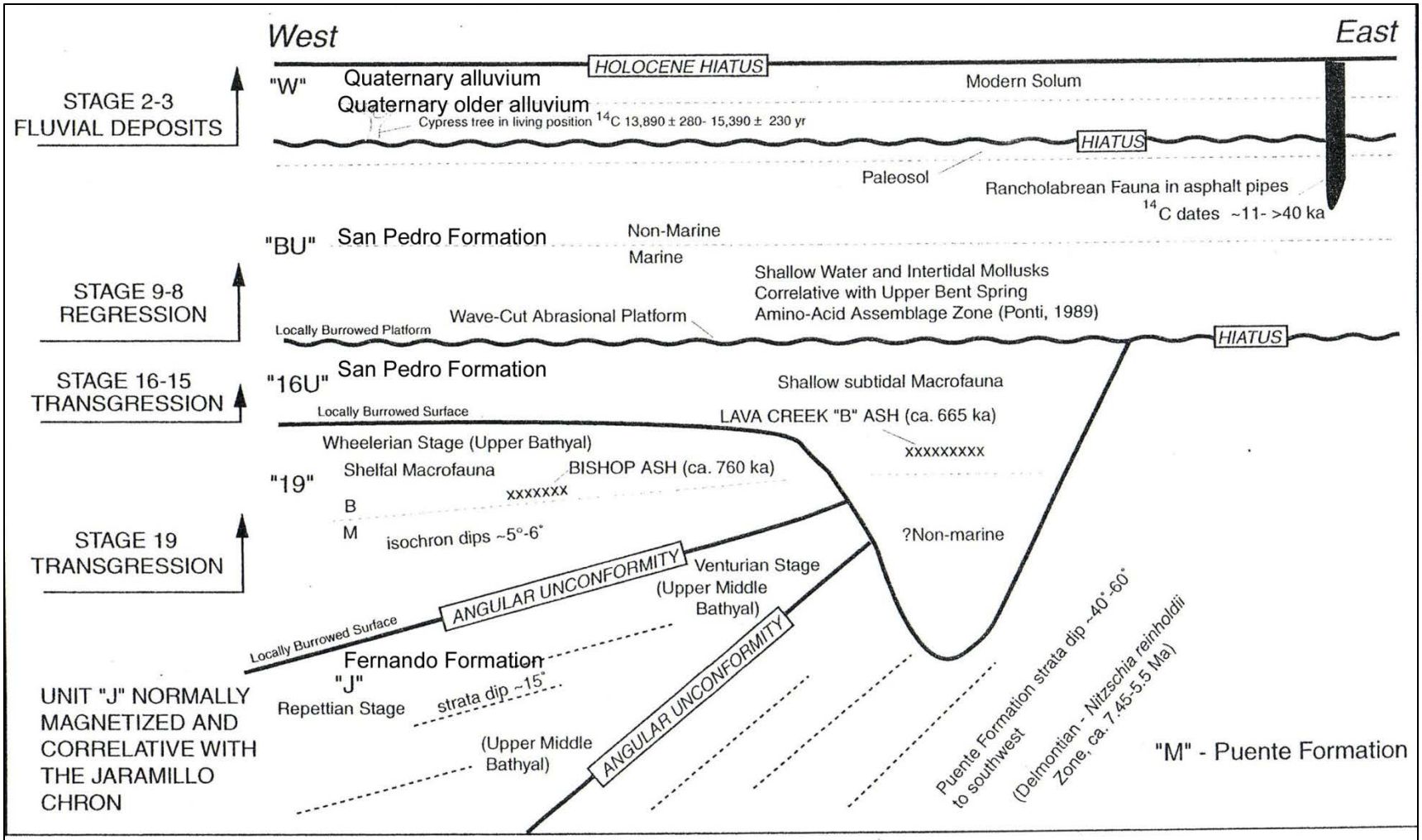
QUATERNARY OLDER ALLUVIUM AND FAN DEPOSITS

These sediments are late Pleistocene in age (50 to 11 thousand years old) and were also deposited by streams flowing over the project area. The sediments consisted greenish grey to black layered silt sand, clay, silty clay and ranged from the base of the Quaternary alluvium at 11 ft. to approximately 21 ft. deep. Much of the unit was saturated with asphalt from the nearby oil field. Paleoenvironments present included stream with marsh or lake deposits.

SAN PEDRO FORMATION

The marine (mid to late Pleistocene (1 million to 50 thousand years old) San Pedro Formation is found from approximately 21 ft. deep to the base of the shaft and is divided into units BU and 16U. All of these sediments were saturated with asphalt from the nearby oil field. The upper unit (BU) was capped by an ancient soil (paleosol) of poorly sorted silts and sands infused with 40-50% oxidized asphalt. Asphalt "oxidizes" in air as the more volatile hydrocarbons evaporate and the asphalt hardens. Below the paleosol, BU consisted of poorly fossiliferous, primarily nearshore marine, silts, sands, pebbles and occasionally cobbles. Many pebbles in the upper 10-15 ft. of the unit are highly polished from nearshore winnowing environments and surf. Silts and sands were frequently interfingered in planar laminations, cross-laminations, or small tabular crossbeds and bioturbation is common. The base of unit BU was placed at a depth of approximately 50 ft. below surface.

Unit 16U comprised the lower 20 ft. of the shaft and is described as having more invertebrate fossils then unit BU as well having wood (Quinn et al. 2000). A highly fossiliferous bed containing the uppermost occurrence of Pacific gaper clams (*Tresus nuttallii*) in the shaft and evidence that the sediments were washed out of an estuary during a flash flood was used as the upper marker bed for this primarily nearshore marine unit. Most of the sediments consisted of silts, sands, and some pebbles and cobbles. Overall there are more and larger cobbles in this unit when compared to unit BU. Beach pebble and mature sand deposits, as well as nearshore marine structures of trough crossbedding from submarine channels were present. At the base of the shaft in unit 16U were a number of tree roots clusters in growth position with the clusters spaced 8-10 ft. apart. When the trees were living, the sediments were far enough above the ocean that the trees could grow. Once the ocean covered the area, the trees died and the roots were topped off. Pacific gaper clams were found burrowing into some of the roots once the ocean covered this portion of the land.



Diagrammatic relationship of stratigraphic units recognized in Hancock Park - Wilshire Boulevard - Fairfax Avenue area, La Brea plain, northern shelf, Los Angeles basin. Symbols: B- Brunhes; M - Matuyama; ka, thousand years; Ma, million years. Stages refer to either Oxygen-isotope or benthic foraminiferal stages.

From Quinn et al. 2000, p.12

Figure 3. Subsurface Geology of Hancock Park

FOSSIL LOCALITIES

Fossils and field number locations were documented according to the Paleontological Mitigation Plan (Gust 2012). A total of 4479 invertebrate, vertebrate, plant, pollen, foraminifera, and nannofossils specimens were identified and assigned to 32 field numbers. These field numbers were later grouped into 11 project localities based on elevation as some of the material was recovered from the pilings and others from the shaft excavation (Table 2). All but one fossil was collected from the mid to late Pleistocene (~330,000 year old) San Pedro Formation. A single freshwater clam (*Anodonta californiensis*) was collected from the late Pleistocene (10,000-~45,000 year old) Quaternary older alluvium.

Table 2. Stratigraphy of Localities

Locality Number	Elev. Ft	Depth Ft	Field Locality Numbers
Quaternary older alluvium, unit "W"			
1	143.9	22	2013_07_12_TSV.1
San Pedro Formation, unit "BU"			
2	135.2 to 133.17	30.7 to 32.7	2013_12_04_KMS.1; 2013_12_04_KMS.2
3	128.8	37	2013_12_14_BRA.1
4	124.7 to 124	40.3 to 41	2013_12_21_BRA.1
5	120.4 to 117	44.6 to 48.9	2014_01_08_BRA.1; 2014_01_09_BRA.1
San Pedro Formation, unit "16U"			
6	117.5 to 112.5	48 to 53	2013_04_19_CDR.1; 2013_06_25_BRA.1; 2013_08_01_BRA.1; 2014_01_22_BRA.1; 2014_01_24_BRA.1
7	109.5 to 108	56 to 56.5	2014_01_31_BRA.1
8	105.8 to 105.3	59.8 to 60.6	2014_02_08_BRA.1; 2014_02_08_BRA.2; 2014_02_14_KMS.1
9	101 to 100.5	64 to 65.4	2013_08_02_BRA.2; 2013_08_20_CDR.1; 2014_02_24_BRA.1; 2014_03_06_BRA.1
10	99 to 94.5	66.9 to 71.4	2013_06_25_BRA.2; 2014_02_25_KMS.1
11	95.9 to 90	70 to 75.9	2013_06_21_BRA.1; 2013_06_24_BRA.1; 2013_07_12_TSV.2; 2013_07_31_BRA.2; 2013_08_21_CDR.1; 2014_03_19_BRA.1; 2014_03_20_BRA.1

Locality 1; Quaternary older alluvium
One freshwater mussel fossil (*Anodonta californiensis*) was identified. The fossil was recovered from Quaternary older alluvial deposits consisting of black, very fine to coarse silty sand. It was found during drilling for P1 from an elevation of 143.9 ft. and a depth of 22.0 ft. (Appendix D). Original field number – 2013_07_12_TSV.1 from Piling 1.

Locality 2; San Pedro Formation, unit BU
Three pollen specimens belonging to pine, grass, and an unidentified pollen grain were identified from a sample collected for palynology, foraminifera, and nannofossil analyses (Table 3; Appendix G). Sediments consisted of black, well indurated, well sorted, fine to very coarse sand with accessory cobbles; dark reddish brown silt to coarse sand; and black, very fine to coarse silty sand from a nearshore marine environment. Material was recovered from elevations between 135.2 and 133.17 ft. and depths of 30.7 to 32.7 ft. (Appendix D). Original field numbers – 2013_12_04_KMS.1 and 2013_12_04_KMS.2 adjacent to Piling 2.

Locality 3; San Pedro Formation, unit BU
A total of 16 specimens of pollen were identified from a sample collected for palynology, foraminifera, and nannofossil analyses. Pollen was from cypress, pine, oak, and miscellaneous other fungal, plant, and dinoflagellate sources (Table 3; Appendix G). Sediments consisted of brownish black, moderately to well indurated, well sorted, very fine to coarse sand from a nearshore marine environment. The sample was collected from an elevation of 128.8 ft. and a depth of 37 ft. (Appendix D). Original field number – 2013_12_14_BRA.1 adjacent to Piling 2.

Locality 4; San Pedro Formation, unit BU
A total of 21 specimens of pollen were identified from a sample collected for palynology, foraminifera, and nannofossil analyses. Pollen was from cypress, Mormon tea, pine, goosefoot, oak, hickory and miscellaneous other sources (Table 3; Appendix G). Sediments consisted of brownish black, poorly to moderately indurated, poorly sorted pebbly sand from a nearshore marine environment. The sample was collected from elevations between 124.7 and 124 ft. and a depth of 40.3 to 41 ft. (Appendix D). Original field number – 2013_12_21_BRA.1 adjacent to Piling 2.

Locality 5; San Pedro Formation, unit BU
A total of 21 specimens of pollen from cypress, pine, goosefoot, oak, bayberry, grass, and miscellaneous other sources, as well as one foraminifera were identified from a sample collected for palynology, foraminifera, and nannofossil analyses (Table 3; Appendix G). One Torrey pine seed and 189 invertebrate specimens, including snails, clams, mussels, scallops, and tusk shells were recovered during excavation. A sample consisting of 5 worm burrow traces was also collected. Sediments consisted of brownish black, poorly to moderately indurated, poorly sorted pebbly sand to silty sand from a nearshore marine environment. Fossils were primarily accumulated in winnowed pebble horizons. The material was recovered from elevations between 120.4 and 117 ft. and a depth of 44.6 to 48.9 ft. (Appendix D). Original field numbers – 2014_01_08_BRA.1 and 2014_01_09_BRA.1, locality over entire shaft.

Locality 6; San Pedro Formation, unit 16U
A total of 100 specimens of pollen from cypress, Mormon tea, fir, aster, sagebrush, alder, pine, goosefoot, oak, hickory, bayberry, flannel bush or line tree, iris, bur-reed, and miscellaneous other fungal, plant, and dinoflagellate sources; 171 specimens of foraminifera from 15 genera and 23 species; and 2 coccolith nannofossils were identified from a sample collected for palynology, foraminifera, and nannofossil analyses (Table 3; Appendix G). Seven seeds, including Torrey pine; 2397 invertebrate specimens, including crabs, barnacles, coral, bryozoans, snails, limpets, clams, mussels, scallops, tusk shells, worm tubes, and sand dollars; and 2 bat ray tooth plates were recovered during excavation. Sediments consisted of brownish black, moderately to well indurated, poorly to moderately sorted pebbly sand from a nearshore marine environment. The material was recovered from elevations between 117.5 and 112.5 ft. and a depth of 48 to 53 ft. (Appendix D). Original field numbers – 2013_04_19_CDR.1, 2013_06_25_BRA.1, 2013_08_01_BRA.1, 2014_01_22_BRA.1 and 2014_01_24_BRA.1, locality over entire shaft.

Locality 7; San Pedro Formation, unit 16U
A total of 15 specimens of pollen were identified from a sample collected for palynology, foraminifera, and nannofossil analyses. Pollen was from cypress, pine, goosefoot, and miscellaneous other fungal, plant, and dinoflagellate sources (Table 3; Appendix G). Sediments consisted of brownish black, poorly indurated, poorly sorted pebbly sand. The sample was collected from elevations between 109.5 and 108 ft. and a depth of 56 to 56.5 ft. (Appendix D). Original field number – 2014_01_31_BRA.1 adjacent to Piling 2.

Locality 8; San Pedro Formation, unit 16U
A total of 21 specimens of pollen from cypress, aster, pine, carrot, sagebrush, oak, grass, and miscellaneous other fungal, plant, and dinoflagellate sources and 1 foraminifera were identified from a sample collected for palynology, foraminifera, and nannofossil analyses (Table 3; Appendix G). Two snails and a specimen of pine were recovered during excavation. A terrestrial mammal pelvis fragment and a weathered, unidentified marine mammal rib fragment were also recovered from the side wall north of P7. Sediments consisted of black to brownish black, non- to poorly indurated, poorly sorted pebbly sand to pebble conglomerate. The material was recovered from elevations between 105.8 and 105.3 ft. and a depth of 59.8 to 60.6 ft. (Appendix D). Original field numbers – 2014_02_08_BRA.1, 2014_02_08_BRA.2, and 2014_02_14_KMS.1, locality over entire shaft.

Locality 9; San Pedro Formation, unit 16U
A total of 100 specimens of pollen from Mormon tea, cypress, fir, pine, alder, oak, bur-reed, and miscellaneous other fungal, plant, and dinoflagellate sources were identified from a sample collected for palynology, foraminifera, and nannofossil analyses (Table 3; Appendix G). Thirteen plant specimens were identified, including Torrey pine and manzanita. Twenty-eight invertebrate fossils, including snails clams, mussels, and burrow traces were recovered during excavation. Sediments consisted of brownish black to black, moderately to well indurated, poorly sorted pebbly sand from a nearshore marine environment. The material was recovered from elevations between 101 and 100.5 ft. and a depth of 64 to 65.4 ft. (Appendix D). Original field numbers – 2013_08_02_BRA.2, 2013_08_20_CDR.1, 2014_02_24_BRA.1 and 2014_03_06_BRA.1, locality over entire shaft.

Locality 10; San Pedro Formation, unit 16U
A total of 112 plant and 523 invertebrate specimens were identified. Plant material included Monterey cypress, Monterey pine, oak, Torrey pine and manzanita. Identified invertebrate material included worm tubes, crab, snails, clams, mussels, tusk shells, sand dollars and burrow traces. Sediments consisted of black, poorly to moderately indurated, poorly sorted pebbly sand to silty sand primarily deposited in a nearshore marine environment. The material was recovered from elevations between 99 and 94.5 ft. and a depth of 66.9 to 71.4 ft. (Appendix D). Original field numbers – 2013_06_25_BRA.2 and 2014_02_25_KMS.1, locality over entire shaft.

Locality 11; San Pedro Formation, unit 16U
A total of 100 specimens of pollen from cypress, pine, aster, fireweed, and miscellaneous other fungal, plant, and dinoflagellate sources were identified from a sample collected for palynology, foraminifera, and nannofossil analyses (Table 3; Appendix G). Thirty plant specimens, consisting primarily of unidentified, partially weathered roots were identified (Figure 31). Two partial pine specimens were also collected. Five hundred sixty-one invertebrate fossils, including crab, snails clams, mussels, scallops, and burrow traces were recovered during excavation. Sediment primarily consisted of black, moderately indurated, poorly sorted clay, silt, and sand to pebbly sand with accessory cobbles and poorly indurated, well sorted silty sand deposited in terrestrial and nearshore marine environments. The material was recovered from elevations between 95.9 and 90 ft. and a depth of 70 to 75.9 ft. (Appendix D). Original field numbers –2013_06_21_BRA.1, 2013_06_24_BRA.1, 2013_07_12_TSV.2, 2013_07_31_BRA.2, 2013_08_21_CDR.1, 2014_03_19_BRA.1, and 2014_03_20_BRA.1, locality over entire shaft.

An additional 35 snail, clam and tusk shells were collected during drilling for pilings that could not be definitively assigned to one of the localities mentioned above. Thirteen of these shells are assigned to either locality 5 or 6. They were recovered during drilling for P7 and P10 from black, pebbly sand at elevations between 121.9 and 110.9 ft. and depths of 45 to 55 ft. (Appendix D). Original field numbers – 2013_07_31_BRA.1 and 2013_08_02_BRA.1. The remaining 22 shells were recovered from drilling of P3 and P11 at elevations between 115.9 and 110.9 ft. and depths of 50 to 55 ft. (Appendix D). These are assigned to either locality 6 or 7. Original field numbers – 2013_07_25_BRA.1 and 2013_07_30_BRA.1.

TECHNICAL RESULTS

CHRONOSTRATIGRAPHY

Nine samples were collected (approximately one every five foot level of the San Pedro Formation) and sent to Biostratigraphy.com for pollen (palynology) and marine plankton (foraminifera and nannofossil) analysis. Attempts were made to determine age, paleoenvironmental and paleoclimate for the samples; however few microfossils were recovered due to the coarse grain size of the material from the shaft (Table 3; Appendix E).

FORAMINIFERA

Foraminifera were recovered from 3 samples and only the one collected at 49.5-50.3 ft. deep (116-115.3 ft. elevation; Locality 6) produced multiple specimens (174 specimens). Although the taxa recovered indicate an age of early Pliocene to early Pleistocene (2.25-5 million years old) the numerous environments represented by the taxa (shallow marine to basinal) suggested to Zippi (2014 p. 5; Appendix E) that the sediments were from an offshore basin with channelized turbiditic sediments. During field observations, these sediments (Level 12, unit 1) were assigned a near-shore marine environment with rip up clasts (chunks of finer grained sediments pulled from older deposits). Finer grained sediments typify deeper marine environments and southern California's history at the time included local uplift and the infilling of our marine basins. The only deeper marine macrofossil, the trench tusk shell (*Dentalium vallicolens*) was also recovered from this deposit (see Mollusks, Scaphopods below).

Based in the coarse gained nature of the rest of the shaft deposits and the fact that most environments observed were near-shore marine, and the fact that Locality 6 had known finer grained material in the form of clay-rich rip-up clasts, it is inferred that the rip up clasts present were scoured from a fine grained marine formation by a flash flood and redeposited at the shaft. Sediments and microfossil contamination may have come from the late Pliocene to early Pleistocene Inglewood Formation outcropping today at the northern end of the Baldwin Hills, or the late Miocene to early Pliocene Puente Formation outcropping to the east of the project in the Hollywood and downtown Los Angeles area. The other two foraminifera specimens recovered produced an extremely broad age range making the results of the foraminiferal dating inconclusive.

NANNOPLANKTON

An identifiable nannoplankton fossil was recovered from only 1 sample at 49.5-50.3 ft. deep (116-115.3 ft. elevation; Locality 6). Unfortunately this species is found throughout the Cenozoic Era (66 million years to the present) making the results of the nannoplankton for dating inconclusive (Appendix E; Zippi 2014 p. 5).

POLLEN

The types of pollen recovered were not useful for determining the age of the sediments. The largest component of the pollen was pine with 116 specimens (Table 3). Cypress (62 specimens) and oak (39 specimens) were the next most abundant. Only Mormon tea indicated a specific environment which was creosote bush scrub <3,600 ft. in elevation. The rest of the taxa recovered are common in many of California's ecosystems.

The presence of hickory which went extinct in California by the end of the Miocene (5 million years ago, UCMP 2014) suggests contamination of the 40.3-41 ft. deep (124.0-124.7 ft. elevation, Locality 4) sample from level 10 unit 1 and the 49.5-50.3 ft. deep (116-115.3 ft. elevation, Locality 6) and from level 12 unit 1 by older sediments. Both samples had frags of Monterey Formation shale, deposited between 17 and 5 million years ago, and could have been the source of the hickory pollen. Other pollen and spores in the samples included fungi and miscellaneous plants common to many ecosystems in California today, which did not assist in the environmental analysis.

Table 3. Pollen Recovered

Data and results from Zippi (2014)

Locality	Depth Ft.	Elev. Ft.	Name	Taxon	Number
2	32.1-32.7	133.8-133.2	pine	*Pinus* spp.	1
			grass	Graminae	1
3	37	128.8	cypress	Cupressacae	2
			pine	*Pinus* spp.	6
			oak	*Quercus* spp.	2
4	40.3-41	124.7-124.0	polypody	Pelypodium	2
			cypress	Cupressacae	2
			pine	*Pinus* spp.	4
			oak	*Quercus* spp.	7
			hickory	*Carya* spp.	1
			Mormon tea	*Ephedra nevadensis*	1
			goosefoot	Chenopodiaceane	1
5	44.6-45.8	120.4-119.2	cypress	Cupressacae	15
			pine	*Pinus* spp.	4
			oak	*Quercus* spp.	1
			bayberry	*Myrica* spp.	1
			goosefoot	Chenopodiaceane	1
			grass	Graminae	1
6; sample probably contaminated by older rip-up clasts	49.5- 50.3	116- 115.3	cypress	Cupressacae	12
			pine	*Pinus* spp.	25
			fir	Abies spp.	3
			oak	*Quercus* spp.	16
			alder	*Alnus* spp.	1
			hickory	*Carya* spp.	2
			bayberry	*Myrica* spp.	1
			polypody	Pelypodium	1
			Mormon tea	*Ephedra nevadensis*	1
			sagebrush	*Artemesia* spp.	1
			aster	Asteraceae	1
			flannel bush	*Fremontodendron* or *Tilia* spp.	2
			iris	*Iris* spp.	2
			bur-reed	*Sparganium* spp.	1

Locality	Depth Ft.	Elev. Ft.	Name	Taxon	Number
			goosefoot	Chenopodiaceae	2
7	56-56.5	109.5-108	cypress	Cupressacae	15
			pine	*Pinus* spp.	2
			goosefoot	Chenopodiaceae	2
8	59.8-60.1	105.8-105.4	cypress	Cupressacae	4
			pine	*Pinus* spp.	2
			oak	*Quercus* spp.	2
			sagebrush	*Artemesia* spp.	2
			aster	Asteraceae	1
			parsley	Umbelliferae	1
			grass	Graminae	1
8	64.2-64.9	101.3-100.6	cypress	Cupressacae	7
			pine	*Pinus* spp.	39
			fir	*Abies* spp.	3
			oak	*Quercus* spp.	11
			alder	*Alnus* spp.	1
			polypody	Pelypodium	1
			bur-reed	*Sparganium* spp.	1
			Mormon tea	*Ephedra nevadensis*	1
11	74.4-75.4	91.5-90.5	cypress	Cupressacae	5
			pine	*Pinus* spp.	33
			polypody	Pelypodium	7
			aster	Asteraceae	2
			fireweed	*Epilobrium* spp.	1
				TOTAL	**268**

LARGER PLANT SPECIMENS

Specimens identifiable only as plant comprised about one-third of the recovered fossils. These were followed in descending number of identified specimens by possible Torrey Pine, Monterey Cypress, Big Berry Manzanita, indeterminate Pine, and Monterey Pine. Single fossils of another type of Manzanita and possible Coast Live Oak were also recovered. These specimens are enumerated by locality (Table 4).

Table 4. Identified Macrobotanical Specimens

Locality	Common name	Taxon	Specimen	Number
5	pine, poss. Torrey pine	*Pinus* sp. cf. *P. torreyana*	seed shell	1
6	pine, poss. Torrey pine	*Pinus* sp. cf. *P. torreyana*	seed shell	5
6	plant, indeterminate	Plantae	seed	1
8	pine, poss. Torrey pine	*Pinus* sp. *(P. torreyana?)*	scale	1
8	pine	*Pinus* sp.	scale	1
9	pine, poss. Torrey pine	*Pinus* sp. *(P. torreyana?)*	scale, seed or nut	9
9	pine	*Pinus* sp.	scale	2
9	manzanita, big berry	*Arctostaphylos glauca*	seed	1
9	manzanita, Eastwood or whiteleaf	*Arctostaphylos* sp. *A. glandulosa* or *A. glandulosa* ssp. *mollis* or *A. viscidae*	seed	1

Locality	Common name	Taxon	Specimen	Number
10	cypress, Monterey	*Hesperocyparis macrocarpa (*formerly *Cupressus macrocarpa)*	cone	27
10	pine, Monterey	*Pinus radiata*	cone	8
10	pine, poss. Torrey pine	*Pinus* sp. *(P. torreyana?)*	scale, seed, cone	24
10	pine	*Pinus* sp.	scale, cone, seed	5
10	manzanita, big berry	*Arctostaphylos glauca*	seeds	19
10	oak, poss. Coast live oak	*Quercus sp.* cf. *Q. argifolia*	leaf	1
10	plant	Plantae	seeds	16
10	plant	Plantae	wood	3
11	pine	*Pinus* sp.	scale	2
11	plant	Plantae	wood	31
			TOTAL	**158**

GYMNOSPERMS, CONIFERS

Prior to human intervention, all of the conifers identified occurred only in coastal California as relict (last remaining) populations due to specific environmental needs. Today the most restricted conifers (Monterey cypress and Torrey pine), only inhabit locations on coasts with cool summers with a mean summer high temperature of 70-83ºF (21.1-28.3ºC), average precipitation of 10.59-32.41" (26.90-82.32cm). These sites all get significant summer fog and cold water upwellings due to submarine canyons adjacent to the shore (Intellicast 2014, the Weather Channel 2014; Appendix F).

Torrey pine (*Pinus* sp. cf. *P. torreyana*)

Thought to be the rarest pine in North America, the Torrey pine is also rare in the fossil record. Prior to work at the Project, Torrey pines were found as needle bundles in the Oligocene (34 – 23 million years old) John Day Formation and as pollen in the Holocene (<11,000 years old) sediments around Torrey Pines State Park in La Jolla and on Santa Rosa Island, California (UCMP 2014, Cole and Wahl 2000, Cole et al. 1994). Scales and seeds assigned to Torrey pine were recovered from multiple depths in near shore marine sediments of the San Pedro Formation (Table 5).

Table 5. Seeds assigned to Torrey pine

LOCALITY	ELEV. FT.	DEPTH FT.	NUMBER OF SEEDS	DIAMETER (GREATEST, SMALLEST AND MEAN)
5	121-117	44.9-48.9	1	24 mm
6	117.5-112.5	48-53	3	23 mm, 19.8 mm, 21 mm
9	100.5-100.7	65.4-65.2	4	22 mm, 17 mm, 20.6 mm
10	99-94.5	66.9-71.4	11	22.5 mm, 15 mm, 19.7 mm

The largest scales of any California pines are those of the closely related Torrey (*P. torreyana*), Coulter (*P. coulteri*) and grey pines (*P. sabianana*). While the scale tips (umbos) of the Torrey pines are <2 cm and pyramidal those of the Coulter and grey pines are reflexed and elongated from 3-7 cm. The size and lack of an elongated and reflexed scale tip suggests that the largest scales recovered are of Torrey pines. The lack of details preserved on the fossil umbos with the well preserved nature of the rest of the scales indicates that the cones were intact as they weathered (presumably in the surf) prior to breaking up. A partial cone assigned to Torrey pine seems to support this (Figure 4).

The nineteen pine seeds collected from the Project range from 15-24 mm with the average being 20.3 mm long (Figure 5, Table 5). While the three large scale species have similarly sized seeds (*P. torreyana* 16-24 mm, *P. coulteri* 15-22 mm, and *P. sabianana* ~20 mm respectively), only the Torrey pine seeds grow as large as 24 mm (Earle 2013). Additionally, modern Torrey pines are limited to coastal habitats similar to the requirements of both Monterey pines and Monterey cypress (Table 4).

Figure 4. Comparison of ES fossil scales attributed to Torrey Pine with modern cones

Figure 5. ES fossil pine seed casings (left) compared with modern Torrey pine (right)

Torrey pines are another of the "closed cone pines" adapted to fire regimes. Modern Torrey pines grow with chamise (*Adenostoma fasciculatum*), California sagebrush (*Artemesia californica*), toyon (*Heteromeles arbutifolia*), lemonade berry (*Rhus integrifolia*), California scrub oak (*Quercus dumosa*), mule fat (*Baccharis viminea*), bush poppy (*Dendromecon rigida*), California encelia (*Encelia californica*), white sage (*Salvia apiana*), black sage (*S. mellifera*), saw-toothed goldenbush (*Haplopappus squarrosus*), Costa Baja manzanita (*Arctostaphylos glandulosa* ssp. *crassifolia*), Santa Rosa Island manzanita (*A. confertiflora*), California buckwheat (*Eriogonum fasciculatum*), warty-stem ceanothus (*Ceanothus verrucosus*), feltleaf ceanothus (*C. arboreus*), western yarrow (*Achillea millefolium*), sea fig (*Carpobrotus chilensis*), iceplant (*Mesembryanthemum* spp.), Indian paintbrush (*Castilleja* spp.), monkey flower (*Mimulus* spp.), California poppy (*Eschscholzia californica*), sedge (*Carex globosa*), onion grass (*Melica imperfecta*), bent grass (*Agrostis* spp.), slender wild oat (*Avena barbata*), and purple cudweed (*Gnaphalium purpureum*) (Esser 1993). As pollen of oak (*Quercus* spp.), and sagebrush (*Artemisia* spp.) were recovered from the pollen analysis it is possible that with more research into the pollen present, California scrub oak (*Quercus dumosa*) and California sagebrush (*Artemisia californica*) may be confirmed in the local environment.

Monterey cypress [*Hesperocyparis macrocarpa* (formerly *Cupressus macrocarpa*) Adams et al. 2009] Modern Monterey cypress seed cones are spheric to elliptic and range from 2.5-3.8 cm long with 8-12 scales and projections on the scales of 2 mm (Hickman 1993). Our cypress seed cones were recovered from one near shore marine locality 66.9-71.4 ft deep (99-94.5 ft elev., Locality 10). Cones are 2.3-4.4 cm, spheric to elliptic with 7-14 scales on the intact cones (Figure 6). On the most intact specimen, projections are 2 mm and the rest of the specimens show evidence of weathering that likely eroded the projections.

Figure 6. A modern Monterey cypress cone (top) with ES cone

Present day naturally occurring populations of Monterey cypress are limited to two relict populations in the Monterey, California area – at Point Lobos State Reserve south of Carmel and Cypress Point along Pebble Beach (Esser 1994). All naturally occurring relict population trees occur within 100 ft (30 m) elevation above sea level (Hickman 1993). Climate where relict populations persist or where recently planted trees have naturalized in New Zealand is characterized by cool, moist summers with abundant sea fog and cool, damp winters with good rainfall. In California this is within a coastal montane chaparral and woodlands ecoregion. The Monterey cypress trees are adapted to fire regimes and although the parent plants may die, a large number of seeds are released after fires (Esser 1994). Seeds do release without fires but in smaller numbers than post fires.

Monterey cypress commonly occurs with Gowen cypress (*Hesperocyparis goveniana* ssp. *goveniana*), California sagebrush (*Artemisia californica*), chamise (*Adenostoma fasciculatum*), Hooker manzanita (*Arctostaphylos hookeri*), woolyleaf manzanita (*A. tomentosa*), chaparral broom (*Baccharis pilularis*), coyotebrush (*B. pilularis* var. *consanguinea*), blue blossom (*Ceanothus thyrsiflorus*), live forever (*Dudleya farinosa*), seaside daisy (*Erigeron glaucus*), golden-yarrow (*Eriophyllum confertiflorum*), lizard tail (*E. staechidifolium*), salal (*Gaultheria shallon*), Douglas iris (*Iris douglasiana*), bush monkey flower (*Mimulus aurantiacus*), Pacific bayberry (*Myrica californica*), skunkweed (*Navarretia squarrosa*), poison-oak (*Toxicodendron diversiloba*), California huckleberry (*Vaccinium ovatum*), and rhodendron (*Rhodendron*) (Jensen 1988, Esser 1994). Pollen of cypress (Cupressaceae), iris (*Iris* spp.), sagebrush (*Artemisia* spp.), and bayberry (*Myrica* spp.) were recovered from the pollen analysis making it probable that with more research into the pollen present, Douglas iris (*Iris douglasiana*), California

sagebrush (*Artemisia californica*), Pacific bayberry (*Myrica californica*), and possibly Gowen cypress (*Hesperocyparis goveniana* ssp. *goveniana*) may be confirmed in the local environment.

Fossils of Monterey cypress are known from late Pleistocene deposits at Rancho la Brea in Los Angeles and mid to late Pleistocene deposits in Costa Mesa, California (Axelrod and Govean 1996, Stock and Harris 1992). These fossils were recovered from 560 miles south of the current stands of Monterey cypress.

Monterey pine (*Pinus radiata*)

Monterey pine cones are typically cone shaped and range from 6-15 cm with minute prickling (Hickman 1993). Seed cones are asymmetrical with the basal scales nearest the branch being normal or reduced in size and those on the non-branch side having bulbous scale tips (umbos) (Cope 1993). Three cone specimens referred to Monterey pine were recovered from one near shore marine locality (66.9-71.4 ft deep, 99-94.5 ft elev., Locality 10; Figure 7).

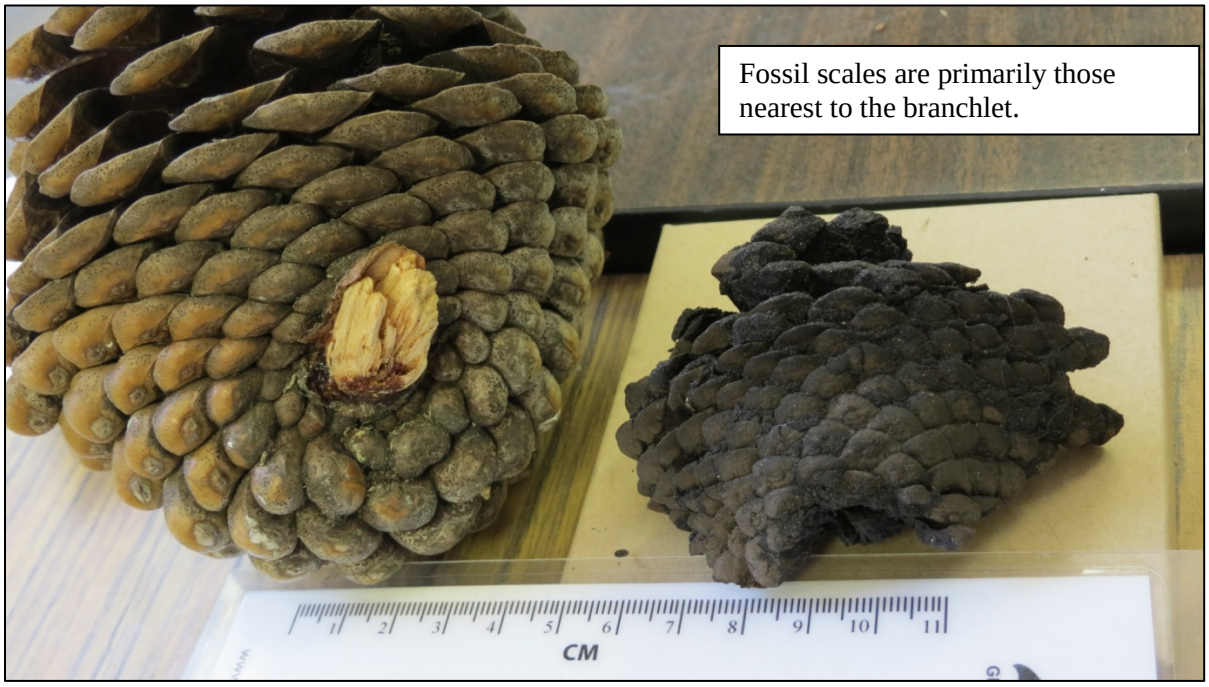


Figure 4. A modern Monterey pine cone compared to ES cone

Found naturally in California in Año Nuevo in Santa Cruz and San Mateo counties, on the Monterey Peninsula of Monterey County, and Cambria in San Luis Obispo County, relict populations of two subspecies are also found on Guadalupe Island (*Pinus radiata* var. *binata*) and Cedros Island (*Pinus radiata* var. *cedrosensis*) off the western coast of Baja California. Trees occur from 0 to 1200 ft (0 to 366 m) above sea level and typically within 7 miles (11 km) of the coast. Climate where relict population persists or where recently planted trees have naturalized is characterized by cool, moist summers with abundant sea fog and cool, damp winters. In California this is within a coastal montane chaparral and woodlands ecoregion (Cope 1993, Hickman 1993).

The Monterey pine is one of the "closed cone pines", a group of pines that are adapted to fire regimes that also includes beach (*Pinus contorta*), Bishop (*P. muricata*), knobcone (*P. attenuatta*), and Torrey (*P. torreyana*) pines. Typically in rocky and infertile areas, cypress can also be present forming a closed cone pine–cypress habitat. Monterey pines grow with Gowen cypress (*Hesperocyparis goveniana* var. *goveniana*), Monterey cypress (*H. macrocarpa*), Santa Cruz cypress (*H. goveniana* var. *abramsiana*), Tecate cypress (*H. guadalupensis* var. *forbesii*), bishop pine (*Pinus muricata*), knobcone pine (*P. attenuata*), coast live oak (*Quercus agrifolia*), Pacific madrone (*Arbutus mensiesii*), California buckthorn (*Rhamnus californica*), woolyleaf manzanita (*Arctostaphylos tomentosa*), California huckleberry (*Vaccinium ovatum*), poison-oak (*Toxicodendron diversiloba*), El Dorado bedstraw (*Galium californicum*), thingrass (*Agrostis diegoensis*), and blue wild rye (*Elymus glaucus*) (Jensen 1988, Cope 1993). Pollen of cypress (Cupressaceae), pine (*Pinus* spp.), and oak (*Quercus* spp.) were recovered from the pollen analysis making it possible that with more research into the pollen present that Gowen cypress (*Hesperocyparis goveniana* var. *goveniana*), Santa Cruz cypress (*H. goveniana* var. *abramsiana*), Tecate cypress (*H. guadalupensis* var. *forbesii*), bishop pine (*Pinus muricata*), knobcone pine (*P. attenuata*), and coast live oak (*Quercus agrifolia*), may be confirmed in the local environment.

Typically seed release of closed cone pines requires fire, although Monterey pine cones can open during higher temperatures and close again once the temperature cools. With "closed cone pines" the cone remains closed and on the branch, typically sealed with resin and can remain so for decades. While the parent plants may die from the fire, the now melted resin allows the cones to open and re-seed the area as long as the cones are exposed to temperatures below 203ºF (95ºC) (Cope 1993).

Fossils of Monterey pines are known from just north of San Francisco to south of San Diego near the United States-Mexico border in sediments ranging from late Miocene to late Pleistocene in age. Although most of the fossils are known from localities usually within a few miles of the modern shoreline, some specimens are known from the hills between Beaumont and San Jacinto in the late Miocene, Mount Eden Formation (Axelrod 1980, Axelrod and Govean 1996).

ANGIOSPERMS, DICOTS, OAKS

A single leaf from the project is assigned to oak, most likely Coast live oak (*Quercus agrifolia*) which has been found at Rancho la Brea and is common in California today (Stock and Harris 1992; Hickman 1993). The partial (2.5 cm long) fossil leaf recovered has an elliptic shape with a rounded tip and a partially incurved and spine toothed margin (Figure 8). The curvature of the leaf is not strong and the good preservation indicates a thickened leaf adapted to dry summers (sclerophyllous). These features and the visible venation of the specimen compare favorably with *Q. agrifolia*.

Found in valleys, slopes, and woodlands less than 4921 ft (<1500 m) in elevation in the western half of California, *Q. agrifolia* leaves range in size from 2.5-6 cm with elliptic, oblate or rounded leaves. The leaf tips are rounded to spine toothed, and the curved margin is weakly spine toothed (Hickman 1993). Additionally *Q. agrifolia* cohabits with modern Monterey pines (Cope 1993).

Figure 8. *Quercus agrifolia* compared with ES fossil oak leaf (*Quercus* spp.)

ANGIOSPERMS, DICOTS, MANZANITAS

Manzanitas represented at Rancho la Brea include bigberry (*Arctostaphylos glauca*), island (*A. insularis*), morro (*A. morroensis*), Pecho (*A. pechoensis*), woollyleaf manzanita (*A. tomentosa*), and whiteleaf (*A. viscidae*) (Stock and Harris 1992 p. 81). Species occurring today with Monterey cypress, Monterey pine, and Torrey pine include Santa Rosa Island (*A. confertiflora*), Costa Baja (*A. glandulosa* ssp. *crassifolia*), Hooker (*A. hookeri*), and woolyleaf manzanita (*A. tomentosa*) (Cope 1993, Esser 1993, 1994). As manzanita includes fifty-seven species and numerous subspecies in California, mostly with very poor documentation of the hard internal seed casings ("stones"), comparison of the stones of from the Project was limited to the potential species listed above as well as images of any other native specimens that could be found (Table 6; Hickman 1993, RSABG 2014, UCSC 2014, UDSA 2014). Additionally most of the manzanita specimens at UCR (2014) had preserved the fruit with no removal of the fleshy parts and it was decided not to damage the specimens in an attempt to identify the stones.

Of those species compared, bigberry (*Arctostaphylos glauca*) is the best fit for the large spheroidal stones from ES. For the other specimen Eastwood's manzanita (*Arctostaphylos glandulosa* or *Arctostaphylos glandulosa* ssp. *mollis*) and whiteleaf (*A. viscidae*) are most similar.

Bigberry Manzanita (*Arctostaphylos* cf. *A. glauca*)

Ranging from north of San Francisco to Baja California, bigberry manzanita is a common site on the rocky slopes of the chaparral woodlands under 5000 ft (<1400 m). The species is rare in the fossil record with only two records - one from the late Pleistocene McKittrick asphalt seeps in Kern County, California and a second from the Rancho la Brea asphalt seeps in Los Angeles (UCMP 2014; Stock and Harris 1992). Twenty-one seeds referred bigberry manzanita were recovered from two near shore marine localities (65.4-65.2ft deep, 100.5-100.7 ft elev., Locality 9; 66.9-71.4 ft deep, 99-94.5 ft elev., Locality 10).

The seed casings of this manzanita are large in size at ±10 mm and fused into a nearly spherical unit (Figure 9, Hickman 1993). Measurements taken of the fossil stones give a range of 6-12 mm and a mean of 9.3 mm within the average range of bigberry manzanita (Table 6).

Figure 9. Modern (left) bigberry (*Arctostaphylos glauca*) compared with ES fossils

Table 6. ES fossil bigberry manzanita stone measurements

Locality	Millimeters of diameeter								Mean
9	6.0	8.0	8.9	9.0	9.0	9.0	9.0	9.0	8.49
9	9.1	9.5	10.0	10.3	10.3	10.5	12.0		10.24
10	9.0								

Other manzanita

A single ribbed specimen of manzanita was found from a nearshore marine environment (65.4-65.2ft deep, 100.5-100.7 ft elev., Locality 9)/ The specimen was not complete enough to identify more specifically.

INVERTEBRATES

QUATERNARY OLDER ALLUVIUM INVERTEBRATES

One fossil, a California floater clam (*Anodonta californiensis*), was recovered from the Quaternary older alluvium. This species is common in western North America both in the fossil and modern record, including that of Rancho la Brea. These clams prefer areas of steady water level in shallow freshwater lakes or low gradient stream along muddy or sandy bottoms (Nedeau et. al. 2005, Xerces 2014).

SAN PEDRO FORMATION INVERTEBRATES

Invertebrates recovered are typical of the San Pedro Formation (Appendix D, E). Aside from one specimen of a Princep's slipper snail (*Crepidula princeps* see Mollusks, Gastropods section below) all taxa recovered are alive today (Appendix G). Additionally all taxa were present from at least 5 million years ago on, making an earliest age for these sediments indeterminate (Hall 2002).

Using the modern ranges of the invertebrates recovered, the environmental analysis indicates shallow marine conditions, primarily between intertidal and 50 m deep. Of the fauna that had temperature information, temperatures correspond well to those found along the coast of California today with 62% requiring ocean temperatures of at least 12.0ºC to survive, classifying this as a Temperate marine fauna (Hall 2002; Appendix G).

Cniderians

A small hydroid polyp (Hydrozoa) was recovered from an elevation of 117.5-112.5 ft (48-53 ft deep, Locality 6). Primarily found in salt water, hydroids can be colonial or solitary. Unlike corals the hyoid life cycle is dominated by their medusa form (free living, soft body) instead of their polyp form (sessile, typically hard exoskeleton), making fossilization a rare event for these animals. A jellyfish is known from the 505-510 million year old, Middle Cambrian Burgess Shale and the group may be as old as 700 million years based on fossils found in South Australia and Canada.

As the specimen could be identified to genus or species and so are of limited scientific value at present for chronostratigraphy or environmental analysis.

Annelid worms

Polychaete worms (Polychaeta) are typically marine and are found in a variety of habitats and range from the Ediacaran (~580 to 545 million years old) to the present. No specimens could be identified to genus or species the specimens recovered and so are of limited scientific value at present for chronostratigraphy or environmental analysis.

Arthropods, Barnacles

Two barnacles (Cirripedia) were recovered from an elevation of 117.5-112.5 ft (48-53 ft deep, Locality 6). Barnacles are found in a variety of marine habitats from shore lines to approximately 228 ft (100 m) deep. Some barnacles live in the skin of whales and are found in sediments as old as the Cambrian (~500 million years old). Unfortunately no specimens could be identified to genus or species making the specimens recovered of limited scientific value at present for chronostratigraphy or environmental analysis.

Arthropods, Crabs

Portions of crabs (Canceridae) were recovered from three localities (117.5-112.5 ft elev., 48-53 ft deep, Locality 6; 99-94.5 ft elev., 66.9-71.4 ft deep, Locality 10; 93-90 ft elev., 72.9-75.9 ft deep, Locality 11). Crabs inhabit a multitude of marine environments from estuary to deep-sea hydrothermal vents. Again as no specimens could be identified to genus or species the specimens are at present of limited scientific value at present for chronostratigraphy or environmental analysis.

Mollusks, Gastropods

Twenty-nine genera of snails were recovered from the shaft (Appendix D) providing excellent variety for environmental analysis. The analysis was based only on the taxa that had been identified to species (Appendix G). In most cases the modern taxa range from 0 to 165 ft (0-50 m) deep in temperate to subtropical waters along the coast of California today. This environment is in line with the sedimentary analysis made during the stratigraphic mapping of the shaft instead of the deeper marine/turbidic

interpretation provided by Zippi (2004; see Chronostratigraphy section 4.1) suggesting again that the samples had been contaminated by older sediments.

As far as the one extinct specimen, this is not the first record of *Crepidula princeps* from the San Pedro Formation (Arnold 1903, Grant and Gale 1931 as per Groves 2014; Powell and Stevens 2000) although with the approximately 3500 invertebrate specimens recovered it is an unusual find (Figure10). With the weathering present on the shell, it is also possible that this specimen recovered from 72.9 to 75.9 ft deep (90-93 ft elevation; Locality 11) was washed out of an older unit adjacent to the shore.

Figure 10. Extinct slipper snail (*Crepidula princeps*) from ES

Mollusks, Bivalves

Thirty-nine genera of bivalves were recovered from the shaft (Appendix D) providing excellent variety for environmental analysis. The analysis was based only on the taxa that had been identified to species (Appendix G). As with the snails, in most cases the modern taxa range from 0 to 165 ft (0-50 m) deep in temperate to subtropical waters along the coast of California today. This environment is in line with the sedimentary analysis made during the stratigraphic mapping of the shaft instead of the deeper marine/turbidic interpretation provided by Zippi (2004; see Chronostratigraphy section 4.1) suggesting again that the samples had been contaminated by older sediments.

The most notable taxon recovered has to be the Pacific gaper clam (*Tresus nuttallii*, Figure 11). The original field identification of geoduck (*Panopea abupta*) was an error. However both species are nearly identical both visually and for environmental purposes. Many of the other bivalves recovered have thick shells like the Pacific gaper clam for protection from the surf, or burrow for protection. These are both typical adaptations for living near the shore.

Figure 11. Individuals of Pacific gaper clam (*Tresus nuttallii*) from ES

Mollusks, Scaphopods

Two species of tusk shell (Scaphopoda) were recovered from the shaft (Appendix G). The six-sided tusk shell (*Dentalium neohexagonum*) inhabits temperate to subtropical waters 0 to 475 ft (0-145 m) deep from the Aleutian Islands to Mexico (SLB 2014). Forty-six specimens were recovered from three localities (121-117 ft elev., 44.9-48.9 ft deep, Locality 5; 117.5-112.5 ft elev., 48-53 ft deep, Locality 6; 97.2 ft elev., 68.7 ft deep, Locality 10)

Sixteen specimens of the trench tusk shell (*D. vallicolens*) were recovered from one locality (117.5-112.5 ft elev., 48-53 ft deep, Locality 6; Figure 12). This tusk shell inhabits temperate to subtropical waters from the Aleutian Islands to Mexico. This is the only taxa recovered that prefers deeper marine habitats of the continental shelf and bathyal waters ranging from 505 to 1673 ft (154-510 m) deep (SLB 2014). The occurrence of a deep water marine invertebrate at the same elevation as Zippi (2014) identified a deeper marine and older foraminiferal fauna supports contamination of these sediments. These specimens were collected from a near shore marine or estuary mouth that had been hit by a flash flood at or near intertidal. The presence of numerous older ripup clasts are the most likely source for the contamination.

Figure 5. Deep marine trench tusk shells (*Dentalium vallicolens*) from ES

Echinoderms

Seventy-five specimens of eccentric sand dollar (*Dendraster excentricus*) were recovered from two localities (117.5-112.5 ft elev., 48-53 ft deep, Locality 6; 97.2 ft elev., 68.7 ft deep, Locality 10). Preferring sand bottoms of sheltered bays from 0-40 m deep, eccentric sand dollars range from Alaska to Baja California in temperate to subtropical waters (Audubon 1998).

Bryozoans

Both encrusting and branching bryozoans (moss animals, Bryozoa) were recovered from an elevation of 117.5-112.5 ft (48-53 ft deep, Locality 6). Habitats of bryozoans include fresh to saltwater, from tropical to polar marine waters, and from shallow to deep marine habitats up to at least 27,900 ft (8500 m). Originating in the Early Ordovician (~470 million years ago), bryozoans live in colonies and are common in the fossil record (Kansas Geological Survey 2005). These specimens were collected from what was interpreted to be a near shore marine or estuary mouth that had been hit by a flash flood at or near intertidal.

VERTEBRATES, FISH

Fish recovered were limited to bat ray tooth plates (*Myliobatis* sp.; 117.5-112.5 ft elev., 48-53 ft deep, Locality 6). Today, the California bat ray (*Myliobatis californica*) is the only bat ray found off the coast of California and is the most common species found as a fossil in Californian deposits less than 10 million years old (PBDB 2014, UCMP 2014). Modern California bat rays range from Oregon to the Sea of Cortez in intertidal waters to ~150 ft (46 m) deep, but prefer muddy or sandy substrates between 10-40 ft (3-12 m) (Gray et al. 1997, Last and Stevens 1994).

VERTEBRATES, TETRAPODS

A marine mammal rib recovered compared very well to that of a northern elephant seal (*Mirounga angustirostris*; Figure 13) and so is assigned an identification of Pinnepedia, large cf. *Mirounga angustirostris*. The rib fragment was recovered from a depth of 60.6 ft. (105.3 ft elev., Locality 8).

Figure 13. Northern elephant seal rib (top) and ES rib (bottom)

One bone is a large terrestrial mammal pelvic fragment and has not been successfully identified to date. This bone was recovered from a depth of 68.7 ft (elev. 97.2 ft, Locality 10). We continue to work on identifying this specimen.

Sometimes things are not as they first appear

The field identification of a pinneped skull, turned out to be boring clams imbedded in cobble of older marine silts. Both the shape of the rock and the placement of the clam frags on the surface as well as the holes bored into the side and filled with frags of shell was similar enough in the field to cause the misidentification. This specimen was recovered from a slump dropping material from an elevation of between 177.5 and 122.5 ft (depth 48-53 ft.; Locality 6).

The asphalt covered fossil minutes after being discovered.

The "tooth row" with a boring clam present (right most hole)

ES "skull" compared to a small modern seal

STRATIGRAPHIC COLUMNS AND PALEOENVIRONMENT

Detailed stratigraphic columns were recorded for all four walls of the Exploratory Shaft that cover 75.89 ft sections from the surface elevation of 165.89 ft to 90 ft at the base of the shaft (Appendix C). Stratigraphy was recorded in 5 to 6 ft thick sections after or during excavation for each of the 16 Project Levels. Sediments are attributed to recent (<100 years old) artificial fill, Quaternary alluvium (Holocene; <10,000 years old), Quaternary older alluvium (late Pleistocene; ~10,000 to 45,000 years old), and mid to late Pleistocene (45,000 - 330,000 years old) San Pedro Formation. The San Pedro Formation correlates with units BU and 16U and the Quaternary older alluvium with unit W of Quinn et al. (2000). Quaternary alluvial sediments were deposited in stream and lake paleoenvironments and were present in the upper 20 ft or so of the exploratory shaft. A poorly developed paleosol at ~147 to145 elevation (~19-21 ft depth) marked the boundary between the alluvium and the San Pedro Formation. The base of unit BU of the San Pedro Formation was placed at a depth of approximately 50 ft below surface. The depositional environment of the San Pedro Formation generally transitioned from nearshore marine to intertidal/beach environment with depth. Unit 16U comprised the lower 20 ft of the shaft and is described as having more invertebrate fossils then unit BU as well having wood (Quinn et al. 2000). A highly fossiliferous bed containing the uppermost occurrence of Pacific gaper clams (*Tresus nuttallii*) in the shaft and evidence that the sediments were washed out of an estuary during a flash flood was used as the upper marker bed for this primarily nearshore marine unit. Unit 16U continues to the base of the cut (75.89 ft depth). Near the base of the cut, terrestrial mud with preserved roots was present between layers of intertidal sediments. Brownish black and black coloration of the sediments at depth is due to asphalt contamination. Beds generally dip ~5 degrees to the west.

Level 1 (0-5.64 ft depth; 165.89-160.25 ft elev.): Artificial fill

The surface of the test shaft consisted of artificial fill sediments that are less than 100 years old. Sediments were primarily reddish brown and very poorly sorted. Grain size varied from fine clay and silt to small boulders. Pavement asphalt, concrete, rusted iron or steel sheet, copper wire were also present (Figure14). No fossils were observed.

Level 2 (5.64-10.19 ft depth; 160.25-155.7 ft elev.): Quaternary alluvium

Only the top few inches of Level 2 consisted of artificial fill. This artificial fill layer was underlain by Quaternary alluvium that is Holocene (<10,000 years old) to late Pleistocene (10,000-~45,000 years old) in age. Quaternary alluvial sediments consisted of stream channels and associated lateral deposits and debris flows. Stream sediments were dark greyish brown to dark yellowish brown in color and were composed of non to poorly indurated, non to poorly sorted, very fine to very coarse silty sand in low flow portions of stream channels and normally graded, clast supported, pebble conglomerate that grade into silty sand in higher flow portions. Trough crossbedding was visible in the high flow portions of the channels. Debris flow and overbank deposits were moderate yellowish brown to light olive brown in color except where contaminated by gasoline, resulting in blue/green tones, or asphalt, resulting in black/brown tones. Sediments were non- to poorly indurated, non- to poorly sorted, massive clay to cobbles. Decomposing marine formations in the Santa Monica Mountains were the source of much of the clay and chert. A paleosol with preserved rootlets up to 2mm in diameter was present at the top of the cut in the western portion of the exploratory shaft. Massive, very dark greenish grey clay of a marsh, lake, or very slowly moving fluvial environment was present at the base of the Level in the eastern portion of the exploratory shaft. No fossils were observed.

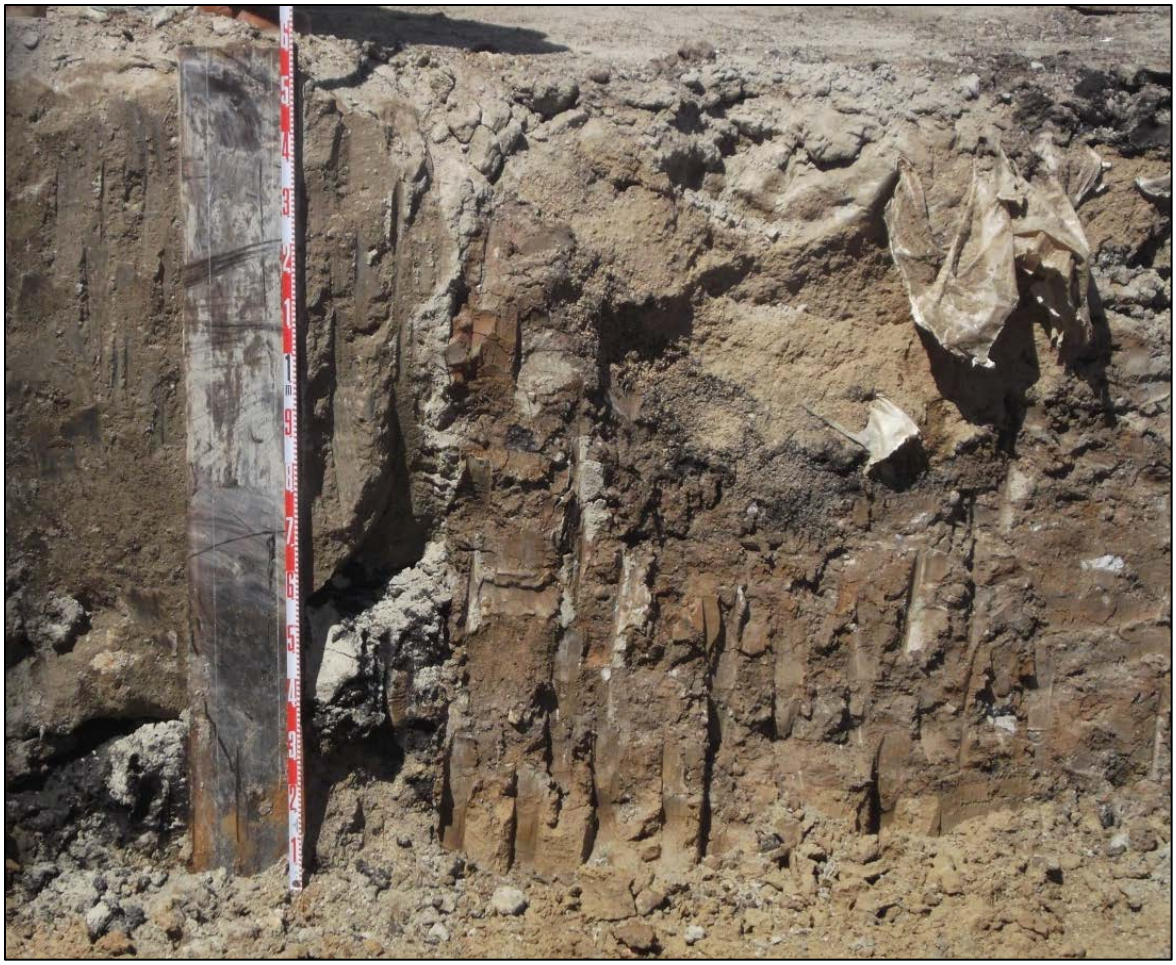


Figure 14. Level 1: artificial fill at center of north wall

Level 3 (10.19-15.26 ft depth; 155.7-150.63 ft elev.): Quaternary older alluvium, unit W
Level 3 consisted of older Quaternary sediments of stream channels and associated lateral deposits, debris flows, and lakes. Stream channel deposits and a debris flow were present at the top of the Level, primarily in the western portion of the test shaft (Figure 15). The stream deposits were composed of light yellowish brown to dark greenish grey, poorly to non-indurated, poorly sorted clay and sand that in places had poorly preserved trough crossbeds with normal grading. These deposits were underlain by lake sediments composed of greenish grey, non- to poorly indurated, very well sorted massive clay and silt with caliche beds, indicative of a marshy or lake environment that experienced occasional drying events. In the eastern portion of the shaft, the clay had been severely reduced due to old gasoline contamination, resulting in glue-green tones, and in places contaminated with asphalt, resulting in a dark brown to black coloration (Figure 16). No fossils were observed.

Level 4 (15.26-18.39 ft depth; 150.63-147.5 ft elev.): Quaternary older alluvium, unit W
Most of the material at the top of this horizon was a continuation of the clay from the lake deposit of Level 3. Below the clay was sandier material of a fluvial origin. The sands were primarily black to brown, moderately to well indurated, poorly sorted, very fine to very coarse grained sand and silty sand with accessory oxidized asphalt. On the western side of the cut, where asphalt contamination was minimized, fluvial sediments were dark greenish grey in color. No fossils were observed.

Figure 15. Level 3: debris flow (very top), stream channel sands (upper) and lake deposits (below)

Level 5 (18.39-22.39 ft depth; 147.5-143.5 ft elev.): Quaternary older alluvium, unit W and San Pedro Formation, unit BU

This Level included the boundary between the Quaternary older alluvium and San Pedro Formation. The top of the Level was composed of asphalt contaminated, moderately indurated, poorly sorted, fluvially deposited sands. The fluvial deposits were underlain by a greenish black to dark bluish gray, poorly developed paleosol layer formed during a drying event. This paleosol marks the top of the San Pedro Formation. The underlying San Pedro Formation was composed of moderately indurated, poorly sorted, massive, very fine to coarse grained, asphalt contaminated silty sands of a nearshore marine environment. This unit contained up to 50% oxidized asphalt in the eastern portion of the cut. No fossils were observed.

Level 6 (22.39-25.89 ft depth; 143.5-140.0 ft elev.): San Pedro Formation, unit BU

San Pedro Formation sediments of this Level consisted of moderately indurated, poorly sorted, brown to brown-black clay and sandy clay at the top of the level followed by interfingering massive black tar sands and brown sandy silts or sandy clays of a nearshore marine environment (Figure 17). Much of the silt-clay units had been heavily bioturbated. No fossils were observed.

Figure 16. Level 3: clay with gasoline (blue-grey) and asphalt contamination (brown-black)

Figure 17. Level 6: interfingered asphalt rich sands (black) and asphalt poor sandy clays (brown)

Level 7 (25.89-29.89 ft depth; 140.0-136.0 ft elev.): San Pedro Formation, unit BU
Most of the material of Level 7 was very dark brown to black, poorly to moderately indurated, fine to very coarse grained sands with rounded, polished pebbles and cobbles interfingered with greenish black to bluish black silty sands. Sediments were deposited in a nearshore marine environment adjacent to the shore. No fossils were observed.

Level 8 (29.89-34.89 ft depth; 136.0-131.0 ft elev.): San Pedro Formation, unit BU
Sediments of Level 8 were deposited in a near shore marine environment adjacent to the shore. It was primarily composed of black to brownish black, moderately indurated, massive, very fine to very coarse grained sand with accessory pebbles and cobbles. A coarse grained sand and fine pebble layer was present through the south west portion of the cut. Along the southern and eastern walls, the black sands were mottled with dark reddish brown silty sand. No fossils were observed.

Level 9 (34.89-39.39 ft depth; 131.0-126.5 ft elev.): San Pedro Formation, unit BU
The San Pedro Formation of Level 9 was primarily composed of black, moderately indurated, fine to coarse grained sands to pebbles of a nearshore marine paleoenvironment. Discontinuous layers of matrix to clast supported pebble conglomerates deposited in nearshore marine winnowing/accretionary zones were also present. The pebble conglomerates ranged from 2 to 6 inches in thickness and often served as the base for tabular crossbeds that were observed in the sands of this level.

Level 10 (39.39-44.89 ft depth; 126.5-121.0 ft elev.): San Pedro Formation, unit BU
San Pedro Formation in Level 10 consisted of moderately to poorly indurated sand and silty sands from a nearshore marine paleoenvironment and moderately indurated matrix to clast supported pebble cobble conglomerate of a nearshore marine winnowing/accretionary zone (Figure 18). Laminations and cross-laminations were observed in the silty sand unit (Figure 19). Sediments were black due to asphalt contamination. Mollusk shell and bivalves fragments were observed in this level, but were not collected.

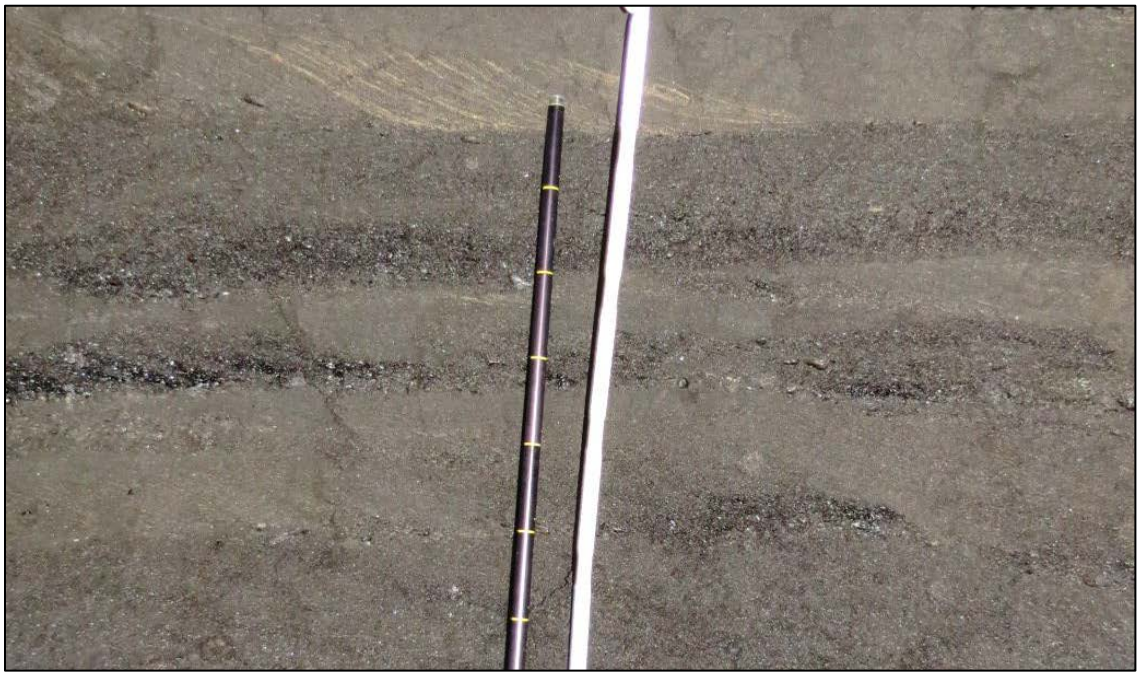


Figure 18. Level 10: alternation of silt/sand and pebble accumulations

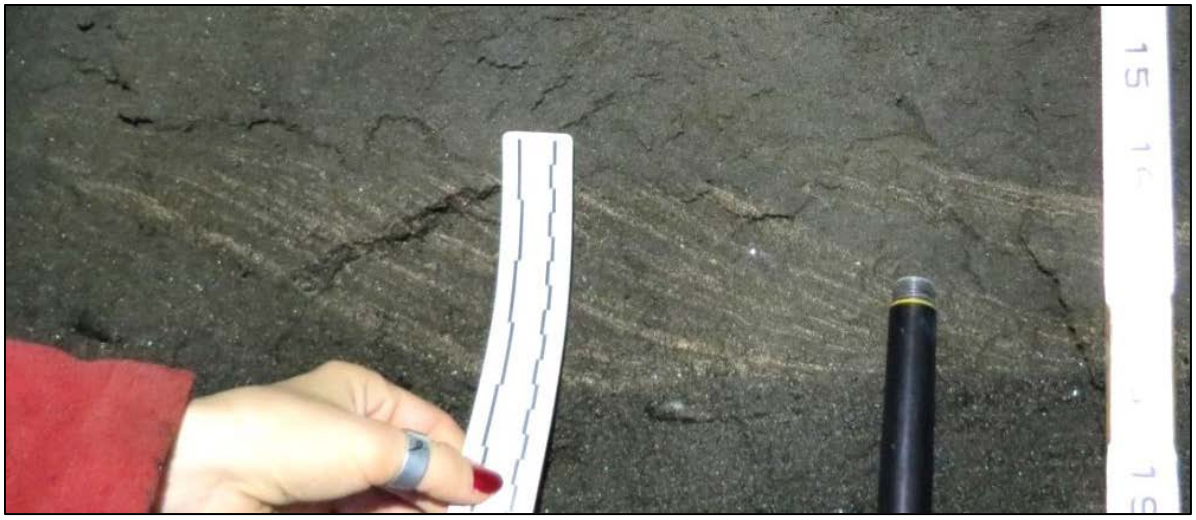


Figure 19. Level 10: close up of cross-laminations

Level 11 (44.89-48.39 ft depth; 121.0-117.5 ft elev.): San Pedro Formation, unit BU
Sediments were deposited in a nearshore marine environment. They were composed of black, moderately indurated silty sand with clast supported pebble stringers and poorly to moderately indurated very fine to very coarse grained sand units. In areas of the silty sand units, planar laminations, cross-laminations, and evidence of bioturbation (Figure 20) were visible due to biotite, in other areas, these deposits were massive. Fossil plant and marine shells were primarily preserved in a pebble lag at an elevation of 118 ft. Many of the fossils preserved in the pebble lag did not show signs of weathering, unlike the few shells observed in the silty sand.

Level 12 (48.39-53.39 ft depth; 117.5-112.5 ft elev.): San Pedro Formation, unit BU and 16U
San Pedro Formation of Level 12 was primarily composed of black, moderately indurated sand with clast supported pockets of coarse sand with fine pebbles and accessory clay ripup clasts of a nearshore marine environment. The top of the western half of the exploratory shaft was composed of nearshore marine, moderately indurated, silty sand with preserved ripple marks and clast supported pebble stringers with preserved terrestrial plant and marine shell material.

The nearshore marine deposits were underlain by sediments from an estuary mouth at or near the intertidal zone that was hit by a flash flood event. The top of unit 16U of the San Pedro Formation is assigned to this distinct and highly fossiliferous bed that contained the first specimens of Pacific gaper clam (*Tresus nuttallii*). Sediments were dark greenish grey to black, poorly to moderately indurated coarse sand, fine pebbles, and mud ripup clasts. Terrestrial plant, marine bivalves, gastropods, and tusk shells were abundant. The base of this deposit were primarily black, poorly indurated, coarse grained sand with Pacific gaper clams accounting for most of the observed fossils.

Figure 20. Level 11: Close up of bioturbation

Level 13 (53.39-57.89 ft depth; 112.5-108.0 ft elev.): San Pedro Formation, unit 16U
The top of Level 13 was a continuation of the flash flood event at the base of level 12. Sediments of the event were greenish black to black due to asphalt contamination and consisted of poorly indurated, clast supported pebble conglomerate with mud ripup clasts up to 15 cm in diameter. Fossil marine invertebrates and occasional plans and bat ray tooth plates accounted for up to 40% of the volume of the bed (Figure 21). Underneath the flood deposits were abundant Pacific gaper clams (*Tresus nuttallii*) that dug down through the flood deposit after the flood event. Many of these fossils were surrounded by a halo composed of mud, pebbles, and smaller fossils.

Underlying the flood sediments were alternating near intertidal and pebbly beach deposits. The sediments deposited in the near intertidal environments consisted of poorly indurated, normally graded, very fine to very coarse grained sand in beach foreshore bedding separated by biotite-rich horizons. The pebbly beach deposits consisted of a poorly indurated, clast supported pebble conglomerate. Fossil shell fragments were present in the conglomerate.

Level 14 (57.89-63.89 ft depth; 108.0-102.0 ft elev.): San Pedro Formation, unit 16U
San Pedro Formation of Level 14 consisted of black and greenish black, non-indurated, interbedded mature sands and pebble lags indicative of a sandy to pebbly beach paleoenvironment. Sediment color was due to both asphalt contamination and pebble color. The sands were coarse to very coarse grained and composed almost entirely of quartz, pebbles were mostly very fine to medium, nearly flattened pieces

Figure 21. Level 13: Shell bed (Locality 6) of flood event underlain by intertidal sand

of Santa Monica Slate, cobbles up to 20 cm in diameter were also occasionally encountered. Fossil shell and wood was present, primarily as fragments, in pebble horizons. A few weathered vertebrate bones were also recovered from pebble lags of this level.

Level 15 (63.89-69.89 ft depth; 102.0-96.0 ft elev.): San Pedro Formation, unit 16U
Sediments consisted of black poorly indurated, normally graded silt, very fine to very coarse grained sand, and pebbles of an intertidal paleoenvironment. Pebbles were present in channels and trough crossbeds. Silty sand units appeared massive, but it is likely that the structures are just poorly preserved. Fossil shell and wood were present.

Level 16 (69.89-75.89 ft depth; 96.0-90.0 ft elev.): San Pedro Formation, unit 16U
The San Pedro Formation of Level 16 was primarily deposited in an intertidal paleoenvironment as seen in Level 15. Sediments were black in color and primarily consisted of poorly to moderately indurated, normally graded silt and very fine to very coarse sand with pebbles and accessory cobbles, and clay ripup clasts. Layers of moderately to very well indurated oxidized asphalt were present in areas where the intertidal zone was exposed subaerially with asphalt seep. Near the base of the Level was a moderately to well indurated terrestrial mud composed of clay, silt, and very fine to fine sand with clusters of partially eroded tree roots (Figure 22). A poorly to moderately indurated, nonsorted pebble conglomerate of an intertidal zone was located at the very base of Level 16, which also marked the base of the exploratory test shaft. Fossil shell and wood, including tree roots, were present along with an unidentified large mammal pelvic fragment.

Figure 22. Level 16: Cluster of brownish-red tree roots circled with orange paint; Locality 11

INTERPRETIVE RESULTS

All except one of the fossils recovered came from the near-shore marine San Pedro Formation between 30.7 and 75.9 ft deep. The shallowest fossil, a clam (*Anodonta californiensis*) at 22 ft deep was recovered from the Quaternary older alluvium. The majority of fossils recovered were invertebrates, primarily clams, snails and tusk shells. Vertebrate remains were rare and consisted of ray teeth, a large marine mammal rib fragment, and a terrestrial mammal pelvis fragment.

Although samples were collected for dating analysis using first and last appearances of taxa, the results were unhelpful as the majority of pollen, foraminifera and nannoplankton seem to have been washed in from older, deeper marine sediments. We know this because some of the taxa were from deeper marine environments and the marine sediments of the shaft were all nearshore, and we never encountered either

the 665,000 year old Lava Creek Ash or the 760,000 year old Bishop Ash that had been seen in cores of Hancock Park (Figure 3; Quinn et. al, 2000). This puts an age of less than 665,000 years on all of the material recovered from the shaft.

Some of the most unique fossils recovered were the plants. The presence of Monterey cypress [*Hesperocyparis macrocarpa* (formerly *Cupressus macrocarpa*) Adams et al. 2009], Monterey Pine, and Torrey pine allows for a climactic interpretation of the area. Climate where relict populations persist are characterized by cool, moist summers with abundant sea fog and cool, damp winters with good rainfall. In California this is within a coastal montane chaparral and woodlands ecoregion. The specimens of Monterey cypress from the shaft are only the third fossil record of this species, although the other two are from Rancho la Brea in Los Angeles and mid to late Pleistocene deposits in Costa Mesa, California (Axelrod and Govean 1996, Stock and Harris 1992). These fossils were recovered from 560 miles south of the current stands of Monterey cypress. For other plants, manzanita and oak were recovered as seeds and leaf imprints.

Invertebrates recovered included cniderians, annelid worm tubes, barnacles, crabs, snails, bivalves, tusk shells, sand dollars and bryozoans. Using the modern ranges of the invertebrates recovered, the environmental analysis indicates shallow marine conditions, primarily between intertidal and 50 m deep. Of the fauna that had temperature information, temperatures correspond well to those found along the coast of California today with 62% requiring ocean temperatures of at least 12.0ºC to survive, classifying this as a temperate marine fauna (Hall 2002; Appendix G). Vertebrates recovered include bat ray tooth plates (*Myliobatis* sp.), a large marine mammal rib fragment and an unidentified terrestrial mammal pelvic fragment.

Detailed stratigraphic columns were recorded for all four walls of the Exploratory Shaft. Sediments are attributed to recent (<100 years old) artificial fill, Quaternary alluvium (Holocene; <10,000 years old), Quaternary older alluvium (late Pleistocene; ~10,000 to 45,000 years old), and mid to late Pleistocene (45,000 - 330,000 years old) San Pedro Formation. Quaternary alluvial sediments were deposited in stream and lake paleoenvironments and were present in the upper 20 ft or so of the exploratory shaft. A poorly developed ancient soil at ~147 to145 elevation (~19-21 ft depth) marked the boundary between the alluvium and the San Pedro Formation. The depositional environment of the San Pedro Formation generally transitioned from nearshore marine to intertidal/beach environment with depth. The lower 20 ft of the shaft had more invertebrate fossils and wood than above. A highly fossiliferous bed containing the uppermost occurrence of Pacific gaper clams (*Tresus nuttallii*) in the shaft and evidence that the sediments were washed out of an estuary during a flash flood was used as the upper marker bed for this primarily nearshore marine unit. Near the base of the cut, terrestrial mud with preserved roots was present between layers of intertidal sediments. Brownish black and black coloration of the sediments at depth is due to asphalt contamination.

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APPENIDX A. QUALIFICATIONS

cogstone
PALEONTOLOGY - ARCHAEOLOGY - HISTORY

SHERRI GUST
Project Manager & Principal Paleontologist

EDUCATION

1994 M. S., Anatomy (Evolutionary Morphology), University of Southern California, Los Angeles

1979 B. S., Anthropology (Physical), University of California, Davis

SUMMARY QUALIFICATIONS

Gust has more than 30 years of experience in California, acknowledged credentials for meeting national standards, and is a certified/qualified principal paleontologist in all California cities and counties that maintain lists. She holds California and Nevada statewide BLM paleontology permits. Gust is an Associate of the Natural History Museum of Los Angeles County in the Vertebrate Paleontology and Rancho La Brea Sections. She is a Member of the Society of Vertebrate Paleontology and the Society of Economic Paleontologists and Mineralogists. She has special expertise in the identification and analysis of fossil bone.

SELECTED PROJECTS

High Desert Corridor, Caltrans Districts 7 & 8, Los Angeles and San Bernardino Counties, CA. Project Manager and Principal Paleontologist. Managed work to complete the Caltrans paleontological documents for a proposed new 63 mile long freeway and rail line from SR 14 in Palmdale to SR 18 in Apple Valley. Produced a combined Paleontological Identification and Evaluation Report. 2013-2014

Interstate 5 HOV Lane Extension, Caltrans District 12, San Juan Capistrano, Dana Point, and San Clemente, Orange County, CA. Project Manager and Principal Paleontologist. Provided a Paleontological Mitigation Plan (PMP) and an updated evaluation. 2012

SR 91/71 Interchange Improvement Project, Caltrans District 8, Riverside County, CA. Project Manager and Principal Paleontologist. Prepared Paleontological Mitigation Plan for interchange improvement. 2014

Purple Line Extension (Westside Subway), Los Angeles County Metropolitan Transportation Authority/FTA, Los Angeles. Project Manager and Principal Paleontologist. The project involves construction of seven stations from the existing Purple Line at Wilshire/Western Avenue along Wilshire Boulevard to the Veterans Administration Hospital in Westwood for 9 miles. Prepared Paleontological Mitigation Plan for the Exploratory Shaft Project and for the entire Project. 2012-2014

Exposition Light Rail Phase 2, **Exposition Transit Authority, Culver City to Santa Monic**a. Project Manager and Principal Paleontologist. Prepared Paleontological Assessment in support of EIR. Subsequently prepared Paleontological Resources Management Plan for 7 linear miles of new rail facilities including stations. Principal Paleontologist and Project Manager. 2012-present

SR 91 Westbound Widening Project between I-5 and SR 57, Caltrans District 12, Orange County, CA. Project Manager and Principal Paleontologist. Prepared Paleontological Mitigation Plan for construction of highway improvements. 2012

State Route 91 HOV Project, Riverside. Project Manager and Principal Paleontologist. Prepared a combined Paleontological Identification/Evaluation Report and Paleontological Mitigation Plan for the SR 91 High Occupancy Vehicle Lane Addition between Adams St. and the 60/91/215 Interchange in Riverside. 2011

US 95 Vertical Curve Correction, south of Needles. Project Manager and Principal Paleontologist. Prepared a combined Paleontological Identification/Evaluation Report and Paleontological Mitigation Plan for a vertical curve correction project south of Needles. 2011

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PALEONTOLOGY - ARCHAEOLOGY - HISTORY

KIM SCOTT
Field & Lab Director for Paleontology

EDUCATION

2013 M.S. Biology with paleontology emphasis, California State University San Bernardino
2000 B.S., Geology with paleontology emphasis, University of California, Los Angeles

SUMMARY QUALIFICATIONS

Scott has more than 18 years of experience in California paleontology. She is a qualified geologist and paleontologist with extensive survey, monitoring and fossil salvage experience. In addition, she has special skills in fossil preparation (cleaning and stabilization) and preparation of stratigraphic sections and other documentation for fossil localities. Scott serves as company safety officer and is the author of the company safety and paleontology manuals. She is a Member of the Society of Vertebrate Paleontology, Geological Society of America and others.

SELECTED PROJECTS

Elvira to Moreno Double Track, San Diego. Conducted paleontological record searches and survey and prepared results report for expansion of rail services. Principal Investigator. 2013-14

Topock Compressor Facility, PG&E, California/Arizona border. Conducted paleontological record searches and survey and prepared results report for groundwater remediation project partially in both states. Field and Lab Director and Report Co-author. 2012-13.

Human External Cargo Training Facility, Southern California Edison, Daggett. Paleontological Survey and Report for Southern California Edison training facility in Daggett, San Bernardino County, CA. Field and Lab Director and Report Author.. 2011-2012

Devers-Mirage 115 KV System Split Project, Southern California Edison, Riverside County. Performed preconstruction paleontological survey, directed paleontological monitoring during construction activities and co-authored monitoring compliance report associated with electrical systems upgrade in of Cathedral City, Indian Wells, Palm Desert, Palm Springs, Rancho Mirage, Thousand Palms and unincorporated Riverside County. Field and Lab Director and Report Co-author. 2011

Geospatial Paleontology Database, Caltrans District 6, 9, and 10. Conducted paleontological research for 15 counties in central and eastern California for paleontological screening tool. Paleontology Researcher. 2011-2012

Eldorado-Ivanpah Transmission Line, Southern California Edison, Eldorado, NV to Ivanpah, CA. Conducted paleontological survey and prepared assessment report for 71 miles of SCE electrical lines and associated telecommunications across both BLM and private lands. Field and Lab Director and Report Co-author. 2010

Regional Renewal and Replacement Project, Mojave Water Agency, Hesperia. Performed paleontological record searches, background research, and survey of roughly 4.345-acre project in San Bernardino County. Field and Lab Director and Report Co-author. 2010

Bakersfield to Palmdale Segment, California High-Speed Rail Authority, Kern and LA counties CA. Assessed the potential impacts on paleontological resources for this segment that stretches across the southern Central Valley, the southern Sierra Nevada and the western Mojave Desert. The project crosses 90-linear miles through public, private, and government-owned lands. Director and Report co-author. 2009-2010

Avenue 52 Grade Separation, Caltrans District 8, Coachella. Directed assessement of paleontological resources within the proposed Avenue 52 Grade Separation over Grapefruit Blvd. Project Director and Report co-author. 2012

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PALEONTOLOGY - ARCHAEOLOGY - HISTORY

COURTNEY RICHARDS
Assistant Field & Lab Director for Paleontology

EDUCATION

2011 M.S., Biological Sciences, Marshall University
2006 B.S., Earth and Space Science, University of Washington

SUMMARY QUALIFICATIONS

Richards is a qualified paleontologist with research, field, and laboratory experience. She supervises field crews, performs paleontological surveys, mapping, monitoring; conducts sensitivity training and sample processing in accordance with project-related paleontological mitigation plans. Ms. Richards has conducted field work for transportation, water, energy and development projects throughout California. Richards has personal expertise in fossil salvage, stratigraphy, fossil preparation, database analysis and identification. She has three years of professional experience in California.

SELECTED PROJECTS

I-605 Katella Avenue Interchange Constraints Analysis, OCTA/Caltrans District 12, Los Alamitos. Principal Investigator. Conducted an initial assessment of paleontological resources constraints in support of the Preliminary Environmental Analysis Report (PEAR). Performed record searches and research. Prepared the geology and paleontology sections of constraints report that included recommendations. Principal Investigator. 2013-2014

I-205 Chrisman New Interchange, Caltrans District 10, Tracy. Paleontologist/Report Co-Author. The project involves construction of a new interchange along I-205 between the MacArthur Drive interchange and I-5, a 2.4-linear mile APE. Conducted record search, background research, and prepared a Paleontological Identification Report (PIR). 2014

MTC Express Lanes, Alameda, Contra Costa, and Santa Clara Counties, Caltrans District 4. Report Contributor. Prepared portions of a Paleontological Identification Report for a 2472 acre HOV lane to toll lane conversion project along portions of Interstates 580, 680, and 880 in Alameda, Contra Costa, and Santa Clara Counties. 2012-2013

Kings River Bridge, Caltrans District 6, Tulare. Paleontologist. Prepared sections of the Paleontological Mitigation Plan and conducted paleontological resources sensitivity training for construction personnel. 2012

SR 88 Improvements near Jackson Creek, Caltrans District 10. Paleontologist. Attended a pre-construction field meeting and prepared portions of a revised Paleontological Mitigation Plan for a rehabilitation and widening project along a 5.5 mile segment of SR-88. 2012

Merced Freeway Project, Caltrans District 10. Assistant Field Director. Conducted and supervised paleontological monitoring, fossil recovery, fossil preparation, and prepared portions of the monitoring compliance report for the 5 mile long State Route 99 expansion project south of Merced. 2012

State Route 41 Rehabilitation Project, Caltrans District 6, Kettleman City. Paleontologist. Prepared and identified fossils recovered from long term monitoring project. 2011-2012

State Route 91 Project, District 8, Riverside. Paleontologist. Performed paleontological monitoring of sensitive sediments during HOV lane construction along a 6 mile segment of SR-91 in Riverside County. 2011-12

Caltrans Fossil Sensitivity Geodatabase, Caltrans Districts 6, 9, & 10. Paleontologist. Performed geology research for an extensive project to map paleontological sensitivity characteristics for over 3000 miles of proposed construction activities along major freeways in 15 Counties. 2011-2012

APPENDIX B. MONITORING DATES AND TASKS

Date	Monitor	Resources Observed/Collected	Monitoring Activities
4/15/2013	C. Richards	none	Monitoring drilling of bore hole I-2 to a depth of 100 ft.
4/16/2013	C. Richards	none	Monitoring boring I-2 from 100 ft to 102 ft depth.
4/17/2013	C. Richards	none	Monitoring drilling of bore hole I-3 to 86 ft depth.
4/18/2013	C. Richards	none	Monitoring drilling for bore hole I-1
4/22/2013	B. Ader	none	Callout.
4/23/2013	B. Ader	Two shell frags observed at 51 ft depth and 71 ft depth.	Monitoring drilling for bore hole I-1 to 95 ft depth and methane hole M-351 to 100 ft depth.
4/24/2013	C. Richards	none	Monitoring drilling of bore hole I-1 from 95 ft to 100 ft depth and augering at M-352 to 100 ft depth.
4/25/2013	C. Richards	none	Monitoring widening of M-352 from 8" to 10" to 96 ft depth.
4/26/2013	C. Richards	none	Onsite to monitor widening of M-351, however installing sensors in M-352 took longer than expected and it was decided that no drilling would occur that day.
4/29/2013	B. Ader	none	Monitoring drilling for hole SAA to 100 ft depth.
4/30/2013	B. Ader	2013BRA0430.1- shell frags from ~70 ft depth.	Monitoring hole SAA being reamed from 90 ft to 100 ft depth and drilling of M-350 to 96 ft depth.
5/1/2013	B. Ader	2013BRA0501.1- wood fragment from ~70 ft depth	Monitoring M-350 being reamed to 96 ft depth.
5/6/2013	B. Ader	none	Callout.
5/8/2013	B. Ader	none	Onsite to monitor trenching, but depth was only 2-4 ft and did not require monitoring- 4hr callout
6/19/2013	B. Ader	none	Monitoring drilling for water well to 43 ft depth.
6/20/2013	B. Ader	2013BRA0620.1- wood frags from ~95 ft depth	Monitoring drilling from water well from 43 ft to 110.5 ft depth.
6/21/2013	B. Ader	2013BRA0621.1- shells from ~73 ft depth; 2013BRA0621.2- wood frags from ~85 ft depth.	Monitoring drilling for water well to 110 ft depth.
6/24/2013	B. Ader	2013BRA06241- wood frags from ~76 ft depth. Shell frags observed at 47 ft and 70 ft depth.	Monitoring drilling for SE water well to 111 ft depth.
6/25/2013	B. Ader	2013BRA0625.1 & 2013BRA0625.2- shells from 50 ft & 70 ft depths, respectively. Wood frags observed at 77 ft.	Monitoring drilling for SW water well to 110 ft depth.
7/12/2013	T. Valle	Small freshwater shell, medium marine shell, large marine shell, fossil wood	Monitoring drilling for P16.
7/15/2013	T. Valle	none	Monitoring drilling for P16 and P14.
7/16/2013	B. Ader	none	Monitoring drilling for P16.
7/17/2013	T. Valle	none	Monitoring drilling for P14.
7/18/2013	T. Valle	none	Monitoring drilling for P2.
7/19/2013	T. Valle	none	Monitoring drilling for P2.
7/22/2013	T. Valle	none	Monitoring drilling for P1.
7/23/2013	B. Ader	none	Monitoring drilling for P1.
7/24/2013	B. Ader	Shell frags observed at 75 ft depth, not collected	Monitoring drilling for P1 and P15.

Date	Monitor	Resources Observed/Collected	Monitoring Activities
7/25/2013	B. Ader	2013BRA0725.1- marine shells from 50 ft depth. Shell frags observed at 80 ft, not collected	Monitoring drilling for P3.
7/26/2013	B. Ader	Shell frags observed at 50 ft depth, not collected	Monitoring drilling for P3.
7/29/2013	B. Ader	Shell frags observed at 68 ft depth, not collected	Monitoring drilling for P11.
7/30/2013	B. Ader	2013BRA0730.1- shells from 50 ft depth in P5.	Monitoring drilling for P11 and P5.
7/31/2013	B. Ader	2013BRA0731.1 & 2013BRA0731.2- shells from 45 ft-55 ft & 68.5 ft, respectively from P7.	Monitoring drilling for P5 and P7.
8/1/2013	B. Ader	P7 - observed shells and wood at 75 ft deep and wood at 86 ft deep; P4 - collected partial to whole shells at 48.5-55 ft deep (2013BRA0801.1); All resources from the San Pedro Fm	Monitoring drilling for bore P7 to 89 ft depth and P4 to 88 ft depth.
8/2/2013	B. Ader	P10 - collected partial to whole shells at 45-55 ft deep (2013BRA0802.1); collected partial to whole shells and wood at 65-69 ft deep (2013BRA0802.2); All resources from the San Pedro Fm	Monitoring drilling for bore P10.
8/5/2013	B. Ader	none	Callout.
8/6/2013	B. Ader	none	Monitored drilling for bore P10 and to P15.
8/8/2013	B. Ader	P6 - observed shell at 51 and 70.5 ft deep; All resources from the San Pedro Fm	Monitoring drilling for P15and P6 to 88.9 ft depth.
8/9/2013	B. Ader	none	Planned drilling on P8 changed to slurry removal for P10.
8/12/2013	B. Ader	none	Callout. Recorded UTM info for all I beams.
8/13/2013	C. Richards	P10 - observed shell frags at 74 ft, 80.5 ft, 84.5 ft, and >87 ft deep. Not collected as none were identifiable.	Monitoring drilling of bore P10 from 62 ft to 87 ft depth.
8/14/2013	B. Ader	none	Monitoring drilling of P10 to 89 ft depth.
8/15/2013	B. Ader	P8 - observed shell frags at 40-50; ft deep and wood at 80 ft deep	Monitored drilling of P8 to 80 ft depth.
8/16/2013	M. Tabencki	none	Monitored drilling of P8 to 89.5 ft depth and drilling of P15 to15 ft depth.
8/19/2013	C. Richards	P15 - observed shell frags at 53 ft but none were identifiable	Monitoring drilling of P15 from 15 ft to 60 ft.
8/20/2013	C. Richards	P15 - 2013CDR0820.1 - shell at 64 ft	Monitoring drilling of P15 from 60 ft to 88 ft.

Date	Monitor	Resources Observed/Collected	Monitoring Activities
8/21/2013	C. Richards	P9 - 2013CDR0821.1 - shells at 71 ft; shell observed but not collected from 53.5 ft, 60 ft, 70 ft, and 71 ft.	Monitoring drilling of P9 to 88 ft.
9/6/2013	K. Scott	none	Stratigraphy for Level 1.
9/20/2013	M. Tabencki	none	Raymond Pile work was to begin, however the excavator had mechanical failure.
9/24/2013	B. Ader	none	Monitoring excavation for Raymond pile removal. Excavated area was backfilled.
9/24/2013	C. Richards	none	Site supervision; paperwork; Spot checking excavation for Raymond pile removal.
9/30/2013	B. Ader	none	Monitoring for Level 2.
9/30/2013	K. Scott	none	Site supervision; paperwork.
10/1/2013	B. Ader	none	Monitoring for Level 2.
10/1/2013	K. Scott	none	Site paperwork; supervision.
10/2/2013	B. Ader	none	Monitoring Level 2 excavation.
10/2/2013	K. Scott	none	Stratigraphy for Level 2; paperwork; supervision; AP sensitivity training
10/3/2013	K. Scott	none	Stratigraphy for Level 2; paperwork; AP sensitivity training
10/4/2013	K. Scott	none	No excavation. Onsite for training and paperwork.
10/7/2013	C. Richards	none	No excavation. Provided AP sensitivity training. Interview with Metro Media.
10/9/2013	C. Richards	none	No excavation. Onsite for work which was then delayed.
10/16/2013	B. Ader	none	Monitoring for Level 3.
10/16/2013	K. Scott	none	Site paperwork; supervision; AP sensitivity training
10/17/2013	M. Tabencki	none	Monitoring for Level 3. Lighting not turned on, making it difficult to see if fossils were present.
10/17/2013	K. Scott	none	Site paperwork; supervision; AP sensitivity training.
10/18/2013	K. Scott	none	Site paperwork; AP sensitivity training; stratigraphy for Level 3.
10/24/2013	B. Ader	none	Documenting shotcrete method at request of Page Museum.
10/25/2013	M. Tabencki	none	Monitoring for Level 4.
10/25/2013	C. Richards	none	Site paperwork; supervision; AP Training.
10/28/2013	B. Ader	none	Monitoring for Level 4.
10/28/2013	C. Richards	none	Site paperwork; supervision. Excavation was scheduled to continue until 9pm. However, due to insufficient lighting, work was shut down for the day at 7:30pm in order to keep the project compliant with the paleo mitigation plan.
10/29/2013	B. Ader	none	Monitoring for Level 4.
10/29/2013	C. Richards	none	Onsite paperwork; supervision.
10/30/2013	B. Ader	none	Monitoring for Level 4.
10/30/2013	K. Scott	none	Onsite paperwork; supervision.
10/31/2013	M. Tabencki	none	Monitoring hand digging in western portion of

Date	Monitor	Resources Observed/Collected	Monitoring Activities
			shaft.
10/31/2013	K. Scott	none	Supervision; Stratigraphy in shaft; paperwork; strat logging for Level 4
11/1/2013	M. Tabencki	none	Monitoring for Level 4.
11/1/2013	K. Scott	none	Level 4 stratigraphy
11/4/2013	B. Ader	none	Monitoring for Level 5.
11/4/2013	C. Richards	none	Field supervision; site paperwork; AP training
11/5/2013	B. Ader	none	Monitoring for Level 5..
11/5/2013	C. Richards	none	Field supervision; site paperwork
11/6/2013	B. Ader	none	Monitoring for Level 5.
11/6/2013	C. Richards	none	Field supervision; site paperwork
11/7/2013	M. Tabencki	none	Monitoring for Level 5.
11/7/2013	C. Richards	none	Field supervision; site paperwork; Level 5 stratigraphy
11/9/2013	M. Tabencki	none	Monitoring for Level 6.
11/9/2013	K. Scott	none	Field supervision; site paperwork; monitoring for Level 6.
11/11/2013	B. Ader	none	Monitoring for Level 6.
11/11/2013	K. Scott	none	Field supervision; site paperwork; monitoring for Level 6.
11/12/2013	B. Ader	none	Monitoring for Level 6.
11/12/2013	K. Scott	none	Field supervision; site paperwork; monitoring for Level 6.
11/13/2013	B. Ader	none	Monitoring for Level 6.
11/13/2013	K. Scott	none	Field supervision; site paperwork; monitoring and stratigraphy for Level 6.
11/14/2013	K. Scott	none	Stratigraphy for Level 6.
11/16/2013	M. Tabencki	none	Monitoring for Level 7.
11/16/2013	C. Richards	none	Field supervision; site paperwork; monitoring for Level 7.
11/18/2013	B. Ader	none	Monitoring for Level 7.
11/18/2013	C. Richards	none	Field supervision; site paperwork; monitoring for Level 7.
11/19/2013	B. Ader	none	Monitoring for Level 7.
11/19/2013	C. Richards	none	Field supervision; site paperwork; monitoring for Level 7.
11/20/2013	B. Ader	none	Monitoring for Level 7.
11/20/2013	C. Richards	none	Field supervision; site paperwork; monitoring and stratigraphy for Level 7.
11/21/2013	C. Richards	none	Stratigraphy for Level 7.
11/25/2013	B. Ader	none	Monitoring for Level 8.
11/25/2013	K. Scott	none	Field supervision; site paperwork; monitoring for Level 8.
11/26/2013	B. Ader	none	Monitoring for Level 8.
11/26/2013	K. Scott	none	Field supervision; site paperwork; monitoring for Level 8.
12/3/2013	K. Scott	none	Call out.
12/3/2013	C. Richards	none	Monitoring for Level 8 and site paperwork.
12/4/2013	K. Scott	none	Monitoring for Level 8 and site paperwork.

Date	Monitor	Resources Observed/Collected	Monitoring Activities
12/4/2013	C. Richards	none	Monitoring for Level 8 and site paperwork.
12/5/2013	C. Richards	none	Monitoring for Level 8 and site paperwork.
12/6/2013	C. Richards	none	Monitoring for Level 8, stratigraphy, and site paperwork.
12/10/2013	B. Ader	none	Monitoring for Level 9 and safety recertification.
12/10/2013	C. Richards	none	Monitoring for Level 9; field supervision; safety recertification; and site paperwork.
12/11/2013	B. Ader	none	Monitoring for Level 9.
12/11/2013	C. Richards	none	Monitoring for Level 9; field supervision; and site paperwork.
12/12/2013	B. Ader	none	Monitoring for Level 9.
12/12/2013	C. Richards	none	Monitoring for Level 9; field supervision; and site paperwork.
12/13/2013	B. Ader	none	Monitoring for Level 9.
12/13/2013	C. Richards	none	Monitoring for Level 9; field supervision; and site paperwork.
12/14/2013	B. Ader	none	Monitoring for Level 9.
12/14/2013	K. Scott	none	Monitoring for Level 9; field supervision; Level 9 stratigraphy; and site paperwork.
12/16/2013	B. Ader	none	Monitoring for Level 9.
12/16/2013	K. Scott	none	Monitoring for Level 9; field supervision; Level 9 Stratigraphy; and site paperwork.
12/20/2013	B. Ader	none	Monitoring for Level 10.
12/20/2013	C. Richards	none	Monitoring for Level 10; field supervision; and site paperwork.
12/21/2013	B. Ader	none	Monitoring for Level 10.
12/21/2013	K. Scott	none	Monitoring for Level 10; field supervision; and site paperwork.
12/23/2013	B. Ader	none	Monitoring for Level 10.
12/23/2013	K. Scott	none	Monitoring and stratigraphy for Level 10; field supervision; and site paperwork.
12/26/2013	B. Ader	none	Monitoring for Level 10.
12/26/2013	K. Scott	none	Monitoring and stratigraphy for Level 10; field supervision; and site paperwork.
12/27/2013	B. Ader	none	Monitoring for Level 10.
12/27/2013	K. Scott	none	Monitoring and stratigraphy for Level 10; field supervision; and site paperwork.
1/2/2014	B. Ader	none	Monitoring for Level 11.
1/2/2014	C. Richards	none	Monitoring for Level 11; field supervision; and site paperwork.
1/3/2014	B. Ader	none	Monitoring for Level 11.
1/3/2014	C. Richards	none	Monitoring for Level 11; field supervision; and site paperwork.
1/8/2014	B. Ader	2014BRA0108.1 - chronostrat sample	Monitoring for Level 11.
1/8/2014	K. Scott	" "	Monitoring for Level 11; field supervision; and site paperwork.
1/9/2014	B. Ader	2014BRA0109.1 - terrestrial plant and marine mollusks	Monitoring for Level 11.
1/9/2014	K. Scott	" "	Monitoring for Level 11; field supervision; and

Date	Monitor	Resources Observed/Collected	Monitoring Activities
			site paperwork.
1/10/2014	B. Ader	" "	Monitoring for Level 11.
1/10/2014	K. Scott	" "	Monitoring and stratigraphy for Level 11; field supervision; and site paperwork.
1/11/2014	B. Ader	" "	Monitoring for Level 11.
1/11/2014	K. Scott	" "	Monitoring and stratigraphy for Level 11; field supervision; and site paperwork.
1/13/2014	B. Ader	none	Monitoring for Level 11.
1/13/2014	K. Scott	none	Stratigraphy for Level 11; field supervision; and site paperwork.
1/17/2014	K. Scott	none	Rescue breather recertification and spot check base of level 11.
1/22/2014	B. Ader	Shells, sand dollar, and plant material collected (2014BRA0122.1)	Monitoring for Level 12.
1/22/2014	C. Richards	" "	Monitoring for Level 12; field supervision; and site paperwork.
1/23/2014	B. Ader	" "	Monitoring for Level 12.
1/23/2014	C. Richards	" "	Monitoring for Level 12; field supervision; and site paperwork.
1/24/2014	B. Ader	" "	Monitoring for Level 12.
1/24/2014	C. Richards	" "	Monitoring for Level 12; field supervision; and site paperwork.
1/25/2014	B. Ader	" "	Monitoring for Level 12.
1/25/2014	C. Richards	" "	Stratigraphy for Level 12; field supervision; and site paperwork.
1/27/2014	B. Ader	" "	Monitoring for Level 12.
1/27/2014	C. Richards	" "	Stratigraphy for Level 12; field supervision; and site paperwork.
1/29/2014	B. Ader	Bivalves from 2014BRA0122.1 observed but not collected - poor condition.	Monitoring for Level 13.
1/30/2014	B. Ader	Mollusks and sand dollars collected (2014BRA0122.1)	Monitoring for Level 13.
1/30/2014	K. Scott	" "	Monitoring for Level 13; field supervision; and site paperwork.
1/31/2014	B. Ader	Mollusks, bat ray tooth, and sand dollars collected (2014BRA0122.1)	Monitoring for Level 13.
1/31/2014	K. Scott	Mollusks and sand dollars collected (2014BRA0122.1)	Monitoring and stratigraphy for Level 13; field supervision; and site paperwork.
2/1/14	B. Ader	2014BRA0122.1 - Mollusks and sand dollars collected - lots of gapers and bean clams (*Tresus*, *Donax*)	Monitoring for Level 13.
2/1/2014	K. Scott	" "	Stratigraphy for Level 13; field supervision; and site paperwork.
2/3/2014	B. Ader	" "	Monitoring for Level 13.
2/3/2014	K. Scott	" "	Stratigraphy for Level 13; field supervision; and site paperwork.
2/7/2014	B. Ader	Shell frags observed, not	Monitoring for Level 14

Date	Monitor	Resources Observed/Collected	Monitoring Activities
		collected	
2/7/2014	C. Richards	" "	Monitoring for Level 14; field supervision; Photoshop strat, and site paperwork.
2/8/2014	B. Ader	2014BRA0208.1- Gastropod and plant material 2014BRA0208.2- Gastropod and plant material	Monitoring for Level 14
2/8/2014	C. Richards	" "	Monitoring for Level 14; field supervision; and site paperwork.
2/10/2014	B. Ader	Bivalves collected from Level 13 material slumping out at the walls(2014BRA0122.1)	Monitoring for Level 14
2/10/2014	C. Richards	" "	Monitoring and stratigraphy for Level 14; field supervision; and site paperwork.
2/11/2014	B. Ader	Bivalves collected from Level 13 material slumping out at the walls(2014BRA0122.1)	Monitoring for Level 14
2/11/2014	C. Richards	" "	Monitoring and stratigraphy for Level 14; field supervision; and site paperwork.
2/12/2014	H. Duke	Shell frags observed, not collected	Monitoring for Level 14
2/12/2014	C. Richards	" "	Monitoring and stratigraphy for Level 14; field supervision; and site paperwork.
2/13/2014	K. Scott	2013KMS0213.1 - chronostrat sample; highly weathered shell in the pebble conglomerate	Monitoring and stratigraphy for Level 14
2/14/2014	K. Scott	2014KMS0214.1 - mammal rib, fish or shark vertebra - highly damaged	Monitoring and stratigraphy for Level 14
2/24/2014	B. Ader	2014_02_24_BRA.1 - bivalves, plant material, burrows.	Monitoring for Level 15
2/24/2014	K. Scott	2014_02_24_BRA.1 - bivalves, plant material, burrows.	Monitoring and stratigraphy for Level 15
2/25/2014	B. Ader	2014_02_25_KMS.1 - bivalves, plant material, burrows.	Monitoring for Level 15
2/25/2014	K. Scott	2014_02_25_KMS.1 - bivalves, plant material, burrows.	Monitoring and stratigraphy for Level 15
3/5/2014	B. Ader	2014_01_22_BRA.1 - slough; 2014_02_24_BRA.1; 2014_02_25_KMS.1; mollusks, wood	Monitoring level 15
3/5/2014	C. Richards	" "	Monitoring level 15
3/5/2014	K. Scott	" "	Supervision, media and stratigraphy for level 15; Metro media and Channel 7 news; Noise control and paleo training.
3/6/2014	B. Ader	" "	Monitoring level 15
3/6/2014	K. Scott	" "	Supervision, media, monitoring and stratigraphy for level 15.
3/7/2014	B. Ader	" "	Monitoring level 15
3/7/2014	K. Scott	" "	Supervision, media, monitoring and stratigraphy for level 15.

Date	Monitor	Resources Observed/Collected	Monitoring Activities
3/8/2014	B. Ader	" "	Monitoring level 15
3/8/2014	K. Scott	" "	Supervision, monitoring and stratigraphy for level 15.
3/10/2014	B. Ader	" "	Monitoring level 15
3/10/2014	K. Scott	" "	Supervision, media, monitoring and stratigraphy for level 15.
3/11/2014	B. Ader	" "	Monitoring level 15
3/11/2014	K. Scott	" "	Supervision, monitoring and stratigraphy for level 15.
3/17/2014	B. Ader	2014_02_25_KMS.1; mollusks, wood	Monitoring level 16
3/17/2014	K. Scott	" "	Supervision and monitoring for level 16.
3/18/2014	K. Scott	" "	Media
3/19/2014	B. Ader	2014_02_25_KMS.1; 2014_03_19_BRA.1	Monitoring level 16
3/19/2014	K. Scott	" "	Supervision, monitoring, and stratigraphy for level 16.
3/20/2014	B. Ader	" "	Monitoring level 16
3/20/2014	K. Scott	" "	Supervision, monitoring, and stratigraphy for level 16.
3/21/2014	B. Ader	" "	Monitoring level 16
3/21/2014	K. Scott	" "	Supervision, monitoring, and stratigraphy for level 16.
3/22/2014	K. Scott	" "	Stratigraphy for level 16; fossil transport to Riverside lab.

APPENDIX C. STRATIGRAPHIC COLUMN

Descriptions of beds:

Level 1 unit 1 = Level 2 unit 1: Reddish brown (5YR 6/4, dry), poorly to nonindurated, nonsorted, clay to small boulders [clay/silt- 75%; sand 20%- very fine to very coarse grained, subrounded; pebbles 5%- very fine to very coarse grained, subrounded to rounded; cobbles to small boulders accessory, max 20 cm.] Pavement asphalt to 50 cm across.
Level 2 unit 1 = Level 1 unit 1: Reddish brown (5YR 6/4, dry) poorly to nonindurated, nonsorted, clay to small boulders [clay-silt 75%; sand 20%- very fine to very coarse grained, subrounded; pebbles 5%- very fine to very coarse grained, subrounded to rounded; cobbles to small boulders accessory, max 20 cm.] Pavement asphalt to 50 cm across plus a rusted iron or steel sheet (sign? unreadable) and a copper wire present.
Level 2 unit 4: Very dark greyish brown (10YR 3/2) at top grading to dark yellowish brown (10YR 4/4) at the base, poorly to nonindurated, poorly to nonsorted, massive silty sand [accessory clay; silt 40%; sand 60%- very fine to very coarse grained, subangular to subrounded.] Paleoenvironment- lower flow portion of a stream channel. Laterally grades into Level 2 units 4b, 6a*, 15, 16, and 17.
Level 2 unit 4a: Dark yellowish brown (10YR 3/4) over most and very dark greyish brown (10YR 3/2) at the base, poorly to nonindurated, normally graded, clast supported, pebble conglomerate channel grading normally into silty sand [silt max 40%; sand 10-50%- very fine to very coarse grained, subangular to subrounded; pebbles 10-90%- very fine to very coarse grained, subrounded to rounded.] Stream channel displaying multiple small scours (max ~45 cm x 10 cm) and poor trough crossbedding with a scoured base. Paleoenvironment- higher flow portion of a stream channel. Laterally grades into Level 2 units 6a* and 15.
Level 2 unit 4b: Very dark greyish brown (10YR 3/2) at top grading to dark yellowish brown (10YR 4/4) at the base, poorly to nonindurated, poorly to nonsorted, massive clayey/silty sand [clay-silt 50%; sand 50%- very fine to very coarse grained, subangular.] Paleoenvironment- lower flow portion of a stream channel. Laterally grades into Level 2 units 4 and 6a*.
Level 2 unit 5: Moderate yellowish brown (10YR 5/4) between P11 and P12 that gleys to blue-green tones to the east due to gasoline contamination, poorly to nonindurated, poorly to nonsorted, massive clay to pebbles [clay-silt 40%; sand 50%- very fine to very coarse grained, subrounded to rounded; pebbles 10%- very fine to coarse grained, max 1 cm, subrounded to rounded.] Paleoenvironment- debris flow and overbank deposits. Laterally grades into Level 2 unit 6.
Level 2 unit 5a: Moderate yellowish brown (10YR 5/4) between P11 and P12 that gleys to blue-green tones to the east due to gasoline contamination, poorly to nonindurated, poorly to nonsorted, massive silt to pebbles [clay-silt 40%; sand 50%- very fine to very coarse grained, subrounded to rounded; pebbles 10%- very fine to coarse grained, max 1 cm, subrounded to rounded.] Paleoenvironment- debris flow and overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 unit 6a.
Level 2 unit 6: Dark greenish grey (5GY 4/1) on the south wall altering to dark greenish grey (5G 4/1) on the east wall - color change is due to gasoline contamination on the east side. Poorly to nonindurated, poorly to nonsorted, massive clay to pebbles [clay-silt 40%; sand 55%- very fine to very coarse grained, subangular; pebbles 5%- very fine to very coarse grained, max 5.5 cm, subangular to subrounded.] Paleoenvironment- debris flow and overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 units 5, 7, and 8.

Level 2 unit 6a: Dark bluish grey (5B 4/1) reduced to blue-green tones by gasoline contamination, poorly to nonindurated, poorly to nonsorted, massive sand to pebbles [sand 95-100%- very fine to very coarse grained, subangular; pebbles accessory-5%- medium to very coarse grained, max 3.5 cm, subangular to subrounded.] Paleoenvironment- debris flow and overbank deposits. Laterally grades into Level 2 units 5a and 6b.
Level 2 unit 6a*: Dark bluish grey (5B 4/1) reduced to blue-green tones by gasoline contamination, poorly to nonindurated, poorly to nonsorted, massive sand to pebbles [sand 95-100%- very fine to very coarse grained, subangular; pebbles accessory-5%- very coarse grained, max 5.5 cm, subrounded.] Paleoenvironment- debris flow and overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 units 4, 4a, 4b, and 6an.
Level 2 unit 6an: Greyish green (5G 5/2) reduced to blue-green tones by gasoline contamination, poorly to nonindurated, poorly to nonsorted, massive silty sand [silt 40%, sand 60%- very fine to very coarse grained, subangular to subrounded.] Paleoenvironment- debris flow and overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 units 6a*, 10, and 12.
Level 2 unit 6b: Very dark greenish grey (5GY 3/1); reduction to blue-greener tones due to gasoline contamination; cracks covered in dark yellowish brown (10YR 4/6) to pale yellow (2.5Y 8/4) oxidation. Poorly to nonindurated, very well sorted, massive clay. Paleoenvironment- marsh, lake, or very slow flowing fluvial. Laterally grades into Level 2 unit 6a.
Level 2 unit 7: Black (2.5N/) due to asphalt with dark yellowish brown oxidation (10YR 5/6) poorly to nonindurated, poorly to nonsorted, massive silty sand with clay [clay-silt 40%, sand 60%- very fine to coarse grained, subrounded.] Paleoenvironment- overbank deposits. Laterally grades into Level 2 units 6 and 6an.
Level 2 unit 8: Mixture: light greenish grey (10Y 7/1), greenish grey (10GY 5/1), greenish black (10Y 2.5/1), very dark grey (N3/1); reduction to blue-green tones due to gasoline contamination. Poorly to nonindurated, poorly to nonsorted, massive clays to pebbles [clay-silt 45%, sand 45%- very fine to coarse grained, subrounded; pebbles 10%- very fine to very coarse grained, max 3.5 cm, subangular to subrounded - many pebbles rotten due to gasoline contamination.] Paleoenvironment- debris flow and overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 units 6 and 9.
Level 2 unit 9: Greenish grey (5GY 5/1); reduction to blue-greener tones due to gasoline contamination, poorly to nonindurated, nonsorted, massive clays to cobbles [clay/ silt- 30%, sand 40%- very fine to very coarse grained, subangular to subrounded; pebbles 30%- very fine to very coarse grained, subangular to subrounded; accessory cobbles fine to coarse grained, max 10 cm, subangular to subrounded.] Paleoenvironment- debris flow and overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 units 8 and 13.
Level 2 unit 10: Greenish grey (10GY 6/1); reduction to blue-greener tones due to gasoline contamination, poorly to nonindurated, nonsorted, massive clays to pebbles [clay-silt 20%, sand 60%- very fine to very coarse grained, subangular to subrounded; pebbles 20%- very fine to very coarse grained, max 4 cm, subangular to subrounded.] Paleoenvironment- debris flow and overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 unit 11.

Level 2 unit 11: Light olive brown (2.5Y 5/3) poorly to nonindurated, nonsorted, bottom 25 cm ungraded, top normally graded clays to pebbles [clay-silt at base 0% grading to 70% at top; sand at base 60%- very fine to very coarse grained, subangular to subrounded grades to 30% at top; pebbles 40%- very fine to fine grained, max 5 mm, subangular to subrounded grades to accessory at top.] Scour between P2 and P3. Paleoenvironment- overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 units 10 and 11a.
Level 2 unit 11a: Moderate yellowish brown (10YR 4/4) poorly to nonindurated, nonsorted, normally graded clay to pebbles [clay-silt 70%; sand 30%- very fine to very coarse grained, subangular to subrounded; pebbles accessory- very fine to fine grained, max 5 mm, subangular to subrounded.] Paleoenvironment- overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 units 11 and 15.
Level 2 unit 12: Light olive brown (2.5Y 5/3) poorly to nonindurated, nonsorted, massive silty sand [silt 50%; sand 50%- very fine to coarse grained, max 1 mm, subangular to subrounded.] Paleoenvironment- debris flow and overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 units 6a*and 12a.
Level 2 unit 12a: Moderate yellowish brown (10YR 4/4) poorly to nonindurated, nonsorted, massive silty sand [silt 50%; sand 50%- very fine to coarse grained, max 1 mm, subangular to subrounded.] Paleoenvironment- debris flow and overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 units 12, and 16.
Level 2 unit 13: Light olive brown (2.5Y 5/3) poorly to nonindurated, nonsorted, reversely graded clay to sand with pebbles in top 8 cm [clay-silt 20% ; sand 60%- very fine to very coarse grained, subangular to subrounded; pebbles 20% in base, grades to 40% at top, very fine to very coarse grained, max 4 cm, subangular to subrounded.] Paleoenvironment- debris flow and overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 units 9 and 13a.
Level 2 unit 13a: Moderate yellowish brown (10YR 4/4) poorly to nonindurated, nonsorted, reversely graded clay to sand with pebbles in top 8 cm [clay-silt 20%; sand 60%- very fine to very coarse grained, subangular to subrounded; pebbles 20% in base, grades to 40% at top, very fine to very coarse grained, max 4 cm, subangular to subrounded.] Paleoenvironment- debris flow and overbank deposits; lots of clay and chert from decomposing marine formations in the Santa Monica Mountains; Santa Monica Slate present. Laterally grades into Level 2 units 13, 14, and 17.
Level 2 unit 14: Light olive brown (2.5Y 5/3) poorly to nonindurated, nonsorted, massive pebbly sand [sand 90%- medium to very coarse grained, less than 0.8 mm, subangular to subrounded; pebbles 10%- very fine to coarse grained, max 3 cm, subangular to subrounded.] Paleoenvironment- wetter debris flow. Laterally grades into Level 2 units 13a, and 17.
Level 2 unit 15: Dark to moderate yellowish brown (10YR 4/4 to 5/4) poorly to nonindurated, nonsorted, massive silty sand with pebbles [clay-silt 50%; sand 40-50%- very fine to very coarse grained, subangular to subrounded; pebbles accessory-10%- very fine to very coarse grained, max 3 cm, subangular to subrounded.] Paleoenvironment- paleosol with 5-10% rootlets, max 1-2 mm diameter. Approximately 10 cm of dark brown (10YR 3/3) mottling at base, max 30% and 3 cm diameter. Laterally grades into Level 2 units 4, and 11a.

Level 2 unit 16: Light yellowish brown (2.5Y 6/4) poorly to nonindurated, poorly sorted, pebbly sand [sand 80%- very fine to very coarse grained, subangular to subrounded; pebbles 20%- very fine to very coarse grained, subangular to subrounded; accessory cobbles- fine grained, max 11 cm, subangular to subrounded.] Paleoenvironment- fluvial. Laterally grades into Level 2 units 4, and 12a.
Level 2 unit 17: Dark yellowish brown (10YR 4/4) poorly to nonindurated, poorly sorted, clays to cobbles [clay-silt 10%, sand 60%- very fine to very coarse grained, subangular to subrounded; pebbles 30%- very fine to very coarse grained, subangular to subrounded; accessory cobbles- fine grained, max 7.5 cm, subangular to subrounded.] Paleoenvironment- fluvial. Laterally grades into Level 2 units 5, 13a, and 14.
Level 2 unit 18: Light olive brown (2.5Y 5/4) poorly to nonindurated, moderately sorted, sand [sand 100%- very fine to very coarse grained, subangular to subrounded.] Paleoenvironment- fluvial.
Level 2 unit 19: Greenish grey (10GY 5/1) reduced to blue-green tones by gasoline contamination, poorly to nonindurated, moderately sorted, sand [sand 100%- very fine to very coarse grained, subangular to subrounded.] Paleoenvironment- fluvial.
Level 3 unit 1 = base of Level 2 unit 6b and Level 4 unit 1: Very dark greenish grey (10G 3/2 - 10G 4/2) to dark greenish grey (5G 5/1 - 5G 3/1) with accessory to 50% browns [olive black (5Y 2/1 - 5Y4/1), to dusky yellowish brown (10YR 2/2), to greyish brown (2.5Y 5/2).] Browns increase to east and transitions unit 1 into unit 1c with increasing asphalt; reduction to blue-greener tones due to gasoline contamination. One small asphalt pocket max 25 cm diameter on the east wall and 15 cm above base of unit. Caliche 0-30% in nodules to max 7.6 cm thick beds at 48-51 cm above base of unit. Poorly to nonindurated, very well sorted, massive clay. Paleoenvironment- marsh, lake, or very slow flowing fluvial with occasional drying events. Laterally grades into Level 3 unit 1c, incised by Level 4 unit 4.
Level 3 unit 1a: Greenish grey near (5GY 6/1) caliche max 80% in a beds at 15 cm above base of unit 1. Poorly-moderately indurated, very well sorted, massive clay. Paleoenvironment- marsh, lake, or very slow flowing fluvial with occasional drying events.
Level 3 unit 1b: Greenish grey near (5G 6/1) caliche max 80% in a beds at 15 cm above base of unit 1. Poorly-moderately indurated, very well sorted, massive clay. Paleoenvironment- marsh, lake, or very slow flowing fluvial with occasional drying events.
Level 3 unit 1c: Greenish black near (5G 3/1); color due to asphalt contamination. Two small asphalt pockets max 25 cm diameter on the east wall, 15 cm above base of unit. Poorly to nonindurated, very well sorted, massive clay to silty clay. Paleoenvironment- marsh, lake, or very slow flowing fluvial. Laterally grades into Level 3 unit 1.
Level 3 unit 2: Greyish green near (10G 4/2); reduction to blue-greener tones due to gasoline. Poorly to nonindurated, very well sorted, massive clay to silty clay. Paleoenvironment- marsh, lake, or very slow flowing fluvial. Laterally grades into Level 3 unit 1.
Level 3 unit 2a: Greyish green near (10G 4/2); reduction to blue-greener tones due to gasoline. Poorly to nonindurated, very well sorted, massive sandy clay [clay to silty clay- 90%; sand 10%- very fine to very coarse grained, subangular to subrounded.] Paleoenvironment- marsh, lake, or very slow flowing fluvial. Laterally grades into Level 3 units 1 and 2b.
Level 3 unit 2b: Greyish green near (10G 4/2); reduction to blue-greener tones due to gasoline. Poorly to nonindurated, very well sorted, massive sandy clay to sandy silty clay [clay to silty clay-70%; sand 20%- very fine to very coarse grained, subangular to subrounded; 10% pebbles- very fine to fine grained, max 5 mm, subangular to subrounded.] Paleoenvironment- marsh, lake, or very slow flowing fluvial. Laterally grades into Level 3 unit 2a and is terminated by Level 3 unit 3.

Level 3 unit 3: Greyish green (10G 5/2) to dark greenish grey (5G 4/1 -5G 5/1), with some light grey (5Y 7/2) to greenish grey (10Y 5/1) at the top; reduction to blue-greener tones due to gasoline. Poorly to nonindurated, poorly sorted, massive clay to pebbles [silty clay-20%; sand 50-80%- very fine to very coarse grained, subangular to subrounded; pebbles 10-30%- very fine to very coarse grained, max 3 cm, subangular to subrounded.] Poorly preserved trough crossbed with normal grading. Paleoenvironment- stream channel. Laterally disappears.
Level 3 unit 4 = base Level 2 unit 14 and 5a: Light grey to (5Y 7/2) to pale olive (5Y 6/4) poorly to nonindurated, poorly sorted, sand [sand 100%- medium to very coarse grained, subangular to subrounded.] Paleoenvironment- stream channel. Laterally disappears.
Level 3 unit 4a: Light yellowish brown (2.5Y 6/3) poorly to nonindurated, well sorted, clay. Paleoenvironment- small stream channel edge lag.
Level 4 unit 1 = Level 3 unit 1: Mottled very dark greenish grey (5GY 3/1 to 10GY 4/1), to black (10Y 2.5/1); black color due to asphalt contamination. Moderately indurated, poorly sorted, sandy silty clay that appears massive [clay-silt 50%; sand 40%- very fine to very coarse grained, subangular to subrounded; pebbles 10%- very fine grained, max 3mm, subangular to subrounded.] Caliche nodules present on north and south walls - max 5 cm thick, 30 cm long. Paleoenvironment- marsh, lake, or very slow flowing fluvial with drying events. Laterally grades into Level 4 units 2, 3b and incised by Level 4 unit 4.
Level 4 unit 2: Dark greenish grey (10Y 4/1); brown color due to asphalt contamination. Moderately indurated, poorly sorted, sand that appears massive [sand 100%- very fine to very coarse grained, subangular to subrounded.] Paleoenvironment- fluvial. Laterally grades into Level 4 units 1, 3 and 3a and incised by Level 4 unit 4.
Level 4 unit 3: Black (10YR 2/1); brown color due to asphalt contamination, but unit was not sticky. Moderately indurated, poorly sorted sand that appears massive [sand 100%- very fine to very coarse grained, subangular to subrounded.] Paleoenvironment- fluvial. Laterally grades into Level 4 units 2, 3a, and 3b.
Level 4 unit 3a: Black (10YR 2/1); brown color due to asphalt contamination and unit was sticky. Moderately to well indurated, poorly sorted, sand that appears massive [sand 100%- very fine to very coarse grained, subangular to subrounded.] Oxidized asphalt accessory to 10% of unit, max 7.6 cm thick and 30 cm long. Paleoenvironment- fluvial with drying events. Laterally grades into Level 4 units 2, 3 and 3b.
Level 4 unit 3b = Level 5 unit 1 and 2: 50-90% black (2.5Y 2.5/1) and 10-50% very dark greenish grey (10Y 3/1); brown color due to asphalt contamination and unit was sticky, but not as much as Level 4 unit 3a. Moderately indurated, poorly sorted, silty sand that appears massive [silt 20%; sand 75%- very fine to very coarse grained, subangular to subrounded; pebbles accessory to 5%- very fine to fine grained, max 6 mm, subangular to subrounded.] Caliche min 61 cm wide and max 3.8 cm thick present at top of unit between P10 and P11. Oxidized asphalt accessory, max 7.6 cm thick and 30 cm long. Paleoenvironment- fluvial with drying events. Laterally grades into Level 4 units 1, 2, 3, and 3a.
Level 4 unit 4 = Level 3 unit 1c: Mottled brownish black near (5YR 2/1) to olive grey (5Y 4/1) to greenish grey (10GY 3/1); brown color due to asphalt contamination. Browns about 60% and greens about 40%. Moderately indurated, poorly sorted, sandy silty clay that appears massive [clay 50%; silt 10%; sand 40%- very fine to very coarse grained, subangular to subrounded; pebbles 10%- very fine grained, max 4 mm, subangular to subrounded.] Paleoenvironment- marsh, lake, or very slow flowing fluvial. Laterally grades into Level 4 unit 1.

Level 5 unit 1 = Level 4 unit 3a, and 3b: Black (10Y 2.5/1) to very dark brown (7.5YR 2.5/2). Moderately indurated, poorly sorted, silty sands that appear massive [silt 20%; sand 80%- very fine to coarse grained, subangular to subrounded.] Paleoenvironment- fluvial.
Level 5 unit 2 = Level 4 unit 3, and 3b: Poorly developed paleosol on top San Pedro Formation (Qsp) unit BU. Greenish black (10Y 2.5/1) to dark bluish gray (10B 4/1). Brownish black coloration due to asphalt contamination. Moderately indurated, poorly sorted, sandy silty clay that appears massive [clay 20%; silt 20%; sand 60%- very fine to fine grained, subangular to subrounded.] Possible root traces between P11-P12 and P3-P4. Caliche present between P12-P13. Paleoenvironment- arid paleosol with a drying event. Laterally grades into Level 5 unit 3a.
Level 5 unit 3 = Level 5 units 3a, and 3b, Level 6 unit 2: Black (10Y 2.5/1) to very dark brown (7.5YR 2.5/2). Moderately indurated, poorly sorted, silty sands that appear massive [silt 20%; sand 80%- very fine to coarse grained, subangular to subrounded.] Paleoenvironment- nearshore marine altered into a paleosol. Laterally grades into Level 5 unit 3b. Locality 1.
Level 5 unit 3a = Level 6 units 3, and 3b: Mottled black (10Y 2.5/1) and reddish brown (5YR 4/4). Moderately indurated, poorly sorted, silty sands that appear massive [silt 10%; sand 90%- very fine to coarse grained, subangular to subrounded). Approximately 10% oxidized asphalt. Paleoenvironment- nearshore marine altered into a paleosol with drying events. Laterally grades into Level 5 unit 2.
Level 5 unit 3b = Level 6 units 3, and 3a: Top of San Pedro Formation (Qsp) unit BU ~330,000 years old (mid-late Pleistocene). Mottled black (10Y 2.5/1) and reddish brown (5YR 4/4). Moderately to well indurated, poorly sorted, silty sands that appear massive [silt 30%; sand 70%- very fine to coarse grained, subangular to subrounded.] Approximately 40-50% oxidized asphalt. Paleoenvironment- nearshore marine altered into a paleosol with drying events. Laterally grades into Level 5 unit 3.
Level 6 unit 1 = Level 5 unit 3b, Level 7 unit 1, Level 8 unit 1, and Level 9 unit 1: Black (N 2.5/); brown-black color due to asphalt contamination. Enough asphalt present to make it sticky and to give it a "gooey brownie" consistency. Moderately indurated, poorly sorted, sands that appear massive [sand 100%- fine to very coarse grained, subangular to subrounded.] Paleoenvironment- nearshore marine. Laterally grades into Level 6 unit 2.
Level 6 unit 2 = Level 5 unit 2: Black (N 2.5/) sands interfingering with dark brown (10YR 3/3) silts and clays; brown-black color due to asphalt contamination. Moderately indurated, poorly sorted, sands interfingering with clayey silts [clay-silt accessory to 50%; sand 50% to 100%- very fine to very coarse grained, subangular to subrounded.] Appears massive except for the interfingering and much of the silt-clay shows biotubation, max 50%. Paleoenvironment- nearshore marine. Laterally grades into Level 6 units 1, and 3.
Level 6 unit 3: Dark brown (10YR 3/3); P7 to P10 the brown is mottled with greenish-grey (10Y 6/1 to 5G 4/1); oxidized asphalt black (7.5YR 2.5/1) to dark brown (7.5YR 3/3); brown-black color due to asphalt contamination. Moderately to well indurated, poorly sorted, clays to sands that appear massive [clay-silt 50%; sand 50%- very fine to very coarse grained, subangular to subrounded.] Paleoenvironment- nearshore marine with a drying event. Laterally grades into Level 6 units 2, and 3a.
Level 6 unit 3a: Dark brown silts-clays (10YR 3/3) mottled with black (N 2.5/) sands; brown-black color due to asphalt contamination. Moderately indurated, poorly sorted, clays to sands that appear massive [clay-silt 5-70%; sand 30-95%- very fine to very coarse grained, subangular to subrounded.] Paleoenvironment- nearshore marine. Laterally grades into Level 6 units 1, 2, and 3.
Level 6 unit 4 = Level 5 units 3b, 4, Level 7 unit 1, Level 8 unit 1, and Level 9 unit 1: Dark brown (10YR 2/1 to 10YR 3/2); brown-black color due to asphalt contamination. Moderately indurated, poorly sorted, sands that appear massive [sand 100%- fine to very coarse grained, subangular to subrounded.] Paleoenvironment- nearshore marine.

Level 7 unit 1 = Level 6 unit 1, Level 8 unit 1 and Level 9 unit 1: Black (10YR 2/1) to very dark brown (7.5YR 2.5/2); brown-black color due to asphalt contamination. Poorly to moderately indurated, sands that appear massive [sand 100%- very fine to coarse grained, subrounded; pebbles accessory- very fine to coarse grained, rounded and frequently polished.] Paleoenvironment- nearshore marine adjacent to shore. Laterally grades into Level 7 unit 4.
Level 7 unit 2 = Level 8 unit 2: Greenish black (10Y 2.5/1); black color due to asphalt contamination. Moderately to well indurated, silty sands that appear massive [silt 15%; sand 85%- very fine to coarse grained, subangular to subrounded.] Paleoenvironment-nearshore marine adjacent to shore.
Level 7 unit 3: Black (10YR 2/1) sands interfingered with bluish black (5B 2.5/1) silty sand. Black color due to asphalt contamination. Moderately indurated, interfingering silts and sands to pebbles [silt 30-40%; sand 60-70%- very fine to coarse grained, subrounded; pebbles accessory- very fine to very coarse grained, rounded and frequently polished.] Paleoenvironment- nearshore marine adjacent to shore. Laterally grades into Level 7 unit 4.
Level 7 unit 4: Black (10YR 2/1) sands mottled with dark brown (7.5YR 3/3) silty sand. Black color due to asphalt contamination. Poorly to moderately indurated, silty sands that appear massive [silt 10%; sand 90%- very fine to very coarse grained, subrounded; accessory pebbles- very fine to very coarse grained, rounded and frequently polished; accessory cobbles- very fine to fine, rounded and frequently polished.] Paleoenvironment- nearshore marine adjacent to shore. Laterally grades into Level 7 units 1, and 4.
Level 8 unit 1 = Level 6 unit 1, Level 7 unit 1 and Level 9 unit 1: Black (10YR 2/1) to very dark brown (7.5YR 2.5/2). Black-brown color due to asphalt contamination. Moderately indurated sands that appear massive [sand 100%- very fine to very coarse grained, subrounded; pebbles accessory- very fine to very coarse grained, rounded and frequently polished; cobbles accessory- very fine to fine grained, rounded and frequently polished.] Coarse grained sand and fine pebble layer in west wall. Paleoenvironment- nearshore marine adjacent to shore. Laterally grades into Level 8 unit 1a. Locality 2.
Level 8 unit 1a = Level 6 unit 1, Level 7 unit 1 and Level 9 unit 1: Black (10YR 2/1) sands mottled with dark reddish brown (5YR 2.5/2) silty sand. Black-brown color due to asphalt contamination. Poorly to well indurated sands and silt that appear massive [clay nodules accessory; silt 10-40%; sand 60-90%- very fine to very coarse grained, subrounded; pebbles accessory-2%- very fine to very coarse grained, rounded and frequently polished; cobbles accessory- very fine to fine grained, rounded and frequently polished.] Coarse grained sand and fine pebble layer in south wall. Paleoenvironment- nearshore marine adjacent to shore. Laterally grades into Level 8 unit 1.
Level 8 unit 2 = Level 7 unit 2: Greenish black (10Y 2.5/1). Black color due to asphalt contamination. Moderately indurated silty sand [silt 15%; sand 85%- fine to very coarse grained, subangular to subrounded.] Paleoenvironment- nearshore marine adjacent to shore.
Level 9 unit 1 = Level 6 unit 1, Level 7 unit 1, and Level 8 unit 1: Black (N 2.5/) color due to asphalt contamination. Moderately indurated, mature sands to pebbles [sand 80%- fine to coarse grained, subangular to subrounded with a minimum of 50% quartz; pebbles 20%- very fine to medium grained, subrounded to rounded and occasionally polished.] In areas where walls have sloughed, sand displays tabular crossbedding sometimes with pebble bases (Level 9 unit 1a, 1b). Paleoenvironment- nearshore marine adjacent to shore. Locality 3.

Level 9 unit 1a: Black (N 2.5/) color due to asphalt contamination. Moderately indurated matrix to clast supported pebble conglomerates 5-15 cm thick [sand 70-40%- fine to very coarse grained, subangular to subrounded with a minimum of 50% quartz; pebbles 30-60%- fine to coarse grained, rounded some are nearer to spherical (includes Monterey Formation shale and chert) but many (Santa Monica Slate) are flattened.] Paleoenvironment- nearshore marine winnowing/accretionary zone. Often serves as base for tabular crossbeds.
Level 9 unit 1b: Black (N 2.5/) color due to asphalt contamination. Moderately indurated matrix to clast supported pebble conglomerates 5-15 cm thick [sand 95-80%- fine to very coarse grained, subangular to subrounded with a minimum of 50% quartz; pebbles 5-20%- fine to coarse grained, rounded some are nearer to spherical (includes Monterey Formation shale and chert) but many (Santa Monica Slate) are flattened, sometimes polished.] Paleoenvironment- nearshore marine winnowing/accretionary zone. Often serves as base for tabular crossbeds.
Level 10 unit 1: Black (N 2.5/) color due to asphalt contamination. Moderately to poorly indurated, mature sand [sand 100%- fine to very coarse grained, subrounded to rounded with a minimum of 50% quartz.] Paleoenvironment- nearshore marine. Locality 4.
Level 10 unit 1a= Level 11 unit 4: Black (N 2.5/) color due to asphalt contamination. Moderately indurated matrix to clast supported pebble to cobble conglomerates [sand 80-40%- fine to very coarse grained, subangular to subrounded with a minimum of 50% quartz; pebbles 20-50%- fine to very coarse grained; cobbles 0-10%- fine to coarse grained (max 25 cm). Pebbles and cobbles are rounded some are nearer to spherical (includes Monterey Formation shale and chert) but many (Santa Monica Slate) are flattened.] Paleoenvironment- nearshore marine winnowing/accretionary zone.
Level 10 unit 1b = Level 11 unit 1: Black (N 2.5/) color due to asphalt contamination. Moderately indurated silty sand with laminations and cross-laminations (ripple marks) primarily showing up due to biotite and sand [silt 40%; sand 60%- very fine to coarse grained, subangular to subrounded.] Paleoenvironment- nearshore marine.
Level 11 unit 1 = Level 10 unit 1b: Black (N 2.5/) and greyish brown (10YR 5/2) color due to asphalt contamination. Moderately indurated silty sand with bioturbation (max 5%), planar laminations and cross-laminations (ripple marks- max 5% and 2 cm thick) primarily showing up due to biotite and sand, and clast supported pebble stringers [silt 40%; sand max 60%- very fine to coarse grained, subangular to subrounded; pebbles max 5% of volume but max 70% in stringers- very fine to coarse grained, rounded.] Marine bivalves accessory and mostly weathered (2014_01_09_BRA.1; Locality 5). Bioturbation = worm burrows at various angles (some collected). Paleoenvironment- nearshore marine. Laterally grades into Level 11 units 1* and 1a.
Level 11 unit 1a: Black (N 2.5/) and greyish brown (10YR 5/2) color due to asphalt contamination. Moderately indurated, fossiliferous silty sand with planar laminations and cross-laminations (ripple marks- max 5% and 2 cm thick) primarily showing up due to biotite and sand, and clast supported pebble stringers [silt 40%; sand max 60%- very fine to coarse grained, subangular to subrounded; pebbles max 5% of volume but max 70% in stringers- very fine to coarse grained, rounded.] Marine bivalves accessory and mostly weathered (2014_01_09_BRA.1; Locality 5). Paleoenvironment- nearshore marine. Laterally grades into Level 11 units 1 and 1*.
Level 11 unit 1*: Black (N 2.5/) color due to asphalt contamination. Moderately indurated, fossiliferous silty sand that appears massive, and clast supported pebble stringers [silt 40%; sand max 60%- very fine to coarse grained, subangular to subrounded; pebbles max 5% of volume but max 70% in stringers- very fine to coarse grained, rounded.] Marine bivalves accessory and mostly weathered (2014_01_09_BRA.1; Locality 5). Paleoenvironment- nearshore marine. Laterally grades into Level 11 units 1 and 1a.

Level 11 unit 2: Black (N 2.5/) color due to asphalt contamination. Poorly to moderately indurated sands that appear massive [sand 100%- very fine to very coarse grained, subangular to subrounded.] Paleoenvironment- nearshore marine.
Level 11 unit 3: Black (N 2.5/) color due to asphalt contamination. Moderately indurated, fossiliferous silty sand with planar laminations and cross-laminations (ripple marks- max 5% and 2 cm thick) primarily showing up due to biotite and sand, and clast supported pebble stringers [silt 40%; sand max 60%- very fine to coarse grained, subangular to subrounded; pebbles max 10% of volume but max 70% in stringers- very fine to very coarse grained, max 5 cm, rounded.] Plant and marine bivalves, gastropods, and tusk shells max 5% primarily in pebble lag at about 36 m (118') elevation (2014_01_09_BRA.1; Locality 5). Many fossils show no weathering. Paleoenvironment- nearshore marine.
Level 11 unit 3*: Black (N 2.5/) color due to asphalt contamination. Moderately indurated, fossiliferous silty sand that appears massive, and clast supported pebble stringers [silt 40%; sand max 60%- very fine to coarse grained, subangular to subrounded; pebbles max 10% of volume but max 70% in stringers- very fine to very coarse grained, max 5 cm, rounded.] Plant and marine bivalves, gastropods, and tusk shells max 5% primarily in pebble lag at 36 m (118') elevation (2014_01_09_BRA.1; Locality 5). Many fossils show no weathering. Paleoenvironment- nearshore marine.
Level 12 unit 1: Black (N 2.5/) color due to asphalt contamination. Moderately indurated sand with clast supported pockets of coarse sand/fine pebbles and accessory clay-silt ripup clasts [clay/silt accessory; sand 80%- very fine to coarse grained, subrounded to rounded; pebbles 20%- very fine to very coarse grained, rounded; accessory fine cobbles.] Paleoenvironment- nearshore marine that had been hit by a flash flood; at or near intertidal.
Level 12 unit 2= Level 13 units 1, 1a: Dark greenish grey (GLEY1 4/1) clay and black (N 2.5/) sand. Black color due to asphalt contamination. Poorly-moderately indurated, fossiliferous, coarse sand, and fine pebbles with mud ripup clasts [clay-silt 70%; sand 20%- very fine to very coarse grained, subangular-rounded; pebbles 10%- very fine to medium grained, rounded.] Terrestrial plants and marine bivalves, gastropods, and tusk shells present (2014_01_22_BRA.1; Locality 6). Paleoenvironment- nearshore marine that had been hit by a flash flood; at or near intertidal.
Level 12 unit 3: Black (N 2.5/) color due to asphalt contamination. Poorly indurated, fossiliferous, primarily coarse grained sand [sand 100%- very fine to very coarse grained, subangular-rounded.] Abundance of gaper clams (2014_01_22_BRA.1; Locality 6). Paleoenvironment- estuary mouth that had been hit by a flash flood; at or near intertidal.
Level 12 unit 4=Level 11 unit 3: Black (N 2.5/) color due to asphalt contamination. Moderately indurated, fossiliferous, silty sand with ripple marks (1- 2 cm thick) and clast supported pebble stringer [silt 40%; sand 55%- very fine to very coarse grained, subrounded-rounded; pebbles 5%- very fine to very coarse grained, rounded.] Terrestrial plant and marine bivalves, gastropods, and tusk shells in pebble stringer (2014_01_09_BRA.1; Locality 5). Paleoenvironment- nearshore marine that had been hit by a flash flood; at or near intertidal.

Level 13 unit 1 = Level 12 units 1, 2, 3: Greenish black (10Y 2.5/1) clay, black sand (10Y N2.5/1). Color due to asphalt contamination. Poorly indurated, fossiliferous, clast supported pebble conglomerate with mud ripup clasts and, max 50% fossils [clay and silt 30%; sand 40%- coarse to very coarse grained, subrounded with a minimum of 50% quartz; pebbles 30%- fine to coarse grained (max 4 cm). Pebbles are rounded some are nearer to spherical (includes Monterey Formation shale and chert) but most are flattened Santa Monica Slate.] Ripup clasts of mud are mostly rolled to circles and are, max 15 cm across. Marine invertebrate and some plant and bat ray fossils (2014_01_22_BRA.1; Locality 6) to 40% of volume of bed. Gaper clams present under shell bed and many have a mud/pebble/ small fossil halo - they dug down through the flood deposit after the flood. Additional bioturbation present mainly in the western 1/2 of the shaft. Paleoenvironment- nearshore marine that had been hit by a flash flood; at or near intertidal.
Level 13 unit 1a = Level 12 unit 2: Greenish black (10Y 2.5/1) clay, black sand (10Y N2.5/1). Color due to asphalt contamination. Poorly indurated, bioturbated silty sand [silt 50%; sand 50%- very fine to very coarse grained, subrounded with a minimum of 50% quartz.] Marine invertebrate and some plant fossils (2014_01_22_BRA.1; Locality 6) to 10% of volume of bed. Paleoenvironment- at or near intertidal.
Level 13 unit 2: Black sand (N2.5/ color due to asphalt contamination. Poorly indurated, normally graded sand in beach foreshore bedding separated by biotite-rich horizons [sand 100%- very fine to very coarse grained, subrounded with a minimum of 50% quartz.] Paleoenvironment- near intertidal.
Level 13 unit 3 = Level 14 unit 4: Black (N2.5/) color due to asphalt contamination and pebble color. Poorly indurated, fossiliferous, clast supported pebble conglomerate [pebbles 100% - very fine to very coarse grained, rounded some are nearer to spherical (includes Monterey Formation shale and chert) but most are nearly flattened pieces of Santa Monica Slate.] Fossils are all frags, some rounded. Paleoenvironment- pebbly beach.
Level 13 unit 3a = Level 14 unit 4: Black (N2.5/) color due to asphalt contamination and pebble color. Poorly indurated, fossiliferous, clast supported pebble conglomerate [sand 30%- very fine to very coarse grained, subangular to subrounded; pebbles 70%- very fine to very coarse grained, rounded some are nearer to spherical (includes Monterey Formation shale and chert) but most are nearly flattened pieces of Santa Monica Slate.] Fossils are all frags, some rounded. Paleoenvironment- pebbly beach.
Level 14 unit 1 = Level 15 unit 1: Black (N2.5/) and greenish black (10Y 2.5/1) color due to asphalt contamination and pebble color. Non-indurated, fossiliferous, mature sands with pebbles [sands 70-90%- coarse to very coarse grained, rounded and primarily quartz; pebbles 10-20%- very fine to medium grained, max 3 cm, subangular to rounded, most are nearly flattened pieces of Santa Monica Slate.] Fossils are shell frags and a partial marine mammal rib from 2014_02_14_KMS.1; Locality 8, some rounded and most in pebble lags. Paleoenvironment- sandy to pebbly beach.
Level 14 unit 2: Black (N2.5/) and greenish black (10Y 2.5/1) color due to asphalt contamination and pebble color. Non-indurated, fossiliferous pebble lags [sands 50%- coarse to very coarse grained, rounded and primarily quartz; pebbles 50%- very fine to very coarse grained, subangular to rounded, most are nearly flattened pieces of Santa Monica Slate; cobbles accessory- max 20 cm -very fine to coarse grained, subrounded to rounded.] Fossils are shell frags from 2014_02_14_KMS.1; Locality 8, some rounded and most in pebble lags. Paleoenvironment- sandy to pebbly beach. Locality 7.
Level 14 unit 3 = Level 15 unit 2: Greenish black (10Y 2.5/1 color due to asphalt contamination and silt. Non-indurated, fossiliferous silty sands [silty sands - silt 50%; sands 50%- very fine to very coarse grained, rounded and primarily quartz.] Fossils are shell frags from 2014_02_14_KMS.1; Locality 8, some rounded and most in pebble lags. Paleoenvironment- sandy to pebbly beach.

Level 14 unit 4 = Level 13 units 3, and 3a: Black (N2.5/)- color due to asphalt contamination and pebble color. Poorly indurated, clast supported pebble conglomerate. Sand 20% (very fine to very coarse grained, subangular to subrounded); pebbles 80% [very fine to very coarse, rounded some are nearer to spherical (include Monterey Formation shale and chert) but most are nearly flattened pieces of Santa Monica Slate.] Fossils are all frags, some rounded. Paleoenvironment- pebbly beach.
Level 15 unit 1 = Level 14 unit 1: Black (N2.5/) - color due to asphalt contamination. Poorly indurated, fossiliferous, normally graded, sand [sand 50-100%- fine to very coarse grained, subangular to subrounded; pebbles 0-50%- very fine to very coarse max 5 cm, subangular to rounded, most are nearly flattened pieces of Santa Monica Slate.] Pebbles at base of unit in channels or at base of normal grading sequences in trough crossbeds but structure is sometimes uncertain. Fossils from 2014_02_24_BRA.1; Locality 9 and include shell and wood. Paleoenvironment- intertidal.
Level 15 unit 2 = Level 14 unit 3: Black (N2.5/) - color due to asphalt contamination. Poorly indurated, fossiliferous, normally graded, biotite rich, silty sand [silt 50%; sand 50%- very fine to medium grained, subangular to subrounded; layers of medium to very coarse grained sand present.] Appears massive but it probably just is poorly preserved. Fossils from 2014_02_24_BRA.1; Locality 9 and 2014_02_25_KMS.1; Locality 10 includes shell and wood. Paleoenvironment- intertidal.
Level 16 unit 1: Black (N2.5/) - color due to asphalt contamination. Poorly to moderately indurated, fossiliferous, normally graded, biotite rich, silty sand [silt 60%; sand 40%- very fine to medium grained, subangular to subrounded.] Fossils from 2014_02_25_KMS.1; Locality 10 includes shell and wood. Paleoenvironment- intertidal.
Level 16 unit 1a: Black (N2.5/) - color due to asphalt contamination. Poorly to moderately indurated, fossiliferous, normally graded, biotite rich, sand [sand 100%- very fine to very coarse grained, normally graded, subangular to subrounded.] Fossils from 2014_02_25_KMS.1; Locality 10 includes shell and wood. Paleoenvironment- intertidal.
Level 16 unit 2: Black (N2.5/) - color due to asphalt contamination. Poorly indurated, fossiliferous, normally graded sand and pebbles [sand 60-95%- fine to very coarse grained, rounded; pebbles 5-40%- very fine to very coarse grained, max 3 cm, rounded to angular]; accessory clay rich ripup clasts. Poorly preserved cross laminations. Fossils from 2014_03_19_BRA.1; Locality 11 includes shell and wood - tree roots. Paleoenvironment- intertidal.
Level 16 unit 2a: Black (N2.5/) - color due to asphalt contamination. Poorly indurated, fossiliferous, normally graded, sand [sand 95-100%- medium to very coarse grained, rounded; pebbles accessory-5%- very fine to very coarse grained, rounded to angular; cobbles accessory- fine - very coarse grained, max 30 cm, rounded.] Fossils from 2014_03_19_BRA.1; Locality 11 includes shell and wood - tree roots. Paleoenvironment- intertidal.
Level 16 unit 3: Black (N2.5/) - color due to asphalt contamination. Well to very well indurated, sand in oxidized asphalt [sand 100%- very fine to very coarse grained, normally graded, subangular to subrounded.] Paleoenvironment- intertidal that was exposed subaerially with asphalt seep.
Level 16 unit 3a: Black (N2.5/) - color due to asphalt contamination. Well to very well indurated, fossiliferous, sand in oxidized asphalt [sand 100%- very fine to very coarse grained, normally graded, subangular to subrounded.] Fossils from 2014_03_19_BRA.1; Locality 11 includes weathered shell. Paleoenvironment- intertidal that was exposed subaerially with asphalt seep.
Level 16 unit 3b: Black (N2.5/) - color due to asphalt contamination. Moderately indurated, sand in asphalt less oxidized then unit 3 [sand 100%- very fine to very coarse grained, normally graded, subangular to subrounded.] Paleoenvironment- intertidal that was exposed subaerially with asphalt seep.

Level 16 unit 3c: Black (N2.5/) - color due to asphalt contamination. Moderately indurated, fossiliferous, nonsorted, sand [sand 100%- very fine to very coarse grained, normally graded, subangular to subrounded.] Fossils from 2014_03_19_BRA.1; Locality 11 includes weathered shell. Paleoenvironment- intertidal that was exposed subaerially with asphalt seep.
Level 16 unit 4: Black (10Y 2.5/1 and 5Y 2.5/1) - color due to asphalt contamination. Moderately to well indurated, fossiliferous, nonsorted mud [clay 20%; silt 60%; sand 20%- very fine to fine grained, subangular to subrounded.] Fossils from 2014_03_19_BRA.1; Locality 11 includes shell and tree roots. Roots are 3 cm to 20 cm across in clusters approximately 1.5-2m across with gaps of 2.5-3.3m between clusters. Roots eroded at their tops. Paleoenvironment- terrestrial then intertidal.
Level 16 unit 4a: Black (10Y 2.5/1 and 5Y 2.5/1) - color due to asphalt contamination. Poorly to moderately indurated, fossiliferous, nonsorted pebble conglomerate [sand 40%- medium to very coarse grained, subangular to subrounded; pebbles 40%- very fine to very coarse grained, subangular to subrounded; cobbles 20%- very fine grained, max 4 cm, subangular to subrounded.] Fossils from 2014_03_19_BRA.1; Locality 11 include shell and tree roots. Roots are 3 cm to 20 cm across in clusters approximately 1.5-2m across with gaps of 2.5-3.3m between clusters. Roots eroded at their tops. Paleoenvironment- terrestrial then intertidal.
Level 16 unit 5: Black (N2.5/) - color due to asphalt contamination. Poorly to moderately indurated, fossiliferous, nonsorted pebble conglomerate [sand 40%- very coarse grained, subangular to subrounded; pebbles 40%- very fine to very coarse grained, subangular to subrounded; cobbles 20%- very fine grained, max 4 cm, subangular to subrounded.] Fossils from 2014_03_19_BRA.1; Locality 11 includes shells and tree roots. Roots are 3 cm to 20 cm across in clusters approximately 1.5-2 m across with gaps of 2.5-3.3m between clusters. Roots eroded at their tops. Paleoenvironment- terrestrial then intertidal.

See pocket at rear of report for poster of stratigraphy

APPENDIX D. ABBREVIATED CATALOG

See CD for full catalog

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
1	Qoa	143.9	22.0	Black (2.5/N) silty sand [50% silts; 50% sands (very fine to coarse, rounded to subrounded)] - based on lithology preserved in *Anodonta californiensis*.	TB	California floater	*Anodonta* sp. cf. *A. californiensis*	both valves	complete	1	2013_07_12_TSV.1
2	San Pedro, unit BU	133.17-133.8	32.1-32.7	Black (10YR 2/1) well indurated, well sorted sand [100% sand (fine to very coarse, rounded to subrounded), acc pebbles (very fine to very coarse, rounded), acc cobbles (fine, rounded)]	CS	chronostrat sample		NA		1	2013_12_04_KMS.1
2	San Pedro, unit BU	133.3-135.2	32.6-30.7	Dark reddish brown (5YR 2.5/2) silt to coarse sand and black (7.5YR 2.51/) well indurated, well sorted silty sand [0-40% silt, 60-100% sands (very fine to coarse, rounded to subrounded)]	CS	chronostrat sample		NA		1	2013_12_04_KMS.2
3	San Pedro, unit BU	128.8	37.0	Brownish black (5YR 2/1) moderately to well indurated, well sorted sand [100% sands (very fine to coarse, round to subrounded)]	CS	chronostrat sample		NA		1	2013_12_14_BRA.1
4	San Pedro, unit BU	124.7-124.0	40.3-41	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand [60% sands (very fine to very coarse, rounded to subrounded), 40% pebbles (very fine to coarse, rounded)]	CS	chronostrat sample		NA		1	2013_12_21_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	BG	pine, Torrey pine?	*Pinus* sp. cf. *P. torreyana*	seed shell	partial	1	2014_01_09_BRA.1
5	San Pedro, unit BU	120.4-119.2	44.6-45.8	Brownish black (5YR 2/1) moderately to well indurated, well sorted sand [100% sands (very fine to coarse, round to subrounded)]	CS	chronostrat sample		NA		1	2014_01_08_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	bent-nose macoma clam	*Macoma nasuta*	valve	complete	1	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	bivalve	Bivalva	valves	partial	5	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	California softshell clam	*Cryptomya californica*	valve	complete	1	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	common Pacific littleneck clam	*Protothaca staminea*	valve	partial	2	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	Cooper's yoldia clam	*Yoldia cooperi*	both valves	partial	1	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	dish surfclam	*Mactromeris catilliformis* (also as *Spisula catilliformis)*	valve	partial and complete specimens	6	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	furrowed nutclam	*Nuculana taphria*	both valves	complete	1	2014_01_09_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	Gould's donax, Gould's bean clam	*Donax gouldi*	valve	partial and complete specimens	8	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	macoma clam	*Macoma* sp.	both valves	partial	1	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	mussle	Mytilidae	valve	partial	1	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	northern bittersweet clam	*Glycymeris septentrionalis*	valves, both on 1 specimen	complete	7	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	Nuttall's cockle	*Clinocardium nuttalli*	valves	partial	11	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	Nuttall's lucine	*Lucinisca nuttalli*	valve	complete	1	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	Pacific calico scallop	*Argopecten ventricosus*	valve	partial and complete specimens	6	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	punctate Pandora clam	*Pandora punctata*	valve	partial	3	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	purple dwarf venus clam	*Nutricola tantilla*	valve	complete	2	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	razor clam	*Siliqua* sp.	valves, both on 1 specimen	partial	2	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	tellin clam	*Tellina* sp.	both valves	complete	2	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	Venus clam	Veneridae	shell	partial	2	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to	MB	Washington clam	*Saxidomus nuttalli*	valve	partial	2	2014_01_09_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
				subrounded)].							
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MB	Western corbula clam	*Juliacorbula luteola* (also as *Corbula luteola)*	valve	complete	4	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	bittium snail	*Bittium quadrigenarium*	shell	complete	4	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	California cone snail	*Conus californicus*	shell	partial and complete specimens	2	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	carinate dovesnail	*Alia carinata*	shell	partial and complete specimens	47	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	channeled nassa snail	*Nassarius fossatus*	shell	partial	4	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	parasitic snail	*Turbonilla* sp.	shell	complete	1	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	periwinkle snail	*Littorina* sp.	shell	complete	2	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	purple dwarf olive shell snail	*Callianax biplicata* (formerly *Olivella biplicata)*	shell	partial and complete specimen	16	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	Récluz's moon snail	*Glossaulax reclusiana*	shell	partial	4	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	San Pedro auger snail	*Terebra pedroana*	shell	complete	1	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	slipper snail	*Crepidula* sp.	shell	complete	5	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	snail	*Barbarofusus* sp.	shell	partial	1	2014_01_09_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	snail	*Ophiodermella* sp.	shell	partial	1	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	topsnail	*Calliostoma* sp.	shell	partial	1	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	variegated dovesnail	*Astyris tuberosa* (formerly *Mitrella tuberosa)*	shell	partial and complete specimens	5	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	Western fat nassa snail	*Nassarius perpinguis*	shell	partial and complete specimens	20	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	Western lean nassa snail	*Nassarius mendicus*	shell	partial	2	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MG	Western white slipper snail	*Crepidula perforans*	shell	partial	1	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	MS	six-sided tusk shell	*Dentalium neohexagonum*	shell	partial	3	2014_01_09_BRA.1
5	San Pedro, unit BU	121-117	44.9-48.9	Brownish black (5YR 2/1) poorly to moderately indurated, poorly sorted pebbly sand to silty sand [max 40% silt, max 60% sands (very fine to very coarse, rounded to subrounded), max 10% pebbles (very fine to very coarse, rounded to subrounded)].	NA	burrow	NA	burrow	partial	5	2014_01_09_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	BG	pine, Torrey pine?	*Pinus* sp. cf. *P. torreyana*	seed and nut	complete	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	BG	pine, Torrey pine?	*Pinus* sp. cf. *P. torreyana*	seed shell	2 partial, 2 fragments	4	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	BW	plant	Plantae	seed	partial	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	116-115.2	49.5-50.3	Brownish black (5YR 2/1) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to very coarse, rounded)]	CS	chronostrat sample		NA		1	2014_01_24_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MAn	barnacle	Cirripedia	barnacle fragments	partial	2	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MAn	crab	Canceridae	claw	partial	1	2014_01_22_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MAr	polychaete worm	Polychaeta	tube	partial	5	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	bent-nose macoma clam	*Macoma nasuta*	valves	partial and complete specimens	5	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	bivalve	Bivalva	both valves	partial	3	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	bivalve	Bivalva	valves, both on 4 specimens	partial and complete specimens	20	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	Bodega tellin clam	*Tellina bodegensis*	valves	partial and complete specimens	5	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	boring softshell clam	*Platyodon cancellatus*	valve	complete	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	butter clam	*Saxidomus gigantea*	valve	partial (10) and complete (11)	21	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	California fat tellin clam	*Leporimetis obesa*	both valves	complete (3) and partial (1)	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	California softshell clam	*Cryptomya californica*	valve, both on 17 specimens	partial and complete specimens	197	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	California softshell clam	*Cryptomya californica*	valve	complete	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	common Pacific littleneck clam	*Protothaca staminea*	valves	partial and complete specimens	18	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	Cooper's yoldia clam	*Yoldia cooperi*	valves	partial	3	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	crassinella clam	*Crassinella* sp.	shell	complete	3	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	Gould's donax, Gould's bean clam	*Donax gouldi*	valves, both on 2 specimens	complete	4	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	heart rockdewller clam	*Petricola carditoides*	valves	partial and complete specimens	6	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	hooked surfclam	*Simomactra falcata*	valves, both for 4 specimens	partial and complete specimens	98	2014_01_22_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	jackknife clam	*Ensis myrae*	both valves	partial	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	left-handed jewel box clam	*Pseudochama exogyra*	valve	complete	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	macoma clam	*Macoma* sp.	shell	partial	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	northern bittersweet clam	*Glycymeris septentrionalis*	valves, both on 1 specimen	partial and complete specimens	280	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	Nuttall's cockle	*Clinocardium nuttalli*	valves	partial	31	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	Nuttall's lucine	*Lucinisca nuttalli*	valves	complete	4	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	Pacific calico scallop	*Argopecten ventricosus*	valves, both on 2 specimens	partial and complete specimens	71	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	Pacific crassinella clam	*Crassinella pacifica*	valves, both on 1 specimen	complete	133	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	Pacific gaper clam	*Tresus nuttallii*	valve, both on 103 specimens	partial and complete specimens	119	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	Pacific rough piddock	*Zirfaea pilsbryi*	valves, both on 1 specimen	partial	3	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	punctate Pandora clam	*Pandora punctata*	valve, both on 4 specimens	partial and complete specimens	11	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	purple dwarf venus clam	*Nutricola tantilla*	valves	partial and complete specimens	94	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	razor clam	*Siliqua* sp.	valves, both on 4 specimens	partial and complete specimens	6	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	sharp-rib semele	*Semele venusta*	valves	complete	23	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	straight horsemussel	*Modiolus rectus*	valves, both for 3 specimens	partial	4	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	tellin clam	*Tellina* sp.	valves	partial and complete specimens	11	2014_01_22_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	thin-shell littleneck clam	*Protothaca tenerrima*	valves, both on 1 specimen	complete	2	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	Washington clam	*Saxidomus nuttalli*	both valves	partial (11) and complete (10)	22	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	Western corbula clam	*Juliacorbula luteola (also as Corbula luteola)*	valves, both on 2 specimens	partial and complete specimens	406	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MB	white-sand macoma clam	*Macoma secta*	valve	complete	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MBr	branching bryozoa	Bryozoa	bryozoa	partial	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MBr	encrusting bryazoan	Bryozoa	bryozoa	partial	4	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MC	coral	Hydrozoa	on gastropod	partial	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	ME	eccentric sand dollar	*Dendraster excentricus*	tests	partial and complete specimens	27	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	ME	echinoid	Echinodermata	plates	partial	3	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	baetic dwarf olive snail	*Callianax baetica* (formerly *Olivella baetica)*	shell	partial and complete specimens	98	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	California ceacum snail	*Caecum californicum*	shell	partial	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	California cone snail	*Conus californicus*	shell	partial and complete specimens	15	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	carinate dovesnail	*Alia carinata*	shell	partial and complete specimens	139	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	channeled nassa snail	*Nassarius fossatus*	shell	partial	5	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	Chinese hat snail	*Calyptraea* sp.	shell	partial and complete specimens	9	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	gem topsnail	*Calliostoma gemmulatum*	shell	partial and complete specimens	6	2014_01_22_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	glorious topsnail	*Calliostoma gloriosum*	shell	complete	2	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	hooked slippershell	*Garnotia adunca* (also as *Crepidula adunca)*	shell	complete	18	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	Ida's miter	*Mitra idae*	shell	partial	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	Lewis's moon snail	*Euspira lewisi* (also as *Lunatia lewisii)*	shell	partial	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	lirularia snail	*Lirularia* sp.	shell	partial and complete specimens	11	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	nassa snail	*Nassarius* sp.	shell	partial and complete specimens	5	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	periwinkle snail	*Littorina* sp.	shell	partial and complete specimens	7	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	pillow barrel-bubble snail	*Acteocina culcitella*	shell	complete	6	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	purple dwarf olive shell snail	*Callianax biplicata* (formerly *Olivella biplicata)*	shell	partial and complete specimens	74	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	Récluz's moon snail	*Glossaulax reclusiana*	shell	partial and complete specimens	20	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	rocksnail	*Ocinebrina* sp.	shell	partial	5	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	San Pedro auger snail	*Terebra pedroana*	shell	partial and complete specimens	9	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	seaweed limpet	*Discurria insessa*	shell	complete	2	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	slipper snail	*Crepidula* sp.	shell	partial and complete specimens	36	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	snail	*Barbarofusus* sp.	shell	partial	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	snail encrusted with bryozoa	Gastropod encrusted with bryozoa	shell	partial	1	2014_01_22_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	spiny cup-and-saucer snail	*Crucibulum spinosum*	shell	partial and complete specimens	4	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	tulip snail	Fasciolariidae	shell	partial	1	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	variegated dovesnail	*Astyris tuberosa (formerly Mitrella tuberosa)*	shell	partial and complete specimens	35	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	Western fat nassa snail	*Nassarius perpinguis*	shell	partial and complete specimens	157	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MG	Western lean nassa snail	*Nassarius mendicus*	shell	partial and complete specimens	18	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MS	six-sided tusk shell	*Dentalium neohexagonum*	shell	partial and complete specimens	40	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MS	trench tuskshell	*Dentalium vallicolens*	shell	partial and complete specimens	16	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MV	bat ray	Myliobatis sp.	tooth plates	complete	2	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Brownish black (5YR 2/1) moderately to well indurated, poorly to moderately sorted pebbly sand [90% sands (very fine to very coarse, round to subangular) 10% pebbles (very fine to medium, round to subangular)]	MV	bat ray	Myliobatis sp.	tooth plates	complete	2	2014_01_22_BRA.1
6	San Pedro, unit 16U	117.5-112.5	48-53	Cobble of grey marine silt probably from the Puente Fm.	NA	pseudofossil		NA		1	2014_01_22_BRA.1
7	San Pedro, unit 16U	108-109.5	56-56.5	Brownish black (5YR 2/1) poorly indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	CS	chronostrat sample		NA		1	2014_01_31_BRA.1
8	San Pedro, unit 16U	105.3	60.6	Black (N 2.5/) poor/non indurated, poorly sorted pebble conglomerate [(45% sands (coarse to very coarse, rounded), 50% pebbles (very fine to very coarse), 5% cobbles (very fine to fine, rounded)]	BG	pine	*Pinus* sp.	scale	partial	1	2014_02_14_KMS.1
8	San Pedro, unit 16U	104.5-107.5	58-61	Brownish black (5YR 2/1) poorly indurated, poorly sorted pebbly sand [95% sands (very fine to very coarse, round to subrounded), 5% pebbles (very fine to medium, rounded)]	BG	pine, Torrey pine?	*Pinus* sp. *(P. torreyana?)*	scale	complete	1	2014_02_08_BRA.2
8	San Pedro, unit 16U	105.4-105.8	60.1-59.8	Brownish black (5YR 2/1) poorly indurated, poorly sorted pebbly sand [65% sands (very fine to very coarse, round to subrounded), 35% pebbles (very fine to medium, rounded)]	CS	chronostrat sample		NA		1	2014_02_08_BRA.1
8	San Pedro, unit 16U	105.3	60.6	Black (N 2.5/) poor/non indurated, poorly sorted pebble conglomerate [(45% sands (coarse to very coarse, rounded), 50% pebbles (very fine to very coarse), 5% cobbles (very fine to fine, rounded)]	MG	California cone snail	*Conus californicus*	shell	partial	1	2014_02_14_KMS.1
8	San Pedro, unit 16U	105.4-105.8	60.1-59.8	Brownish black (5YR 2/1) poorly indurated, poorly sorted pebbly sand [65% sands (very fine to very coarse, round to subrounded), 35% pebbles (very fine to medium, rounded)]	MG	Récluz's moon snail	*Glossaulax reclusiana*	shell	partial	1	2014_02_08_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
8	San Pedro, unit 16U	105.3	60.6	Black (N 2.5/) poor/non indurated, poorly sorted pebble conglomerate [(45% sands (coarse to very coarse, rounded), 50% pebbles (very fine to very coarse), 5% cobbles (very fine to fine, rounded)]	MV	northern elephant seal	cf. *Mirounga angustirostris*	rib	fragment	1	2014_02_14_KMS.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	BA	big berry manzanita	*Arctostaphylos glauca*	seed	partial	1	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	BA	Eastwood or whiteleaf manzanita	*Arctostaphylos* sp. *A. glandulosa* or *A. glandulosa* ssp. *mollis* or *A. viscidae*	seed	partial	1	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	BG	pine	*Pinus* sp.	scale	partial	2	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	BG	pine, Torrey pine?	*Pinus* sp. *(P. torreyana?)*	scale	partial	1	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	BG	pine, Torrey pine?	*Pinus* sp. cf. *P. torreyana*	seed and nut	partial	1	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	BG	pine, Torrey pine?	*Pinus* sp. cf. *P. torreyana*	seed shell	4 partial, 3 fragments	7	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.6-101.3	64.9-64.2	Brownish black (5YR 2/1) well indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine, rounded)]	CS	chronostrat sample		NA		1	2014_03_06_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	MB	bivalve	Bivalva	valves	partial	2	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	MB	macoma clam	*Macoma* sp.	valves	partial	5	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	MB	mussle	Mytilidae	valve	complete	1	2014_02_24_BRA.1
9	San Pedro, unit 16U	101.0	64.0	Brownish black non indurated, moderately sorted silty sands [29% silt, 65% sands (very fine to fine, subrounded), 5% pebbles (very fine to very coarse, subrounded), 1% cobbles (very fine, subrounded)]	MB	northern bittersweet clam	*Glycymeris septentrionalis*	valve	complete	1	2013_08_20_CDR.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	MB	Pacific gaper clam	*Tresus nuttallii*	both valves	partial	3	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	MB	razor clam	*Siliqua* sp.	valves	partial	3	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	MB	tellin clam	*Tellina* sp.	valves, both on 1 specimen	partial	2	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	MG	California cone snail	*Conus californicus*	shell	partial	3	2014_02_24_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	MG	Chinese hat snail	*Calyptraea* sp.	shell	partial	1	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	MG	Kellet's whelk snail	*Kelletia kelletii*	shell	partial	1	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	MG	purple dwarf olive shell snail	*Callianax biplicata* (formerly *Olivella biplicata)*	shell	partial and complete	3	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	MG	snail	*Ophiodermella* sp.	shell	partial	1	2014_02_24_BRA.1
9	San Pedro, unit 16U	100.5-100.7	65.4-65.2	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	NA	burrow	NA	burrow	partial	2	2014_02_24_BRA.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BA	big berry manzanita	*Arctostaphylos glauca*	seeds	5 complete, 13 partial, 1 fragment	19	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BA	oak, cf. Coast live oak	*Quercus sp.* cf. *Q. argifolia*	leaf	partial	1	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	Monterey cypress	*Hesperocyparis macrocarpa (*formerly *Cupressus macrocarpa)*	cone	6 complete, 14 partial, 6 fragments	26	2014_02_25_KMS.1
10	San Pedro, unit 16U	96.9	69.0	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	BG	Monterey cypress	*Hesperocyparis macrocarpa (*formerly *Cupressus macrocarpa)*	cone	partial	1	2014_02_25_KMS.1C
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	Monterey pine	*Pinus radiata*	cone	basal, partial	1	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	Monterey pine	*Pinus radiata*	scale	2 partial, 4 fragments	6	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	Monterey pine	*Pinus radiata*	scale	partial cone and 16 scales	1	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	pine	*Pinus* sp.	scale	partial	1	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	pine	*Pinus* sp.	cone	partial and 1 fragment	1	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	pine	*Pinus* sp.	seed shell	2 fragments	2	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	pine	*Pinus* sp.	cone	complete	1	2014_02_25_KMS.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	pine, Torrey pine?	*Pinus* sp. *(P. torreyana?)*	scale	2 complete, 3 partial, 4 fragments	9	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	pine, Torrey pine?	*Pinus* sp. cf. *P. torreyana*	seed shell	9 partial and 7 fragments	16	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	pine, Torrey pine?	*Pinus* sp. cf. *P. torreyana*	seed and nut	2 complete and 1 partial	3	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	BG	pine, Torrey pine?	*Pinus* sp. cf. *P. torreyana*	seed and nut	partial	1	2014_02_25_KMS.1A
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	pine, Torrey pine?	*Pinus* sp. *(P. torreyana?)*	scale	complete	1	2014_02_25_KMS.1D
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	pine, Torrey pine?	*Pinus* sp. *(P. torreyana?)*	seed shell	partial	1	2014_02_25_KMS.1D
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	pine, Torrey pine?	*Pinus* sp. *(P. torreyana?)*	scales	2 partial	2	2014_02_25_KMS.1E
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BG	pine, Torrey pine?	*Pinus* sp. *(P. torreyana?)*	cone	partial	1	2014_02_25_KMS.1E
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BW	plant	Plantae	seeds	8 complete, 8 partial	16	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BW	plant	Plantae	wood		0	2014_02_25_KMS.1
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BW	plant	Plantae	wood	partial (in 3 pieces)	1	2014_02_25_KMS.1D
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	BW	plant	Plantae	wood	partial (in 3 pieces)	1	2014_02_25_KMS.1E
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MAn	crab	Canceridae	Carapace (3), part of claw	partial	4	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MAr	polychaete worm	Polychaeta	tube	partial	4	2014_02_25_KMS.1
10	San Pedro, unit 16U	95.0	70.0	Black poorly sorted sands [10% clay/silt, 80% sands (very fine to very coarse, sub angular), 10% pebbles (very fine to coarse, rounded)]	MB	bivalve	Bivalva	valve	partial	1	2012_04_30_BRA.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	bivalve	Bivalva	valves, both on 4 specimens	partial	13	2014_02_25_KMS.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	bivalve	Bivalva	valves, both for 1 specimen	partial	3	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MB	bivalve	Bivalva	valves	complete	11	2014_02_25_KMS.1A
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MB	bivalve	Bivalva	valves	partial	7	2014_02_25_KMS.1A
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	bivalve	Bivalva	valves	partial	3	2014_02_25_KMS.1D
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	California fat tellin clam	*Leporimetis obesa*	both valves	partial	1	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MB	California softshell clam	*Cryptomya californica*	valves	complete	2	2014_02_25_KMS.1A
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	common Pacific littleneck clam	*Protothaca staminea*	valves	partial	4	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	Cooper's yoldia clam	*Yoldia cooperi*	valves, both for 20 spcimens	partial and 2 complete	28	2014_02_25_KMS.1
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	Cooper's yoldia clam	*Yoldia cooperi*	both valves	partial	1	2014_02_25_KMS.1D
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	dish surfclam	*Mactromeris catilliformis* (also as *Spisula catilliformis)*	valves, both on 2 specimens	partial	4	2014_02_25_KMS.1
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	dish surfclam	*Mactromeris catilliformis* (also as *Spisula catilliformis)*	valve	complete	1	2014_02_25_KMS.1D
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	duck clam	Mactridae	valve	partial	1	2014_02_25_KMS.1D
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	giant egg cockle	*Laevicardium elatum*	valves, both for 1 specimen	partial	7	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	Ida tellin clam	*Tellina idae*	valves, both on 2 specimens	partial	5	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	macoma clam	*Macoma* sp.	valves, both for 19 specimens	partial	31	2014_02_25_KMS.1
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	macoma clam	*Macoma* sp.	valve	patial	1	2014_02_25_KMS.1D

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	mussle	Mytilidae	valves, both on 16 specimens	partial and complete specimens	35	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	northern bittersweet clam	*Glycymeris septentrionalis*	valve	complete	2	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MB	northern bittersweet clam	*Glycymeris septentrionalis*	valve	complete	1	2014_02_25_KMS.1A
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	Nuttall's lucine	*Lucinisca nuttalli*	valves, both on 22 specimens	partial	25	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MB	Pacific crassinella clam	*Crassinella pacifica*	valves	complete	3	2014_02_25_KMS.1A
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	Pacific gaper clam	*Tresus nuttallii*	both valves	partial	1	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MB	Pacific gaper clam	*Tresus nuttallii*	both valves	partial	1	2014_02_25_KMS.1A
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	Pacific rough piddock	*Zirfaea pilsbryi*	valve	partial	1	2014_02_25_KMS.1D
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	painted sunset clam	*Gari fucata*	valves, both for 27 specimens	partial and 3 complete	46	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	punctate Pandora clam	*Pandora punctata*	valves, both on 8 specimens	partial and complete specimens	10	2014_02_25_KMS.1
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	punctate Pandora clam	*Pandora punctata*	valve	complete	1	2014_02_25_KMS.1D
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MB	purple dwarf venus clam	*Nutricola tantilla*	valves	complete	4	2014_02_25_KMS.1A
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MB	razor clam	*Siliqua* sp.	both valves	complete	1	2014_02_25_KMS.1A
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	razor clam	*Siliqua* sp.	valve	partial	1	2014_02_25_KMS.1D
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MB	scallop	Pectinidae	valve	complete	1	2014_02_25_KMS.1A
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	straight horsemussel	*Modiolus rectus*	valves, both for 6 specimens	partial	16	2014_02_25_KMS.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	straight horsemussel	*Modiolus rectus*	valve	complete	1	2014_02_25_KMS.1D
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	tellin clam	*Tellina* sp.	valves, both on 44 specimens	partial and complete specimens	59	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MB	tellin clam	*Tellina* sp.	both valves	partial	2	2014_02_25_KMS.1A
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	tellin clam	*Tellina* sp.	both valves	complete	1	2014_02_25_KMS.1D
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	thin-shell littleneck clam	*Protothaca tenerrima*	valves, both for 8 specimens	partial	9	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	Washington clam	*Saxidomus nuttalli*	valves, both for 2 specimens	partial	6	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MB	white-sand macoma clam	*Macoma secta*	both valves	partial	3	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MB	wrinkled rock borer clam	*Hiatella arctica*	valves	complete	2	2014_02_25_KMS.1A
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	ME	eccentric sand dollar	*Dendraster excentricus*	test	partial	44	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	ME	eccentric sand dollar	*Dendraster excentricus*	test	partial	1	2014_02_25_KMS.1A
10	San Pedro, unit 16U	95.7-95.1	69.8-70.4	Black (N 2.5/) moderately indurated, poorly sorted pebbly sand [85% sands (very fine to very coarse, round to subrounded), 15% pebbles (very fine to medium, rounded)]	ME	eccentric sand dollar	*Dendraster excentricus*	test	partial	3	2014_02_25_KMS.1D
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	baetic dwarf olive snail	*Callianax baetica* (formerly *Olivella baetica)*	shell	partial	12	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MG	baetic dwarf olive snail	*Callianax baetica* (formerly *Olivella baetica)*	shell	partial	2	2014_02_25_KMS.1A
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	beta rocksnail	*Ocinebrina beta*	shell	partial	1	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	bubble snail	*Rictaxis* sp.	shell	partial	4	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	California cone snail	*Conus californicus*	shell	partial	3	2014_02_25_KMS.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	California frogsnail	*Crossata californica*	shell	partial	1	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	carinate dovesnail	*Alia carinata*	shell	partial	3	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MG	carinate dovesnail	*Alia carinata*	shell	complete	2	2014_02_25_KMS.1A
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	channeled nassa snail	*Nassarius fossatus*	shell	partial	2	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	dovesnail	*Amphissa* sp.	shell	complete	3	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	moon snail	*Glossaulax* sp.	shell	partial	21	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	pillow barrel-bubble snail	*Acteocina culcitella*	shell	complete	1	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	purple dwarf olive shell snail	Callianax biplicata (formerly Olivella biplicata)	shell	partial and complete specimens	25	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	seaweed limpet	*Discurria insessa*	shell	partial	2	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	slipper snail	*Crepidula* sp.	shell	partial	3	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MG	slipper snail	*Crepidula* sp.	shell	complete	1	2014_02_25_KMS.1A
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	snail	Gastropoda	shell	partial	2	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	symmetrical turretsnail	*Turritella cooperi*	shell	partial	3	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	tegula snail	*Tegula* sp.	shell	partial	1	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	variegated dovesnail	*Astyris tuberosa* (formerly *Mitrella tuberosa)*	shell	partial	4	2014_02_25_KMS.1
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	Western fat nassa snail	*Nassarius perpinguis*	shell	partial and complete specimens	9	2014_02_25_KMS.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	MG	Western lean nassa snail	*Nassarius mendicus*	shell	partial and complete specimens	2	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	MS	six-sided tusk shell	*Dentalium neohexagonum*	shell	partial	1	2014_02_25_KMS.1A
10	San Pedro, unit 16U	99-94.5	66.9-71.4	Black (N 2.5/) poorly indurated, poorly sorted pebbly sand to silty sand [25-45% silt, 45-60% sands (very fine to very coarse, round to subrounded), 0-15% pebbles (very fine to fine, rounded)]	NA	burrow	NA	burrow	partial	3	2014_02_25_KMS.1
10	San Pedro, unit 16U	97.2	68.7	Black (N 2.5/) moderately indurated, poorly sorted silty sand [40% silt, 60% sand (very fine to very coarse, round to subround)]	TV	terrestrial vertebrate				1	2014_02_25_KMS.1A
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	BG	pine	*Pinus* sp.	scale	2 partial	2	2014_03_19_BRA.1
11	San Pedro, unit 16U	89.0	76.9	Brownish black (5YR 2/1) poorly sorted, pebbly sand [90% sands (medium to very coarse, rounded to subrounded); 10% pebbles (very fine to fine, subrounded)].	BW	plant	Plantae	wood		0	2013_06_24_BRA.1
11	San Pedro, unit 16U	93.9	72.0	Black (2.5/N) pebbly sand [50% sands (fine to very coarse, rounded to subrounded), 50% pebbles (very fine to medium, max 1.2cm, rounded to subrounded)] - based on lithology preserved in *Saxidomis nuttalli*.	BW	plant	Plantae	wood		0	2013_07_12_TSV.2
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	BW	plant	Plantae	wood		0	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1A
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1AA
11	San Pedro, unit 16U	top 92.4' (root passed below excavation area)	top 73.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1AB
11	San Pedro, unit 16U	top 91.4' (root passed	top 74.4' (root passed	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1AC

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
		below excavation area)	below excavation area)								
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1B
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1C
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1D
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1E
11	San Pedro, unit 16U	top 90.2' (root passed below excavation area)	top 75.7' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1F
11	San Pedro, unit 16U	top 90.2' (root passed below excavation area)	top 75.7' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1G
11	San Pedro, unit 16U	top 90.1' (root passed below excavation area)	top 75.8' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1H
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.5' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1I

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
11	San Pedro, unit 16U	top 90.5' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1J
11	San Pedro, unit 16U	top 91.9' (root passed below excavation area)	top 74' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1K
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1L
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1M
11	San Pedro, unit 16U	top 91.2' (root passed below excavation area)	top 74.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1O
11	San Pedro, unit 16U	top 91.2' (root passed below excavation area)	top 74.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1O and/or Q
11	San Pedro, unit 16U	top 91.4' (root passed below excavation area)	top 74.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1Q
11	San Pedro, unit 16U	top 91.3' (root passed below excavation area)	top 74.6' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1R
11	San Pedro, unit 16U	top 91.25' (root passed	top 74.6' (root passed	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1T

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
		below excavation area)	below excavation area)								
11	San Pedro, unit 16U	top 91.7' (root passed below excavation area)	top 74.3' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1U
11	San Pedro, unit 16U	top 91.7' (root passed below excavation area)	top 74.2' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1V
11	San Pedro, unit 16U	top 91.7' (root passed below excavation area)	top 74.3' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1W
11	San Pedro, unit 16U	top 91.5' (root passed below excavation area)	top 74' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1X
11	San Pedro, unit 16U	top 92' (root passed below excavation area)	top 73.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1Y
11	San Pedro, unit 16U	top 92' (root passed below excavation area)	top 73.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	BW	plant	Plantae	wood		1	2014_03_19_BRA.1Z
11	San Pedro, unit 16U	91.5-90.5	74.4-75.4	Brownish grey (5YR 4/1) moderately to well indurated, poorly sorted silty sand [85% clay/silt, 15% sand (very fine to medium, rounded)]	CS	chronostrat sample		NA		1	2014_03_20_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MAn	crab	Canceridae	claw	partial	1	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	bent-nose macoma clam	*Macoma nasuta*	valve, both on 6 specimens	partial and complete specimens	17	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed	top 74.9' (root passed	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	bent-nose macoma clam	*Macoma nasuta*	valves, both on 2 specimens	complete	4	2014_03_19_BRA.1A, B, and C

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
		below excavation area)	below excavation area)								
11	San Pedro, unit 16U	92.0	73.0	Black moderately sorted, poorly indurated pebbly sands [90% sands (very fine to medium, sub angular), 10% pebbles (medium to coarse, rounded)]	MB	bivalve	Bivalva	valve	partial	3	2013_06_21_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	bivalve	Bivalva	valves	partial	5	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	bivalve	Bivalva	valves	partial	4	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	bivalve	Bivalva	valves	partial	3	2014_03_19_BRA.1A
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	bivalve	Bivalva	valves	partial	8	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	bivalve	Bivalva	valves	partial and complete specimens	6	2014_03_19_BRA.1B
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	bivalve	Bivalva	valves	partial	5	2014_03_19_BRA.1D
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	bivalve	Bivalva	valves	partial	8	2014_03_19_BRA.1M
11	San Pedro, unit 16U	top 91.25' (root passed below excavation area)	top 74.6' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	bivalve	Bivalva	valves	partial	5	2014_03_19_BRA.1N
11	San Pedro, unit 16U	top 91.2' (root passed	top 74.4' (root passed	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	bivalve	Bivalva	valves	partial	17	2014_03_19_BRA.1O and/or Q

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
		below excavation area)	below excavation area)								
11	San Pedro, unit 16U	top 91.9' (root passed below excavation area)	top 74' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	bivalve	Bivalva	valves	partial	5	2014_03_19_BRA.1S
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	boring softshell clam	*Platyodon cancellatus*	both valves	partial	3	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	boring softshell clam	*Platyodon cancellatus*	both valves	partial	1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	California fat tellin clam	*Leporimetis obesa*	both valves	partial	1	2014_03_19_BRA.1A, B, and C
5 or 6	San Pedro	121.9-110.9	44-55	Black (2.5/N) pebbly sands [90% sands (very fine to very coarse, rounded to subrounded); 10% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Saxidomus* sp?.	MB	California softshell clam	*Cryptomya californica*	valve, both for 2 specimens	complete	3	2013_07_31_BRA.1
11	San Pedro, unit 16U	top 92.4' (root passed below excavation area)	top 73.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	California softshell clam	*Cryptomya californica*	valves	partial	2	2014_03_19_BRA.1AB
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	California softshell clam	*Cryptomya californica*	valve	complete	1	2014_03_19_BRA.1B
5 or 6	San Pedro	121.9-110.9	44-55	Black (2.5/N) pebbly sands [90% sands (very fine to very coarse, rounded to subrounded); 10% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Saxidomus* sp?.	MB	California surfclam	*Mactrotoma californica*	valve	complete	1	2013_07_31_BRA.1
11	San Pedro, unit 16U	top 91.2' (root passed below excavation area)	top 74.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	Carpenter's tellin clam	*Tellina carpenteri*	valves	partial	1	2014_03_19_BRA.1O and/or Q
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	common Pacific littleneck	*Protothaca staminea*	valves, both on 10 specimens	partial and complete specimens	20	2014_03_19_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
						clam					
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	common Pacific littleneck clam	*Protothaca staminea*	both valves	partial	2	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	common Pacific littleneck clam	*Protothaca staminea*	both valves	partial and complete specimens	2	2014_03_19_BRA.1L
11	San Pedro, unit 16U	top 91.2' (root passed below excavation area)	top 74.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	common Pacific littleneck clam	*Protothaca staminea*	both valves	complete	1	2014_03_19_BRA.1O and/or Q
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	Cooper's yoldia clam	*Yoldia cooperi*	both valves	partial and complete specimens	3	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	dish surfclam	*Mactromeris catilliformis* (also as *Spisula catilliformis)*	valves, both on 67 specimens	partial and complete specimens	70	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	duck clam	Mactridae	valve	partial	2	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	top 91.2' (root passed below excavation area)	top 74.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	duck clam	Mactridae	valves	partial	1	2014_03_19_BRA.1O and/or Q
11	San Pedro, unit 16U	93.9	72.0	Black (2.5/N) pebbly sand [50% sands (fine to very coarse, rounded to subrounded), 50% pebbles (very fine to medium, max 1.2cm, rounded to subrounded)] - based on lithology preserved in *Saxidomis nuttalli*.	MB	geoduck clam	*Panopea abrupta*	both valves	complete	1	2013_07_12_TSV.2
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	giant egg cockle	*Laevicardium elatum*	valves	partial	2	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	hooked surfclam	*Simomactra falcata*	valves, both on 3 specimens	partial and complete specimens	6	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	littleneck clam	*Protothaca* sp.	both valves	partial	1	2014_03_19_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
11	San Pedro, unit 16U	95.9	70.0	Black (2.5/N) pebbly sands [max 80% sands (very fine to very coarse, rounded to subrounded); max 30% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Callianax biplicata*.	MB	macoma clam	*Macoma* sp.	shell	complete	3	2013_07_31_BRA.2
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	macoma clam	*Macoma* sp.	valves, both on 19 specimens	partial and complete specimens	33	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	macoma clam	*Macoma* sp.	valves	partial	2	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91.4' (root passed below excavation area)	top 74.4' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	macoma clam	*Macoma* sp.	both valves	partial	1	2014_03_19_BRA.1AC
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	mussle	Mytilidae	valves	complete	2	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	Nuttall's cockle	*Clinocardium nuttalli*	valve	partial	1	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	Nuttall's cockle	*Clinocardium nuttalli*	valve	partial	1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	Nuttall's lucine	*Lucinisca nuttalli*	valves, both on 9 specimens	partial and complete specimens	18	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	Nuttall's lucine	*Lucinisca nuttalli*	valve	complete	1	2014_03_19_BRA.1B
11	San Pedro, unit 16U	94.0	71.0	Dark bluish black to brownish black poorly sorted silty pebbly sands [60% silt, 30% sands (very fine to medium, subrounded), 10% pebbles (very fine to medium, subrounded)]	MB	Pacific gaper clam	*Tresus nuttallii*	valve	partial	3	2013_08_21_CDR.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	Pacific gaper clam	*Tresus nuttallii*	both valves	partial and complete specimens	64	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	Pacific gaper clam	*Tresus nuttallii*	both valves	partial	3	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	93.9	72.0	Black (2.5/N) pebbly sand [50% sands (fine to very coarse, rounded to subrounded), 50% pebbles (very fine to medium, max 1.2cm, rounded to subrounded)] - based on lithology preserved in *Saxidomis nuttalli*.	MB	Pacific littleneck clam	*Leukoma staminea*	both valves	complete	1	2013_07_12_TSV.2

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	Pacific rough piddock	*Zirfaea pilsbryi*	valves, both on 4 specimens	partial	5	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	Pacific rough piddock	*Zirfaea pilsbryi*	valve	partial	1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	Pacific rough piddock	*Zirfaea pilsbryi*	valves	partial	3	2014_03_19_BRA.1B
11	San Pedro, unit 16U	top 91.2' (root passed below excavation area)	top 74.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	Pacific rough piddock	*Zirfaea pilsbryi*	valves	partial	6	2014_03_19_BRA.1O and/or Q
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	Pacific rough piddock	*Zirfaea pilsbryi*	valves	partial (broken)	2	2014_03_19_BRA.1L
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	Pacific spear scallop	*Chlamys hastata*	valve	partial	1	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	painted sunset clam	*Gari fucata*	both valves	partial	1	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	punctate Pandora clam	*Pandora punctata*	valves, both on 3 specimens	partial and complete specimens	7	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	purple dwarf venus clam	*Nutricola tantilla*	valve	whole	1	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	purple dwarf venus clam	*Nutricola tantilla*	valve	complete	1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	purple dwarf venus clam	*Nutricola tantilla*	valve	complete	1	2014_03_19_BRA.1M

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	razor clam	*Siliqua* sp.	valves, both on 5 specimens	partial and complete specimens	7	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91.25' (root passed below excavation area)	top 74.6' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	razor clam	*Siliqua* sp.	both valves	partial	1	2014_03_19_BRA.1P
5 or 6	San Pedro	121.9-110.9	44-55	Black (2.5/N) pebbly sands [90% sands (very fine to very coarse, rounded to subrounded); 10% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Saxidomus* sp?.	MB	ribbed corbula	*Caryocorbula porcella*	both valves	complete	1	2013_07_31_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	sickle jackknife clam	*Solen sicarius*	both valves	partial	3	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	spiny pricklycockle clam	*Trachycardium quadragenarium* (also as *Dallocardia quadrageneria)*	valves	partial	8	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	sunset clam	*Gari sp.*	valve	partial	1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	tellin clam	*Tellina* sp.	valves, both on 5 specimens	partial and complete specimens	7	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	thin-shell littleneck clam	*Protothaca tenerrima*	both valves	complete	1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	trapezoid thracia	*Thracia trapezoides*	both valves	partial and complete specimens	2	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MB	Venus clam?	Veneridae?	valves	complete	2	2014_03_19_BRA.1B
11	San Pedro, unit 16U	93.9	72.0	Black (2.5/N) pebbly sand [50% sands (fine to very coarse, rounded to subrounded), 50% pebbles (very fine to medium, max 1.2cm, rounded to subrounded)] - based on lithology preserved in *Saxidomis nuttalli*.	MB	Washington clam	*Saxidomus nuttalli*	both valves	complete	1	2013_07_12_TSV.2
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MB	Washington clam	*Saxidomus nuttalli*	both valves	partial	1	2014_03_19_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MB	Washington clam	*Saxidomus nuttalli*	valve	partial	1	2014_03_19_BRA.1A, B, and C
5 or 6	San Pedro	121.9-110.9	44-55	Black (2.5/N) pebbly sands [90% sands (very fine to very coarse, rounded to subrounded); 10% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Saxidomus* sp?.	MB	Washington clam	*Saxidomus* (?) sp.	both valves	partial	1	2013_07_31_BRA.1
5 or 6	San Pedro	121.9-110.9	44-55	Black (2.5/N) pebbly sands [90% sands (very fine to very coarse, rounded to subrounded); 10% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Saxidomus* sp?.	MG	baetic dwarf olive snail	*Callianax baetica* (formerly *Olivella baetica)*	shell	complete	1	2013_07_31_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	baetic dwarf olive snail	*Callianax baetica* (formerly *Olivella baetica)*	shell	partial and complete specimens	34	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91.2' (root passed below excavation area)	top 74.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	baetic dwarf olive snail	*Callianax baetica* (formerly *Olivella baetica)*	shell	partial and complete specimens	2	2014_03_19_BRA.1O and/or Q
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	California cone snail	*Conus californicus*	shell	complete	1	2014_03_19_BRA.1
11	San Pedro, unit 16U	95.9	70.0	Black (2.5/N) pebbly sands [max 80% sands (very fine to very coarse, rounded to subrounded); max 30% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Callianax biplicata*.	MG	carinate dovesnail	*Alia carinata*	shell	complete	1	2013_07_31_BRA.2
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	carinate dovesnail	*Alia carinata*	shell	partial and complete specimens	7	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MG	carinate dovesnail	*Alia carinata*	shell	complete	1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	carinate dovesnail	*Alia carinata*	shell	complete	1	2014_03_19_BRA.1M
11	San Pedro, unit 16U	top 91.2' (root passed below excavation area)	top 74.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	carinate dovesnail	*Alia carinata*	shell	complete	1	2014_03_19_BRA.1O and/or Q
11	San Pedro, unit 16U	top 91' (root passed	top 74.9' (root passed	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MG	channeled nassa snail	*Nassarius fossatus*	shell	partial	1	2014_03_19_BRA.1A, B, and C

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
		below excavation area)	below excavation area)								
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	Chinese hat snail	*Calyptraea* sp.	shell	partial and complete specimens	3	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	moon snail	Naticidae	shell	partial	1	2014_03_19_BRA.1M
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	moon snail?	*Euspira sp.?*	shell	partial	1	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	nassa mud snail	Nassariidae	shell	partial	7	2014_03_19_BRA.1B
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	parasitic snail	*Turbonilla sp.*	shell	partial	1	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	Princip's slippersnail	*Crepidula princeps*	shell	partial	1	2014_03_19_BRA.1
5 or 6	San Pedro	121.9-110.9	44-55	Black (2.5/N) pebbly sands [90% sands (very fine to very coarse, rounded to subrounded); 10% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Saxidomus* sp?.	MG	purple dwarf olive shell snail	Callianax biplicata (formerly Olivella biplicata)	shell	complete	3	2013_07_31_BRA.1
11	San Pedro, unit 16U	95.9	70.0	Black (2.5/N) pebbly sands [max 80% sands (very fine to very coarse, rounded to subrounded); max 30% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Callianax biplicata*.	MG	purple dwarf olive shell snail	Callianax biplicata (formerly Olivella biplicata)	shell	complete	1	2013_07_31_BRA.2
11	San Pedro, unit 16U	94.0	71.0	Dark bluish black to brownish black poorly sorted silty pebbly sands [60% silt, 30% sands (very fine to medium, subrounded), 10% pebbles (very fine to medium, subrounded)]	MG	purple dwarf olive shell snail	*Callianax biplicata* (formerly *Olivella biplicata)*	shell	complete	1	2013_08_21_CDR.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	purple dwarf olive shell snail	Callianax biplicata (formerly Olivella biplicata)	shell	partial and complete specimens	15	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MG	purple dwarf olive shell snail	*Callianax biplicata* (formerly *Olivella biplicata)*	shell	complete	1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	top 91.25' (root passed below excavation area)	top 74.6' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	purple dwarf olive shell snail	Callianax biplicata (formerly Olivella biplicata)	shell	complete	1	2014_03_19_BRA.1N

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
11	San Pedro, unit 16U	top 91.9' (root passed below excavation area)	top 74' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	purple dwarf olive shell snail	*Callianax biplicata* (formerly *Olivella biplicata)*	shell	complete	3	2014_03_19_BRA.1S
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	Récluz's moon snail	*Glossaulax reclusiana*	shell	partial	3	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	slipper snail	*Crepidula* sp.	shell	partial	1	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MG	slipper snail	*Crepidula* sp.	shell	partial	1	2014_03_19_BRA.1A
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MG	slipper snail	*Crepidula* sp.	shell	partial	1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	snail	*Barbarofusus* sp.	shell	partial	2	2014_03_19_BRA.1
11	San Pedro, unit 16U	95.9	70.0	Black (2.5/N) pebbly sands [max 80% sands (very fine to very coarse, rounded to subrounded); max 30% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Callianax biplicata*.	MG	snail	Gastropoda	shell	internal whorl	1	2013_07_31_BRA.2
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	snail	Gastropoda	shell	partial	1	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91.25' (root passed below excavation area)	top 74.6' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	snail	Gastropoda	shell	partial	3	2014_03_19_BRA.1N
11	San Pedro, unit 16U	top 91.7' (root passed below excavation area)	top 74.3' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	snail	Gastropoda	shell	partial	1	2014_03_19_BRA.1W
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	symmetrical turretsnail	*Turritella cooperi*	shell	partial	2	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	tegula snail	*Tegula sp.*	shell	partial	1	2014_03_19_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MG	topsnail	*Calliostoma* sp.	shell	partial	1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	variegated dovesnail	*Alia tuberosa*	shell	complete	1	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	variegated dovesnail	*Astyris tuberosa*(formerly *Mitrella tuberosa)*	shell	complete	8	2014_03_19_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	wentletrap snail	*Opalia* sp.	shell	partial	1	2014_03_19_BRA.1
5 or 6	San Pedro	121.9-110.9	44-55	Black (2.5/N) pebbly sands [90% sands (very fine to very coarse, rounded to subrounded); 10% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Saxidomus* sp?.	MG	Western fat nassa snail	*Nassarius perpenguis*	shell	complete	1	2013_07_31_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	Western fat nassa snail	*Nassarius perpinguis*	shell	partial and complete specimens	15	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 91' (root passed below excavation area)	top 74.9' (root passed below excavation area)	Black (5YR 2/1) poorly indurated, well sorted silty sand [80% silt, 20% sand (very fine to medium, rounded)]	MG	Western fat nassa snail	*Nassarius perpenguis*	shell	complete	1	2014_03_19_BRA.1A, B, and C
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	Western fat nassa snail	*Nassarius perpinguis*	shell	partial and complete specimens	4	2014_03_19_BRA.1M
11	San Pedro, unit 16U	top 91.9' (root passed below excavation area)	top 74' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	Western fat nassa snail	*Nassarius perpinguis*	shell	partial and complete specimens	5	2014_03_19_BRA.1S
5 or 6	San Pedro	121.9-110.9	44-55	Black (2.5/N) pebbly sands [90% sands (very fine to very coarse, rounded to subrounded); 10% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Saxidomus* sp?.	MG	Western lean nassa snail	*Nassarius mendicus*	shell	complete	1	2013_07_31_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	MG	Western lean nassa snail	*Nassarius mendicus*	shell	partial and complete specimens	8	2014_03_19_BRA.1
11	San Pedro, unit 16U	top 90.4' (root passed below excavation area)	top 75.4' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	Western lean nassa snail	*Nassarius mendicus*	shell	partial	1	2014_03_19_BRA.1M

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
11	San Pedro, unit 16U	top 91.9' (root passed below excavation area)	top 74' (root passed below excavation area)	Black (5YR 2/1) moderately indurated, poorly sorted silty sand [80% clay/silt, 20% sand (very fine to medium, rounded)]	MG	Western lean nassa snail	*Nassarius mendicus*	shell	partial	5	2014_03_19_BRA.1S
5 or 6	San Pedro	121.9-110.9	44-55	Black (2.5/N) pebbly sands [90% sands (very fine to very coarse, rounded to subrounded); 10% pebbles (very fine to fine, rounded)] - based on lithology preserved with *Saxidomus* sp?.	MS	six-sided tusk shell	*Dentalium neohexagonum*	shell	complete	1	2013_07_31_BRA.1
11	San Pedro, unit 16U	93 -at least 90	72.9 -at least 75.9	Black (5YR 2/1) moderately indurated, poorly sorted clay/silt sand to pebbly sand [0-95% clay/silt, 5-75% sand (very fine to very coarse, round), 0-25% pebbles (very fine to very coarse, round), acc cobbles (very fine to very coarse, round)]	NA	burrow	NA	burrow	partial	1	2014_03_19_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with Chione sp.	MB	bivalve	Bivalva	both valves	complete	1	2013_07_25_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with Chione sp.	MB	California softshell clam	*Cryptomya californica*	valve	complete	1	2013_07_25_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with *Chione undatella*.	MB	California surfclam	*Mactrotoma californica*	both valves	complete	1	2013_07_30_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with *Chione undatella*.	MB	frilled Venus	*Chione undatella*	both valves	partial	1	2013_07_30_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with *Chione undatella*.	MB	Gould's donax, Gould's bean clam	*Donax gouldi*	valve	complete	1	2013_07_30_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with Chione sp.	MB	hooked surfclam	*Simomactra falcata*	valve, both for 1 specimen	complete	2	2013_07_25_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with *Chione undatella*.	MB	lord dwarf-venus	*Nutricola lordi*	valve	complete	1	2013_07_30_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with *Chione undatella*.	MB	northern bittersweet clam	*Glycymeris septentrionalis*	valve	complete	1	2013_07_30_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with *Chione undatella*.	MB	ribbed corbula	*Caryocorbula porcella*	valve	complete	1	2013_07_30_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with Chione sp.	MB	tellin clam	*Tellina* sp.	both valves	complete	1	2013_07_25_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with *Chione undatella*.	MB	tellin clam	*Tellina* sp.	valve	complete	1	2013_07_30_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with Chione sp.	MB	Venus clam	*Chione* sp.	valve	partial	1	2013_07_25_BRA.1

Locality	Formation	Elev (Ft)	Depth below surface (feet)	Lithology	Group	Common name	Taxon	Element	Portion	Number of Specimens	Field #
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with Chione sp.	MG	California cone snail	*Conus californicus*	shell	complete	1	2013_07_25_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with *Chione undatella*.	MG	carinate dovesnail	*Alia carinata*	shell	complete	1	2013_07_30_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with Chione sp.	MG	purple dwarf olive shell snail	Callianax biplicata (formerly Olivella biplicata)	shell	complete	1	2013_07_25_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with *Chione undatella*.	MG	purple dwarf olive shell snail	Callianax biplicata (formerly Olivella biplicata)	shell	partial	1	2013_07_30_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with Chione sp.	MG	Récluz's moon snail	*Glossaulax reclusiana*	shell	partial	1	2013_07_25_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with *Chione undatella*.	MG	slipper snail	*Crepidula* sp.	shell	partial	1	2013_07_30_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with Chione sp.	MG	snail	*Barbarofusus* sp.	shell	partial	1	2013_07_25_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with Chione sp.	MG	Western lean nassa snail	*Nassarius mendicus*	shell	complete	1	2013_07_25_BRA.1
6 or 7	San Pedro, unit 16U	115.9-110.9	50-55	Black (2.5/N) sands [100% sands (very fine to very coarse, rounded to subrounded)] - based on lithology preserved with Chione sp.	MS	six-sided tusk shell	*Dentalium neohexagonum*	shell	complete	1	2013_07_25_BRA.1

APPENDIX E. MICROFOSSIL CHRONOLOGY

Hi Kim, Bethany,

We came up with an age of early Late Pliocene to Early Pliocene, primarily from forams, but supported by palynology. The Pliocene age is solid, but of course, there is always the chance that the sediment was reworked from older strata. If you have conflicting younger ages from mammalian or invertebrate fossils, you should favor those. However, if there is no hard evidence that the sediments are indeed Middle Pleistocene, then you should consider the early Late Pliocene age as correct.

The results were hindered by the coarse grain size of the raw sample material. Samples suitable for micropaleontology are typically fine grain sediments, fine sand, silt, clay and limestone. Some coals are good for palynology. Coarse sands and larger grain sizes usually do not yield good microfossil assemblages, plus the when they do produce microfossils there is a good chance they are reworked from older strata. For the nannofossil preps, we used both the unwashed asphaltic sample and the washed sample, but results were nearly identical.

If you decide to do additional analyses, please try to select fine grain lithologies. The asphalt can make it hard to see the grain size, but usually grain size can be felt by rubbing the sediment between your thumb and index finger. I would be happy to discuss sampling with you if you plan on taking more samples for microfossil analysis.

Regards,
--
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Biostratigraphic analysis of 9 samples from the Wilshire Boulevard Subway Excavation, Los Angeles, CA

Pierre A. Zippi, Ph.D., Biostratigraphy.com, LLC
Report # 1080, July 16, 2014

Executive summary:
Nine samples from a Wilshire Boulevard subway excavation site in Los Angeles, CA were submitted for palynology, foraminifera and nannofossil analyses to determine the age, paleoenvironment and paleoclimate of the sampled strata. One sample, 2014-01-24-BRA.1, yielded sufficient fossils to produce a reliable age estimate of early Late Pliocene, Latest Repettian or early Venturian. The environment of deposition was marine, likely channelized turbidite fill of a deep-water basin. These sediments have not been buried deeper than a few hundred feet. The generally poor microfossil recovery is due to the coarse grain size of the samples. The coarse grain size and turbiditic depositional processes allow the possibility that the microfossils are re-deposited from the erosion of older strata.

Sample analysis summary:

1 - 2013-12-04-KMS.1

Lithology:	Granitic quartz, feldspar sand
Age:	Undetermined
Environment:	Undetermined
Foram recovery:	None
Nannofossils:	None
Palynology:	Very rare pollen
Kerogen:	100% asphaltic residue

2 - 2013-12-21-BRA.1

Lithology:	Granitic quartz, feldspar pyrite and mica pebbly sand
Age:	Undetermined; broadly Middle Eocene to Recent
Environment:	Marine, possible basin turbidite fill
Foram recovery:	None
Nannofossils:	None
Palynology:	Very rare pollen, spores and marine dinoflagellates
Kerogen:	81% asphaltic residue, 4% charcoal/coal, 8% cuticle, 4% amorphous organic matter

3 - 2014-01-24-BRA.1

Lithology:	Brown mud with abundant fine-grained quartz and mica sand, minor lignite, rare ostracods, small echinoid spines and shell hash
Age:	early Late Pliocene, Latest Repettian or early Venturian
Environment:	Marine basinal turbidite fill
Foram recovery:	Abundant mixed water depth assemblages
Nannofossils:	Very rare
Palynology:	Abundant terrestrial pollen, spores and fungi with associated marine dinoflagellates
Kerogen:	18% charcoal/coal, 8% tracheids, 34% cuticle, 1% pollen, 39% AOM

4 - 2014-01-08-BRA.1

Lithology:	Brown mud with abundant fine-grained quartz and mica sand with minor lignite
Age:	Undetermined; broadly Paleocene to Recent
Environment:	Marine, possible basin turbidite fill
Foram recovery:	Very rare
Nannofossils:	None
Palynology:	Very rare pollen and marine dinoflagellates
Kerogen:	57% asphaltic residue, 1% charcoal/coal, 8% tracheids, 12% cuticle, 22% AOM

5 - 2014-01-31-BRA.1

Lithology:	Coarse-grained quartz and rock chip sand with minor shell fragments and mica
Age:	Undetermined; broadly Paleocene to Recent
Environment:	Marine, possible basin turbidite fill
Foram recovery:	None
Nannofossils:	None
Palynology:	Very rare pollen, spores and fungi
Kerogen:	1% asphaltic residue, 79% charcoal/coal, 8% cuticle, 1% pollen, 11% AOM

6 - 2014-02-08-BRA.1

Lithology:	Coarse-grained quartz and rock chip sand with minor shell fragments and mica
Age:	Late Miocene to Early Pleistocene (probably early Late Pliocene)
Environment:	Marine, possible basin turbidite fill
Foram recovery:	Very rare
Nannofossils:	None
Palynology:	Very rare pollen, fungi and reworked darker pollen
Kerogen:	20% charcoal/coal, 8% cuticle, 4% fungal, 68% AOM

7 - 2014-03-06-BRA.1

Lithology:	Quartz and rock chip sand with mica and minor pyrite
Age:	Undetermined; broadly Middle Eocene to Recent
Environment:	Marine, possible basin turbidite fill
Foram recovery:	None
Nannofossils:	None
Palynology:	Moderate palynology recovery; mainly terrestrial pollen, spores and fungi with associated marine dinoflagellates and rare reworked pollen
Kerogen:	34% charcoal/coal, 4% tracheids, 22% cuticle, 4% pollen, 36% AOM

8 - 2014-03-20-BRA.1

Lithology:	Quartz and rock chip sand, abundant wood fragments, shell fragments and mica
Age:	Undetermined; broadly Miocene to Early Pleistocene
Environment:	Marine, possible basin turbidite fill
Foram recovery:	None
Nannofossils:	None
Palynology:	Abundant terrestrial pollen and fungal spores with associated marine dinoflagellates and rare reworked pollen
Kerogen:	22% charcoal/coal, 10% tracheids, 48% cuticle, 8% pollen, 8% fungal, 4% AOM

9 - 2014-12-14-BRA.1

Lithology:	Medium-grained quartz and rock chip sand with mica
Age:	Undetermined
Environment:	Marine, possible basin turbidite fill
Foram recovery:	None
Nannofossils:	None
Palynology:	Very rare pollen and fungal spores with associated marine dinoflagellates and one reworked pollen
Kerogen:	24% asphaltic residue, 12% charcoal/coal, 18% cuticle, 8% fungal, 38% AOM

Biostratigraphic analysis of 9 samples from the Wilshire Boulevard Subway Excavation, Los Angeles, CA

Pierre A. Zippi, Ph.D., Biostratigraphy.com, LLC
Report # 1080, July 16, 2014

Introduction:
Nine samples from a Wilshire Boulevard subway excavation site in Los Angeles, CA were submitted for palynology, foraminifera and nannofossil analyses to determine the age, paleoenvironment and paleoclimate of the sampled strata.

Materials, methods and personnel
Nine excavation site samples were analyzed for nannofossils, foraminifera, palynology, and kerogen. Preparations for each analysis type were made from separate sub-samples. The raw samples were supplied by Cogstone, Riverside, CA. The multidisciplinary project was coordinated by Dr. Pierre Zippi, Biostratigraphy.com, LLC, Garland, Texas.

Foraminifera
Samples were washed in solvents to remove the asphalt component, then washed and sieved at 63 µm for foraminifera with detergent and warm water. The samples were oven dried. Residues were sieved and each fraction was examined with a binocular microscope for lithologic composition and foraminifera. Dr. Peter Thompson performed foraminiferal analyses. Dr. Thompson has more than 30 years experience working with foraminifera in oil and gas exploration.

Nannofossils
Slides were prepared from both the unwashed asphaltic sample and the washed foram residue. Residues were mounted on microscope slides and examined with a Zeiss microscope for nannofossil composition and abundance. Ronald Morin performed nannofossil analyses. Mr. Morin has more than 35 years experience working with nannofossils in oil and gas exploration.

Palynology
Samples were washed with solvents to remove asphalt. Carbonate minerals were dissolved using HCl and silicate minerals removed using HF. The remaining organic residue was washed with cold HNO_3 followed by a wash with ammonia or KOH. The residues were sieved through a 7-µm mesh screen to remove small particles that would be unidentifiable in transmitted light microscopy. Residues were mounted on a coverslip with polyvinyl alcohol and fixed to a microscope slide with elvacite. Samples were examined at a minimum of 500X with a research grade Zeiss Axio Imager. Dr. Pierre Zippi performed the palynological analyses. Dr. Zippi has more than 30 years experience working with palynology in oil and gas exploration.

Kerogen and thermal maturation of organics
Kerogen and spore color are not altered by a quick rinse of cold HNO_3, so the palynology slides were also used for visual kerogen analysis. Samples were examined at a minimum of 500X with a research grade Zeiss Axio Imager microscope. Dr. Pierre Zippi of Dallas, Texas performed kerogen analyses and spore color analyses. Dr. Zippi has more than 20 years experience working with organic residues in oil and gas exploration.

Results of Biostratigraphic Analyses

Foraminifera
Foraminifera were recovered from 3 of 9 samples. The foram recovery was very poor except for one sample, 2014-01-24-BRA.1. Most of the samples were relatively coarse sand rich with no microfossils. Twenty-four foram taxa were identified from the 3 samples with foram recovery. The foraminiferal data is presented in Appendix 1.

Nannofossils
Nannofossils were recovered in 1 of 9 samples. Nannofossil results very poor. Coarse sandy sediment usually does not yield good nannofossil results. Two nannofossil taxa were identified from the one sample that yielded nannofossils. The nannofossil data is presented in Appendix 2.

Palynology
Palynological analyses were performed on 9 samples. Palynological recovery ranged from excellent to very poor due to coarse grain sample material. Forty-four taxa were recovered from 9 samples: 35 terrestrial taxa and 9 marine taxa. The palynological data is listed in Appendix 3. The palynological data is presented in Appendix 3 and in a distribution chart (Enclosure 1).

Kerogen
Kerogen analyses were performed on the same 9 sample residues as the palynology. The kerogen results were generally very good. Seven types of particulate kerogen were encountered and quantified. The kerogen data is presented in Appendix 4 and a distribution chart (Enclosure 2).

Thermal maturity of organics by spore color:
The %Ro (est.) was estimated from spore color thermal alteration index (TAI). Smooth or lightly sculptured spores with average thickness wall (roughly 1 to 1.5 µm) were preferentially selected for color estimation. Fungal spores, algae, dinoflagellates and thick-wall pollen and spores were not used for this estimate.

Lithology
The lithology was described for the washed residue of 9 samples. The lithology data was presented in the executive summary.

Discussion

Age

Age intervals can be defined by biostratigraphic first and last appearance events. Ages based on last appearance events are the posted age or older downwards, while ages based on first appearance events are the posted age or younger upwards.

Nannofossils

The single species of nannofossil identified in sample 2014-01-24-BRA1 was *Coccolithus pelagicus*, which has a broad age range of Paleocene to Recent. The remaining samples were barren of nannofossils. Due to poor recoveries, nannofossils did not significantly contribute to age determinations. The coarse sandy sediment found in most of the samples is not a favorable lithology to nannofossil deposition.

Foraminifera

Two of the three samples with foraminifera contained faunas that allowed an age determination.

Sample 2014-01-24-BRA.1 yielded a foraminiferal fauna that constrains the sample age to Early Pliocene to early-Late Pliocene (older than approximately 2.25 my). Five of the twenty-three species recovered have first appearance (FA) events in the Early Pliocene and two species, *Neogloboquadrina asanoi* and *Plectofrondicularia californica*, have last appearance (LA) events in the early-Late Pliocene around 2.25 mya. The remaining taxa have slightly longer age ranges that do not conflict with this age assignment.

Sample 2014-02-08-BRA.1 contained a single specimen of *Islandiella californica*, which broadly restricts this sample to Late Miocene to Early Pleistocene.

The single specimen of *Haplophragmoides* sp. (Middle Jurassic to Recent) found in sample 2014-01-08-BRA.1 does not contribute to a precise age. No foraminifera were observed in the remaining samples.

Palynology

The palynomorph assemblage broadly restricts the samples age to Early Pleistocene to Middle Miocene. This is a broader, but consistent age range compared to the foraminiferal results.

The presence of *Carya, Ephedra* and *Quercus*, along with the absence of *Sequoia* and *Tsuga* suggests a warm dry climate, which is consistent with a mid-Pliocene age.

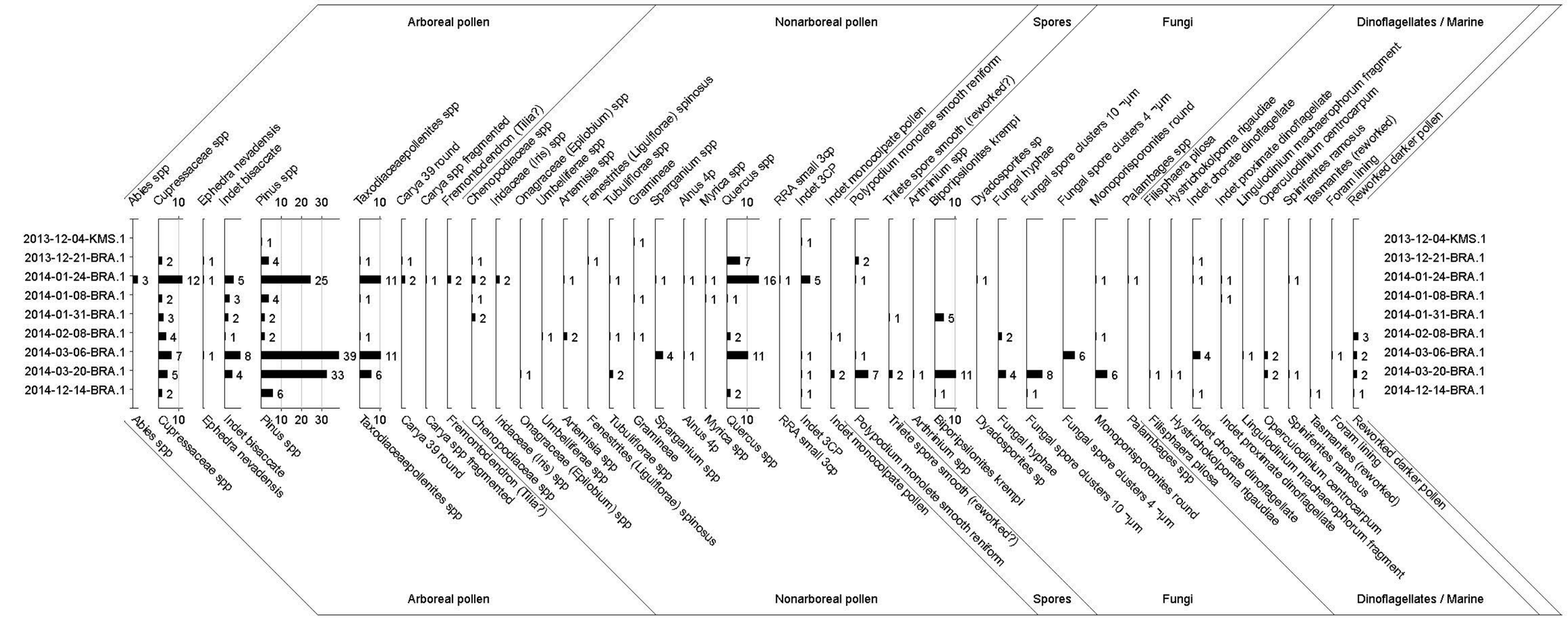
Environment:

The foram sample with good fossil recovery suggests that the depositional environment was an offshore basin that received channelized turbiditic sedimentation. The forams are a mixture of shallow, neritic, planktonic and basinal types. This mixture is common when turbidites are sourced from local up-slope sediments. The mixture of amorphous organic matter and terrestrial kerogen types, and the mixture of terrestrial pollen and marine dinoflagellates support the turbiditic basin environment. Reworking and re-deposition of microfossils is common in turbiditic environments. It is likely that these basin fill sediments were faulted into their present sub-aerial position.

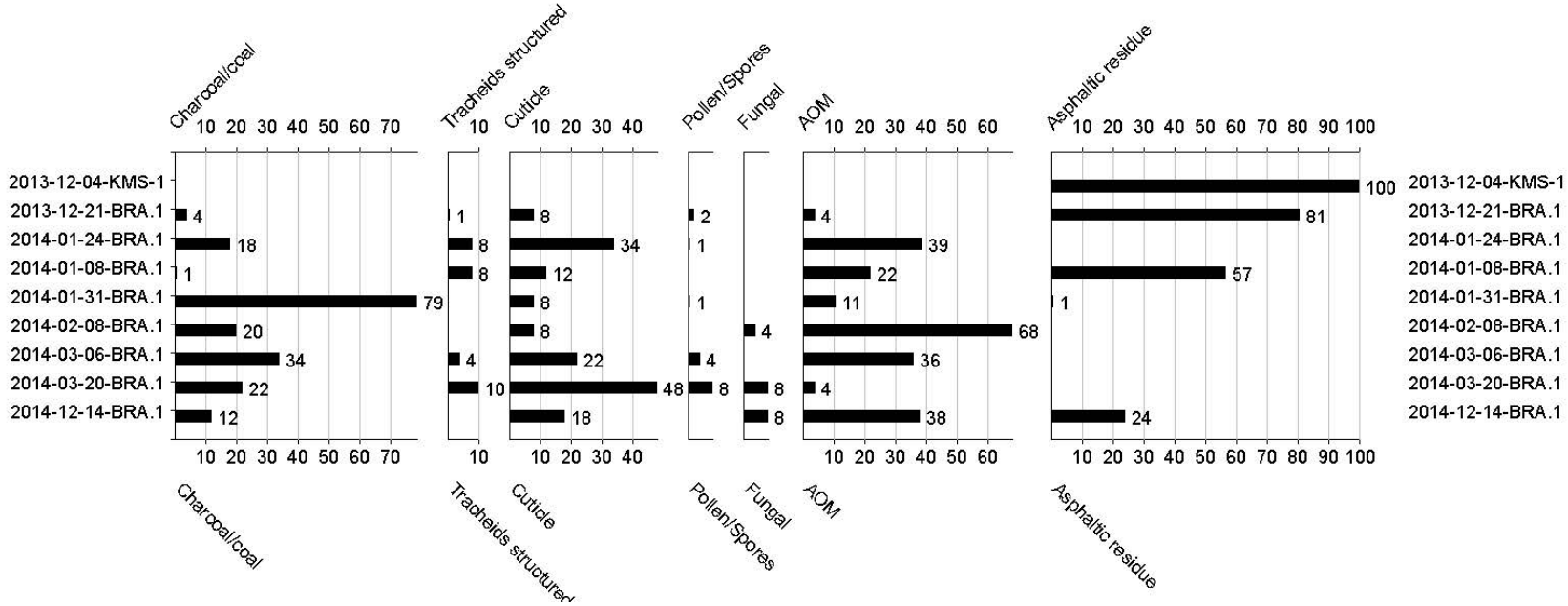
Thermal history:
The pollen color was consistently pale yellow, except for the obviously reworked palynomorphs. Pale yellow indicates an estimated vitrinite reflectance value of approximately %Ro = 0.20. This translates to a maximum temperature of burial of 24°C (75°F). This low burial temperature indicates that these sediments were not buried more deeply than a few hundred feet.

Recommendations:
Results were poor in most samples because the sample lithology was too coarse. Coarse grain, sandy sample material should be avoided for microfossils analyses. Clays and muds are the preferred lithology for recovering microfossils of any type. Fine-grain carbonaceous sediments are best for palynology. Marine shales, marls, limestones and fine grain clastics are best for foraminifera and nannofossils.

Wilshire Boulevard Subway Excavation, Los Angeles, CA
Palynology Distribution Chart - Count Data



Wilshire Boulevard Subway Excavation, Los Angeles, CA
Kerogen Distribution Chart



Appendix 1: Foraminifera sample analysis data

2013-12-04-KMS.1
Barren

2014-12-21-BRA.1
Barren

2014-01-24-BRA.1

30	Elphidiella hannai
9	Elphidium granulosum
2	Bolivina interjuncta
2	Bolivina lomitensis
3	Bolivina sinuata
7	Bolivina spissa
1	cf Rectuvigerina transversa
5	Cibicides fletcheri
11	Epistominella pacifica
20	Eponides grandis
1	Frondicularia advena
2	Islandiella californica
6	Islandiella carinata
1	Plectofrondicularia californica
20	Uvigerina peregrina
23	Uvigerina parvula
1	Buliminella subfusiformis
3	Melonis pompilioides
1	Hansenica rotundimargo
17	Globigerina bulloides
2	Neogloboquadrina pachyderma sinistral
3	Neogloboquadrina pachyderma dextral
1	Neogloboquadrina asanoi

2014-01-08-BRA.1

1	Haplophragmoides sp.

2014-01-31-BRA.1
Barren

2014-02-08-BRA.1

1	Islandiella californica

2014-03-06-BRA.1
Barren

2014-03-20-BRA.1
Barren

2014-12-14-BRA.1
Barren

Appendix 2: Nannofossils sample data

2013-12-04-KMS.1
Barren

2013-12-21-BRA.1
Barren

2014-01-24-BRA.1
Coccolithus sp.
Coccolithus pelagicus

2014-01-08-BRA.1
Barren

2014-01-31-BRA.1
Barren

2014-02-08-BRA.1
Barren

2014-03-06-BRA.1
Barren

2014-03-20-BRA.1
Barren

2014-12-14-BRA.1
Barren

Appendix 3: Palynology sample data

2013-12-04-KMS.1

1	Pinus spp
1	Gramineae
1	Indet 3CP

2013-12-21-BRA.1

2	Cupressaceae spp
1	Ephedra nevadensis
4	Pinus spp
1	Taxodiaceaepollenites spp
1	Carya 39 round
1	Chenopodiaceae spp
1	Fenestrites (Ligulflorae) spinosus
7	Quercus spp
2	Polypodium monolete smooth reniform
1	Indet chorate dinoflagellate

2014-01-24-BRA.1

3	Abies spp
12	Cupressaceae spp
1	Ephedra nevadensis
5	Indet bisaccate
25	Pinus spp
11	Taxodiaceaepollenites spp
2	Carya 39 round
1	Carya spp fragmented
2	Fremontodendron (Tilia?)
2	Chenopodiaceae spp
2	Iridaceae (Iris) spp
1	Artemisia spp
1	Tubuliflorae spp
1	Sparganium spp
1	Alnus 4p
1	Myrica spp
16	Quercus spp
1	RRA small 3cp
5	Indet 3CP
1	Polypodium monolete smooth reniform
1	Dyadosporites sp
1	Monoporisporonites round
1	Palambages spp
1	Indet chorate dinoflagellate
1	Indet proximate dinoflagellate
1	Spiniferites ramosus

2014-01-08-BRA.1

2	Cupressaceae spp
3	Indet bisaccate
4	Pinus spp
1	Taxodiaceaepollenites spp
1	Chenopodiaceae spp
1	Gramineae
1	Myrica spp
1	Quercus spp
1	Indet proximate dinoflagellate

2014-01-31-BRA.1

3	Cupressaceae spp
2	Indet bisaccate
2	Pinus spp
2	Chenopodiaceae spp
1	Trilete spore smooth (reworked?)
5	Biporipsilonites krempi

2014-02-08-BRA.1

4	Cupressaceae spp
1	Indet bisaccate
2	Pinus spp
1	Taxodiaceaepollenites spp
1	Umbelliferae spp
2	Artemisia spp
1	Tubuliflorae spp
1	Gramineae
2	Quercus spp
1	Indet monocolpate pollen
2	Fungal hyphae
1	Monoporisporonites round
3	Reworked darker pollen

2014-03-06-BRA.1

7	Cupressaceae spp
1	Ephedra nevadensis
8	Indet bisaccate
39	Pinus spp
11	Taxodiaceaepollenites spp
4	Sparganium spp
1	Alnus 4p
11	Quercus spp
1	Indet 3CP
1	Polypodium monolete smooth reniform
6	Fungal spore clusters 4 ¬µm
4	Indet chorate dinoflagellate
1	Lingulodinium machaerophorum fragment
2	Operculodinium centrocarpum
1	Foram lining
2	Reworked darker pollen

2014-03-20-BRA.1

5	Cupressaceae spp
4	Indet bisaccate
33	Pinus spp
6	Taxodiaceaepollenites spp
1	Onagraceae (Epilobium) spp
2	Tubuliflorae spp
1	Indet 3CP
2	Indet monocolpate pollen
7	Polypodium monolete smooth reniform
2	Trilete spore smooth (reworked?)
1	Arthrinium spp
11	Biporipsilonites krempi
4	Fungal hyphae
8	Fungal spore clusters 10 ¬µm
6	Monoporisporonites round
1	Filisphaera pilosa
1	Hystrichokolpoma rigaudiae
2	Operculodinium centrocarpum
1	Spiniferites ramosus
2	Reworked darker pollen

2014-12-14-BRA.1

2	Cupressaceae spp
6	Pinus spp
2	Quercus spp
1	Indet 3CP
1	Biporipsilonites krempi
1	Fungal spore clusters 10 ¬µm
1	Indet chorate dinoflagellate
1	Tasmanites (reworked)
1	Reworked darker pollen

Appendix 4: Kerogen sample data

2013-12-04-KMS-1
100 Asphaltic residue

2013-12-21-BRA.1
4 Charcoal/coal
1 Tracheids structured
8 Cuticle
2 Pollen/Spores
4 AOM
81 Asphaltic residue

2014-01-24-BRA.1
18 Charcoal/coal
8 Tracheids structured
34 Cuticle
1 Pollen/Spores
39 AOM

2014-01-08-BRA.1
1 Charcoal/coal
8 Tracheids structured
12 Cuticle
22 AOM
57 Asphaltic residue

2014-01-31-BRA.1
79 Charcoal/coal
8 Cuticle
1 Pollen/Spores
11 AOM
1 Asphaltic residue

2014-02-08-BRA.1
20 Charcoal/coal
8 Cuticle
4 Fungal
68 AOM

2014-03-06-BRA.1
34 Charcoal/coal
4 Tracheids structured
22 Cuticle
4 Pollen/Spores
36 AOM

2014-03-20-BRA.1
22 Charcoal/coal
10 Tracheids structured
48 Cuticle
8 Pollen/Spores
8 Fungal
4 AOM

2014-12-14-BRA.1
12 Charcoal/coal
18 Cuticle
8 Fungal
38 AOM
24 Asphaltic residue

APPENDIX F. TREES AS ENVIRONMENTAL INDICATORS

Location	Endemic trees	California chaparral and woodlands ecoregion	coldest month	mean high	mean low	warmest month	mean high	mean low	Hottest day	Hottest days	Average Rainfall	wettest months	special conditions	source
Santa Cruz, CA	Monterey pine (*Pinus radiata*)	California montane chaparral and woodlands	Dec/ Jan	61^{o}F (16.1^{o} C)	40^{o}F (4.4^{o}C)	Aug	76^{o}F (24.4^{o} C)	53^{o}F (11.7^{o} C)	Sept 107^{o}F (41.7^{o} C)	at least 23 over 100^{o}F (37.8^{o}C) since 1948	31.53" (80 cm)	Nov to Apr	Monterey Bay submarine canyon upwelling; summer coastal fog	Intellicast 2014
Monterey, CA	Monterey cypress (*Hesperocyparis macrocarpa*) & Monterey pine (*Pinus radiata*)	California montane chaparral and woodlands	Dec/ Jan	60^{o}F (15.5^{o} C)	43^{o}F (6^{o}C)	Sept	71^{o}F (21.7^{o} C)	53^{o}F (11.5^{o} C)	Oct 104^{o}F (40^{o}C)	at least 8 over 100^{o}F (37.8^{o}C) since 1948	21.23" (53.9 cm)	Nov to Mar	Monterey Bay submarine canyon upwelling; summer coastal fog with populations in the wettest areas along the west side of the peninsula	Intellicast 2014
Carmel, CA	Monterey cypress (*Hesperocyparis macrocarpa*) & Monterey pine (*Pinus radiata*)	California montane chaparral and woodlands	Dec/ Jan	58^{o}F (14.4^{o} C)	44^{o}F (6.7^{o}C)	Sept	70^{o}F (21.1^{o} C)	53^{o}F (11.5^{o} C)	Oct 104^{o}F (40^{o}C)	at least 11 over 100^{o}F (37.8^{o}C) since 1949	20.35" (51.6 cm)	Nov to Mar	Monterey Bay submarine canyon upwelling; summer coastal fog with populations in the wettest areas along the west side of the peninsula	The Weather Channel 2014
Cambria, CA	Monterey pine (*Pinus radiata*)	California montane chaparral-woodlands	Dec/ Jan	65^{o}F (18.3^{o} C)	45^{o}F (7.2^{o}C)	Sept	71^{o}F (21.7^{o} C)	52^{o}F (11.1^{o} C)	Sept 102^{o}F (38.9^{o} C)	unknown	17.61" (44.72 cm)	Nov to Mar	submarine upwelling; summer coastal fog	The Weather Channel 2014
Santa Rosa Island, CA	Torrey pine (*Pinus torreyana*)	California coastal sage and chaparral	Dec/ Jan	59^{o}F (15^{o}C)	39^{o}F (3.9^{o}C)	Aug	83^{o}F (28.3^{o} C)	53^{o}F (11.7^{o} C)	Jul, Sept 110^{o}F (43.3^{o} C)	unknown	32.41" (82.32 cm)	Nov to Mar	submarine upwelling; summer coastal fog; fossils of Torrey pine (*Pinus torreyana*) present	The Weather Channel 2014
La Jolla, CA	Torrey pine (*Pinus torreyana*)	California coastal sage and chaparral	Dec	66^{o}F (18.9^{o} C)	49^{o}F (9.4^{o}C)	Aug	78^{o}F (25.6^{o} C)	67^{o}F (19.4^{o} C)	Sept 111^{o}F (43.9^{o} C)	at least 20 over 100^{o}F (37.8^{o}C) since 1945	10.59" (26.90 cm)	Nov to Apr	Scripps and La Jolla submarine canyon upwelling; summer coastal fog; fossils of Torrey pine (*Pinus torreyana*) present	Intellicast 2014
Guadalupe Island,	Monterey pine (*Pinus	California coastal sage	Jan/ Feb	66^{o}F (18.9^{o}	52.9^{o}F (11.6^{o}	Sept	75.6^{o} F	61.5^{o} F	95^{o}F (35^{o}C	0 over 95^{o}F	estimate d 15-30"	Nov to April	Summer coastal fog; trees in the	(1951-1980) Colegio de

Location	Endemic trees	California chaparral and woodlands ecoregion	coldest month	mean high	mean low	warmest month	mean high	mean low	Hottest day	Hottest days	Average Rainfall	wettest months	special conditions	source
Baja CA	*radiata*)	and chaparral; cloud forest		C)	C)		(24.2 C)	(16.4^{0} C)	)	(35^{0}C) from 1951 to -1980	(38.1-76.4 cm) where *P. radiata* occurs		wettest areas along the north side of the island.	Postgraduados
Cedros Island, Baja CA	Monterey pine (Pinus radiata)	California coastal sage and chaparral	Jan	73^{0}F (22.8^{0} C)	57.7^{0}F (14.3^{0} C)	Sept	85.1^{0} F (29.5 C)	68.9^{0} F (20.5^{0} C)	Jul 104^{0}F (40^{0}C)	unknown	2.1" (5.3 cm)	Dec to Feb	summer coastal fog	Weatherbase 2014 (1954 on)
Miracle Mile District, Los Angeles, CA	fossils of Monterey cypress (Hesperocyparis macrocarpa) & Monterey pine (Pinus radiata)	California coastal sage and chaparral	Jan	68^{0}F (20.0^{0} C)	47^{0}F (8.3^{0}C)	Aug	84^{0}F (28.9^{0} C)	64^{0}F (17.8^{0} C)	Jun 112^{0}F (44.4^{0} C)	at least 80 over 100^{0}F (37.8^{0}C) since 1909	15.14" (38.45 cm)	Nov to Mar	fossils from PLE and Rancho la Brea	Intellicast 2014
Santa Monica, CA	NA	California coastal sage and chaparral	Jan	64^{0}F (17.8^{0} C)	50^{0}F (10.0^{0} C)	Sept	71^{0}F (21.6^{0} C)	63^{0}F (17.2^{0} C)	Sept 104^{0}F (40^{0}C)	at least 2 over 100^{0}F (37.8^{0}C) since 1948	13.27" (33.71 cm)	Nov to Mar	submarine upwelling; summer coastal fog	Intellicast 2014

APPENDIX G. INVERTEBRATE ENVIRONMENTAL ANALYSES

ENVIRONMENTAL ANALYSIS OF SNAILS RECOVERED

Latitudinal range refers to the range of the modern animal.
ºC refers to the effective temperature, duration of warmth, or the primary reproductive seasons at the northern end of the geographic range.
Taxa listed after "Hall 2002" indicates other names the taxon was referred to.

Common Name	Taxon	Environment (Reference)	Elevations of localities (in ft)							
			121-117	117.5-112.5	105.4-105.8	105.3	100.5-100.7	99-94.5	93- at least 90	**Totals**
parasitic snail	*Turbonilla sp.*	Genus range 60N-5S, Gulf of California; 10.97^{0}C (Hall 2002).	1						1	2
bubble snail	*Rictaxis* sp.							4		4
seaweed limpet	*Discurria insessa*	Individuals live out their entire life on the blades of one feather boa kelp *(Egregia* sp.) in the low intertidal zone; it is occasionally found on the stalked kelp *(Pterogyphora* sp.). Polar to subtropical- Alaska to Baja California (Audubon 1998, SLB 2014).		2				2		4
pillow barrel-bubble	*Acteocina culcitella*	Demersal; depth range 4-311 m. Also found subtidally. Temperate to subtropical- Alaska to So. California (SLB 2014). 58N-28N, intertidal - 293 m on sand; 5(?) Ma to Holocene; 10.65^{0}C (Hall 2002).		6				1		7
gem topsnail	*Calliostoma gemmulatum*	Temperate to subtropical- C. California to Gulf of California (SLB 2014). 34N-23N, intertidal, among rocks; 8 Ma - Holocene; 15.51^{0}C (Hall 2002).		6						6
glorious topsnail	*Calliostoma gloriosum*	Sublittoral rocky bottoms. Temperate- San Francisco to San Diego (Light 2007).		2						2
topsnail	*Calliostoma* sp.		1						1	2
lirularia snail	*Lirularia* sp.			11						11
tegula snail	*Tegula* sp.	Genus range 57N-5S; 10.89^{0}C (Hall 2002)						1	1	2
Chinese hatsnail	*Calyptraea* sp.	Genus range 56N-5S through Gulf of California (Hall 2002).		9			1		3	13
hooked slippershell	*Garnotia adunca* (a.k.a. *Crepidula adunca*)	Demersal. Occurs from middle to low intertidal zones; females live the majority of their lives on the outside of the shell of the Turban Snail (*Tegula* spp.), while males move from snail to snail. Temperate to tropical- Canada to Mexico (SLB 2014). 48N-23N, on gastropod shells, protected outer coasts, intertidal; 13 Ma - Holocene; 12.64^{0}C (Hall 2002, *Crepidula adunca*).		18						18
Western white slipper snail	*Crepidula perforans*	Benthic. Found on rocks, typically on insides of shells, or in clam holes, along the intertidal zone and deeper. Temperate to subtropical- Canada to Baja California (SLB 2014). 65N-23N(?); 5 Ma - Holocene; <10^{0}C (Hall 2002).	1							1

Common Name	Taxon	Environment (Reference)	Elevations of localities (in ft)							Totals
			121-117	117.5-112.5	105.4-105.8	105.3	100.5-100.7	99-94.5	93- at least 90	
Princip's slippersnail	*Crepidula princeps*	EXTINCT. Genus range 72N-5S; 27 - 2.5 Ma; <10^{0}C (Hall 2002)							1	1
slippersnail	*Crepidula* sp.	Genus range 72N-5S; <10^{0}C (Hall 2002).	5	37				4	3	49
spiny cup-and-saucer snail	*Crucibulum spinosum*	Benthic. Circumglobal in warm seas (SLB 2014). 42N - Chile, intertidal-55 m, rocks and shells; 23? or 13 Ma - Holocene; 13.53^{0}C (Hall 2002).		4						4
bittium snail	*Bittium quadrigenarium*		4							4
California frogsnail	*Crossata californica*	Benthic. Subtropical- Eastern and Southwestern Pacific (SLB 2014).						1		1
wentletrap snail	*Opalia* sp.		1							1
periwinkle snail	*Littorina* sp.	Genus range 72N-5S, rocky reefs and in splash zone; <10^{0}C (Hall 2002)	2	7						9
Récluz's moon snail	*Glossaulax reclusiana*	Eastern Pacific (SLB 2014). 42N-21N, through Gulf of California; 27 Ma - Holocene; 13.82^{0}C (Hall 2002, *Polinices (Nerverita) reclusiana*).	4	21	1				3	29
moon snail	*Glossaulax* sp.	Genus range 72N-5S, intertidal - 3055 m, on mud or sand; 27 Ma - Holocene; <10^{0}C (Hall 2002, *Polinices* sp.)						21		21
Lewis's moon snail	*Euspira lewisii* (a.k.a. *Lunatia lewisii*)	Benthic; depth range 0 - 50 m. Boreal to subtropical- Alaska to continental USA (SLB 2014). 51N-28N; 13? or 8 Ma - Holocene; 15.51^{0}C (Hall 2002, *Lunatia lewisii, Polinices (Eusperia) lewisii*).		1						1
moon snail?	*Euspira* sp.?								1	1
moon snail	Naticidae								1	1
California ceacum snail	*Caecum californicum*	Eastern Pacific (SLB 2014). Genus range 23N-5N, intertidal - 64 m among rocks; 8 Ma - Holocene; 19.21^{0}C (Hall 2002).		1						1
symmetrical turretsnail	*Turritella cooperi*	Eastern Pacific (SLB 2014). 37N-28N, >20 m, sand and mud; 13 Ma - Holocene; 13.94^{0}C (Hall 2002).						3	2	5
carinate dovesnail	*Alia carinata*	Benthic; depth range 0 - 5 m. Often found on the giant kelp, *Macrocystis*, and among eelgrass and algae. Boreal to subtropical- Alaska to Baja California (SLB 2014).	47	139				5	11	202
variegated dovesnail	*Alia tuberosa*	Eastern Pacific (SLB 2014).							1	1
dovesnail	*Amphissa* sp.	Genus range 58N-28N, intertidal - 641 m; 10.65^{0}C (Hall 2002).						3		3
variegated dovesnail	*Astyris tuberosa* (was *Mitrella tuberosa)*	Temperate to subtropical- British Columbia to Mexico (SLB 2014). 55N-23N; 23 Ma - Holocene; 11.38^{0}C (Hall 2002, *Mitrella tuberosa*).	5	35				4	8	52
snail	*Barbarofusus* sp.		1	2					1	4
tulip snail	Fasciolariidae			1						1

Common Name	Taxon	Environment (Reference)	Elevations of localities (in ft)							Totals
			121-117	117.5-112.5	105.4-105.8	105.3	100.5-100.7	99-94.5	93- at least 90	
channeled nassa snail	*Nassarius fossatus*	Benthic. On mudflats above low tide line and just below. Temperate to subtropical- British Columbia to Baja California (Audubon 1998, SLB 2014). 49N-27N, offshore - 7 m, bays, lagoons, sandy substrates; 5 Ma - Holocene; 11.81^{0}C (Hall 2002, *Nassa fossatus, Nassarius fossatus*).	4	5				2	1	12
Western lean nassa snail	*Nassarius mendicus*	Benthic. Temperate- Canada to USA (SLB 2014). 55N-25N; 13 Ma - Holocene; 12.64^{0}C (Hall 2002, *Nassarius (Demondia) mendicus*).	3	1				2	14	20
Western fat nassa snail	*Nassarius perpinguis*	Benthic. Temperate (SLB 2014). 48N-28N, intertidal in lagoons and offshore in shallow water; 8 Ma - Holocene; 12.64^{0}C (Hall 2002, *Nassarius (Caesia)* aff. *N. (C.) perpinguis*).	21	157				9	25	212
nassa snail	*Nassarius* sp.	Genus range 55N-5S; 11.38^{0}C (Hall 2002).		5						5
nassa mud snail	Nassariidae								7	7
Kellet's whelk snail	*Kelletia kelletii*	Benthic; depth range 0 - 69 m. It is found in kelp beds on rocky and soft bottoms. Subtropical- USA to Mexico (SLB 2014).					1			1
California cone snail	*Conus californicus*	Demersal; depth range 0 - 45 m. It is found on rocky and sandy bottoms. Temperate to subtropical- C. California to Baja California (Audubon 1998, SLB 2014). 34N-28N, intertidal - 46 m; 13? or 8 Ma - Holocene; 13.15^{0}C (Hall 2002).	2	16		1	3	3	1	26
SP auger snail	*Terebra pedroana*	Eastern Pacific (SLB 2014).	1	9						10
snail	*Ophiodermella* sp.		1				1			2
Ida's miter	*Mitra idae*	Benthic; depth range 0 - 21 m. On rocks in tidepools. Temperate- No. California to Baja (Audubon 1998, SLB 2014). 39N-33N; 8 Ma - Holocene; 13.54^{0}C (Hall 2002).		1						1
beta rocksnail	*Ocinebrina beta*	Eastern Pacific (SLB 2014).						1		1
rocksnail	*Ocinebrina* sp.			5						5
baetic dwarf olive snail	*Callianax baetica* (was *Olivella baetica)*	Benthic. Common but difficult to see because they frequently burrow through the sand. Temperate -Canada to So. California (SLB 2014). 55N-23N, lagoons at low tide, offshore in shallow water, sand; 8 Ma - Holocene; 10.89^{0}C (Hall 2002, *Olivella baetica*).		99				14	36	149
purple dwarf olive shell snail	*Callianax biplicata* (was *Olivella biplicata)*	Benthic. On sand bottoms from low tide line to 46 m. Temperate to subtropical- British Columbia to Baja California (Audubon 1998, SLB 2014). 49N-25N, lagoon entrances, offshore in shallow water; 13 Ma - Holocene; 11.81^{0}C (Hall 2002, *Olivella biplicata*).	16	79			3	25	21	144
snail	Gastropoda			1				2	6	9
									Total	1067

ENVIRONMENTAL ANALYSIS OF BIVALVES RECOVERED

Latitudinal range refers to the range of the modern animal.
ºC refers to the effective temperature, duration of warmth, or the primary reproductive seasons at the northern end of the geographic range.
Taxa listed after "Hall 2002" indicates other names the taxon was referred to.

Common Name	Taxon	Environment (Reference)	Elevations of localities (in ft)					
			121-117	117.5-112.5	100.5-100.7	99-94.5	93- at least 90	Totals
furrowed nutclam	*Nuculana taphria*	Benthic. Temperate- Eastern Pacific (SLB 2014). 37N-28N; 13 Ma - Holocene; 13.94^{0}C (Hall 2002).	1					1
Cooper's yoldia	*Yoldia cooperi*	Benthic. Subtropical- Eastern Pacific (SLB 2014). 40N-32N; 23 Ma - Holocene; 13.36^{0}C (Hall 2002)	1	3		29	3	36
northern bittersweet clam	*Glycymeris septentrionalis*	Benthic; depth range 0 - 55 m (SLB 2014). 60N-25N; 13 Ma - Holocene; 11.38^{0}C (Hall 2002).	7	281	1	3		292
straight horsemussel	*Modiolus rectus*	Sessile; depth range 0 - 15 m. Temperate- No and C. Pacific (SLB 2014). 54N-5S, mudflats, intertidal to 15 m; 13 Ma - Holocene; 11.47^{0}C (Hall 2002).		4		17		21
mussel	Mytilidae		1		1	35	2	39
Pacific calico scallop	*Argopecten ventricosus*	Benthic; brackish; depth range 12 - 50 m. Inhabits shallow bays, sloughs and calm offshore areas; often associated with eelgrass beds. Temperate to subtropical- Eastern Pacific, North to South America (SLB 2014). 34N-5S; 8 Ma - Holocene; 15.51^{0}C (Hall 2002).	6	71				77
Pacific spear scallop	*Chlamys hastata*	Benthic; depth range 2 - 150 m. Rocky, and soft bottoms in subtidal depths. Temperate- Northeast Pacific and Northeast Atlantic (SLB 2014). 60N-33N; 13 Ma - Holocene; 10.31^{0}C (Hall 2002).					1	1
scallop	Pectinidae					1		1
Nuttall's cockle	*Clinocardium nuttalli*	Benthic; depth range 0 - 182 m. Muddy to gravelly bottoms in protected bays and estruaries. Temperate to subtropical- Pacific- Japan to So. California; Atlantic- Gulf of Mexico to Canada (Audubon 1998, SLB 2014). 63N-33N, intertidal - 180 m; 13 Ma - Holocene; <10^{0}C (Hall 2002).	11	31			2	44
giant egg cockle	*Laevicardium elatum*	Demersal. Eastern Pacific (SLB 2014).				7	2	9
spiny prickly cockle	*Trachycardium quadragenarium* (a.k.a. *Dallocardia quadrageneria)*	Demersal. Eastern Pacific (SLB 2014). 37N-27N, intertidal to 50 m, sandflats, bays and sandy substrates; 23 Ma - Holocene; 13.94^{0}C (Hall 2002).					8	8
left-handed jewel box	*Pseudochama exogyra*	Benthic. Found in large clusters on rocks along the open coast. Subtropical- Eastern Pacific - USA to Mexico (SLB 2014). 38.3N-22.9N, intertidal to 25 m; 5 Ma - Holocene; 13.15^{0}C (Hall 2002).		1				1
Pacific crassinella	*Crassinella pacifica*	Demersal. Eastern Pacific (SLB 2014). 34N-1S; 17 Ma - Holocene; 15.51^{0}C (Hall 2002).		133		2		135
crassinella	*Crassinella* sp.			3				3

Common Name	Taxon	Environment (Reference)	Elevations of localities (in ft)					Totals
			121-117	117.5-112.5	100.5-100.7	99-94.5	93- at least 90	
Nuttall's lucine	*Lucinisca nuttalli*	Demersal. Eastern Pacific (SLB 2014). 37N-22N, intertidal to 46 m, also reported as 10 to 75 m, in sand; 27 Ma - Holocene; 13.94^{0}C (Hall 2002, *Lucina nuttallii*).	1	4		25	19	49
California surfclam	*Mactrotoma californica*	Benthic; depth range 0 - 15 m. Temperate- Northeast Pacific (SLB 2014). 36.6N-8.9N, Gulf of California, intertidal - 15 m sandflats, bays; 5 Ma - Holocene; 13.94^{0}C (Hall 2002, *Mactra californica*).	1					1
hooked surfclam	*Simomactra falcata*	Benthic; depth range 0 - 50 m. Temperate to subtropical- Eastern Pacific- Canada to Mexico (SLB 2014). 54N-30N, 13 Ma - Holocene; 11.47^{0}C (Hall 2002, *Spisula falcata*).		100			6	106
dish surfclam	*Mactromeris catilliformis* (a.k.a. *Spisula catilliformis)*	Demersal. Eastern Pacific (SLB 2014). 38N-28N; 27 Ma - Holocene; 13.15^{0}C (Hall 2002, *Spisula catilliformis*).	6			5	70	81
Pacific gaper clam	*Tresus nuttallii*	Benthic; depth range 0 - 30 m. It burrows up to 1 m deep in sand and mud along the intertidal zone from shallow depths to 30 meters. Prefers sandier areas in bays and protected places. Temperate to subtropical - British Columbia to Baja California (Audubon 1998, SLB 2014). 57N-25N, bays and offshore to 30 m; 17 Ma - Holocene; 10.97^{0}C (Hall 2002).		119	3	2	71	195
~~geoduck~~	~~*Panopea abrupta*~~	Spec reassigned to *Tresus nuttallii* (Groves 2014)					~~1~~	0
duck clam	Mactridae					1	3	4
jackknife clam	*Ensis myrae*	Demersal. Eastern Pacific (SLB 2014). 36.6N-27.2N, 5-25 m; 5 Ma - Holocene; 13.94^{0}C (Hall 2002).		1				1
razor clam	*Siliqua* sp.	Genus range 72N-25N, intertidal to 55 m, sandy, surf swept beaches; <10^{0}C (Hall 2002).	2	6	3	2	8	21
sickle jackknife clam	*Solen sicarius*	Benthic; depth range 0 - 55 m. Found buried in sandy-muddy substrate, in relatively sheltered areas along the intertidal zone to depths of 55 meters, at times on eelgrass. Temperate (SLB 2014). 54N-30N, 13 Ma - Holocene; 11.47^{0}C (Hall 2002).						0
Gould's bean clam	*Donax gouldi*	Demersal. Eastern Pacific (SLB 2014). 37.1N-24.1N, intertidal - 5 m, beaches and hydoid colonies; 5 Ma - Holocene; 13.94^{0}C (Hall 2002).	8	5				13
painted sunset clam	*Gari fucata*	Demersal. Eastern Pacific (SLB 2014). 34N-25N; 27 Ma - Holocene; 15.51^{0}C (Hall 2002).				46	1	47
sunset clam	*Gari sp.*	Genus range 61N-2S; 10.17^{0}C (Hall 2002)					1	1
sharp-rib semele	*Semele venusta*	Demersal. Eastern Pacific (SLB 2014).		23				23
California fat tellin	*Leporimetis obesa*	Demersal. Eastern Pacific (SLB 2014). Genus range 35N-25N; 27 Ma - Holocene; 13.53^{0}C (Hall 2002).		1		1	1	3

Common Name	Taxon	Environment (Reference)	Elevations of localities (in ft)					Totals
			121-117	117.5-112.5	100.5-100.7	99-94.5	93- at least 90	
bent-nose macoma	*Macoma nasuta*	Benthic; depth range 0 - 50 m. Commonly found along the intertidal zone, buried 10 to 15 cm deep in clay, mud, sand or gravel substrate. Temperate to subtropical- Alaska to Baja California Sur (Audubon 1998, SLB 2014). 60N-28N, bays, lagoons, estuaries, mud of bays; 27 Ma - Holocene; 10.31^{0}C (Hall 2002).	1	5			21	27
white-sand macoma	*Macoma secta*	Benthic; depth range 0 - 50 m. Buried in fine sand or sandy mud. Temperate to subtropical- British Columbia to Baja California (Audubon 1998, SLB 2014). 54N-25N, sand near bay mouth beyond surf zone; 23 Ma - Holocene; 11.47^{0}C (Hall 2002).		1		3		4
macoma	*Macoma* sp.	Genus range 71N-4S; <10^{0}C (Hall 2002).	1	1	5	32	38	77
Bodega tellin	*Tellina bodegensis*	Benthic; depth range 0 - 100 m. Temperate to subtropical- Alaska to Baja California Sur (SLB 2014). 57N-25N, intertidal to 100 m, sandflats in bays, sandy substrate, 17? or 8 Ma - Holocene; 10.97^{0}C (Hall 2002).		5				5
Carpenter's tellin	*Tellina carpenteri*	Benthic; depth range 0 - 661 m. Sand and sandy-muddy bottoms. Temperate to subtropical- Alaska to Gulf of California (Audubon 1998, SLB 2014).					1	1
Ida tellin	*Tellina idae*	Demersal. Eastern Pacific (SLB 2014).				5		5
tellin	*Tellina* sp.		2	13	2	62	7	86
heart rockdewller clam	*Petricola carditoides*	Benthic; depth range 0 - 50 m. Nests in empty pholad holes and in crevices along the low intertidal zone. Temperate to subtropical- Alaska to Baja California Sur (SLB 2014). 57N-26N; 13 Ma - Holocene; 10.89^{0}C (Hall 2002).		6				6
frilled Venus	*Chione undatella*	Eastern Pacific (SLB 2014).		1				1
Venus clam	*Chione* sp.			1				1
Pacific littleneck	*Leukoma staminea*	Benthic; depth range 0 - 10 m. Buries in gravel, sand and mud to more than 10 cm deep along the mid-intertidal zone. Boreal- Northeast Pacific (SLB 2014). 61N-23N; 17? or 13 Ma - Holocene; 10.17^{0}C (Hall 2002, *Protothaca stamina*).					1	1
lord dwarf-venus	*Nutricola lordi*	Benthic; depth range 0 - 70 m. Found along the intertidal zone in sand and mud substrate, commonly among roots of eelgrass. Temperate (SLB 2014). 59N-26N; 5 Ma - Holocene; 10.60^{0}C (Hall 2002, *Psephidia lordi*).		1				1
purple dwarf venus clam	*Nutricola tantilla*	Benthic; depth range 0 - 120 m. Found along the intertidal zone in sand and mud substrate, commonly among roots of eelgrass. Polar to subtropical- Bering Sea to Baja California Sur (SLB 2014). 61N-28N, intertidal to 120 m; 8 Ma - Holocene; 10.17^{0}C (Hall 2002, *Transennella tantilla*).	2	94		4	3	103
common Pacific littleneck	*Protothaca staminea*	Benthic; depth range 0 - 10 m. Buries in gravel, sand and mud to more than 10 cm deep along the mid-intertidal zone, prefers bays and estruaries, sometimes in gravelly sand on rocky coasts. Polar to subtropical- Aelutian Islands to Baja California (Audubon 1998, SLB 2014). 61N-23N; 17? or 13 Ma - Holocene; 10.17^{0}C (Hall 2002).	2	18		4	25	49

Common Name	Taxon	Environment (Reference)	Elevations of localities (in ft)					Totals
			121-117	117.5-112.5	100.5-100.7	99-94.5	93- at least 90	
thin-shell littleneck	*Protothaca tenerrima*	Benthic; depth range 0 - 30 m. Polar to subtropical- Alaska to Baja California Sur (SLB 2014). 57N-28N; 13 Ma - Holocene; 10.89^{0}C (Hall 2002).		2		9	1	12
littleneck	*Protothaca* sp.						1	1
butter clam	*Saxidomus giganteus*	Benthic; depth range 0 - 50 m. Buries in substrate to depths of 30 cm along mid- to lower intertidal areas. Temperate to subtropical- No. California to Baja California (SLB 2014). 60N-37N, intertidal to 40 m; 5 Ma - Holocene; 10.31^{0}C (Hall 2002).		21				21
Washington clam	*Saxidomus nuttalli*	Benthic; depth range 0 - 12 m. Buries more than 12" in sand or mud in bays and protected places. Temperate (Audubon 1998). 40.7N-27.7N, intertidal to 10 m, sandy areas of bays, sand; 5 Ma - Holocene; 11.03^{0}C (Hall 2002).	2	22		6	3	33
Washington clam	*Saxidomus* (?) sp.		1					1
Venus clam	Veneridae		2					2
Venus clam?	Veneridae?						2	2
wrinkled rock borer clam	*Hiatella arctica*	Benthic; depth range 0 - 800 m. Found on sand and rubble in reefs. Inhabits the intertidal zone, attached by byssus on algal holdfasts, mussel mats and in empty burrows of rock boring bivalves. Inhabits hard bottoms. Free-living. Temperate Circumglobal (SLB 2014). 71.4N-10N, intertidal - 1190 m, low tide to sublittoral; 5 Ma - Holocene; <10^{0}C (Hall 2002).				2		2
Western corbula clam	*Juliacorbula luteola* (a.k.a. *Corbula luteola)*	Eastern Pacific (SLB 2014). 37N-23N; 23? or 17 Ma - Holocene; 13.94^{0}C (Hall 2002, *Corbula luteola*).	4	406				410
ribbed corbula	*Caryocorbula porcella*	Eastern Pacific (SLB 2014).		2				2
California softshell clam	*Cryptomya californica*	Benthic; brackish; depth range 0 - 80 m. Found in estuaries, along the intertidal zone buried in mud and sand; may be up to 50 cm or more deep in the substrate; with its short siphon, feeds from burrowing shrimp and echiurid worm burrows. Commensal with the fat innkeeper worm (*Urechis caupo)*. Temperate to subtropical- Northeastern Pacific, Peru (SLB 2014). 60N-6S; 13 Ma - Holocene; 10.31^{0}C (Hall 2002).	1	202		2	3	208
boring softshell clam	*Platyodon cancellatus*	Benthic; depth range 0 - 20 m. Burrows in soft clay or rock along the intertidal zone. Creates an unusually elongated burrow, like the shape of its shell. Temperate to subtropical- Canada to Baja California Sur (SLB 2014). 54N-28N; 13 Ma - Holocene; 11.47^{0}C (Hall 2002).		1			4	5
Pacific rough piddock	*Zirfaea pilsbryi*	Benthic. Temperate- Canada to USA (SLB 2014). 70N-25N; 8 Ma - Holocene; <10^{0}C (Hall 2002).		2		1	17	20
trapezoid thracia	*Thracia trapezoides*	Benthic; depth range 11 - 200 m. Temperate- Northeast Pacific (SLB 2014). 57.4N-28.2N, 11 - 200 m; 23 Ma - Holocene; 10.89^{0}C (Hall 2002, *Thracia (Homoeodesma) trapezoides*).					2	2

Common Name	Taxon	Environment (Reference)	Elevations of localities (in ft)					
			121-117	117.5-112.5	100.5-100.7	99-94.5	93- at least 90	Totals
punctate Pandora clam	*Pandora punctata*	Benthic; depth range 2 - 50 m. Often found washed ashore along exposed coasts in sand-mud substrate. Temperate- Northeast Pacific (SLB 2014). 49.9N-26.2N, subtidal to 50 m; 8 Ma - Holocene; 11.81^{0}C (Hall 2002).	3	11		11	7	32
bivalve	Bivalva		5	24	2	37	65	133
							Total	2466

ENVIRONMENTAL ANALYSIS OF SCAPHOPODS RECOVERED

Latitudinal range refers to the range of the modern animal.
ºC refers to the effective temperature, duration of warmth, or the primary reproductive seasons at the northern end of the geographic range.

Common Name	Taxon	Environment (Reference)	Elevations of localities (in ft)			
			121-117	117.5-112.5	99-94.5	Totals
six-sided tusk shell	*Dentalium neohexagonum*	37N-23N, Gulf of California, 7-256 m, sandy mud; 8 Ma - Holocene; 13.94^{0}C (Hall 2002).	3	42	1	46
trench tuskshell	*Dentalium vallicolens*	Depth range 154-510 m. Temperate to subtropical- Aleutian Islands to Mexico (SLB 2014).		16		16

ENVIRONMENTAL ANALYSIS OF ECHINODERMS RECOVERED

Latitudinal range refers to the range of the modern animal.
ºC refers to the effective temperature, duration of warmth, or the primary reproductive seasons at the northern end of the geographic range.

Common Name	Taxon	Environment (Reference)	Elevations of localities (in ft)		
			117.5-112.5	99-94.5	Totals
eccentric sand dollar	*Dendraster excentricus*	Benthic. On sand bottoms of sheltered bays from low tide line to 40 m. Temperate to subtropical (Alaska to Baja California) (Audubon 1998). 55N-23N; 5 Ma - Holocene; 11.47^{0}C (Hall 2002).	27	48	75
echinoid	Echinodermata		3		3