CURRENT RESEARCH IN THE PLEISTOCENE

Volume 23 2006

A Peopling of the Americas Publication

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College Station, Texas

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Volume 23 **2006**

Current Research in the Pleistocene is published annually by the Center for the Study of the First Americans. ISSN 8755-898X.

Typesetting and camera-ready preparation by C&C Wordsmiths, Lenoir, North Carolina

Printed by Thomson-Shore, Inc, Dexter, Michigan.

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From the Editor

In November 2000, the discipline of Paleolithic archaeology in Japan was rocked by the Fujimura scandal, in which famed archaeologist Fujimura Shin'ichi was photographed planting artifacts into an "Early Paleolithic" site in northern Japan. Six years later, we are happy to report that Japanese Paleolithic archaeology is alive and well. As the 16 Special Focus papers presented in this volume of *Current Research in the Pleistocene* attest, archaeologists in Japan are conducting their research in a rigorous scientific setting, and any lingering questions of integrity have been put to rest. The papers presented here report on a variety of topics, from the precise dating of Japan's first Upper Paleolithic cultures, to the emergence of pottery technologies during the late glacial. Much attention understandably focuses on the evolution of stone technology during the Upper Paleolithic. We hope that this collection of papers will not only serve as an update on Japanese Paleolithic archaeology for our English-reading audience, but will also facilitate future international collaborations between the archaeologists of northeast Asia and the Americas. I thank Akira Ono and Masami Izuho for assembling this group of papers, and Charles T. Keally for correcting the English in 11 of them.

For Volume 24 (2007), the Special Focus section will be "Paleoclimates and Paleoenvironments of the Late Glacial." We are soliciting manuscripts that address the following kinds of questions: How are millennial-scale global climatic oscillations during the late Glacial expressed in various regional proxy records? How did such oscillations impact human populations? Authors wishing to present new evidence of late-Glacial climates and environments, or regional syntheses of climate, environmental, and human adaptive change are welcome to submit manuscripts. Please contact the *CRP* editor (goebel@tamu.edu) for more information.

For Volume 25 (2008), we plan on soliciting manuscripts with a special focus on paleodietary reconstruction. Our hope is to assemble a group of papers (1) reporting new information about the diets and subsistence pursuits of northeast Asia and America's first human inhabitants, and (2) presenting new methods of dietary analysis. Again, please contact the *CRP* editor if you would like to participate in this project.

Ted Goebel

Special Focus: News in the Paleolithic Archaeology of Japan

Assembled and edited by Akira Ono (Tokyo Metropolitan University) and Masami Izuho (Sapporo Buried Cultural Property Center). We gratefully acknowledge the help of Professor Charles T. Keally, who polished the text of articles submitted by Japanese-speaking contributors.

Correlation of Tephra Layers with Upper Paleolithic Industries in Kyushu

Satoshi Abe

This paper presents a chronological framework of tephra layers and Upper Paleolithic industries in Kyushu, Japan. On the basis of the latest records from Southern Kyushu, many tephra layers and ^{14}C dates have contributed to establishment of the archaeological chronology from the Pleistocene to Holocene (Miyata 2005; Okuno et al. 2000) (Figure 1). The Aira-Tn (AT), P17, P15, and P14 tephras, and Kr-Kb pumice that erupted from the volcanoes in southern Kyushu play an important role in the Paleolithic chronology. Although the AT is the widespread tephra over Japan and Korea, the P17, P15, P14, and Kr-Kb spread only over southeastern Kyushu.

It is possible to distinguish several modes of lithic tools relating to projectiles in the Japanese Upper Paleolithic, including ordinary flakes, blades, microblades, and bifaces, based on differences in operational chains (Tamura 2005). If Upper Paleolithic industries in Kyushu are observed from this viewpoint, several important features become clear (Anzai 2003).

The Upper Paleolithic in Kyusyu is separated into early (EUP) and late (LUP) stages at the boundary of the AT tephra (ca. 25,000–24,000 RCYBP). Furthermore, each stage is divided into several substages based on tephras, stratigraphic sequences, and lithic typology. The earliest Upper Paleolithic industry was documented at the Ishinomoto site, Locality 8 (layer 6b, ca. > 33,000–31,000 RCYBP), and was characterized by various denticulate and initial flake industries. The flake industry of the EUP developed with edge-ground axes, but blade industry was rare or absent (Magano site). Initial blade industry in Kyushu is characterized by backed blades, whose appearance dates to ca. 29,000–28,000 RCYBP. A dual mode of lithic tools with flake and blade

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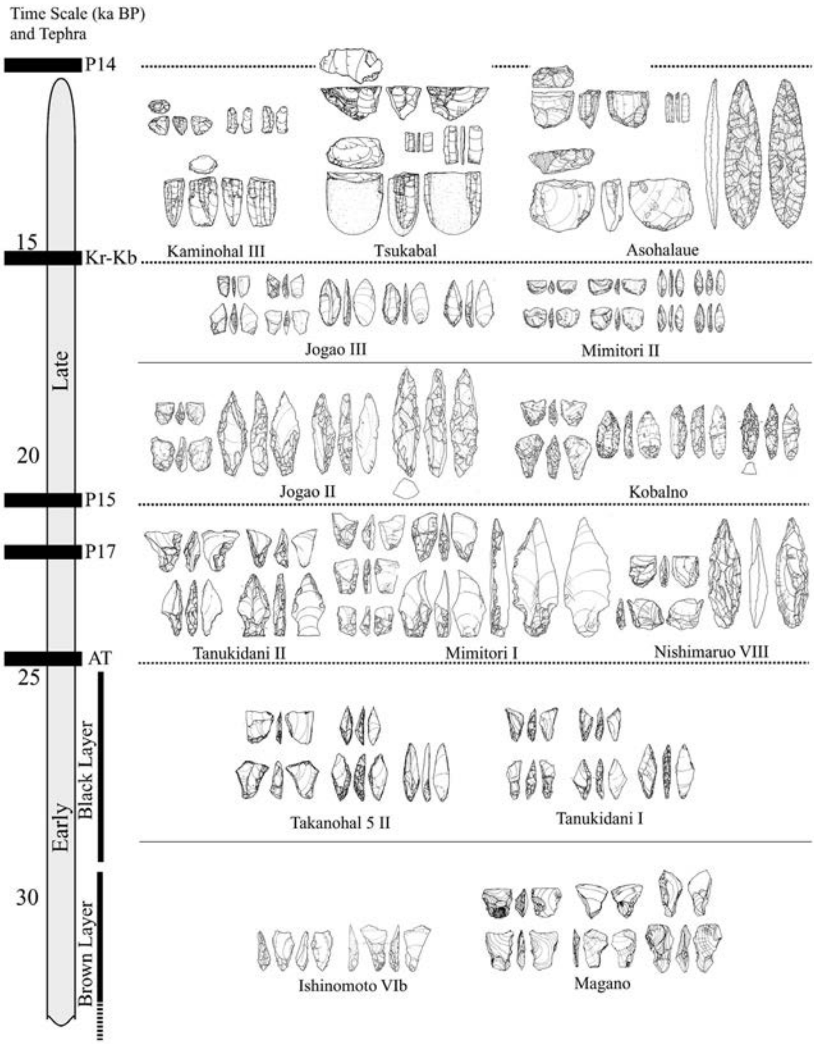

Figure 1. Correlation of tephra layers with Upper Paleolithic industries in Kyushu.

industries (Takanohal, Locality 5, cultural layer II; Tanukidani, cultural layer I) was maintained through Upper Paleolithic Kyushu (Sato 1992), but establishment of this occurred later than in eastern Japan (Anzai 2003).

A blade industry characterized by stemmed points developed in the first substage of the late Upper Paleolithic (LUP) (Mimitori, cultural layer I), roughly from AT to P17 tephras (ca. 23,000–22,000 RCYBP). Regional differences had become remarkable just before P17. A flake industry characterized by trifacial points, *Kou*-type backed flakes, and stemmed flakes developed in southern and eastern Kyushu (Jogao, cultural layer II, and Kobalno) (Abe

2005). Bifacial tools as a new mode that restricted the entire lithic technology did not occur, although bifacial points appeared in low frequencies in each region (Nishimaruo, layer VIII). After that, at the same time of decreasing of trifacial points, a small-blade and small-flake industry containing numerous microliths, such as trapezoids, triangles, and semicircles (Jogao, cultural layer III; Mimitori, cultural layer II), developed and functionally was connected to the following initial microblade industry with prism-shaped and conical-shaped microcores (Uenohal, cultural layer III) when the Kr-Kb pumice had fallen (ca. 16,000–15,000 RCYBP). Wedge-shaped microcores in only northern Kyushu appeared, and various microcores except wedge-shaped microcores, appeared in eastern and southern Kyushu (Tsukabal and Asohalaue) after the prism-shaped microcores. These later microblade industries related to bifacial leaf-shaped points (Asohalaue). The microblade industry in Kyushu had ended at the latest by the time the P14 tephra (ca. 12,000–11,000 RCYBP) had fallen.

At present a lot of excavations are occurring, especially in southern Kyushu, and an increase in materials and improvement in the accuracy of this chronology are expected.

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On Variation of Assemblage Size in Late-Pleniglacial Hokkaido: Sampling Error or Behavioral Signature?

Masami Izuho and Yuichi Nakazawa

Assemblage size, here defined as the amount of artifacts recovered from a single geological layer, has provided a basis for discussing spatial and temporal variation of hunter-gatherer site occupational history and land use (Clark and Straus 1983). In Hokkaido, northern Japan, more than 400 late Pleniglacial sites typologically attributable to the Upper Paleolithic, dated to ca. > 27,000–24,000 to 11,000 RCYBP, have been found in both surface and buried contexts since the beginning of Paleolithic research (Izuho and Akai 2005). In spite of intensive excavations mostly conducted under contract projects on the large island of Hokkaido (77,981 km^3), excavated sites remain a small fraction of the known total (< 15 percent). Of these, late Pleniglacial sites tend to be concentrated on large plains and basins (e.g., southern Ishikari Lowland, Tokachi Plain, Kitami Basin), where modern population growth has accelerated city extensions and road construction.

Considering limitations of small-scale probes (Brown 1975) and a potential bias in site discovery in Hokkaido (Nakazawa et al. 2005), here we address the issue of how much assemblage size can be explained by the degree of occupational intensity versus the effect of sample size. We examined the effect of trench size on a sampled population size (Orton 2000), which is normally treated as assemblage size. We performed an analysis of the relationship between excavated area (m^2) and assemblage size as represented by the number of recovered artifacts distributed in an intensively researched region. We wished to see if assemblage size is affected by the amount of excavated area and site location. Given the assumption that assemblage size is a reflection of human occupational intensity, if occupational intensity was spatially uniform within a geographically defined space, such as a plain or river basin, it is expected that assemblage size is correlated with the size of excavated areas. In other words, the larger the area of excavation, the more the artifacts recovered. Conversely, if occupations were clustered/clumped or scarce in specific locations within a region, assemblage sizes will *not* be correlated with amounts of excavated areas. Intensively occupied locations will have larger sites than less intensively occupied locations. Based on site densities and the high proportion of excavated sites, we selected a geographic area that late Pleniglacial hunter-gatherers would have intensively occupied—the southern Ishikari Lowland in southwest Hokkaido (Nakazawa et al. 2005:Figure 1a).

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The sites in the southern Ishikari Lowland are all open-air and are buried in loam sediments on river terraces or in inland paleo-dunes.

An analysis of 14 assemblages recovered in excavations shows that there is a significant correlation between the amount of excavated area and number of recovered artifacts in the assemblages of the southern Ishikari Lowland (Spearman's r = .754; p = .002) (Figure 1). Correlations, however, vary among site locations—river terraces versus dunes. Although a

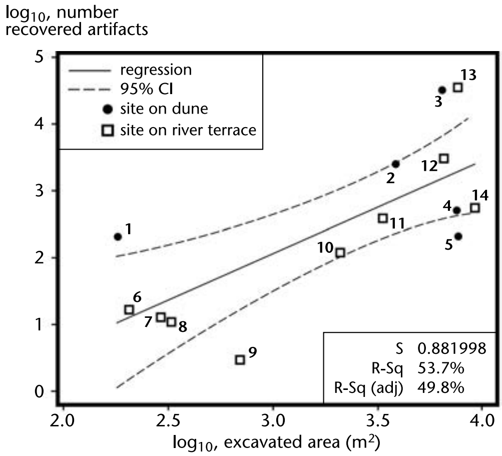

Figure 1. Number of recovered artifacts plotted against trench size from the sites on the southern Ishikari Lowland. **1,** Shukubaisan-kakuyama; **2,** Meboshigawa; **3,** Kashiwadai 1; **4,** Marukoyama-abv; **5,** Marukoyama-blw; **6,** Misawa 1-blw; **7,** Misawa 3-blw; **8,** Bibi 4; **9,** Yukanboshi C15-blw; **10,** Osatsu 2; **11,** Kiusu 7; **12,** Oruika 2; **13,** Osatsu 16; **14,** Kiusu 5-C.

significant correlation was observed among river terrace assemblages (Spearman's r = .821; p = .007; N = 9), no correlation was found among dune assemblages (Spearman's r = .154; p = .805; N = 5). These relations imply that late Pleniglacial hunter-gatherers foraged across the landscape evenly, but sometimes occupied the same locations multiple times either by chance or redundantly. Since assemblage sizes of the largest site (Kashiwadai 1 [N = 32,633]) and a small site (Shukubaisankakuyama [N = 211]) in dunes are beyond the upper 95 percent confidence limit of the regression coefficient (Figure 1), an effect of palimpsest formation due to multiple occupations (Binford 1982; Straus 1979) is expected, perhaps because the hill-like dunes allowed foragers to strategically monitor the availability and mobility of gregarious grazers such as bison, horse, and reindeer (Aikens and Akazawa 1996; Izuho and Takahashi 2005; Kuzmin et al. 2005), and/or to efficiently access other nearby resources including water, firewood, fish, and waterfowl on the surrounding flat landscape with a mosaic of taiga and steppe vegetation (Igarashi 1993). Nevertheless, the effect of sample size on the observed variation of assemblage sizes is not negligible because 50 percent of the variation in assemblage sizes is explained by trench size (r^2 = .49; p = .003). This suggests that both sample size and occupational history can explain the variation in assemblage sizes of late Pleniglacial Hokkaido.

We thank Lawrence Straus for helpful comments on the manuscript.

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Summary of the "Final Report" on Japan's Archaeological Hoax

Charles T. Keally

On November 5, 2000, the *Mainichi Shimbun* (newspaper) revealed that they had observed Fujimura Shin'ichi planting artifacts on the "Early Palaeolithic" site at Kami-Takamori in Miyagi Prefecture, northern Japan (Mainichi Shimbun 2000a, 2000b). The Japanese Archaeological Association took the lead to conduct and coordinate the multi-disciplinary investigation of this hoax. The Association issued its final report on May 24, 2003 (The Special Inspection Committee for the Problem on the Early and Middle Palaeolithic 2003).

I was not directly involved in the investigation, but I observed the re-

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excavation of the Kami-Takamori site, watched the examination of the artifacts from the Chichibu sites, read the reports on the re-excavation of three sites, and read the 625 pages of the Japanese Archaeological Association's "Final Report" (The Investigative Commission for the Zazaragi Site Excavations 2003; The Investigative Commission for the Kamitakamori Site Excavations 2002; The Committee for the Emergency Investigation of the Early Palaeolithic Sites 2002; The Special Inspection Committee for the Problem on the Early and Middle Palaeolithic 2003). The research I saw and the reports I read constitute about the best archaeological research I have seen in nearly 40 years of work in archaeology in Japan.

Fujimura was an amateur archaeologist. His archaeological activities began in 1973, and he began working with professional archaeologists in 1974. He was involved with 186 sites in 9 prefectures. He helped excavate 33 of these sites, in 8 prefectures, and participated in surface collection at the other 153 sites. He "discovered" his first "Early Palaeolithic" artifacts in 1980.

The Japanese Archaeological Association's investigation of Fujimura's activities included re-excavation of 10 of the excavated sites, study of about 3,000 artifacts from 40 of the sites and Fujimura's private collection, a detailed analysis of the content of fieldwork diaries and related publications, analysis of conferences and academic publications, and interviews with Fujimura.

The investigation found planted artifacts, indications of surface-collected artifacts supposedly from deeply buried strata, considerable typological similarity to Holocene Jomon artifacts, and a strong correlation between Fujimura's presence during fieldwork and the finding or unearthing of artifacts, among many other indications of fakery in the finds.

The Japanese Archaeological Association's "Final Report" concluded that none of the materials Fujimura had been involved with could be used for research purposes. This conclusion applies to the materials from three sites published in *Current Research in the Pleistocene*—Takamori, Ohira, and two of the three cultural layers at Tomizawa (Kamata et al. 1993; Keally 2002; Ota and Saino 1993; Yanagida 1992; also see: Keally 1987, 1992).

I found the Japanese Archaeological Association's "Final Report" presentation and conclusions fully convincing. All the evidence points to Fujimura's planting artifacts on all the 186 sites he was associated with, over the entire 25 years he was doing fieldwork. What began as the "investigation of the Early and Middle Palaeolithic problem in Japan" ended as the investigation of an archaeological hoax spanning 25 years and 186 sites, including 33 excavated sites, and all prehistoric periods.

The Japanese Archaeological Association's "Final Report" has one major weakness—it does not address the reasons why there was so little public (published) criticism of Fujimura's "Early and Middle Palaeolithic" finds for 20 years. There was only one audible voice of dissent in the early years (Oda 1985; Oda and Keally 1986), then complete public (published) silence for 12 years until 1998 (Takeoka 1998), and two more years of near silence until a newspaper, and not archaeologists, exposed the hoax in 2000. The "Final Report" puts considerable blame on the leaders of the group Fujimura worked with for shutting out criticism (The Special Inspection Committee for the

Problem on the Early and Middle Palaeolithic 2003:546–47) and on the too-severe wording of the criticisms [by Oda and Keally 1986] (The Special Inspection Committee for the Problem on the Early and Middle Palaeolithic 2003:604). However, there is no answer to the question: Who killed the public criticism for 12 years from 1986 to 1998? There was a lot of private criticism heard throughout these 12 years of public silence. But this criticism was never heard at conferences nor seen in archaeological publications. This public silence needs to be explained, but the "Final Report's" comments do not explain this silence.

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The Shirataki Obsidian Mine Area and the Yubetsu-Horokazawa Technological Complex

Hideaki Kimura

Hokkaido is the northernmost island of the Japanese archipelago. The Yubetsu River rises from the main range of Hokkaido and eventually empties into the Okhotsk Sea. There is an obsidian deposit at the top of Mt. Akaishi (1,147 m), located in the upper region of the tributaries of the Yubetsu (Kimura 1992, 1995, 1997, 2005). Its supposed size is 6 billion tons, making it the biggest obsidian mine in Japan.

At the top of Mt. Akaishi large-scale obsidian exposures occur. Paleolithic materials have been collected there, evidently indicating people of that age once stepped into the summit area. Outcrops of obsidian also occur along a hillside higher than 900 m, and chunks of obsidian are available downslope of the hillside and along the river.

Scientific analyses including X-ray fluorescence and naked-eye observation are crucial in identifying the actual point of acquisition of the obsidian within and around the Mt. Akaishi deposit.

The group of Shirataki sites, which includes about 100 sites around Mt. Akaishi, can be divided into three subgroups depending on altitude: 1) about 1,000–800 m, summit and around outcrops; 2) about 600 m, along the hillside; and 3) about 400 m, on the terrace of the Yubetsu River. These sites do not date to a single time but instead accumulated over a long period from ca. 25,000 to 10,000 RCYBP. They could have proceeded through three stages, with the early stage being marked by a "knife-type tool" and microblade industry, ca. 25,000–18,000 RCYBP, the middle stage being marked by the flourishing of microblades, ca. 18,000–13,000 RCYBP, and the late stage being marked by the appearance and development of tanged points, ca. 13,000–10,000 RCYBP.

Recent research at the source area and hillside, as well as a large-scale rescue survey along the terrace of the Yubetsu River, promotes detailed Paleolithic study. Particularly, since 1987 I have been investigating the Horokazawa site (Toma locality) located directly under the outcrop on the hillside of Mt. Akaishi. This site alone has produced more than 500,000 tools and flakes from only 96 m^2. Another 13 sites located along the Yubetsu terrace have been the subject of detailed investigations, producing more than 4,500,000 remains from concentrations.

The excavated assemblage from the Horokazawa site (Toma locality) dem-

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onstrates that the site was a workshop where raw material from the outcrop was transported and rough-outs and preforms were manufactured for transport somewhere else. This is verified by blanks for microblade cores found at sites along the terrace that are of the same stage as those from the Toma locality. Through investigation on this workshop site we can suggest that strategies of obsidian procurement differed according to Paleolithic stage. The large workshop sites on the hillside and intensive exploitation around outcrops at the summit area are closely connected to the flourishing of microblade industry during the middle stage. Further, there may have been some unitary control of stone-material export by a certain group during this time. Obsidian artifacts originating from the source area and Yubetsu terraces have been found all over Hokkaido and Sakhalin (Kimura 2006).

There is another major result of this research. A huge amount of material has been refitted, indicating that the Horoka, Pirika, and Yubetsu techniques are indistinguishable since they all proceed through a single manufacturing scheme. As shown in Figure 1, that scheme has been practiced through several stages, all having in common a good command of materials in various forms and optionally selecting the adequate technique to produce microcores, eventually microblades. I refer to this technological integral as the "Yubetsu-Horokazawa technological complex."

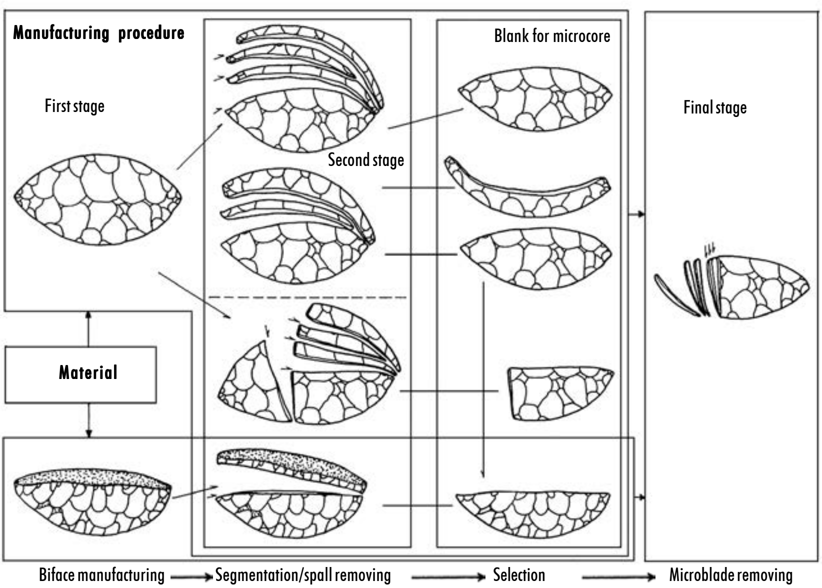

Figure 1. Yubetsu-Horokazawa technological complex, schema of manufacturing procedure.

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The Temporal Correspondence between Archaeological Chronology and Environmental Changes 28,000–11,000 CALYBP in Eastern Honshu

Yuichiro Kudo

This paper examines the temporal correspondence between the geochronological settings and archaeological chronology 28,000–11,000 CALYBP in eastern Honshu, the largest of the four main Japanese islands.

Climatic reconstruction is based on GISP2 data (Stuiver and Grootes 2000), with additional input from high-resolution analysis of annually laminated sediments of Lake Togoike (Fukusawa 1999) and Lake Suigetsu (Fukusawa et al. 2003) in Japan. Five geochronological phases are apparent: the Last Glacial Maximum (LGM, until ca. 24,000 CALYBP), Stage I (ca. 24,000–15,500 CALYBP), Stage II (ca. 15,000–13,200 CALYBP), Stage III (ca. 13,200–11,500 CALYBP) and Stage IV (after 11,500 CALYBP) (Figure 1). Stage I can be subdivided into Ia and Ib, based on the reconstruction from Lake Suigetsu. Stage II corresponds closely with Greenland Interstadial 1 (GI-1), Stage III with Greenland Stadial 1 (GS-1), and Stage IV with the early Holocene (Kudo 2004a, 2004b).

The archaeological chronology has several phases, based mostly on data from stratified sites on the Musashino and Sagamino Uplands on the Kanto Plain around Tokyo. The ^{14}C dates for these sites were calibrated using the CalPal_2005_SFCP calibration curve (Weninger et al. 2005). The bars of calibrated ^{14}C ages of each site indicate the length of 1σ with plural samples (Figure 1). The backed-point industry of Sagamino Phase V dates to 28,000–25,000 CALYBP, geochronologically the LGM. The backed-point industries of Sagamino Phases VI and VII date to 24,000–21,000 CALYBP, immediately after the LGM (early Stage Ia). The succeeding point industry dates to 22,000–18,000 CALYBP (late Stage Ia). The microblade industry dates to 18,000–15,000 CALYBP (Stage Ib). The 20,000 CALYBP date for microblades at the Yoshioka B site is still questionable. The microblade industry appears in eastern Honshu (Kudo 2004a) several thousand years after its appearance in Hokkaido (ca.

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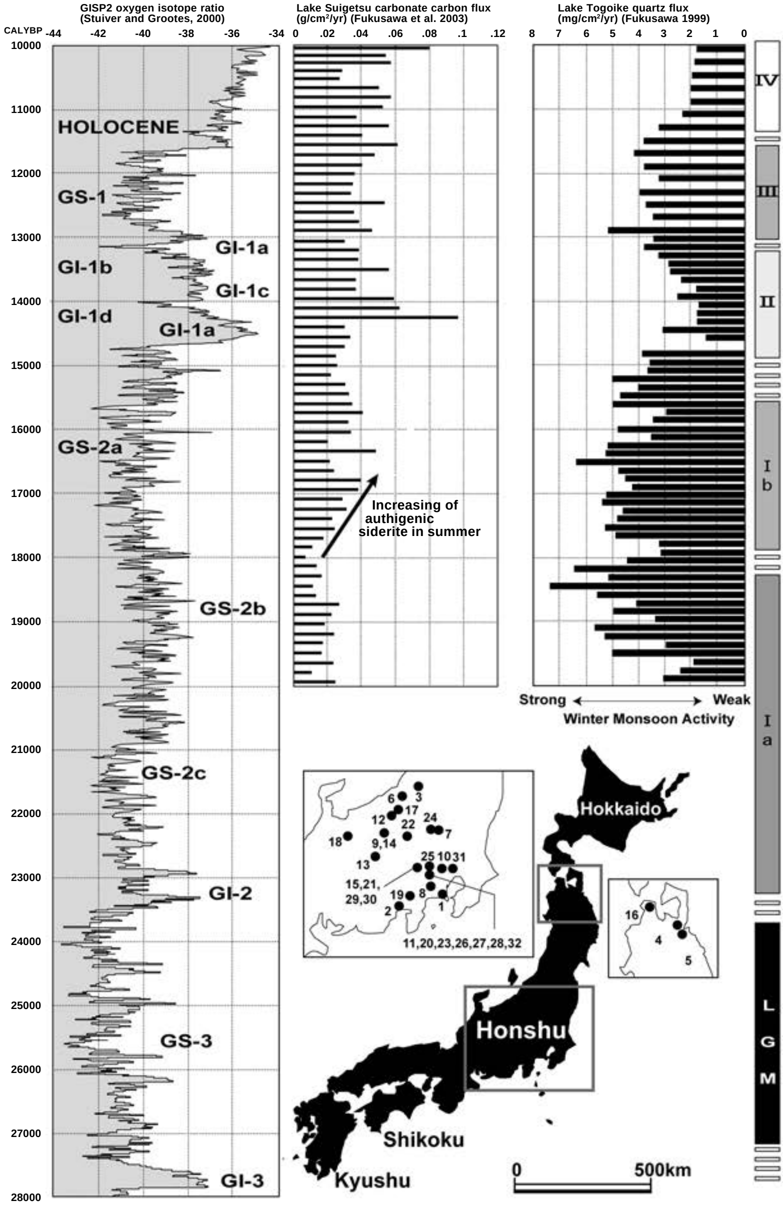

Figure 1. The temporal correspondence between archaeological chronology and geochronological settings in eastern Honshu, 28,000–11,000 CALYBP (n = number of dated samples): **1**, Natsushima shell mound (n = 1); **2**, Ikeda B (n = 2); **3**, Kurohime Cave (n = 3); **4**, Kushibiki (n = 1); **5**, Takihishi (n = 1); **6**, Unoki-Minami (n = 4); **7**, Saishikada-Nakajima (7a, n = 1; 7b, n = 1); **8**, Keio-SFC (n = 1); **9**, Seiko-Sanso B (n = 3); **10**, Manpukuji no.2 (n = 1); **11**, Tsukimino-Kamino 2 (n = 1); **12**, Kubodera-Minami (n = 7); **13**, Nakajima B (n = 1); **14**, Kannnoki (n = 5); **15**, Miyagase-Kitahara (n = 3); **16**, Odai-yamamoto I (n = 6); **17**, Araya (17a, n = 1; 17b, n = 15); **18**, Miyanomae (18a, n = 1; 18b, n = 1);

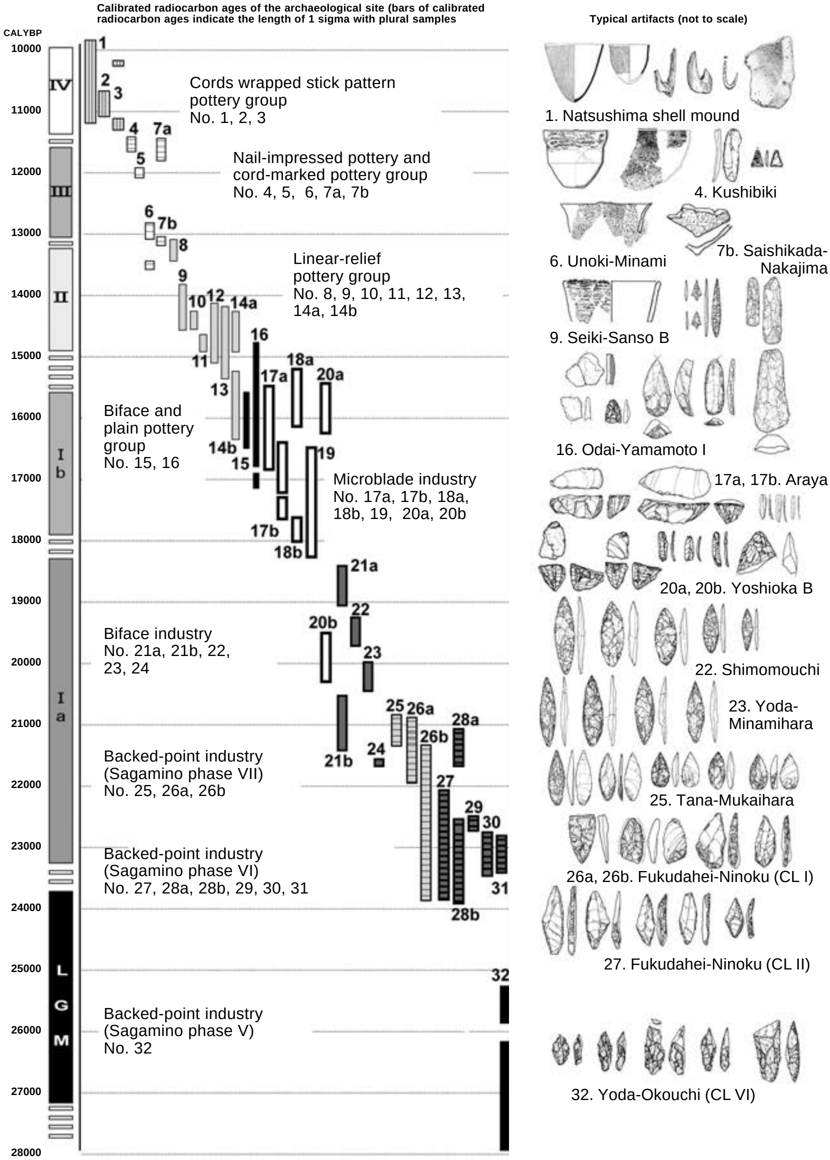

Figure 1 (cont'd).
19, Yasumiba (n = 1); **20**, Yoshioka B (20a, n = 1; 20b, n = 2); **21**, Miyagase-Sazaranke (21a, n = 1; 21b, n = 1); **22**, Shimomouchi (n = 1); **23**, Yoda-Minamihara (n = 5); **24**, Kogurehigashi-Arayama (n = 1); **25**, Tana-Mukaihara (n = 2); **26**, Fukudahei-Ninoku CL I (26a, n = 3; 26b, n = 5); **27**, Fukudahei-Ninoku CL II (n = 8); **28**, Yoda-Toriimae (28a, n = 1; 28b, n=4); **29**, Miyagase-Nakappara (n = 1); **30**, Miyagase-Ueppara (n = 2); **31**, Kitashinjyuku-Nichome (n = 1); **32**, Yoda-Okouchi (n = 5).

25,000–24,000 CALYBP) in the far north of Japan (Izuho and Akai 2005; Izuho and Takahashi 2005).

The beginning of pottery technology (plain pottery and bifaces) dates to 17,000–15,000 CALYBP, preceding the abrupt warming and vegetation changes of Stage II. The succeeding linear-relief pottery coincides with Stage II (Figure 1). The number of sites with pottery increases in this phase. The nail-impressed and cord-marked pottery phases correspond to Stage III, a cooling period, and the pottery marked with a cord-wrapped stick corresponds to Stage IV, the early Holocene.

Better dating of the archaeological sequence is needed to obtain a more reliable picture of the detailed correspondences between geochronological and cultural changes.

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Observations on the Backed-Knife Industry of Hokkaido, Japan

Yusuke Kumabayashi

Here I discuss the Hirosato backed-knife industry of Hokkaido that differs from the backed-blade industry of Honshu. There are differing forms of the Hirosato backed knives (Figure 1), characterized by flat retouching on both sides and the interior base surface. Hirosato backed knives are formed from blades or elongated flakes.

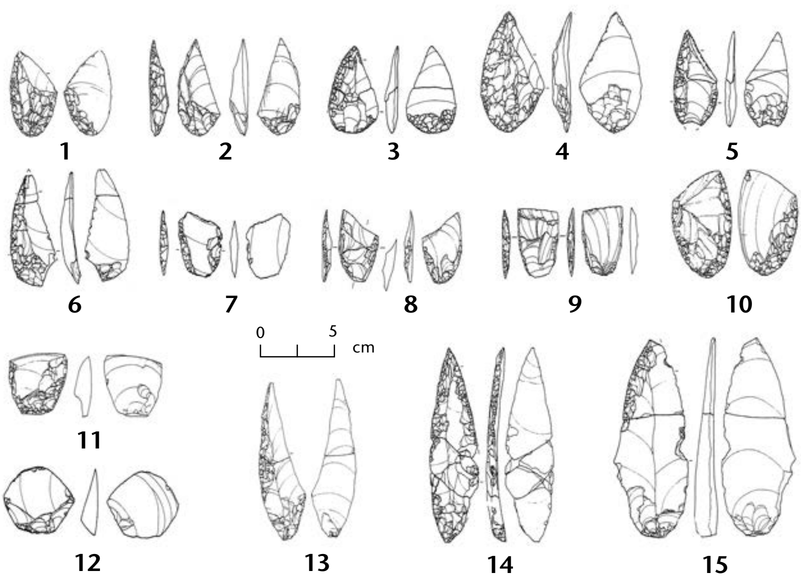

Figure 1. Hirosato backed knives. Hirosato 8: **1, 10, 11, 13**; Kamioka 2: **2, 8, 9**; Kamishirataki 7: **3–7, 12, 14, 15.**

Hirosato-type backed knives are known from six sites: Hirosato 8, Kamioka 2, Kamishirataki 7, Kamishirataki 8, Oketoazumi locality E, and Nissin 2 (Kumabayashi 2005; Sakamoto 2003).

Endscrapers, round scrapers, gravers, sidescrapers, axe-shaped stone tools, retouched flakes, trapezoids, and cores compose Hirosato backed-knife assemblages. The flaking technology is a combination of the blade technique and irregular-shaped-flake technique. The presence of these techniques suggests that the Hirosato industry should be chronologically assigned to the first half of the late Paleolithic in Hokkaido.

The Kamishirataki 7 site, an obsidian source, is characterized mainly by knives, blades, and flakes. However, the Hirosato 8 site, situated scores of km

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from an obsidian source, is characterized by retouched tools and endscrapers (Kumabayashi 2005; Sakamoto 2003).

In this paper, I present three problems of the Hirosato industry. First is the problem of locality; that is, whether the Hirosato backed-knife industry emerged spontaneously in Hokkaido, or was influenced by Honshu or northeast Asian industries. Second is the problem of its relation to microblade industries. These two industries are entirely different. I discuss whether a group with the Hirosato knife industry was replaced by a group with the microblade industry, or was incorporated into the microblade technique. Third is the problem of dating. There are no ^{14}C data for the Hirosato industry, and no marker tephras have been found at Hirosato industry sites. Only data of obsidian hydration dating are available.

To solve these problems, we must do more detailed observation and analysis of the Hirosato industry. It is important to understand the aspects and problems of the Hirosato industry in order to investigate its relation to the microblade industry of Hokkaido that immediately succeeded but differed from it.

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The *Kou* Point and *Kou* Industry in the Upper Paleolithic of Southwestern Japan

Kazuki Morisaki

The *Kou* Industry is one of the major industries of the Japanese Upper Paleolithic. Kou industries appeared soon after AT volcanic ash (ca. 25,000 RCYBP) had fallen, and probably disappeared a few thousand years later. They are characterized by a unique side-blow technique, the “Setouchi method” (Figure 1) (Barnes 1993) and Kou-type backed point (Kou point). Although their distribution is mainly restricted to the Setouchi region (a part of southwestern Japan), increasing numbers of Kou points have been discovered in surrounding regions for the last several decades (Figure 1). For these interesting facts, the Kou industry has received attention by many researchers. The purpose of this paper, therefore, is to try to give a new explanation for this phenomenon.

As mentioned above, Kou points are distributed not only in the Setouchi

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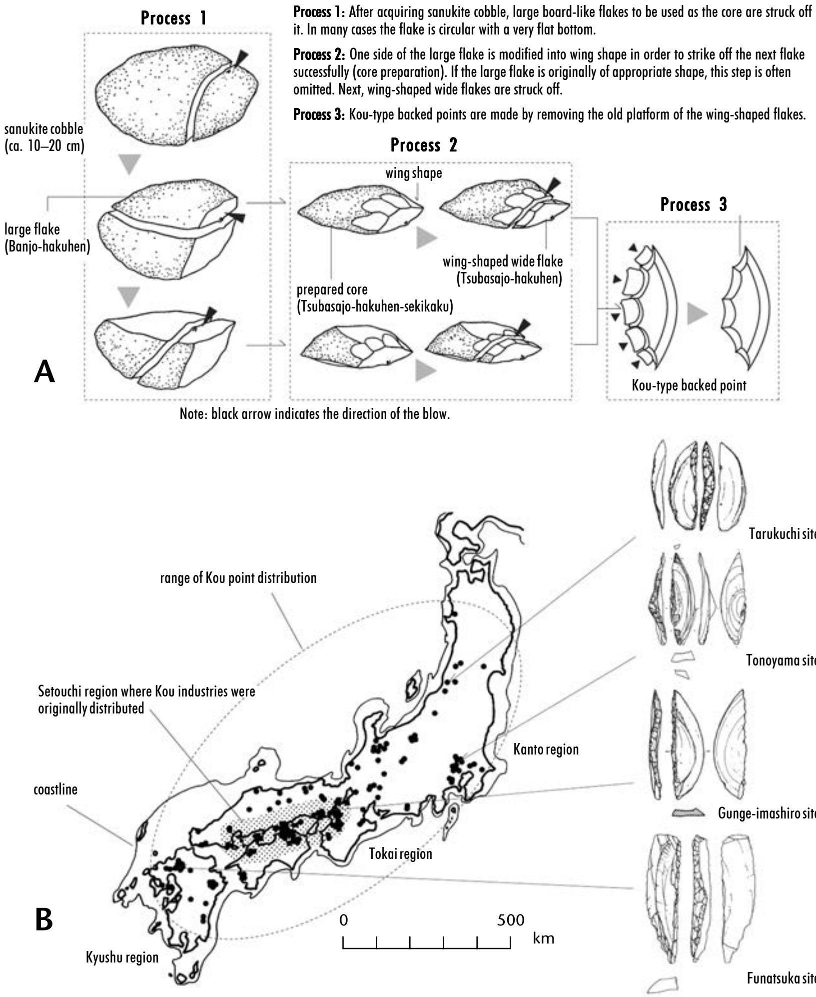

Figure 1. **A,** the scheme of the Setouchi method (modified from Matsufuji 1974). **B,** distribution of Kou points (modified from Miura 2003). The maximum diffusion area extends over 1,000 km from northeast to southwest.

region but also in Kyushu, Tohoku, Tokai, and Kanto regions. They are made of local lithic raw materials, and not all elements of the Kou industry exist in non-Setouchi regions. For example, although Kou points have been found in sites in the Kanto region, none of those sites has produced archaeological evidence that implies the existence of the Setouchi method. At several sites in the Kyushu, Tokai, and Tohoku regions, we can see both Kou points and archaeological evidence that implies the existence of the Setouchi method among the other artifacts. Kou points, however, are not the main hunting weapons, and the Setouchi method is not the major technique there. These facts suggest that at least the majority of Kou points in non-Setouchi regions must have been made by alternative techniques used by local groups of each region.

Many researchers have interpreted the existence of a few elements of the Kou industry in non-Setouchi regions as the result of the migration of human groups from the Setouchi region. Even if this is the case, they do not explain why such migration took place and why non-Setouchi people made Kou points. This paper presents the following alternative explanation. First, the emergence of local styles such as Kou points suggests the formation of more regional societies in this period. Second, it was not yet easy to adapt to local environments, because severe climatic fluctuations were still continuing (ca. 25,000–20,000 RCYBP). Accordingly, we suppose that human groups inhabiting such environments needed to integrate and organize more expanded alliance networks among themselves in order to minimize risk by sharing information (Gamble 1983). If this hypothesis is correct, there is a possibility that Kou points in non-Setouchi regions were a kind of material culture which carried a stylistic message through these networks in order to facilitate intergroup communication (Tamura 1992).

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A *Chaîne Opératoire* Approach to the Production of Tanged Points from South Kanto (Japan)

Kenji Nagai

The purpose of this paper is to describe the *chaîne opératoire* of tanged point (TP) production from the Incipient Jomon period of Japan (ca. 13,000–9500

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RCYBP). Specific attention is paid to the relationship between lithic assemblages and site formation processes, both of which are the result, to some extent, of technological routines. I further illustrate how such analyses can contribute to interpreting a particular local group in the south Kanto region (Figure 1). The interpretations presented here are based on both experimental and archaeological studies.

While pioneering studies of Japanese archaeologists have detailed a highly

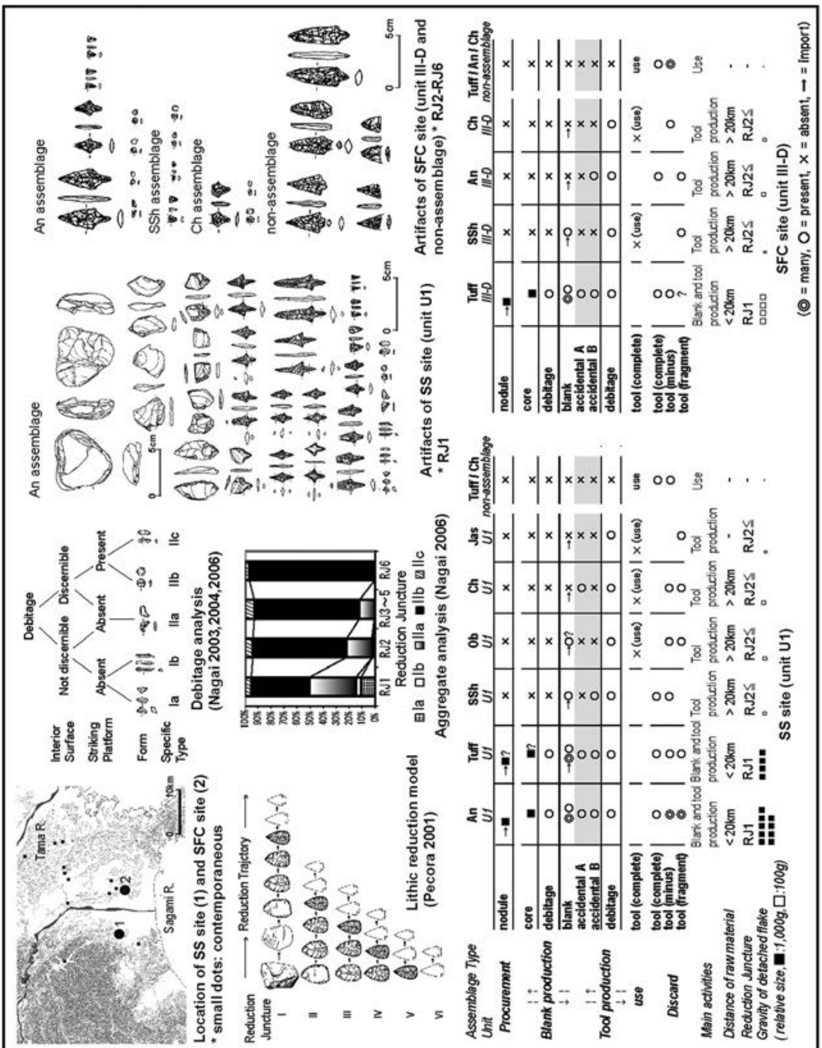

Figure 1. The *chaîne opératoire* for the production of tanged points in the South Kanto region. Raw material types include andesite (An), tuff (Tuff), siliceous shale (SSh), obsidian (Ob), chert (Ch) and jasper (Jas).

patterned TP reduction technique, there have been no comprehensive studies of the variation in TP production techniques, or of the dynamics of fabrication, use, and abandonment. This is partially due to the fact that, until recently, Incipient Jomon archaeology has focused primarily upon the typology of settlement systems by describing and classifying archaeological evidence. Additionally, the lack of detailed lithic debitage analysis has compromised a comprehensive understanding of the lithic assemblages.

TP manufacture is fundamentally a bifacial reduction sequence, and is best analyzed as such (Ishii 2001; Nagai 2006). For this reason, this study incorporated experimental data from bifacial flake aggregate analysis (Nagai 2003, 2004, 2006) into Pecora's (2001) "reduction juncture" model (Figure 1). In addition, dynamic "life histories" of artifacts from two sites located in the south Kanto region were identified. These include the Sannomiya-Shimoyato site (SS, unit U1) and Shonan Fujisawa Campus site (SFC, unit I-A, unit III-B, unit III-D; 11,350 ± 160 RCYBP). Several types of pottery and a great number of TPs have been retrieved from the Sagamino FB lower beds at both sites.

The *chaîne opératoire* of TP manufacture of south Kanto is depicted as a simple diagrammatic model in Figure 1. The peoples from both sites primarily exploited local raw material (within < 20 km). Artifacts produced from local raw materials are represented at each site in all stages of manufacture (e.g., RJ1). As well, exotic raw materials (> 20 km) were brought to each site as preformed blanks. These blanks were then retouched and shaped, on site, into desired forms (e.g., RJ2–RJ6). These tools were then actively used on site, and frequently they were abandoned once broken. Because this general raw material provisioning and conservation strategy appears to have been used at both sites, it can be considered a general "technological routine."

The critical difference between the sites was the frequency of occupational settlement. Shiraishi (1992), Fujiyama (2001), and others have suggested that the SS site functioned mainly as the center of TP production and transportation; however, the analysis presented here does not support this hypothesis. It is argued here that the SS site did not function as a factory site, but is instead simply a unit in a palimpsest. In the south Kanto landscape, the SS site is well situated to provide ecological efficiency of land use and/or resource use. Relying and fixing upon a single spot prompted a legitimate regional society in the Initial Jomon period. If one considers proxies of technical ability as an indicator of social hierarchy (e.g., accidental failure rates, symbolic use of color, architectural skill, etc.), peoples of both the SFC and SS sites appear not to have had such hierarchy. This is suggested by the fact that the evidence presented here does not indicate that both peoples ever adopted special rules concerning work specialization, nor did they have expert stone workers. Thus, I advocate a non-expertise characterization of this local group from south Kanto in the Incipient Jomon period.

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Refitted Points: Biface Reduction Strategy in the Terminal Pleistocene of Honshu Island

Masaki Naganuma

This paper presents an example of a refitted biface from Honshu Island (central Japan). In the terminal Pleistocene, "biface reduction" was a main strategy of hunter-gatherer lithic technology (e.g., making leaf-shaped points, preforms of wedge-shaped microcores, axes, and disc-like cores) in the northern part of Japanese Islands (Naganuma 2002, 2003). Such industries spread widely across the Russian Far East, the arctic region of Beringia, and northern North America. However, it is not so easy to understand the reduction sequence of bifacial tools. Intensive flaking deleted features of blanks while the reduction sequence was carried out across a plurality of sites under high residential mobility. These interpretations were developed in studies of Paleoamericans (Bamforth 2003; Kelly 1988), but they have a wide range of applicability in other regions and times in the world. Studies about the multifunctionality of bifacial tools continue to rely on micro-wear analysis; however, refitted materials also provide significant information.

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At Mattobara site locality C (37° 13′ 42″ N, 138° 46′ 22″ E), a 148-m^2 excavation revealed 4,171 stone artifacts (Ono 1997). The majority of tools include 82 partially retouched small points and 7 massive bifacial points. Two scrapers, a graver, and a few other retouched tools occur. Though there were no suitable samples for dating, typological comparison suggests the assemblage dates to the late Upper Paleolithic. There are three types of raw materials. Fine gray-colored hard shale (n = 3,124) seems to have originated from valleys more than 150 km northeast of the Mattobara site. Obsidian outcrops are present in mountains about 150 km south of the site, but there are only 36 flakes and 5 obsidian points in the site. Local igneous or sedimentary rocks (andesite, tuff, crude local shale, etc.) occur as pebbles along rivers near the site. Most of the points are made of gray hard shale or obsidian.

Figure 1 shows the bifacial reduction sequence of refitted materials of a single nodule. The raw material is dark-colored hard shale, but the color and the roundness of its surface suggest that it was acquired near the Mattobara site. First, Figure 1-1 shows all 82 flakes, 2 points, and a bifacial core refitted. A flat pebble with a diameter of about 13 cm and thickness of 5 cm is restored. Next, Figure 1-2 shows the appearance of a pebble with reduced thickness. Some flakes produced from this stage have remains of surface cortex. One of them was retouched and shaped into a small point (middle row, right). Furthermore, another small blade-like flake was also retouched and processed into a small point (middle row, left). It is interesting that these blanks of small points are not so long or thick. Third, Figure 1-3 shows a final bifacial core left in the site. Although this biface is unshaped, there are similarly sized (length and width) bifacial leaf-shaped points from the site (also made of local raw materials such as andesite and tuff), and we can estimate that this biface would have become a preform of a leaf-shaped point with still more careful continued reduction. This case illustrates the multiple usage of one biface, as a core for supplying flake blanks for small points and as a preform of a larger, massive leaf-shaped point. It was fortunate for us to succeed in refitting these materials because one stone may have been reduced in a relatively short period of time at a single place (one site). There is the possibility that this is related to the usage of local raw materials. Indeed, the refitting of exotic fine gray hard shale and obsidian is difficult, and reduction sequences are represented only partially at Mattobara. This case will form the basis of an effective model for understanding the biface reduction strategy.

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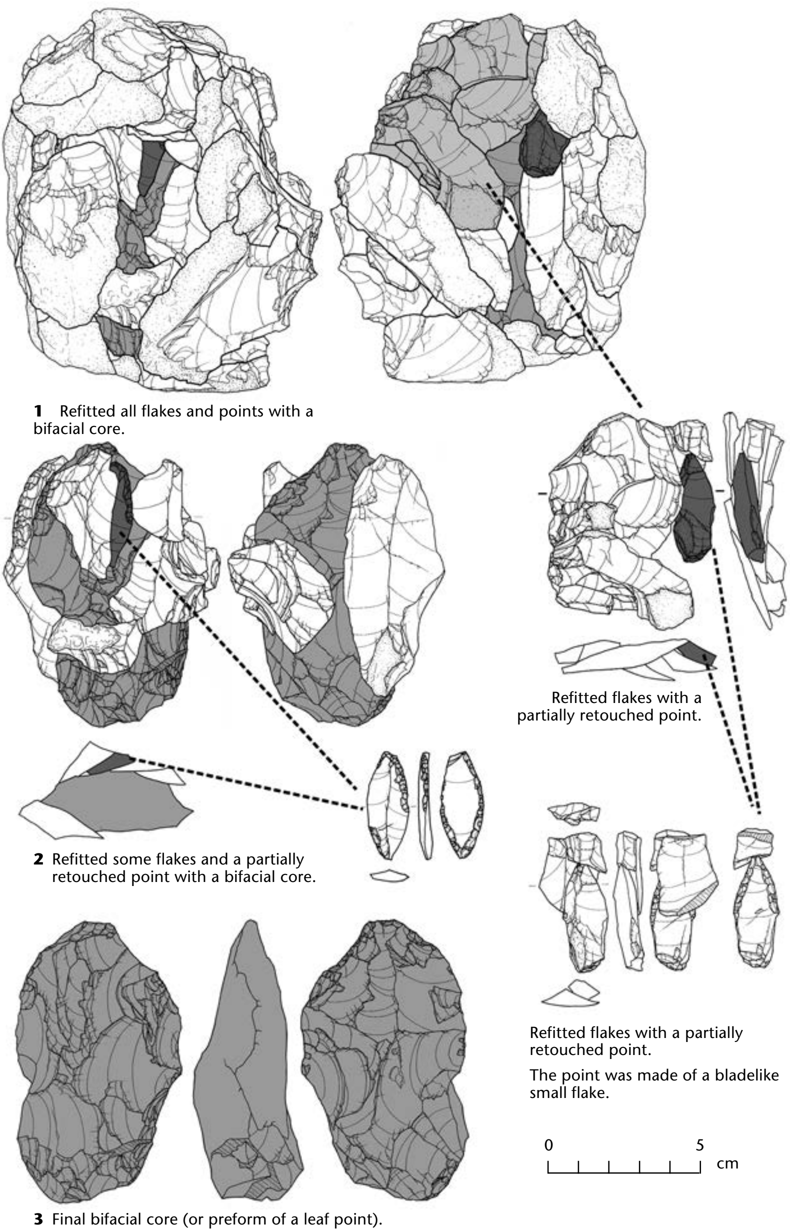

Figure 1. Refitted points from Mattobara site Locality C (manufactured on hard shale).

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Early Upper Paleolithic Sites in the Southwestern Islands of Japan: Indirect Evidence of Plant Utilization

Mari Nakamura

Early Upper Paleolithic sites were recently discovered in the Southwestern Islands, which lie between Okinawa and Kyushu in Japan. This study introduces certain remarkable stone tools that suggest plant utilization.

The first indicators of plant utilization are artifacts found at the Yokomine C and Tachikiri sites on Tanegashima Island, including anvil stones, hammerstones, and grinding stones. Actually, it is difficult to observe wear marks such as striations and/or polish on the grinding stones; but since they are fist-sized stones with partially flat surfaces, the principal characteristics of stones selected for use as grinding stones, I interpret them as grinding stones. They are much more common compared with flaked stone tools. The tools found are mostly of the large type such as edge-polished axes. In addition, some stone mounds, burnt soils, and carbon concentrations were also found at the sites. They suggest the presence of earth ovens where stones were heated in a pit, into which food items might be placed and covered with stones for baking. Considering that the warm-temperate evergreen broad-leaved forest (so-called “lucidophyll forest”) would have been native to these islands, plants like tubers and seeds around the forest might have been cooked in this way. These archaeological remains could be dated by stratigraphic association with key tephras and AMS ^{14}C dates. Similar tools found away from Tanegashima Island include shards of edge-polished stone axes at the Tsuchihama-Yaya site, Amamioshima Island, and grinding stones at the Garazo sites, Tokunoshima Island (Figure 1).

Stone axes from the early Upper Paleolithic are found throughout Japan, with the exception of Hokkaido Island. These tools were made from flat pebbles or large flakes, given an oval shape or parallel edges, and polished mainly at the blade end. Some researchers suspect these axes were used to butcher large animals; however, I believe they were tools for chopping down small trees and for woodworking. Similar to Neolithic tools, their blade ends were finely polished; moreover, many axes were found in severely damaged condition. Above all, such tools have not been found on Hokkaido Island, which was primarily inhabited by large animals.

The second indicator of plant utilization is the fact that only a small number

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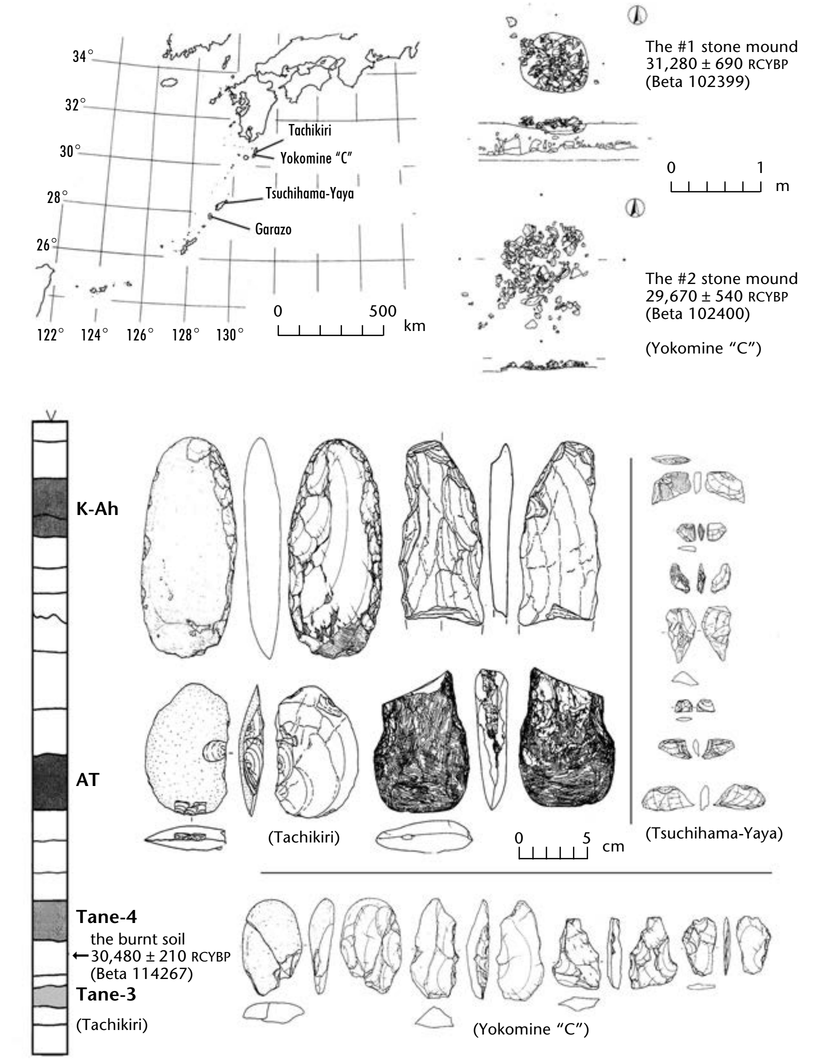

Figure 1. Early Upper Paleolithic sites in the Southwestern Islands of Japan (after Association of Kyushu Paleolithic Culture 2000; Dogome 1998; Okuno et al. 2000).

of flaked-stone tools that were likely used for hunting and/or butchering animals were found in the Southwestern Islands. Those materials are shale and sandstones found nearby. In particular, sandstones possess the advantages of availability and workability. They simultaneously have the disadvantages of being fragile and rendering a blunt blade edge; they are therefore not an ideal material for making flaked tools. However, sandstone tools, including refitting stones, were excavated at the Yokomine C site (Minamitane town Board of Education 2005). Their low durability may indicate they were used infrequently or for short periods, which suggests that the people in this region were less dependent on hunting than the people in the northern region.

These facts can be explained by a system of plant utilization (Fujimoto 2000). Although individual cases do not provide direct evidence, considering the entire character of the assemblages together suggests that the early Upper Paleolithic occupants of the Southwestern Islands relied heavily on plants. The Southwestern Islands form an interesting region exhibiting local adaptations of the culture from the Japanese Archipelago.

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Stone Tool Assemblage Variability during the Last Glacial Maximum in Hokkaido

Yuichi Nakazawa and Masami Izuho

Over the last three decades, as academic and contract projects have recovered sites attributable to the Last Glacial Maximum (LGM, ca. 20,000–18,000 RCYBP) in Hokkaido, situated between 42° to 46° north latitude, archaeologists have come to realize that those sites have varied assemblages in terms of blank production technologies (methods of core reduction) and stone tools. Some 10 open-air sites have been identified in secure stratigraphic contexts. These are bracketed by loam sediments and marker tephras called En-a (17,000 RCYBP) and Spfa 1 (41,000 RCYBP), and have reliable ^{14}C dates that

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correspond to the LGM. These sites are located on two large plains, the Ishikari Lowland and Tokachi Plain, which are geographically separated by the Hidaka Range (Izuho and Takahashi 2005). Similar to some late glacial open-air sites in the European Plain (Clark 2005), owing to the high acidity of the pyroclastic sediments and present-day humidity, the LGM sites in Hokkaido do not preserve faunal remains or bone artifacts (the exception is hearths from the Kashiwadai 1 site, which have yielded heavily eroded bone fragments, identified only as ungulates [Nara et al. 1999]), and therefore the recovered artifact assemblages are essentially composed of lithics, manuports, and pigments (e.g., red ocher, dark brown manganese).

The LGM assemblages are characterized by pronounced differences in blank production—blades, microblades, and flakes. The majority are flake-based assemblages (e.g., Kamiitaira 2, Kyouei 3, Minamimachi 2-sp.1, Seo II-D, Shimaki 1, Kashiwadai 1-FL, and Marukoyama-blw) characterized by small to large tools including scrapers, perforators, and minimally retouched pieces made on short and wide flakes detached from flake cores (Nakazawa 2001; Yamahara 1996). The blade-based assemblage is composed of numerous scrapers and burins made on transported thick and wide blades with heavy-duty tools (e.g., choppers), only recovered from the Kawanishi C site on a river terrace of the Tokachi Plain (Obihiro Board of Education 1998). A microblade assemblage consisting of microblades, scrapers, and burins on narrow blades, and anvils, is found only at the Kashiwadai 1 site on an inland paleodune of the southern Ishikari Lowland (Hokkaido Buried Cultural Property Center 1998).

To make these observations more precise, we discuss the degree of diversification of the LGM stone tool assemblages in Hokkaido. An application of Kaufman's (1998) diversity index to the number of stone tool classes in an assemblage shows that the blade-based assemblage has the highest value ($\theta = 1.11$), the microblade assemblage has the lowest ($\theta = -.06$), and the flake-based assemblages (mean of = .80, s.d. = .25) are between these two extremes. This suggests that the diversity among the groups of assemblages is greater than the diversity within each group of assemblages. Moreover, the richness values of blade-based and microblade assemblages fall outside the range of 95 percent of confidence limits for a sampled mean of richness in the flake-based assemblages ($L_1 = .61$, $L_2 = .98$) . It indicates that the LGM assemblages are not derived from a single population. However, we cannot fully test the hypothesis as to whether or not the LGM assemblages include distinctive units that correspond to empirically recognized differences in blank production technologies, since the LGM assemblages with blade and microblade technologies have only been identified from two sites.

Variability in the LGM stone assemblages is further explored in terms of the role of stone tools in weapon systems. Only the microblade assemblage yielded hunting weapons, presumably composite organic points slotted with microblades, analogous to those of the late glacial and initial Holocene in northern Eurasia (Chard 1974; Clarke 1976; Derevianko 1998). This does not necessarily imply that foragers using the flake and blade blank technologies did not perform hunting activities; rather it indicates that those employing "non-microblade technologies" may have utilized non-barbed organic weapons such as bone, antler, or ivory points with wood or bone foreshafts that could have been shaped by sidescrapers and burins. If so, foragers in Hokkaido would have employed multiple weapon systems during the LGM, similar to the alternate weapon system of backed bladelets and shouldered points in Solutrean assemblages in western Europe (Straus 2002). Since probable linkages among stone tools, blank production technologies, and possibly used organic weapons were polythetic, we suggest that the LGM stone tool assemblages in Hokkaido are best described as "technocomplex assemblages" (Clarke 1968) that would have been a response to diverse socioeconomic and environmental conditions during the LGM.

We thank Lawrence Straus for helpful comments on the manuscript.

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Lithic Raw Material Utilization in Central Honshu during the Terminal Pleistocene

Katsuhiro Sano

This paper describes acquisition and reduction sequences of lithic raw materials during the terminal Pleistocene in central Honshu (Figure 1). This period is characterized by microblade industries at ca. 14,000 RCYBP that gradually gave way to bifacial point industries at ca. 13,500–13,000 RCYBP, and to bifacial-stemmed point industries at ca. 12,500–12,000 RCYBP. The bifacial-stemmed point industries lasted until ca. 11,000 RCYBP.

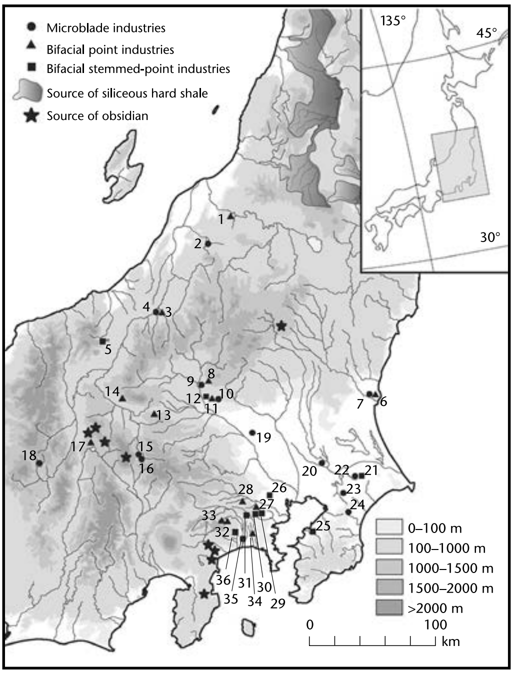

Figure 1. Topographic map of central Honshu, showing locations of sites.
Microblade industries: 2, Nakatsuchi; **4,** Shomen-Nakajima (M); **7,** Ushirono B; **9,** Uenohara; **10,** Kashiranashi; **15,** Nakappara 5B; **16,** Nakappara 1G; **18,** Yanagimata A; **19,** Shirakusa; **20,** Kashiwahara; **22,** Airport No. 61; **23,** Kidoba; **24,** Oami-Yamadadai No. 8.
Bifacial point industries: 1, Uenotaira C; **3,** Shomen-Nakajima (B); **6,** Ushirono A; **8,** Bogaito; **11,** Aratokita-Sankido; **13,** Happusan VI; **14,** Karasawa B; **17,** Nakajima B; **27,** TNT No. 27; **28,** TNT No. 426; **32,** Kitahara (No. 10/11 North); **33,** Minami (No. 2); **34,** Yoshioka site Group A.
Bifacial stemmed-point industries: 5, Seiko-Sanso B; **12,** Kojimada-Yokaichi; **21,** Airport No. 12; **25,** Sannodai; **26,** Mukainohara B; **29,** Hanamiyama; **30,** Miyanomae; **31,** Miyagase site Group; **35,** Keio SFC; **36,** Sannomiya-Shimoyato.

A comparison of the distribution of raw material sources reveals distinct features among these industries. The modern humans responsible for the microblade industries equipped themselves with high-quality raw materials. Especially the wedge-shaped microblade cores were made predominantly on non-local materials such as the siliceous hard shale present in northern Honshu (Sano 2002). The siliceous hard shale was carried over distances of more than 200 km and was completely exhausted (Sano 2006). On the other hand, the bifacial point industries relied mainly on local materials comprising

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cherts, siliceous tuffs, and glassy andesites, while materials such as obsidian were transported over distances of 100 km. In the bifacial-stemmed point industries, raw material composition is dominated by local materials derived from diverse origins. A small amount of high-quality material was sometimes carried to sites from more distant sources.

Reduction sequences were adapted to the available lithic raw materials. In the microblade industries, knappers prepared bifaces for wedge-shaped microblade cores. Flakes that were produced in the process of preparing the bifaces were often transformed into tools. This measure appears to have occurred less commonly in the bifacial point industries. At this time, although considerable flakes were removed during the production of bifacial points, by-products were certainly not exploited as frequently as in the microblade industries. In addition to bifaces, blade cores also provided flake blanks. The reduction sequences employed here must be regarded as wasteful. The bifacial-stemmed point industries show hardly any exploitation of by-products. Lithic tools were made principally on irregular cores, and the methods of tool blank production are similar to those of the Neolithic period. That is, efficient strategies for producing standardized blanks were no longer applied; instead, people used simple methods to get pieces that they then modified into the intended tools through retouching. Lithic artifacts were made of abundant local materials rather than of high-quality materials from distant sources.

Following the emergence of pottery at some microblade and bifacial point industry sites, this new technology is frequently associated with lithic concentrations belonging to the bifacial-stemmed point industries (Kudo 2004; Ono et al. 2002). Thus, the reduction in size of raw material acquisition territories, the change from rational and economical reduction sequences to expedient and wasteful strategies, and the emergence of pottery all coincided temporally within approximately 3,000 years in the terminal Pleistocene. Those hominids no longer needed to reduce lithics sparingly and deliberately because they discontinued utilizing non-local high-quality materials in favor of abundant local materials; moreover, pottery vessels probably allowed them to exploit more diverse sources in local areas.

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The Shirataki Sites: An Overview of Upper Paleolithic Sites at an Obsidian Source in Hokkaido, Japan

Hiroyuki Suzuki and Yasuo Naoe

We present an overview of tool manufacture activities reconstructed through excavations in the Shirataki area. The Shirataki sites are located in the northeastern part of Hokkaido, Japan. They are situated on the terrace of the Yubetsu River flowing into the southern foothills of Mt. Akaishi (Figure 1). The mountain yields a large quantity of obsidian; obsidian rubble is found in the outcrops of the mountain top and the hillside, and cobbles are found in the stream that originates near the mountain top. About 100 Upper Paleolithic sites, many of which are quite large in size, are clustered in this area, suggesting that Paleolithic people visited frequently for the abundant high-quality obsidian resources.

A total of 17 sites, which constitute ca. 100,000 m^2, have been excavated prior to highway construction in the past 10 years, yielding a total of 4,630,000 lithic artifacts weighing ca. 10 tons (Hokkaido Archaeological Operations Center 2000, 2001, 2002, 2004a, 2004b, 2006). Among them, 14 sites belong to the Upper Paleolithic, and more than 99 percent of the artifacts are made of obsidian. At many of the sites, more than two types of lithic industry are recognized. This is especially the case at Kami-shirataki locality 8 (which yielded ca. 1,350,000 lithic artifacts, the largest quantity among the sites) where 10 types of industries are identified. This is the largest number of industrial types found at a site in Shirataki.

In order to reconstruct specific tool manufacture activities and patterns of raw material procurement at an obsidian source, we patiently refitted artifacts from the sites. At present, we have obtained ca. 35,000 refits comprising ca. 125,000 pieces and identified about 3,200 groups of raw materials. By analyzing these conjoined pieces as well as retouched tools, we have inferred, for each lithic industry, types of artifacts imported to the site, techniques of tool manufacture employed at the site, and possible types of artifacts exported from the site (Figure 1). When we find the same industrial types at more than one site we can make inter-site comparisons of these items; likewise, when we find different industries at the sites we can make comparisons among industries.

This constitutes a rare case, in which an extensive investigation was undertaken for sites located near a lithic source to reconstruct lithic consumption patterns by refitting a large quantity of artifacts.

At the Shirataki sites, therefore, we were able to reconstruct tool manufacture activities on the basis of abundant conjoined artifacts, and to examine

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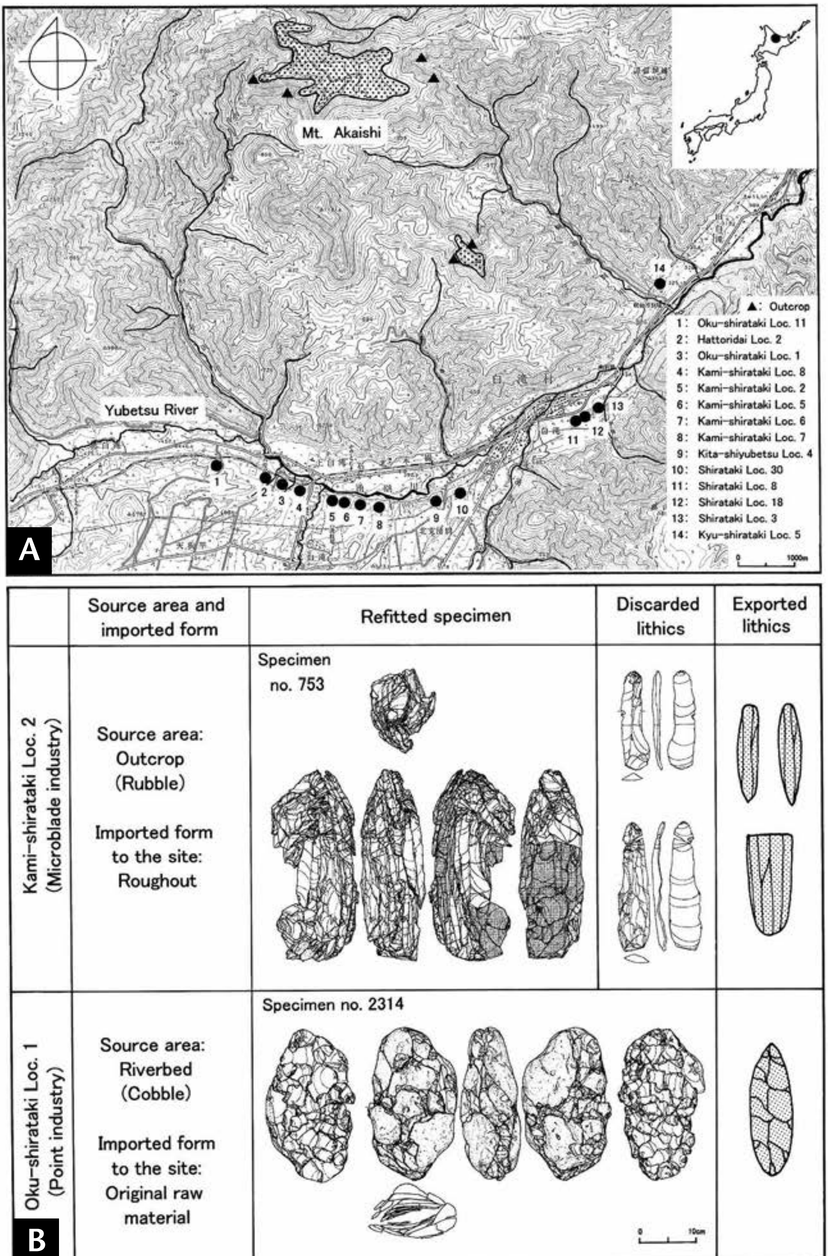

Figure 1. **A,** map showing location of Shirataki sites in relation to Mt. Akaishi obsidian flow; **B,** lithic consumption process reconstructed by refitting.

chronological differences in lithic consumption pattern among different industries and among the same industries found at different contemporary sites. The Shirataki sites thus provide important insights into lithic consumption strategy as a means of environmental adaptation.

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Dating and Function of the Oldest Pottery in Japan

Yasuhiro Taniguchi

The earliest pottery in Japan (all predating the Earliest Jomon) evolved through three phases, called Phase 1 (pre-Linear-relief), Phase 2 (Linear-relief) and Phase 3 (post-Linear-relief). Presently there are 103 ^{14}C dates for these early pottery types, 12 for Phase 1, 41 for Phase 2, and 50 for Phase 3 (Keally et al. 2003; Taniguchi 2002, 2004, 2005). The average and 1-sigma values of the dates provide an estimate of the central date and the range of each phase. Calibrated with CalPal_A2003 (Weninger et al. 2003), these ages and sigmas are 15,460 ± 490, 14,320 ± 690, and 12,610 ± 1240 CALYBP, respectively. The full range of these dates falls roughly between 16,000 and 11,400 CALYBP, and the succeeding early Earliest Jomon (Phase 4) pottery is well dated to less than 11,400 CALYBP.

The function of this earliest pottery is not clear because no one has yet studied this question. However, the $\delta^{13}C$ values for carbonized adhesions on this earliest Japanese pottery mostly fall between -24‰ and -25‰ of the values of C3 plants (Taniguchi 2005). The quantities of pottery in sites, and their correlation with changes in climate (Figure 1), suggest some very limited and occasional function during the more than 4,000 years of the three earliest pottery phases, a function or functions quite different from those of the later Jomon phases.

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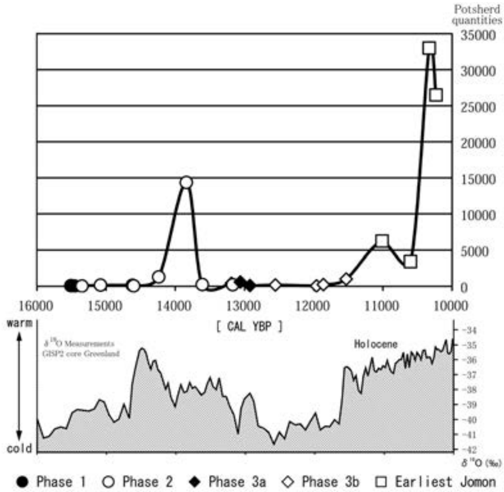

Figure 1. Temporal changes in potsherd quantities of early pottery in Japan.

During the three earliest pottery phases, potsherd quantities were very low, with a small increase in Phase 2, especially in Kyushu, followed by a decrease in Phase 3. Phase 1 precedes the Oldest Dryas and correlates with glacial conditions in all of Japan. Phase 2 correlates roughly with the Bølling and Allerød warmer periods, and a slight increase and spread of the deciduous oak forest in western Japan. Phase 3 correlates with the cooler/colder Younger Dryas. The explosive increase in pottery quantities at the beginning of Earliest Jomon (Phase 4) correlates with the early Holocene and the wide expansion of the deciduous oak (*Quercus serrata, Q. dentata*) and chestnut (*Castanea crenata*) forest that came to dominate all of western and central Japan. It also correlates with the appearance of sedentary settlements and shellmounds.

Pottery clearly was in use in Japan before the end of the last glaciation, by about 16,000 CALYBP, but its function was limited, probably for processing acorns or other plants, and many contemporary sites yield no pottery. With the onset of the Holocene, pottery became an integral and necessary part of the Jomon culture for leaching acorns, for daily cooking, and for many other uses.

I would like to thank Professor Charles T. Keally for translating the manuscript, and Professor Akira Ono for reading the manuscript and correcting technical terms.

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Taisho 3 Site: The Discovery of the Earliest Ceramic Culture in Hokkaido

Toshiro Yamahara

I present the earliest ceramic culture in Hokkaido based on the recent discovery of the Taisho 3 site in the Tokachi Plain (42° 48′ 46″ N, 143° 11′ 51″ E), southeastern Hokkaido (Obihiro Board of Education 2006). This open-air site is located on the lower river terrace (i.e., "Kamisatsunai IIb terrace") along the Tobetsu River, a tributary of the largest river, Tokachi River, in the Tokachi Plain. The site elevation is 97 to 98 m above sea level and 2 m higher than the present riverbed. It was first identified as a site of the blade arrow point assemblage (ca. 8,000–7,000 RCYBP) during a test excavation associated with road construction. Subsequent full excavation conducted by Obihiro Centennial City Museum archaeologists in 2003 led to recovery of pottery from the layer below that of the blade arrow point assemblage.

The pottery recovered with stone implements is from a yellowish brown loam accumulated on terrace gravels. The pottery assemblage includes a minimum of 12–15 vessels. AMS ^{14}C dates obtained from 11 samples of organic residue are as follows: 12,400 ± 40 (Beta-194626), 12,220 ± 40 (Beta-194627), 12,350 ± 40 (Beta-194628), 12,460 ± 40 (Beta-194629), 12,210 ± 40 (Beta-194630), 12,130 ± 40 (Beta-194631), 12,290 ± 60 (IAAA-41603), 12,330 ± 70 (IAAA-41604), 12,120 ± 60 (IAAA-41605), 12,470 ± 60 (IAAA-41606), and 12,160 ± 60 (IAAA-41607) RCYBP. These dates are reliably distributed within a range of 14,410 to 14,080 CALYBP.

The characteristic pottery vessel is a deep bowl with a small projection at the center of a curved base (Figure 1). It ranges from 10–25 cm in height and 4–7 mm in thickness. It is decorated by some kind of impression technique presumably using a nail or bone stick. Some decorations are associated with fat linear applique. Some of these attributes are commonly observed on vessels from initial Neolithic (i.e., incipient Jomon) sites in Honshu, although the design of decorations here is unique.

Not only does the Taisho 3 site yield the earliest ceramic wares in Hokkaido, it is also the northernmost among sites in the Japanese Archipelago with potteries older than 10,000 RCYBP. The presence of pottery in the terminal

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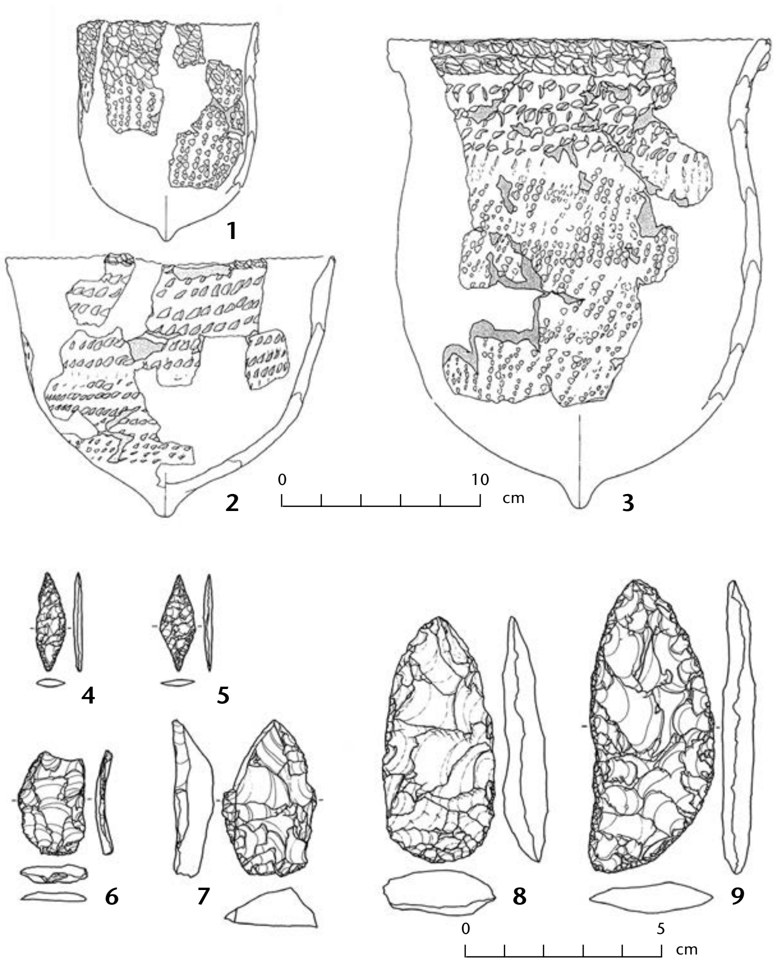

Figure 1. The early pottery and stone implements of the Taisho 3 site (**1–3,** pottery fragments; **4–5,** small points; **6–7,** burins; **8–9,** bifaces).

Pleistocene of Hokkaido requires us to revise our understanding of the Pleistocene/Holocene transition in Hokkaido, especially with respect to a consensus that late Upper Paleolithic cultures continued after 12,000 RCYBP. Moreover, the Taisho 3 site is important in discussions of the origins of pottery and transition to the initial Neolithic in northeastern Asia, especially given the geographic location of Hokkaido between Honshu and the Russian Far East, where terminal Pleistocene potteries have already been found.

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Current Issues in the Study of the Early Upper Paleolithic in Musashino Upland, Tokyo

Takuya Yamaoka

The Musashino Upland is part of the south Kanto Plain around Tokyo, in east-central Japan. Over 200 Upper Paleolithic sites have been excavated there since the 1970s (Hidai 2000), and a detailed chronology has been established on both stratigraphic and morpho-typological bases (Figure 1). This Musashino Upland chronology is the standard for the early Upper Paleolithic throughout the Japanese islands.

The uniform and relatively thick geology of sites on the Musashino Uplands facilitates accurate and refined alignment of strata between sites. The Tachikawa Loam is the uppermost loamy deposit, and abundant Paleolithic artifacts have been obtained only from this group of strata. (Human artifacts have never been found in the deeper and older Musashino Loam deposits [Stratum XIII and deeper] on the Musashino Upland.) In general, the Tachikawa Loam is divided into 12 strata (Stratum I to Stratum XII), mainly on the bases of texture, minerals, and color (Akazawa et al. 1980). Lithic industries from the lower strata (VI-X) belong to the early Upper Paleolithic (Sato 1992). The oldest industries from Stratum X are thought to be initial Upper Paleolithic industries.

The widespread Aira-Tn marker tephra (AT, ca. 25,000–24,000 RCYBP) (Japan Association for Quaternary Research 2000:42–43) is normally found in Stratum VI, coinciding well with the transition from OIS (oxygen-isotope stage) 3 to OIS 2 (Machida 2005; Ono et al. 2002). Reliable AMS dates were obtained from hearth features in Stratum X at the Musashidai Nishi-chiku site—29,860 ± 150 RCYBP (Beta-182638) and 30,380 ± 400 RCYBP (Beta-156135) (Kawashima and Onishi 2004:308-309)—but dates for this stratum on the Musashino Upland are still rare. More reliable AMS dates and other tephra data are needed to clarify the timing of the appearance of Upper Paleolithic industries on the Upland.

Lithic industries from the Musashino Upland changed considerably during the early Upper Paleolithic. Lithic industries from Stratum X contain trapezoids and edge-ground tools (axes). The blade-flaking technique and typical flake tools are very scarce in these industries. Lithic industries from Stratum VI, however, contain many backed blades, and the blade-flaking technique and typical flake tools are common in these later industries. Overall, the oldest industries from Stratum X differ considerably from the general characteristics of Upper Paleolithic lithic industries. Moreover, features of these industries represent a diversity of lithic raw material utilization and manufacturing complex during the early Upper Paleolithic, and this begs further discussion on the definition of Upper Paleolithic beginnings.

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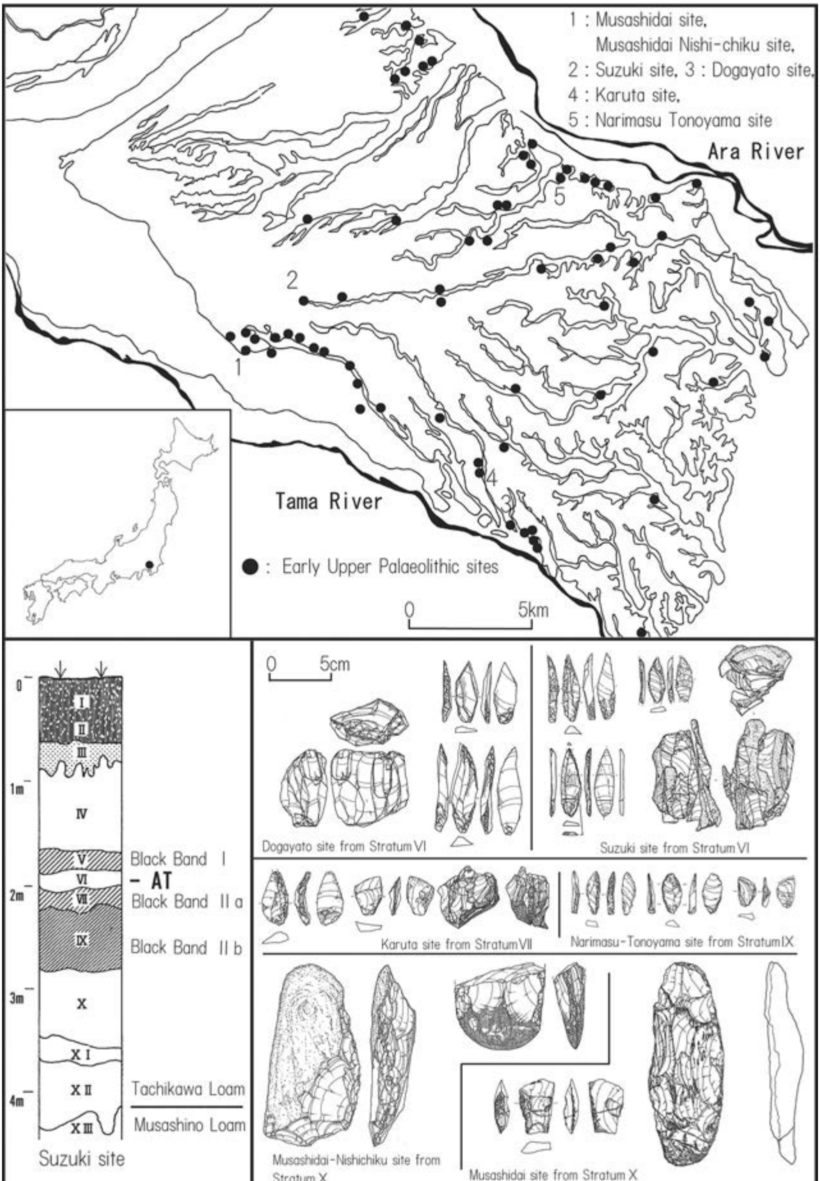

Figure 1. Early Upper Paleolithic sites and stratigraphy on the Musashino Upland around Tokyo (Hidai 2000; Suzuki Site Publication Committee 1978).

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Archaeology: Eurasia and Africa

Preliminary Investigation of the New Middle Stone Age Site of Plovers Lake, South Africa

Juliet K. Brophy, Darryl J. de Ruiter, Patrick J. Lewis, Steven E. Churchill, and Lee R. Berger

This study is a preliminary assessment of a faunal assemblage derived from Plovers Lake Cave, a newly investigated fossil deposit in the Sterkfontein Valley of South Africa. This cave infill is populated by numerous stone tools of a middle Stone Age (MSA) character. The material discussed in this report is from an ex situ faunal sample recovered between 2001 and 2004. Although the material was disturbed by an episode of limestone mining in the 1920s, taphonomic indicators suggest this disturbance did not significantly affect the composition of the assemblage. The macromammal faunal sample consists of 8,539 specimens, of which 2,215 are identifiable to Family and element (Table 1). The Bovidae numerically dominate the assemblage, though the most common individual animal is the rock hyrax (*Procavia capensis*). Although primates are rare, a particularly rich carnivore assemblage is evident. Microfauna recovered from the site include numerous shrews and rodents, primarily from the Family Muridae. Three extinct taxa have been recognized so far; considered with the MSA tools, they suggest an age for the deposit in excess of 30,000 years. Several fragments of a single human individual have been recovered to date.

The high abundance of carnivores relative to ungulates, combined with the presence of tooth-marked bones and numerous coprolites, suggests carnivore involvement in the accumulation. However, cut-marked bones are present, as are stone tools, suggesting some human activity in the vicinity of the cave. Among the ungulates, there is a high preponderance of open grassland grazers (90%), alongside a small number of more closed habitat animals (10%) (see Table 1). Water-dependent taxa dominate the ungulates (57%), while partially water dependent (6%) and water-independent taxa (37%) are

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Table 1. The ex situ faunal assemblage recovered from Plovers Lake, South Africa.

Genus and species	MNI	Habitat■	Diet▲	Water dependence◆
Homo sapiens	1	UB	OM	WD
Papio ursinus	1	OW	OM	PWD
Ceropithecus aethiops	1	OW	B	PWD
Felis lybica	1	UB	C	PWD
cf. *Panthera pardus*	1	UB	C	WI
Parahyaena brunnea	4	WBG	C	WI
cf. *Crocuta crocuta*	1	WBG	C	PWD
Lycaon pictus	2	WBG	C	WI
Canis mesomelas	8	UB	C	WI
Vulpes chama	4	WBG	C	WI
Otocyon megalotis	2	WBG	I	WI
Atilax paludinosus	1	UB	C	WD
Suricata suricatta	1	WBG	C	WI
Genetta tigrina	3	OW	C	PWD
cf. *Galarella sanguinea*	1	UB	C	PWD
cf. *Cynictis penicillata*	1	WBG	C	WI
cf. *Mungos mungo*	1	UB	C	PWD
Ictonyx striatus	1	UB	C	PWD
Mellivora capensis	1	UB	C	PWD
Aonyx capensis	1	UB	C	WD
Procavia capensis	23	UB	MF	WI
Equus burchelli	5	WBG	G	WD
Phacochoerus aethiopicus	2	WBG	G	WI
Hippo/Rhino indet.	1	UB	G	WD
Megalotragus sp.†	1	WBG	G	WD
Connochaetes sp.	4	WBG	G	WD
Medium-sized Alcelaphine	6	WBG	G	WD
Damaliscus niro†	1	WBG	G	WD
Damaliscus dorcas	12	WBG	G	WD
Antidorcas marsupialis	14	WBG	MF	WI
Antidorcas bondi†	7	WBG	MF	WI
Raphicerus campestris	2	WBG	B	WI
Hippotragus sp.	2	WBG	G	WD
Redunca arundinum	1	WBG	G	WD
Redunca fulvorufula	4	WBG	G	WD
Taurotragus oryx	2	OW	B	PWD
Tragelaphus strepsiceros	2	OW	B	PWD
Syncerus caffer	3	CWF	G	WD
Pelea capreolus	1	WBG	MF	WI
Hystrix africaeaustralis	9	UB	OM	WI
Lepus sp.	8	WBG	MF	WI
Steatomys pratensis	1	OW	I	—
Aethomys chrysophilus	8	OW	OM	—
Dendromus melanotis	1	WBG	I	—
Tatera sp.	1	WBG	OM	—
Mystromys albicaudatus	3	WBG	OM	—
Otomys irroratus	10	WBG	MF	—
Praomys natalensis	1	WBG	OM	—
Cryptomys hottentotus	1	WBG	MF	—
Crocidura sp.	10	OW	I	—
Total	183			

■CWF=closed woodland or forest, OW=open woodland, WBG=wooded or bushy grassland, UB=ubiquitous
▲B=browser, MF=mixed feeder, G=grazer, C=carnivore, OM=omnivore, I=insectivore
◆WD=water dependent, PWD=partially water dependent, WI=water independent
†extinct taxon

fewer. Other non-ungulate aquatic species are recorded, including water mongoose (*Atilax paludinosus*) and Cape clawless otter (*Aonyx capensis*). The majority of the small mammals recovered represent grassland-adapted taxa, though the Vlei rat (*Otomys irroratus*) is today often associated with marshy areas (Rautenbach, 1982). The combined fauna therefore indicate a predominantly grassland environment with some form of nearby permanent water source such as a lake or perennial river.

Current activity is directed toward retrieving a representative faunal sample from a recently recognized in situ deposit. Comparison of an in situ sample with the present ex situ assemblage will help to improve our understanding of the environmental and ecological conditions prevalent in the later Pleistocene of southern Africa. That the majority of materials known from this time period in southern Africa have been recovered from coastal sites underscores the importance of this new non-coastal locality.

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The Middle-to-Upper-Paleolithic Transition in Transbaikal, Siberia: The Khotyk Site Chronology and Archaeology

Yaroslav V. Kuzmin, Ludmila V. Lbova, A. J. Timothy Jull, and Richard J. Cruz

The transition from the Middle Paleolithic (i.e., the Mousterian technocomplex) to Upper Paleolithic was an important process related to the emergence of modern humans and new technologies (Bar-Yosef 2002; Nitecki and Nitecki 1994). A few sites in Siberia have both Middle and Upper Paleolithic components in stratigraphic order, and previously the age of the Middle-to-Upper-Paleolithic (MP/UP) transition in southern Siberia was estimated to be about 43,000–35,000 RCYBP (Derevianko 2001). There is a viewpoint that in Siberia Middle and Upper Paleolithic sites coexisted for a long period, from about 43,000 to 35,000 RCYBP (Derevianko 2001) and possibly to about 27,000 RCYBP (Kuzmin 2004:206).

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The Khotyk site (52° 13′ N, 109° 50′ E) is situated in southern Transbaikal, on the bedrock slope of the Ona River basin, about 35 m above the water level. Cultural materials are incorporated into matrix of colluvial loams reaching 4 m in thickness. The site was excavated by L. V. Lbova in 1993 and 1998–2004 (Lbova 2000:93–110, 2002, 2005). There are six cultural components identified at the site. From bottom to top, layers 6, 5, and 4 contain Mousterian (Levallois) artifacts; layers 3, 2, and 1 are characterized by Upper Paleolithic technologies. Previously, layers 3 and 2 were ^{14}C dated to about 32,100–29,300 and 28,700–26,200 RCYBP, respectively (Lbova 2002; Orlova et al. 2005; Vasil'ev et al. 2002:528).

In order to better secure the chronology of the MP/UP transition at this site, mammal bone samples from layers 2–5 were collected in the same unit of the 2003 excavation campaign. Earlier, samples for layers 2 and 3 (see above) were taken from different parts of site profiles, and this may be responsible for wide deviation of ^{14}C dates belonging to the same cultural component. Collagen extraction was done by slow dissolution of whole pieces of bone in weak hydrochloric acid (Kuzmin and Orlova 2004:144–145), and AMS ^{14}C dating was performed at the NSF-Arizona AMS Laboratory.

The general character of the stone assemblage from layer 5 is Middle Paleolithic and includes discoidal cores, axe-like and notched tools, and hammerstones with anvils (Lbova 2005). In layer 4, Levallois-like cores, *racloirs*, and denticulate and beak-shaped tools occur; this assemblage may be considered "transitional" between Middle and Upper Paleolithic (Lbova 2002). In layers 2 and 3, Levallois cores are still present (4.5–9% of total number of cores), but blade cores are the most typical ones. In layer 2, a few definite "narrow-face" (i.e., early type of *tortsovyi*, or "end") cores and microcores are also noteworthy. Tools from layers 2 and 3 include knives, points, *racloirs*, borers, chisels, and notched and denticulate tools. These assemblages are clearly Upper Paleolithic in appearance (Lbova 2002). Bone adornments, bones with incisions and cutmarks, and pieces of red ocher from layers 2 and 3 are some of the earliest art objects in Siberia (Derevianko and Rybin 2003; Lbova 2000, 2002). As for faunal remains from Khotyk site, in the upper layers (1–3) horse (*Equus* sp.), Mongolian gazelle (*Procarpa gutturosa*), and woolly rhinoceros (*Coelodonta antiquitatis*) dominate; in the lower layers (4–6), wild sheep (*Ovis ammon*) is important along with the above species (Klementiev 2005).

^{14}C dating of selected samples has yielded the following age determinations:

1) layer 5/2, depth of 3.00–3.50 m below the surface: > 38,700 RCYBP (AA-60614, $\delta^{13}C$ = -21.4‰);
2) layer 4, depth 2.00–2.20 m: 35,100 ± 1500 RCYBP (AA-60613, $\delta^{13}C$ = -21.9‰);
3) layer 3, depth 1.40–1.60 m: 38,200 ± 2800 RCYBP (AA-60267, $\delta^{13}C$ = -20.8‰);
4) layer 2, depth 1.00–1.20 m: 32,700 ± 1400 RCYBP (AA-60266, $\delta^{13}C$ = -20.4‰).

The inversion of dates in layers 4 (about 35,100 RCYBP) and 3 (about 38,200 RCYBP) may be explained in any of the following ways: relocation of bone by post-depositional cryogenic activity, as evidenced by ice-wedge structures at the contact between layers 3 and 4; rodent burrowing; site disturbance by digging of storage pits from layer 2 downwards. Under any conditions, it is possible to estimate tentatively the age of the MP/UP transition at Khotyk at about 38,000 RCYBP.

It seems that Upper Paleolithic complexes in Transbaikal may be even older, up to about 43,900–38,900 RCYBP according to recent ^{14}C dating of the Podzvonkaya site (Tashak 2002; Vasil'ev et al. 2002). The appearance of art at that time in Transbaikal, along with the recent discovery of a rich non-utilitarian assemblage at Denisova Cave (Altai Mountains, southern Siberia) dated to about 37,000 RCYBP and perhaps older (Derevianko and Shunkov 2004), indicates the origin of symbolic behavior in Siberia much earlier than it was previously thought.

Looking at the timing of the MP/UP transition on a Siberia-wide scale, there is increasing evidence that it took place very early, before about 40,000 RCYBP (Derevianko 2001; Goebel 2004). Obviously, more work needs to be done in order to understand better the chronological and archaeological patterns of this process, as recently shown in the discussion of Eurasian records on the MP/UP transition and origin of the Upper Paleolithic (Derevianko 2005).

This study was partially supported by grants from U.S. NSF (EAR97-30699 and EAR01-15488), Fulbright Program (No. 03-27672), Russian Foundation for Basic Sciences (RFFI, Nos. 04-06-80403 and 06-06-80108), Russian Foundation for the Humanities (RGNF, No. 06-01-00527), Russian Academy of Sciences (No. 21.1/1.5), and Siberian Branch of the Russian Academy of Sciences (No. 73). We are grateful to Dr. L. A. Orlova (Institute of Geology and Mineralogy, Novosibirsk, Russia) for pretreatment of samples.

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The Late-Glacial Neolithic Complex of the Gromatukha Site, Russian Far East: New Results and Interpretations

Sergei P. Nesterov, Minoru Sakamoto, Mineo Imamura, and Yaroslav V. Kuzmin

One of the major criteria in defining the Neolithic stage in East Asian prehistory is the presence of pottery (Barnes 1999; Kuzmin 2003). In the late 1990s it became clear that the earliest Neolithic cultural complexes of the Russian Far East, Osipovka and Gromatukha, were older than about 10,000 RCYBP (Kuzmin and Jull 1996), as originally established in the early 1980s (Okladnikov and Medvedev 1983). Ongoing excavations in the 1980s and 1990s at three Osipovka complex sites, Gasya, Khummi, and Goncharka 1, determined their ^{14}C age at about 13,300–10,300 RCYBP (Derevianko et al.

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2004a; Kuzmin and Shewkomud 2003; Kuzmin et al. 2003). Thus, the timing of the Osipovka complex was securely established.

The Gromatukha site (51° 49′ N, 128° 49′ E) is located along the bank of the Zeya River (part of the greater Amur River basin), on a terrace-like surface about 13 m above the water level. It was originally excavated in 1965–1966, exposing about 400 m^2 of cultural layer (Okladnikov and Derevianko 1977). A few samples for ^{14}C dating were collected, but none originated from the earliest cultural layer. Only plant-tempered potsherds belonging to the earliest Neolithic component were accessible for dating until the late 1990s (Kuzmin 2002a; O'Malley et al. 1999). In addition, two charcoal samples were collected from the lower part of the excavation walls during brief site visits in 1999 and 2000. These specimens produced ^{14}C dates of 12,340 ± 60 RCYBP (AA-36079) (Jull et al. 2001) and 12,120 ± 40 RCYBP (AA-60765) (both on charcoal), and about 13,300–7300 RCYBP on pottery temper (Derevianko et al. 2004a).

Ambiguities connected with degree of association between dated samples and the earliest pottery, and the reliability of pottery temper ^{14}C dates (Kuzmin 2002a:231–2), however, have hampered efforts to define the final age of the Gromatukha complex for years. A new excavation campaign conducted at the Gromatukha site in 2004 unearthed about 80 m^2 of the cultural layer (Derevianko et al. 2004b). This led to the recovery of charcoal samples securely associated with pottery and stone tools from three cultural layers (1 through 3, from top to bottom of sequence). Layer 1 is associated with the Late Neolithic Osinoozerskaya complex, recently dated to about 3600–3300 RCYBP (Nesterov et al. 2005). Layer 2 contains Early Neolithic stone artifacts and pottery with comb pattern; it was tentatively dated to about 5100 RCYBP (Jull et al. 2001). In layer 3, lying on top of bedrock, plant-tempered pottery was found. This pottery is coarse, 0.7–0.8 cm thick, and has a primitive design in the form of grooves on both sides of sherds (e.g., Derevianko and Petrin 1995; Kuzmin 2002b:40). The stone inventory from layer 3 includes microblades, scrapers, knives, and bifacially worked leaf-shaped bifaces (Derevianko et al. 2004b). The assemblage has a definite Initial Neolithic appearance, as defined by Derevianko (1994) and Kuzmin and Shewkomud (2003:41).

AMS ^{14}C dating of samples collected in 2004 was conducted at the University of Tokyo (Tokyo, Japan; Lab code MTC) and Beta Analytic, Inc. (Miami, Florida, USA; Lab code Beta), with sample pretreatment carried out at the National Museum of Japanese History (Sakura City, Chiba Pref., Japan). Liquid-scintillation-counting ^{14}C dating was performed at the Institute of Geology, Siberian Branch of the Russian Academy of Sciences (Novosibirsk, Russia; Lab code SOAN). For cultural layer 3, four charcoal specimens were ^{14}C dated. Two samples from a depth of 1.30 m below the surface were dated to 12,340 ± 70 RCYBP (MTC-05936) and 12,300 ± 70 RCYBP (MTC-05938). A sample collected at 1.20 m below the surface returned an age of 12,380 ± 70 RCYBP (MTC-05937), and a specimen from a depth of 1.10–1.15 m gave a ^{14}C value of 11,580 ± 190 RCYBP (SOAN-5762). Two charcoal samples from cultural layer 2 were dated to 10,660 ± 40 RCYBP (Beta-205394) (depth of 1.20 m) and 6175 ± 125 RCYBP (SOAN-5761) (depth of 1.15 m).

Therefore new excavations and ^{14}C dating confirm the late-Glacial age of the earliest complex at the Gromatukha site, that it emerged at least by about 12,400 RCYBP and perhaps even earlier, by about 13,300 RCYBP. This makes it one of the first pottery assemblages in the Old World, along with Incipient Jomon of Japan and the oldest Neolithic of China at Miaoyan and Yuchanyan sites (Kuzmin 2006). Obvious differences in shape and technology of vessel manufacture among these three large regions (Keally et al. 2003) suggest that pottery was invented in all regions independently of one another (all within East Asia, however) at the end of the Pleistocene.

This study was partially funded by grants from Ministry of Education, Culture, Sports, Science, and Technology of Japan (Mombu-Kagakusho, 2003); Russian Foundation for the Humanities (RGNF; No. 06-01-00436a); Russian Foundation for Basic Sciences (RFFI; Nos. 96-06-80688, 99-06-80348, and 06-06-80258); Fulbright Program (USA, Nos. 21230, 1997; and 27672, 2004); and the United States National Science Foundation (U.S. NSF, Nos. EAR97-30699 and EAR01-15488).

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The Final-Pleistocene Pottery of Siberia: Ust'-Karenga 12 Site Case Study

Viktor M. Vetrov, Yaroslav V. Kuzmin, and G. S. Burr

The emergence of pottery in northern Asia marks the beginning of the Neolithic (Kuzmin and Orlova 2000; Oshibkina 1996). In Siberia, the earliest pottery-bearing complex was found in the late 1970s in layer 7 of the Ust'-Karenga 12 site (Vetrov 1985, 1992). Ust'-Karenga 12 (54° 28′ N, 116° 31′ E) is located in the northern Transbaikal (eastern Siberia), at the confluence of the Karenga and Vitim rivers, on a terrace about 15 m above the water level (Vetrov 1992). Cultural materials occur in an alluvial sand matrix that is subdivided into 10 stratigraphic components. Pottery vessels from layer 7 are of parabolic shape, from 12–14 to 20 cm in diameter, and from 16–18 to 35–38 cm high. Vessel walls are 0.4–0.5 cm thick. Designs cover the upper part of the vessel bodies and are represented by comb pattern and zigzag, herringbone, and cogged stamps (Kuzmin 2002:42; Vetrov 1985). A particular feature of this pottery is that it was plant fiber–tempered during manufacture; this is a unique case among the Early Neolithic complexes of Siberia. The lithic inventory from layer 7 includes wedge-shaped cores, transverse burins of the Araya type, bifacial knives, and microblade tools; it has a Final Paleolithic or Mesolithic appearance (Vetrov 1985; Vetrov and Kuzmin 2005).

There are several ^{14}C dates from the Ust'-Karenga 12 site obtained in the 1980s and 1990s. The pre-pottery final-Paleolithic layer 8 is dated to about

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13,600–12,700 RCYBP (Vetrov and Kuzmin 2005); a single older value of about 16,400 RCYBP (Vasil'ev et al. 2002:527) seems contrary to palynological and archaeomagnetic data (Vetrov and Kuzmin 2005:60–61) and can be discarded. Layer 7 with pottery has yielded three ^{14}C dates: two charcoal values of about 11,200–10,800 RCYBP (Kuzmin and Orlova 2000:358; Vetrov 1995), and one pottery temper value of about 10,600 RCYBP (O'Malley et al. 1999). These age determinations are older than any other secure Neolithic assemblages in Siberia (which typically date to no earlier than about 8000 RCYBP [Kuzmin and Orlova 2000; Weber et al. 2006]), and perhaps are as old as the 11,500–10,800 RCYBP Ust'-Menza 1, Studenoe 1, and Ust'-Kyakhta sites (Aseev 2003:37; Konstantinov 1994:153), all located in the southern Transbaikal and presumably associated with pottery (Kuzmin and Orlova 2000).

Questions regarding the mixture of Paleolithic-like stone artifacts and pottery in layer 7 of Ust'-Karenga 12, possibly belonging to different stages of Siberian prehistory, have required additional geoarchaeological study of this unusual complex. In order to secure an estimate of the age of layer 7, charcoal collected in presumed direct association with pottery as well as organic temper from potsherds was AMS ^{14}C–dated, using routine procedures for charcoal (Taylor 1987) and low-temperature combustion for organic-tempered pottery (O'Malley et al. 1999). When powdered material from the internal surface of a potsherd is burned at 400°C in an oxygen-enriched environment, if the yield of carbon extracted from the combustion is greater than about 0.1%, then the ^{14}C determination is usually in accord with other criteria (site stratigraphy, charcoal ^{14}C dates, and general chronological framework of prehistoric cultural complexes).

Two charcoal samples representing small particles spread across cultural layer 7 were collected in 2003 from a depression with potsherds at a depth of 1.00 m below the surface. They yielded ^{14}C ages of 12,180 ± 60 RCYBP (AA-60201) and 12,170 ± 70 RCYBP (AA-60202). Two potsherds were collected from layer 7 in the 1990s from different parts of the site. Temper extracted from them was dated to 11,065 ± 70 RCYBP (AA-38101; carbon yield 0.80%, $\delta^{13}C$ = -30.1‰ (Kuzmin and Keally 2001:1124) and 10,870 ± 30 RCYBP (AA-60667; carbon yield 0.98%, $\delta^{13}C$ = -29.3‰).

Thus the terminal-Pleistocene age of pottery from layer 7 of the Ust'-Karenga 12 site is confirmed by the new data presented here. We can safely say that the pottery from Ust'-Karenga 12 is the earliest in all of Siberia. It is only slightly younger than the Initial Neolithic Osipovka and Gromatukha complexes from southern Russian Far East, now ^{14}C-dated to about 13,300–12,400 RCYBP using charcoal (Kuzmin et al. 2004; Nesterov et al. 2005), and other earliest Neolithic complexes in neighboring East Asia (Japan and China) firmly dated to about 13,700–13,300 RCYBP (Keally et al. 2004). It seems that pottery emerged in Siberia during the late Glacial, about 12,200–10,800 RCYBP, in a steppe-like environment with dwarf birch and alder, mixed with pine and larch light forests (Vetrov and Kuzmin 2005:61).

This study was partially supported by grants from U.S. NSF (EAR95-08413, EAR97-30699, and EAR01-15488), Fulbright Program (No. 03-27672), and Russian Foundation for Basic Sciences (RFFI, Nos. 06-06-80258 and 06-06-80108).

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Archaeology: Latin America

A Newly Discovered Site Plan for Pali Aike Cave, Magallanes, Southern Chile

Thomas Amorosi

Junius Bird excavated Cañadon Leona, Cerrato Sota, Fell's and Pali Aike rockshelters in Magallanes, southern Chile, in 1936–1937 and published some results from these excavations (Bird 1938a, 1983b, 1951, 1960).

Subsequently, other authors (Crabtree 1970; Luedtke n.d. [1994]; Markgraf 1993; Nami 1998; Neves et al. 1999) have conducted limited studies of materials from these sites. While complete analyses of these collections are currently underway, this paper describes a previously unreported plan view map of Pali Aike's ash layer (Figure 1).

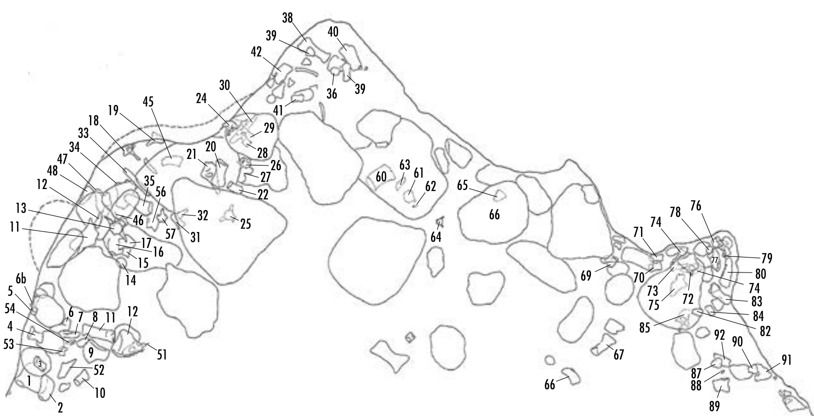

Figure 1. Plan view of the sloth and horse remains recovered from levels P34-P37 at the depth of 60 inches below ground surface from the rear of Pali Aike Cave. The plan view is not labeled and does not have a cardinal direction or scale. Inconsistencies in the numbering of mapped bones reflect the idiosyncrasies of Bird's notes.

Bird's plan view records the excavated Divisions C and D and central trench at the rear of the cave. Two mammalian species, *Mylodon* sp. (giant ground sloth) and *Hippidion* sp. (horse), are shown in situ within the ash layer.

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Bird does not indicate the presence of any cultural artifacts and only drew the more complete, distinctive bone elements from a larger group of sloth remains. Of these, 102 sloth remains and one horse tibia recovered from levels P34–P37 are numbered and placed at a depth of > 60 inches below the ground surface ("P34–P36, Divisions C and D; P37, Division D; Period V").

Stratigraphically, the plan view begins from the ash interface (P34–P36) and continues downward (P37). Most of the drawn sloth remains are clustered in five areas. Taphonomic observations from Bird's field notes and laboratory analysis ascertains that these remains were washed into position by water flooding along the cave floor, suggesting the ash layer was reworked.

Bird felt that the sloth remains were the result of human predation, but there is a low incidence of carnivore gnawing on the surfaces of the bones and no indication of butchery. Also, there are numerous immature sloth remains in the assemblage, suggesting that sloths used this cave as a birthing den and carnivores occasionally visited it. Few lithic materials were recovered from the lower levels, and none were found in or below the ash layer. This suggests infrequent human occupation of the cave.

Bird (1988:107–109) thought he had uncovered a semi-articulated sloth skeleton covered by large rounded rocks in the upper levels of the ash.

These remains were not separated; upon closer examination, they appear to represent only a jumble of skeletonized adult and juvenile fragments that washed into the area before deposition.

Bird combined sloth, horse, and guanaco samples from the soil interface above and within the ash layer for dating. This bulk sample, derived from Bird's P21 and P25 Period III and P27, P28, P30, and P31 Period V, helped to date the ash layer from 8639 ± 450 to 6689 ± 450 RCYBP (C485) (Bird 1951, 1988:107). Bird (1988:106–107; Markgraf 1985) thought these age estimates were too young. Now that sloth remains can be directly linked to several levels within the ash, a new set of AMS ^{14}C and related bone chemistry signatures are planned.

Special thanks are due to Samantha Alderson, Sumru Aricanli, Paul Beelitz, Kristy House, John Hanson, Judith Levinson, Craig Morris, and Ian Tattersall at the Division of Anthropology, and the AMNH for making the Pali Aike and other Southern Chile materials available for study. This short note is dedicated to the memory of Craig Morris who encouraged me to continue with this research.

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Levels with Extinct Fauna in the Forest Rockshelter El Trébol (Northwest Patagonia, Argentina)

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We here describe the deep levels of excavation of the El Trébol site (Hajduk et al. 2004 and i. p.), which bear extinct fauna associated with evidence of human activity. The site is located in the eastern flank of the Andes (41° 04′ 35″ S and 71° 29′ 25″ W; ca. 780 m a.s.l) in a forested lacustrian environment of Nahuel Huapi Lake, near the forest-steppe ecotone.

The interior cave surface measures around 110 m^2. Excavations during 2002 and 2004 reached 15 m^2, of which only 1.7 m^2 was excavated into the lower levels (including Level 5). Note that levels follow a downward slope toward the interior; in the stratigraphic description that follows, the depths given are maximum values (Figure 1). The lowest levels (4.90 m) contain faunal remains but are culturally sterile. These are covered by roof-fall that paves the entire excavated surface, possibly related to strong seismic and volcanic events. The interstices among these rocks contain the first remains of human occupation associated with extinct megafauna (Level 5, 3.50 m) in a matrix of volcanic sand. A sterile ocher sediment (Level 4,3 m) fills the upper interstices and covers parts of the roof-fall level. Overlying the fallen rocks, a dark organic sediment with hearths (Levels 3 to 1, 2.90 m) includes remains of successive occupations. A thin volcanic ash layer covers these levels (2.35 m).

Concerning the first level of occupation (Level 5), a sample composed of dermal ossicles of ground sloth, burnt and with human-made cut marks, was

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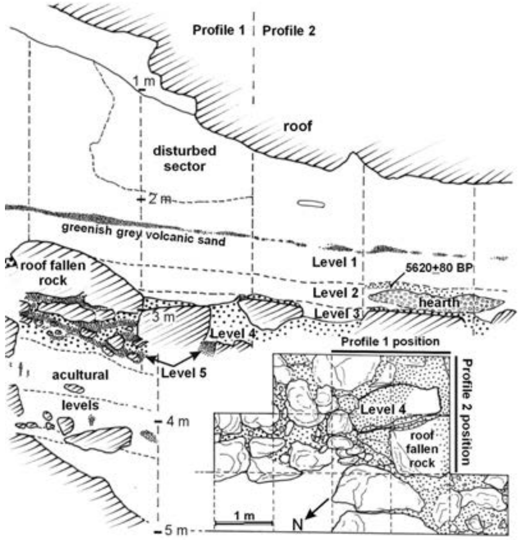

Figure 1. Stratigraphic profile of El Trébol.

AMS-dated at 10,570 ± 130 RCYBP (AA-65707). At that time the environment was an open forest of *Nothofagus* sp., which was already present at 13,000 yr B.P. (Whitlock et al. 2006).

Concerning Level 3, a bone sample was dated AMS 5731 ± 70 RCYBP (AA65708), for Level 2 hearth charcoal was AMS-dated at 5620 ± 80 RCYBP (LP-1525); and for upper Level 1, bone was AMS-dated at 5863 ± 83 RCYBP (AA-65712). From Level 1 were recovered projectile points of basalt, of comparable age to those recovered from the Cueva Traful site (Crivelli Montero et al., 1993).

Considering the dates obtained and the estimated date of extinction of the ground sloths (Borrero 1997), the decreasing presence of dermal ossicles of this animal in the Levels 3-2-1 appears to represent a secondary association.

The considerable difference in age between Levels 5 and 3 suggests a stratigraphic discontinuity, as was noted during excavation of the site. Possibly occupants of Level 3 partially removed sediment and rocks in order to lower the floor and thereby gain access to certain protected spaces within the rockshelter (Hajduk et al. [in press]). In spite of this disturbance, in some places above sterile Level 4 there remain sediments (initially included with Level 3) containing extinct fauna in probable primary association with man. In one case bones of a deer larger than *Hippocamelus bisulcus* (Huemul), showing cut marks, are associated with dermal ossicles of Mylodontinae.

Dermal ossicles in Levels 3, 2, and 1 would derive from this remaining sediment; their removal and redeposition would have occurred during the later occupations.

Archaeological remains are scarce. Lithic raw material is not local; colored chert, basalt, and especially chalcedony are the predominant toolstone, and all were transported from the steppe. Level 5 yielded 69 flakes, which include bifacial thinning flakes, a flake with a natural sharp cutting edge, an endscraper, a sidescraper, and two bone awls.

The archaeofaunal material from Level 5 includes scant dental and bone fragments of megamammals, along with 137 osteoderms of mylodontine. Of the specimens, 40 are burnt and 9 exhibit cut marks, indicating that pieces of meat with skin were roasted at the site. Other remains pertain to a big indeterminate deer, *Hippocamelus bisulcus,* Artiodactyla indet., *Canis avus, Lycalopex culpaeus* (red fox), *Lagidium* sp. (vizcacha), *Chaetophractus* sp. (armadillo), and Aves (*Milvago* and *Cignus* size); some bear cut marks and show evidence of intentional fracture and exposure to fire. A small proportion of remains are those of freshwater fish and clams. The bone remains of Level 5 bear manganese stains and are poorly preserved compared with those recovered in Levels 3, 2, and 1.

In general this site suggests a low occupational density of the forest, perhaps a seasonal occupation by small human groups. Among the activities carried out at the site, there is evidence of final stages of tool manufacture, tool use, and consumption of faunal resources from forested-lacustrian environment and from forested-steppe ecotone.

The archaeological background of the Argentine Patagonian forested environment is still not well known. El Trébol is the first site in the Argentine Patagonian forest to yield extinct fauna and one of the few in Argentina with evidence that humans exploited them.

We are indebted to all the volunteers that supported us in fieldwork at the El Trébol site, and we offer thanks to Nora Fleghenheimer for revising our English version of this paper, to Timothy Jull, Arizona University, for covering part of the cost of AMS analysis, and to an anonymous benefactor of Bariloche, Argentina.

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Folsom Points from Los Guachimontones Site, Jalisco, Mexico

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Recent archaeological research at the Los Guachimontones site (Jalisco, Mexico) yielded two fluted projectile point fragments (Esparza 2004:81–2) that fit the Folsom type (D. Stanford, pers. comm., December 2005). Los Guachimontones is by far the most important ceremonial building of the Teuchitlán Tradition, occupied around 350 B.C. to A.D. 500 (Weigand 1993). Although the finds are *anno domine*, we consider them relevant because of the scarcity of Folsom points in Mexico (Pearson 2002) and their potential importance for Paleoamerican research in Jalisco.

Although the three last authors believe that the specimens are of local obsidian, the first author considers they are probably of dark-green chert. Ongoing petrographical analyses will help to determine the raw material used to make these points, as well as their source. The first specimen was found along with obsidian prismatic blades within a layer below the fine clay floor of the ball court of the site (Figure 1A) (Weigand 1993; Weigand and García de Weigand 2005). It is a meso-basal fragment of a Folsom point (Figure 1B) 39 mm long, 34 mm wide, and 8 mm thick. Irregularities and contrabulbs of the scars suggest it was retouched by irregular pressure. Flake spacing and the absence of edge and basal grinding suggest it is likely an unfinished preform (D. Stanford, pers. comm., November 2005).

The other specimen is a basal portion of another Folsom preform (Figure 1C). It was found in Circle 6 of Los Guachimontones (Figure 1A). Because it was associated with human bones and shards dating to late pre-Classic times (ca. 100 B.C.), it might be a burial offering (Cach 2003). It is 29 mm long, 22 mm wide, and 8 mm thick. This specimen may have been broken during manufacture.

These points may have been collected for ceremonial use by Los Guachimontones inhabitants from nearby locations, such as the beaches at Zacoalco

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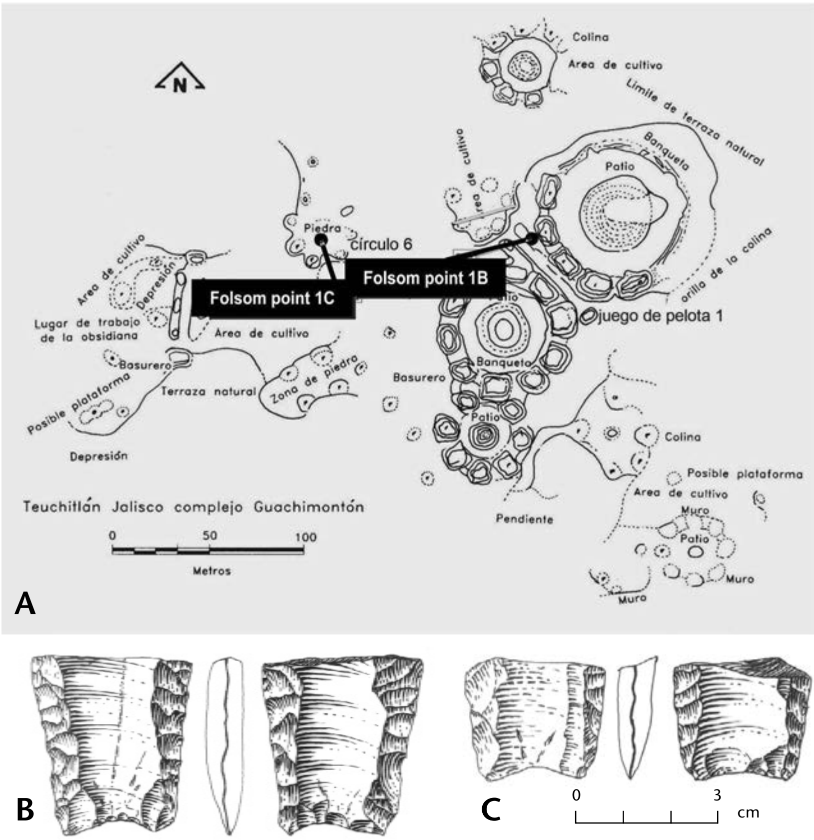

Figure 1. **A,** Map showing the original location of the points; **B–C,** Folsom points found in Los Guachimontones site.

Lake (around 45 km to the south) that have produced Paleoamerican surface finds (Arroyo Cabrales et al. 2003), and similar localities near Guadalajara (Irish et al. 2000). The Los Guachimontones finds are, in fact, the westernmost occurrence of Folsom points yet found in Mexico. They also increase to eight the number of occurrences of recorded and published Folsom points in Mexico (Pearson 2002:Table 6).

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A Possible Plainview Component in Central Chihuahua, Mexico

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During 2003 excavations we located a possible Plainview base at a site (C75-01) located 40 km southwest of Chihuahua City (Figure 1). The Plainview base was found while testing for Archaic-period deposits in deep terrace fill.

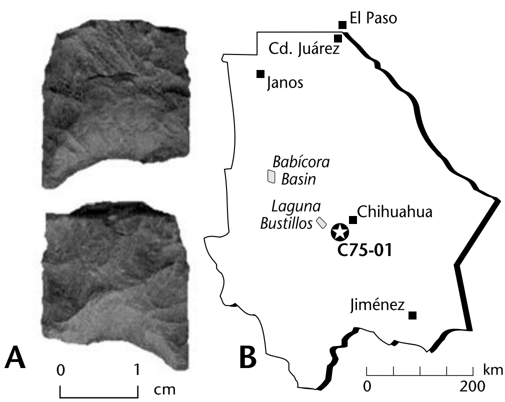

Figure 1. **A,** Plainview point base recovered from C75-01; **B,** map showing location of C75-01.

Site C75-01 is within the southern basin and range province at an approximate elevation of 1,850 m. Two adjacent caves at the base of a cliff overlook bajada and the Río Santa Isabel Valley to the west and north. A constructed

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terrace in front of the caves contains deposits exceeding 2 m in depth. We believe that the terrace was built during the middle- to late-Archaic period (ca. 5000–2000 yr B.P.). Ceramic-period artifacts are present in the uppermost strata of terrace fill and most abundant on the surface. However, deposits are bioturbated resulting in some artifact displacement. Such is the case in the stratum that contained the Plainview base found at 145 cm below surface, although well under all Ceramic-period materials. Late middle-Archaic-period projectile points were found both above and below the Plainview point base. Lithics from several strata may contain additional material equal in age to this broken point based on material type, condition, and morphology.

The maximum width (19.7mm) and thickness (5.1mm) of this point fragment are within the size range of Plainview points (Hartwell 1995, Johnson and Holliday 1987). Characteristic attributes of Plainview points that are present include basal thinning, lateral and basal grinding, and a biconvex or lenticular cross section. Lateral grinding extends 17.7 and 12.0 mm and is truncated by rejuvenation flake scars on both edges of the base.

A ^{14}C date of 9120 ± 50 yr B.P. (Beta 185635) comes from a fragment of charred, unidentified plant tissue found 20 cm deeper than the Plainview base in the same stratum of terrace fill. This ^{14}C age approximates the few other ^{14}C ages for Plainview contexts. Holliday et al. (1999:451) conclude that the Plainview type "centered around ca. 10,000 yr B.P., but perhaps continuing to 9000 yr B.P." Whether this ^{14}C date from C75-01 is fortuitous or genuinely represents the age of a Plainview component is irresolvable on present evidence. We strongly suspect that Archaic-period terrace construction incorporated an older Plainview component into the fill. Future excavation near the cave entrances is a possible solution for clarifying this issue.

The few preceding reports of Plainview projectile points from northwest Mexico are restricted to surface collections (Justice 2002:78, 85; Phelps 1990:54ff, 1998:103). Marrs (1949: Figures 30, 31) located possible Plainview points east of Jiménez that are also from surface scatters. If corroborated by additional diagnostic artifacts from secure contexts, this find expands the known distribution of Plainview artifacts into high basin and range country along the east flank of the Sierra Madre Occidental.

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Preliminary Results of Excavations at the Late-Pleistocene Site of Las Monedas, Semiarid Coast of Chile

César Méndez and Donald Jackson

Our ongoing early settlement research program along the Los Vilos coast (31° S) considers all Pleistocene evidence, with or without cultural associations (Méndez et al. 2004), and no matter how complex the depositional context of the remains. Under these premises, our research team excavated the Las Monedas site (LV. 210), where late-Pleistocene mammal bones were ambiguously associated with a few lithic artifacts (Méndez et al. 2006). The site lies along a small ravine that drains a paleolacustrine basin (Varela 1981), just 2 km from the edge of the sea. Discontinuous stratigraphic profiles expose evidences through different energy-event layers, defined by the particle size of the sediments. Most remains were identified within two low-energy strata composed mainly of fine-grained sands. Excavations limited to the upper cultural stratum (layer 6) involved in situ unearthing and piece plotting of all materials in a 15-m^2 area. The record was very sparse, with only 33 bone remains and 18 lithic artifacts. A small test pit (1 m^2) confirmed the presence of a lower, less dense stratum separated from the upper stratum by a thin sandy compact layer.

Among bone materials, native horse (*Equus* sp.), extinct camelid (*Palaeolama* sp.), and ground sloth (Milodontinae) were identified. Most are vertebrae of the first two taxa and ground sloth skin bones (i.e., ossicles). Nonetheless, remains are considerably fragmented, preservation is good, and there are no signs of weathering. Rootlet etching is present on one side of the bones, suggesting depositional stability, while evenly distributed abrasion implies flow of sediment particles carried by water (Lyman 1994). Culturally modified remains are restricted to a humerus of native horse, which bears a traumatic fracture with an impact point and negative flake scars. No carnivore action was detected on this bone; however, other horse and camelid remains exhibit these traces. One third metacarpal of *Equus* sp. was recorded in direct associa-

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tion with a fine-grained volcanic tuff flake (Figure 1). Other anthropogenic evidences, including a small chipped nodule, suggest lithic reduction on this locally available and abundant rock. Faunal diversity, high fragmentation, and anthropogenic traces on one bone and lithic material argue for some degree of cultural agency in the formation of the deposit. However, the particular nature of water flow was principally responsible for the secondary deposition of the materials. We propose that it is likely that the observed remains were originally deposited at a short distance upstream (since transport traces are few) and not necessarily in the same positions as recorded at the site.

Attempts to date horse bones, by conventional and AMS ^{14}C techniques, have

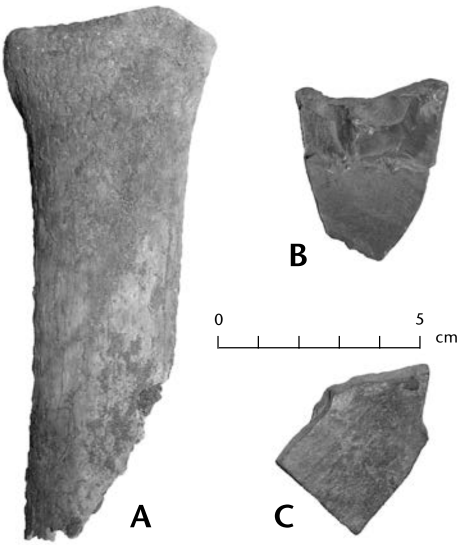

Figure 1. Bones and lithics from Las Monedas (LV. 210): **A,** third metacarpal of *Equus* sp.; **B,** chipped nodule; **C,** flake directly associated with **A.**

been unproductive. The abundance of flowing water and bone exposure seem to be responsible for collagen loss. Regional experience suggests remains should be of late-Pleistocene age, an idea supported by the taxa represented and the site's similarity and proximity (less than 2 km to the west) to Quebrada Quereo (Núnez et al. 1994). Both sites share analogous geological contexts, and both exhibit two independent stratigraphic events with extinct fauna, but only Quereo has definite evidence accounting for human processing of extinct herbivores (Jackson et al. 2003). It is significant that taphonomic observations described for Las Monedas are mainly the same as those recorded for the earliest level of Quereo (López et al. 2004). Also, 800 m northwest of Las Monedas, the El Membrillo site exhibits remains of *Mylodon*, native horse, and *Palaeolama*, some with anthropogenic traces and others in surface association with lithic artifacts (Jackson 2002). Altogether, the evidence from Quereo, El Membrillo, and Las Monedas suggests a complex ecological and cultural panorama for the terminal Pleistocene of the Los Vilos coast.

Though materials at the Las Monedas site are complex and elusive, they suggest probable close proximity to a primary deposit. For this reason new excavations at the edge of the ravine, more dating attempts, and assessing formation processes that account for bone-artifact associations could reveal significant relations.

Research funded by FONDECYT grant 1030585.

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Early-Holocene Secondary Burials in the Pampas of Argentina

Clara Scabuzzo and Gustavo G. Politis

In this paper we analyze and discuss two new secondary burials from the Arroyo Seco 2 archaeological site and present new ^{14}C evidence that places them in the early Holocene. They are the earliest evidence of this kind of inhumation in the Pampas and Patagonia.

Arroyo Seco 2 is a multicomponent stratigraphic site with a range of human occupations dating from the late Pleistocene (12,240 to 11,700 RCYBP) to recent times. This site, which is buried in eolian sediments of the La Postrera Formation, is located in the Pampean grassland, close to Arroyo Seco creek (Fidalgo et al. 1986; Politis 1989; Politis and Guitérrez 2006).

During the early and middle Holocene, the site was used for burial purposes. To present, 44 human skeletons have been recovered in 32 single and

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multiple burials. Among the burials, 29 are primary, 2 are secondary, and one cannot be clearly determined. Skeletons range from newborn to mature individuals and consist of both sexes (14 male, 13 female, 17 indet.) (Barrientos 1997; Politis et al. 2006; Scabuzzo and Politis 2006). Seventeen ^{14}C dates on collagen from human remains place these skeletons between ca. 7800 and 4800 RCYBP (Politis et al. 2006).

The earliest level of burials includes both primary and secondary inhumations. The first group is formed by four skeletons with projectile points (mid-sized triangular, stemless) stuck between and within the bones. These burials are dated to between 7808 and 7615 RCYBP. There is only one secondary burial (no. 33) recovered from this level (at 1.85 m depth), and collagen from it has been AMS ^{14}C-dated to 7636 ± 87 RCYBP (AA-59504) and 7602 ± 87 RCYBP(AA-59505). This burial includes at least four individuals, two females and two males. Skeletons are incomplete; 4 skulls and 22 long bones from lower limbs (with the exception of one radius) predominate. Long bones were disarticulated and clustered with the skulls on both sides. Some vertebrae and mandibles were found articulated.

The other secondary burial belongs to another inhumation level (ca. 0.65 to 0.70 m depth). Collagen was AMS ^{14}C-dated to 6823 ± 69 RCYBP (AA-59503). It includes the incomplete skeleton of an adult male (> 40 yrs old). Long bones from upper and lower limbs predominate; they were placed parallel to one another in a cluster with the skull on one side. No articulated bones were recovered. The two secondary burials show some differences: chronology, number of individuals, and elements present. However, there are some similarities: skulls did not show any artificial deformation, burials did not have any funerary goods (which are quite common in primary burials [Politis et al. 2006]), and both lack red ocher or any other coloring mineral.

In Pampean and northern Patagonia archaeological sites, secondary burials are common along with formal areas of inhumation that have been associated with the social complexity that occurred during the late Holocene (Barrientos 1997, 2002). However, a review of burial practices in South America indicates that secondary burials are present in the early Holocene in some regions. Several examples demonstrate this. In Boleiras Cave in Lagoa Santa, Brazil, a secondary inhumation was dated to as early as 8360 ± 50 RCYBP (Neves et al. 2002); in La Fundición 1 site, Chile, a single secondary burial was dated to ca. 8700 RCYBP (Costa-Junqueira 2001); and in the site of Huachichocana, Argentina, a secondary inhumation was dated to ca. 9600 RCYBP (Aschero 2000).

The evidence summarized above indicates that secondary burials in the Pampean region are much earlier than has been suggested and that they are not a sensible indicator of social complexity as has been proposed (Barrientos 1997, 2002). Moreover, it also points out that perimortem manipulation of the body is not an attribute of complex societies; rather, it is a cultural practice that has a long history in South America across a wide geographical area (see also Santoro et al. 2005). Complexity and variability in mortuary practices preceded the emergence of social complexity postulated for the late Holocene in the Pampas by several millennia and were probably embedded in the cultural repertoire of the late-Pleistocene/early-Holocene inhabitants of South America.

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Early Use of Ocher in the Pampean Region of Argentina

Rocio Scalise and Violeta Di Prado

In this paper we summarize and discuss early evidence of the use of red ocher in the Pampean region of Argentina. We also present new data about the presence of red ocher in the late-Pleistocene levels of the Arroyo Seco 2 site.

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Mineral pigments in late-Pleistocene archaeological sites are frequently found in both the Old and New Worlds. The minerals commonly used as coloring agents were red iron oxide and yellow or brown iron hydroxide, generically referred to as ocher. In Africa, humans were using ocher as early as 200,000 years ago, and in Europe pigments have been found in numerous sites dated to around 50,000–40,000 years ago (Barham 1999). In Australia, pieces of ocher, especially red ocher, were found in the lowest levels of the oldest sites dated to 55,000–60,000 years ago (Roberts et al. 1990, 1993). In North America, Paleoindian sites of all ages show traces of ocher use, especially in human mortuary contexts (Frison 1998).

In South America, late-Pleistocene evidence of ocher use in the Pampean grasslands is found at the Arroyo Seco 2 site, located in the plains between the Tandilia and Ventania mountain ranges and in rockshelters such as Cueva Tixi and Abrigo Los Pinos in Tandilia (Politis and Madrid 2001).

In Tandilia, sites with mineral pigments from this period include Abrigo Los Pinos, which dates to between 10,465 and 8750 RCYBP (Mazzanti 1999a), and Cueva Tixi, which dates to between 10,375 and 10,045 RCYBP (Mazzanti 1999b). These sites are small rockshelters that might have been used sporadically by hunter-gatherers while traveling around the region (Mazzanti 2002). Red ocher appeared as small chunks. Yellow ocher was also found but in a lower proportion. These pigments bear possible use marks associated with lithic artifacts, mainly flakes.

In the lowest levels of the Arroyo Seco 2 site (a multi component late-Pleistocene through late-Holocene site), 52 pieces of red ocher were found in association with lithic artifacts and faunal remains, especially *Lama guanicoe* and extinct fauna (Politis 1989; Politis and Gutiérrez 2006). These levels are dated to between 12,240 ± 110 RCYBP and 7540 ± 80 RCYBP (n = 13 dates) and include lithostratigraphic units Y, S, and Z. Most of the red ocher pieces are small fragments (< 1 cm) that predominantly were found in Unit Y (n = 41) and are regularly distributed between levels III to X. Only two larger pieces have faceted faces, evidence of use. Four fragments appeared in Unit S, and six fragments were found in unit Z.

The archaeological evidence summarized above suggests that mineral pigments have been widely used among Pampean foragers since their arrival in this region during the late Pleistocene. However, its uses are not yet clear, since it could have been used for preserving fur, wood, and other perishable materials, decorating, tanning, body painting or tattooing, and art production (Roper 1989). Likewise, this predominance of red ocher in the earliest sites could be related to the symbolic power of this color or to the stone itself. Moreover, in five sites in Tandilia (La China 1, 2, and 3, El Sombrero Abrigo, and Cima), which date between 10,270 and 11,150 RCYBP, the use of red, pink, and yellow quartzite has been recorded despite the fact that white quartzite of the same quality was more readily available. This suggests that color was a prime criterion in selecting raw material (Flegenheimer and Bayón 1999).

In many cross-cultural contexts, rocks are endowed with sacred and symbolic properties, and in many cases the symbolic meaning of minerals is closely linked to color (Boivin 2004): "Color symbolism is one of the symbolic frameworks used extensively by contemporary societies to convey information and abstract messages through material objects" (Hovers et al. 2003). Ethnographic evidence suggests that they could represent blood or power, and could also acquire sacred meaning depending on the context. Within this framework, the use of red ocher by early people in the region should be explored.

In the Pampas, the presence of red ocher in the earliest sites suggests that the functional (utilitarian) use and the symbolic significance of this pigment were embedded in the cultural background of the first groups that arrived in the region and would be related to an old tradition whose roots can be found in the Old World Paleolithic. It also means that early foragers, when exploring their newly colonized environment, routinely searched for red ocher in order to satisfy their needs for symbolic expression.

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Comments on South American Fishtail Points: Design, Reduction Sequences, and Function

Rafael Suárez

The fishtail point has a discontinuous distribution and dispersion pattern in South America (Borrero 1983). Some fishtail points have been recorded in Central America and at the El Inga site in Ecuador (Bird and Cooke 1978; Mayer-Oakes 1986; Ranere and Cooke 1991). However, the pattern appears more frequently in the southern cone of South America, Pampa-Patagonia of Argentina, the Uruguayan plains, central and southern Chile, and southern Brazil. Isolated fishtail points have also been recovered in Perú (Chauchat and Zevallos 1979; Briceño 1999). Fishtail points have not yet been reported in Colombia, Venezuela, Bolivia, Paraguay, the Amazon Basin, or the northern and central regions of Brazil.

In Uruguay complete fishtail points range in size from 35 to 109 mm long, 21 to 56.8 mm wide, and 5 to 11 mm thick; their weight ranges from 5.4 to 51.8 g. Approximately 68 percent are not fluted, 24 percent are fluted on one face of the stem, and only 8 percent are fluted on both faces of the stem.

Based on the available information for Uruguay (n ~ 90 fishtail points), I suggest at least three main lithic reduction sequences for making fishtail points by Paleoamerican knappers (Suárez 2003c). One technique includes complete bifacial thinning from initial to final stages of reduction. In Uruguay, this technique is illustrated by Suárez and López (2003:73, Figure 5). Additional early-stage bifaces, ranging from ca. 130 to 195 mm long, and other fluted bifaces with some Paleoamerican technological features, including nipple isolation and platform prepared by retouch and abrasion, have been recognized in Uruguay (Suárez 2002:318, Figure 3). Fishtail points made using complete bifacial thinning are relatively long and generally exhibit fluting and good spacing of flake scars. These points were likely used in lances or hand-held spears. Another recognized reduction technique is bifacial thinning in the final stage of manufacture, similar to the one reported for southern Patagonia (Nami 2003). The last technique observed in some samples starts with a thin flake and uses a unifacial method of manufacture without bifacial thinning.

Recent observations and comments have led to the definition of two morphological variants of fishtail points found in the southern cone (Suárez 2001). The first variant is the "classic" design with insinuated and rounded shoulders (Bird 1969:Figures 2 and 5; Emperaire et. al. 1963:Figure 21.4), with a shoulder angle of 140° to 160° (Suárez 2001). The second variant comprises fishtail points with very pronounced shoulders at an angle of 90° to 110° (Suárez 2003b:115, Figure 1A; Suárez and López 2003:73, Figure 5). Based on these observations, I suggest an idealized resharpening or rejuvenation model for fishtail points of the southern cone (Suárez 2003a:33, Figure 2).

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Regarding the function of fishtail points, which South American researchers generally regard as a class comprising a wide range of lithic artifacts, some were likely used as weapons (spears or darts) in hunting activities. There are very good examples with fractures and impact damage caused by hunting activities. Some of the artifacts identified as fishtail "projectile" points, however, could have been stemmed bifacial knives. Detailed microwear analysis is necessary because some South American authors classify as "fishtail projectile points" lithic artifacts whose morphology is inappropriate for use as projectile weapons. Many identified as "fishtail projectile points" have a very rounded blade tip and asymmetric blade edges (Figure 1) that would resist penetrating the hide and connective tissues of prey animals. In some instances, once projectile points were no longer effective in hunting activities, they may have been modified into other functional forms such as stemmed knives. Note that I am not asserting that all fishtail points were knives; nevertheless, I believe we should consider that some of these artifacts may have been used as knives.

New evidence and data acquired in the last two decades make it possible to

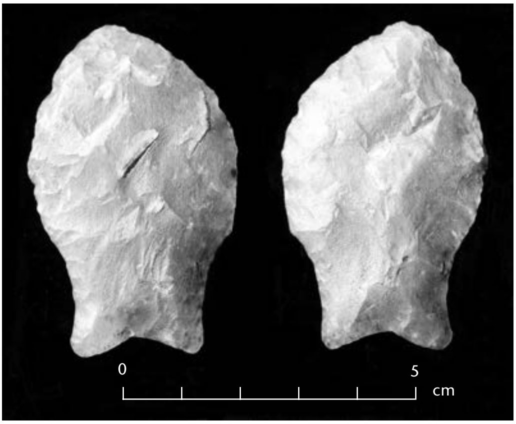

Figure 1. A heavily resharpened fishtail point from the Paso Sena site (southwest Uruguay).

propose new observations. There are at least three reduction strategies employed in the manufacture of fishtail points for the period ca. 11,000–10,000 RCYBP in South America. Thus fishtail point manufacture appears to have been a more flexible and less standardized process than Clovis or Folsom point manufacture (Callahan 1979; Flenniken 1978). This technological flexibility is also reflected in the percentage of fishtail points that exhibit fluting compared with Clovis or Folsom points of North America for the same time span. It is important to note that other North America Paleoamerican point types—Goshen, Mesa, and Agate Basin, for example—are not fluted (Bradley 1993; Frison 1991, 1999; Kunz et. al. 2003; Stanford 1999).

Finally, fishtail points exhibit great variability and diversity in design and production technologies and functions.

Comments by Laura Miotti and Bruce Bradley on a previous draft of this paper are gratefully acknowledged. National Geographic Society supports the investigations on the early human occupation of Uruguay with grant 7892-05.

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Pleistocene Microvertebrates from Santa Cruz Nuevo, Puebla, México

Rosa E. Tovar and Marisol Montellano

The Pleistocene was characterized by drastic climatic changes that influenced patterns of evolution and geographical distribution of the biota. At the end of this period occurred an important event, the extinction of megafauna; however, few genera of microvertebrates have been reported as extinct. Holman (1995) notes that no family or genus of herpetofauna became extinct and that only 12 of 129 taxa are in doubt.

In Mexico, 776 Pleistocene-age localities bear mammal remains in which 286 species and 146 genera are identified; 30 percent of the species are not present today in Mexico (Arroyo-Cabrales et al. 2002). There are 29 registered localities with 98 genera and 118 species of birds, of which 17 species are reported as extinct (Corona 2002). Present in 27 localities are remains of herpetofauna, including 10 genera and 19 species of amphibians with no extinct species, and 27 genera and 39 species of reptiles with 4 extinct species. It is clear that the avian and herpetofauna fossil record in Mexico is poor.

In the southeastern part of the state of Puebla, near the village of Santa Cruz Nuevo (Figure 1), a sequence of ca. 38 m of fluvial late-Cenozoic sands, silts, and gravels outcrops. During the last four years sediment from different sites was collected for screen washing, and Pleistocene remains of anurans, reptiles, birds and micromammals were recovered. The objective of the study was to evaluate change in the microfaunal assemblage from the late Pleistocene to the present.

Until now, 22 families, 24 genera, and 11 species of vertebrates identified include *Ambystoma* sp., *Bufo occidentalis*, *Bufo* cf. *valliceps*, *Bufo* sp., *Rana* sp., *Kinosternon* sp., *Rhinoclemys* sp., *Gopherus* cf. *berlandieri*, *Sceloporus* cf. *grammicus*,

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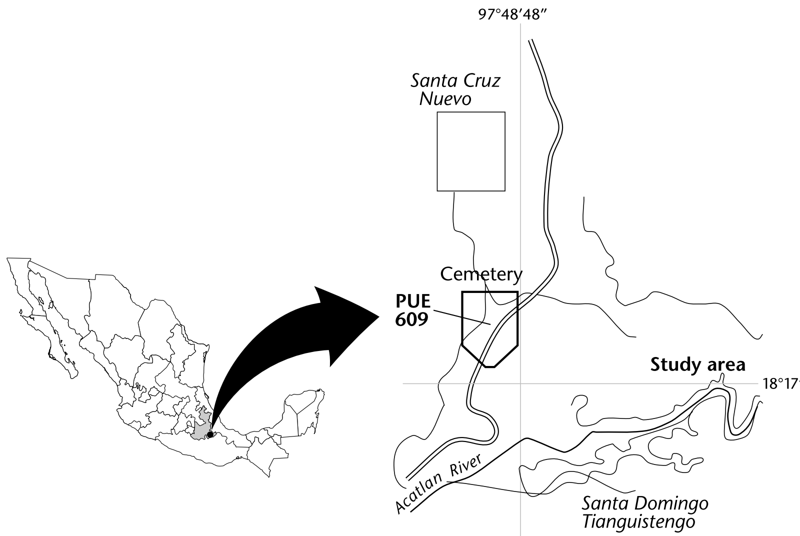

Figure 1. Map showing location of the site near the village of Santa Cruz Nuevo, Puebla.

Sceloporus cf. *horridus, Conopsis* sp., *Lampropeltis* sp., *Leptodeira* sp., *Senticolis* sp., *Thamnophis* sp., *Trimorphodon* sp., *Crotalus* sp., remains of plethodontids, spade-foot frogs, skinks, *Neotoma mexicana, Peromyscus difficilis, Reithrodontomys* sp., *Sylvilagus floridanus, Sylvilagus* sp., and *Bassariscus* cf. *sumichrasti.* Megafauna identified includes *Odocoileus* sp., *Pampatherium mexicanum, Glyptotherium* sp., *Equus conversidens, Mammuthus* sp., and unidentified genera of deer, bear, goat, and mastodont. The presence of *Peromyscus difficilis, Neotoma mexicana,* and *Pampatherium mexicanum* confirms a late-Pleistocene age for the deposit. Excellently preserved fossil remains suggest the identified taxa probably lived near the deposit area.

Of the family-level taxa identified, 50 percent are present today in the study area (Bufonidae, Scaphiopodidae, Ranidae, Phrynosomatidae, Colubridae, Viperidae, Kinosternidae, Leporidae, Muridae, Procyonidae, and Cervidae); 18 percent are reported extinct in North America (Pampatheriidae, Glyptodontidae, Equidae, and Elephantidae); and 32 percent have experienced a change in their geographic distribution (Ambystomatidae, Plethodontidae, Bataguridae, Testudinidae, Scincidae, Antilocapridae, and Ursidae).

As expected, most of the megafauna taxa became extinct, and some of them (Antilocapridae and Ursidae) today are distributed differently.

The presence of the gopher turtle *Gopherus* is noteworthy because it represents the southernmost record of the genus in North America. At present, four species range from southern Nevada in the United States to southeastern San Luis Potosí in Mexico. Recently *Gopherus* was reported in the state of Hidalgo (Nájera-Hernández and Castillo-Cerón 2004a, 2004b), filling the gap between northern Mexico and Puebla.

This faunal association is a mixture of taxa with different ecological requirements. Although most of the fossil taxa inhabit a semiarid environment (*Bufo occidentalis*, *Sceloporus* cf. *horridus*, *Gopherus* cf. *berlandieri*, *Peromyscus difficilis*, and the family Scaphiopodidae), they are found together with taxa usually associated with more humid (tropical and subtropical) conditions, such as the frog *B. valliceps* and the turtle *Rhinoclemys* (Ernst and Barbour 1989; Porter 1970). Giant armadillos (*Pampatherium* and *Glyptotherium*) are considered tropical or semitropical organisms (Gillete and Ray 1981). Salamanders of the genus *Ambystoma* live in rivers or lakes in temperate subtropical areas; on the other hand, salamanders of the family Plethodontidae are partially or completely arboreal species that inhabit cloud forest or wet montane forest (Wake and Lynch 1976). Bears inhabit the oak forest. The presence of different species with disparate ecological requirements suggests the existence of a disharmonious or ecologically incompatible association, as proposed by Fay (1988) and Graham and Lundelius (1984).

Bufo occidentalis, *Sceloporus* cf. *horridus*, *Sceloporus* cf. *grammicus*, and the genera *Rhinoclemmys* and *Senticolis* are here reported for the first time in North America. The genera *Conopsis* and *Leptodeira* and the families Plethodontidae and Scincidae are new fossil records for Mexico.

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Archaeology: North America

Late-Pleistocene and Early-Holocene Projectile Points at Fort Bliss, Southern Tularosa Basin, New Mexico and West Texas

Daniel S. Amick and Paul D. Lukowski

This paper summarizes recent reanalysis of 436 late-Pleistocene/early-Holocene (LP–EH) projectile points from the archaeological curation facility at Fort Bliss in El Paso, Texas. These artifacts were largely collected through CRM surface surveys of this military installation during the past 30 years. Fort Bliss encompasses approximately 4,760 km^2 of the southern Tularosa Basin in the northern Chihuahuan Desert. This intermontane basin is dotted with small playas and dominated by eolian geomorphology, with alluvial fans on valley margins. Because of its exceptional history of long-term systematic surveying and access restrictions to recreational artifact collectors, this sample provides the most representative measure of LP–EH occupations in this region.

Determination of point type depended on subjective judgments while carefully comparing classifications with several relevant taxonomies (Bradley 1991; Carmichael 1986; Frison 1991; Hofman and Graham 1998; Holliday 1997; Huckell 1996; Irwin-Williams 1973; Judge 1973; Justice 2002a, 2002b; Sellards 1952; Smiley 2002; Turner and Hester 1993; Wormington 1957). Changing patterns in LP–EH land use and lithic procurement for the southern Tularosa Basin are clearly documented in this dataset (Table 1). Clovis (n = 3), Plainview (n = 1), and Agate Basin (n = 5) are rare. Folsom points and fluted preforms clearly dominate, though these numbers are inflated by including artifacts from earlier collections (n = 168, private; n = 5, public) reported in studies designed to reconstruct the Folsom archaeological record of this region (Amick 1991, 1994a, 1994b, 1996, 2000). Omitting private collections, Folsom points still represent an impressive 37 percent (n = 99) of the 268 LP–EH projectile points that were systematically collected from Fort Bliss. Cody Cluster points (Alberta, Cody, Scottsbluff, Eden, Firstview) are also

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Table 1. Toolstone variation among late-Pleistocene and early-Holocene projectile points and fluted preforms from Fort Bliss U.S. Army Air Defense Artillery Center, Texas, and New Mexico.

Toolstone	Clovis	Folsom	Midland	Agate Basin	Plainview	Golondrina	Alberta
Obsidian	1	12		1		1	1
Pedernal chalcedony		3					
Brown (Trout Creek) jasper		1					
Gold-yellow jasper		17	1				
Gold-red jasper		4					
Socorro red silicified rhyolite		4					
Dendritic gold jasper		1					
Rancheria (Lake Valley) chert		129	2	2	1	2	2
Rancheria micrite							
San Andres chert		1					
Silicified caliche							
Edwards (San Angelo) chert		8					
Tecovas jasper							
Alibates agatized dolomite							
Misc. chalcedonies	1	13	2				
Misc. jaspers		3				1	
Misc. cherts	1	72	5	2		1	2
Misc. petrified woods		1					
Misc. igneous/metamorphic		3					
Totals	3	272	9	5	1	5	5

Notes: The Folsom point counts includes 54 Folsom fluted preforms. Ninety-nine of these Folsom points and preforms and Midland points were curated at the Fort Bliss Artifact Repository, 29 (30%) of which had been documented 12 years earlier (Amick1991) but could not be relocated during this expanded study in June 2002. Those losses may be attributable to accession errors, classification disagreements, item misplacement,

common (n = 51, 22 percent). Early-Archaic Jay (n = 13) and Bajada (n = 21) points are less frequent and combined account for only 15 percent of the sample. Middle-Archaic San Jose points constitute 20 percent (n = 46) suggesting rebounding mid-Holocene occupational intensity.

Raw material identifications correspond to published descriptions for this region with most occurring as secondary deposits of the Rio Grande axial gravels (Amick 1994a, 1994b; Banks 1990; Brett 1984; Carmichael 1986:161–202; Church 2000; Church and Hack 1939; Church et al. 1996; Dello-Russo 2004; Hawley 1975; Huckell and Kilby 2002; LeTourneau 2000). Exceptions include Rancheria chert, also available from primary sources in the Lake Valley Formation (and others) around the Caballo Mountains about 100 km northwest of the Tularosa Basin, and trace amounts of Edwards, Alibates, and Tecovas from the Llano Estacado region. The diverse lithology of Rio Grande gravels makes it difficult to characterize diachronic patterns in toolstone use, but general trends are apparent. Rancheria is the most common material in this sample at 42 percent (n = 185), including 47 percent (n = 129) of the Folsom points and preforms. A small proportion of Folsom points and performs are Edwards (n = 8, 3 percent). Cody points reflect a broad range of toolstones (though not the distinctive jaspers and cherts common among Folsom points), including 5 Tecovas, 2 Edwards, and one Alibates (combined 16 percent). During the Early Archaic (Jay, Bajada, San Jose), the use of poor-

Table 1. Cont'd.

Toolstone	Cody	Firstview	Scottsbluff	Eden	Jay	Bajada	San Jose	Totals
Obsidian					1		1	18
Pedernal chalcedony								3
Brown (Trout Creek) jasper								1
Gold-yellow jasper								18
Gold-red jasper								4
Socorro red silicified rhyolite	2						1	7
Dendritic gold jasper								1
Rancheria (Lake Valley) chert	12	6		3	1	7	18	185
Rancheria micrite					2	4	3	9
San Andres chert	1							2
Silicified caliche					1			1
Edwards (San Angelo) chert	2							10
Tecovas jasper	3	2						4
Alibates agatized dolomite			1					1
Misc. chalcedonies	1					2	3	21
Misc. jaspers	3		1					9
Misc. cherts	9	9	1		2	7	15	125
Misc. petrified woods					1		1	3
Misc. igneous/metamorphic	1				5	1	4	14
Totals	34	16	3	3	13	21	46	436

loss, or theft. This table also includes 173 Midland points and Folsom points and preforms from Fort Bliss that are held in private collections and public artifact repositories documented by Amick (1994a). The additional 14 Folsom points and preforms reported in a non-collection survey of Fort Bliss Maneuver Areas 4D and 5E (Stuart 1997) are not included in this table.

quality local stones (basalt, caliche, etc.) increases to 14 percent (n = 11) and Rancheria diminishes to 32 percent (n = 26).

Judge (1973) reported similar low ratios of Clovis and Plainview from the central Rio Grande Valley, but this pattern contrasts with substantial Clovis evidence reported from Mockingbird Gap in the intermediate Jornada del Muerto basin (Judge 1973; Weber 1963; Weber and Agogino 1997). These intraregional patterns may indicate a more clumped distribution for Clovis compared with Folsom. The substantial numbers of Folsom and Cody artifacts at Fort Bliss suggest environmental conditions were especially favorable for these grassland bison hunters in south-central New Mexico around 10,800–9000 RCYBP, an inference supported by paleoenvironmental reconstructions (e.g., Van Devender 1990). Continuing finds are expected from repeated collections of this severely eroded landscape. For example, a non-collection survey has recorded 14 Folsom points and preforms (Stuart 1997) from Fort Bliss lands surveyed and collected 13 years previously (Amick 1991; Carmichael 1986). Interestingly, only two Folsom points are reported from northern Mexico (Sanchez 2001:125–26), demonstrating the need for increased survey. Fort Bliss Cody points show a notable frequency of Llano Estacado sources (from 400–700 km east and northeast), which is consistent with recognized evidence of the large-scale toolstone movement among Cody points (Root 1992, 1997; Wheat 1972). In contrast, early- and middle-Archaic occupants of this region show a clear shift toward use of immediately available, poor-quality toolstones reflecting significantly decreased mobility.

Thanks to the assistance from Jim Bowman and Kevin von Finger and the staff at the Fort Bliss Directorate of Environment, without whom this project could not have been completed. Special thanks to Dr. Tim Baugh and the staff of the TRC El Paso office for arranging and facilitating this study conducted during June 2002.

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CA-SMI-623: An Early-Holocene Site from the South Coast of San Miguel Island, California

Todd J. Braje and Jon M. Erlandson

Research by University of Oregon archaeologists has documented a substantial occupational history on the south coast of San Miguel Island (Braje et al. 2005), once thought to be largely devoid of settlement (Rogers 1929). Systematic survey of the south coast recorded 66 new sites (Braje and Erlandson 2005), bringing the number of sites in the area to 131 (19 percent of the 676 island sites). These include Native American sites from 9500 to 1200 years old and historic sites related to 19th-century fishing and 20th-century military activities.

A surprising result of our survey is the discovery of a cluster of three buried shell middens, all located within 1 km of each other, dating to the early Holocene. Exposed in actively eroding gullies, they are situated near the base of the steep southern escarpment, 200–300 m from the coast.

One site, CA-SMI-623, is a small stratified shell midden exposed in the wall of a gully near the mouth of Russell Canyon (Figure 1). The site contains two discrete shell midden lenses eroding from dark paleosols between 1.2 and

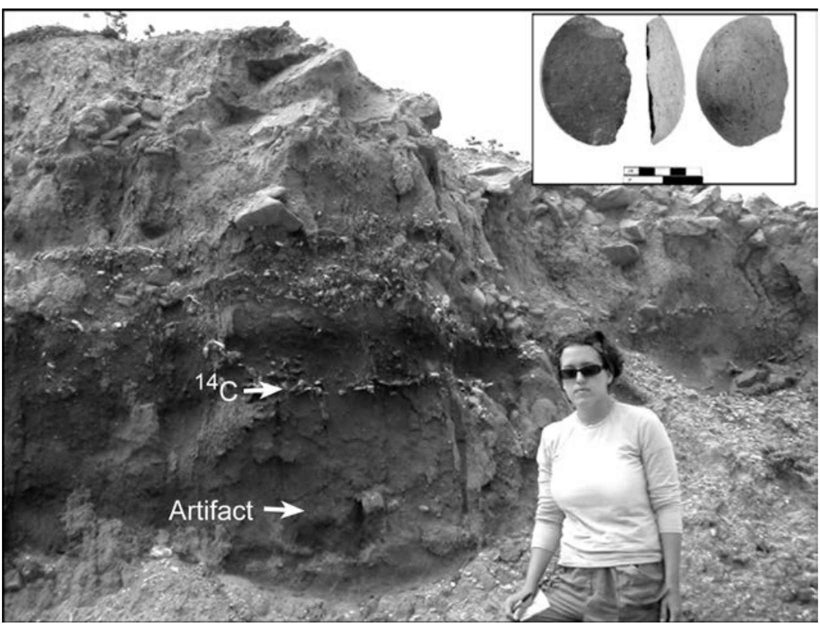

Figure 1. Stratigraphic profile of CA-SMI-623, with deeply buried flake tool (inset).

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2.25 m below the surface. The midden is dominated by the shells of sea mussel (*Mytilus californianus*), with smaller amounts of black abalone (*Haliotis cracherodii*), owl limpet (*Lottia gigantea*), turban snail (*Tegula* spp.), small barnacles, and other rocky shore taxa. Two metavolcanic cores, two metavolcanic flakes, and one quartzite flake were also found.

An owl limpet shell was extracted in situ from the lower shell midden stratum and submitted to NOSAMS facility at Woods Hole for AMS ^{14}C dating. A conventional date of 8400 ± 35 RCYBP yielded a one-sigma calibrated age range of 8750–8580 CALYBP (OS-48349). This date expands the evidence of early maritime activity on California's Channel Islands and suggests that the south coast of San Miguel was important for early coastal foragers (Braje et al. 2004; Erlandson et al. 2005).

Almost 1 m below the basal shell midden, a large chipped-stone flake tool was found firmly embedded in situ in the gully wall profile in a dark brown non-midden soil (Figure 1 inset). Made on a primary flake struck from a metavolcanic beach cobble, this tool has unifacial edge damage on one margin. The age of this tool is uncertain, but it may significantly exceed 8750 years. Further work is planned to expand our knowledge of the chronology and contents of CA-SMI-623.

Our research has been supported by Channel Islands National Park, the Marine Conservation Biology Institute, Western National Parks and Monuments, and the University of Oregon. We thank Ann Huston, Kelly Minas, Bob DeLong (NMFS), and Ian Williams for their support.

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A Possible Chipped-Stone Boat Effigy from the Early-Holocene Component of the Eel Point Site (CA-SCLI-43), San Clemente Island, California

Jim Cassidy

A goal of processual archaeology is to explain human behavior (Binford 1962). However, symbolic acts representing cognition among prehistoric peoples are seldom preserved in the material remains of archaeological sites (Pearson 2002). A form of symbolic behavior widely recognized among ethnographic groups is the attempt to mitigate perceived risks by creating representational objects and conveying them to the spiritual world through the use of fire and smoke.

Extensive excavations conducted at the Eel Point site on San Clemente Island have established the presence of an early Holocene component dating to between 8500 and 9500 CALYBP (Raab et al. 1994). These excavations have recovered an extensive woodworking chipped-stone toolkit from a localized deposit on the basal layer of this occupation floor (Cassidy et al. 2004; Fagan 2003:117-19; Rondeau et al. 2006). Situated in the center of this work area is a stone-lined hearth containing charcoal and shellfish remains. Also found in this hearth is a wedge-shaped stone object that, unlike the flat grayish-colored flakes that surround the hearth, exhibits a glossy black exterior that suggests it had been burned (Figure 1).

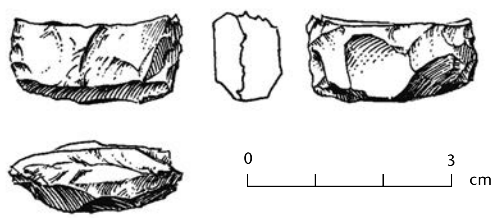

Figure 1. Chipped-stone artifact from the early-Holocene layer of CA-SCLI-43.

This wedge-shaped stone object is 3 cm long. The top is formed by a concave negative bulb of percussion; both sides are chipped flat, both ends are bifacially chipped to form symmetrical points, and the bottom bears three linear-pressure flake scars. Together these features mimic the streamlined shape of a canoe. A real seafaring watercraft has a pointed bow and often stern for efficient movement and steerage through water, high, flat sides that form gunwales to prevent swamping by waves, and a linear keel structure for strength and stability.

The woodworking toolkit associated with the early Holocene occupation of Eel Point may have served multiple purposes. However, constructing and maintaining watercraft would have been an activity essential for the survival of

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the occupants of this site on San Clemente Island, located 80 km from the southern California coast.

Traversing the open ocean in small hand-paddled watercraft involves great risk. Mitigating mortal risk by symbolically offering representational objects as a means of appeasing deities is a universally recognized form of ritualized cultural expression. This chipped-stone artifact, shaped like a canoe and associated with an early-Holocene insular site, may represent such an expression.

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Paleoamerican Stone Selection at Blackwater Locality No. 1: Alibates Silicified Dolomite and Edwards Plateau Chert Frequency Analysis

Peter C. Condon

Salvage excavations conducted in late 1963 and early 1964 at Blackwater Locality No. 1 by F. Earl Green and El Llano Archaeological Society members yielded Clovis- and Folsom-age artifacts from four structurally and chronologically defined stratigraphic deposits (Green 1992; Haynes and Agogino 1966). These cultural deposits, located along the north bank of the Clovis type site, contained a number of artifacts made from Alibates silicified dolomite (Alibates) and Edwards Plateau chert (Edwards). Alibates and Edwards, both distinctly colored lithics, originate in north Texas and central Texas, respectively (Holliday 1997:245). Other material types (quartzite, silicified wood, and Tecovas jasper), although present, occur in lesser frequencies. To more carefully test Hester's (1972:93) findings of Clovis and Folsom stone selection at Blackwater Locality No. 1, I conducted an independent analysis of material type frequency on these previously unanalyzed collections.

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My analysis of lithic material considered all artifacts regardless of style or functional interpretation. I visually identified Alibates and Edwards using comparative samples housed at Eastern New Mexico University, Portales, New Mexico. My comprehensive lithic analysis indicated a diachronic shift in stone preference between the Clovis and Folsom components (Condon 2005).

Artifacts (n = 482) were separated into four assemblages defined by their stratigraphic association (Condon 2005; Green 1992). Stratum B_1 and B_2, the lower Clovis deposit, yielded 126 artifacts. (Attempts to distinguish these two deposits as distinct stratigraphic units were unsuccessful; consequently, artifacts recovered from Stratum B_1 and B_2, including three Clovis projectile points, were treated as a single assemblage.) Overlying Stratum B_1 and B_2 was the upper Clovis component of Stratum B_3, identified as the gray sand deposit (Haynes et al. 1992:340). Stratum B_3 contained 111 artifacts, including three complete Clovis projectile points, a reworked Clovis projectile point, and a small obsidian biface.

Classified as Alibates were 54 artifacts (42.85%) recovered from the lower Clovis assemblage and 42 artifacts (37.83%) recovered from the upper Clovis assemblage. Edwards chert made up 28.56% (n = 36) of the lower Clovis assemblage and 29.72% (n = 33) of the upper Clovis assemblage.

Folsom artifacts were separated from the underlying Clovis deposits by a laminated clay horizon designated Stratum C_1 (Green 1992:335; Haynes et al. 1992). Stratum C_1 did not contain diagnostic lithic artifacts. Stratum D_{1a} (the lower Folsom deposit identified directly above Stratum $C_{1)}$ contained 88 artifacts, including three Folsom and two Clovis projectile point fragments. Overlying the lower Folsom occupation was Stratum D_{1b}, (the upper Folsom deposit), which contained 157 artifacts, including 14 Folsom projectile point and preform fragments.

Within the two Folsom assemblages the frequency of artifacts made from Alibates dramatically decreased, while the frequency of those made from Edwards chert increased. Classified as Edwards chert were 57 artifacts (64.77 percent) within the Stratum D_{1a} assemblage and 109 artifacts (69.42 percent) within the Stratum D_{1b} assemblage. Alibates made up 11.36 percent (n = 10) of the lower Folsom assemblage and 9.55 percent (n = 15) of the upper Folsom assemblage.

A test of association was calculated for the Clovis and Folsom assemblages using the chi-square statistic. The null hypothesis states that material frequency will remain constant through time. The selected significance level was 0.05. The chi-square calculation failed to indicate a change in material preference in either the Clovis ($X^2 = 0.269$; df = 1; p = 0.604) or the Folsom components ($X^2 = 0.306$; df = 1; p = 0.580); however, applying the chi-square statistic to the four assemblages collectively identified a distinct pattern in material selection between the Clovis and Folsom lithic assemblages ($X^2 = 80.67$; df = 3; p = 0.000).

This brief assessment of the four lithic assemblages recovered from the 1963–1964 excavation parallels Hester's (1972) previous findings regarding early Paleoamerican material selection at Blackwater Locality No. 1. To this end, distinct patterns in material frequency within the Clovis and Folsom assemblages may reflect a more dramatic shift in stone preference through time. While these comparisons are broad in scope, they provide the framework for future work in defining the range of Paleoamerican adaptive strategies exhibited at the Clovis-type site.

Special thanks to Phillip H. Shelley, John L. Montgomery, and Paul Lukowski for review and comments on this article. Thanks also to Joanne Dickenson for providing access to the collections.

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A Possible Clovis-age Quartzite Workshop (5GN149) in Gunnison County, Colorado

Judith R. Cooper

5GN149 is a lithic workshop in the Gunnison Basin, Colorado. The site is composed of an extensive scatter of chipping debris (6,800 m^2) dispersed across the surface of a bench (2,420 m a.s.l.) overlooking the Gunnison River 125 m below. The site was used multiple times throughout prehistory, as indicated by point types spanning the late Paleoindian to the late Prehistoric. Although no diagnostic Clovis artifacts have been recovered, 5GN149 has yielded manufacturing debris reminiscent of Clovis technology (Figure 1).

Surface collecting and near-surface excavation from 2002 to 2004 at 5GN149 produced approximately 5,000 lithic artifacts, though this represents only a fraction of the entire assemblage. Four clusters with well-defined boundaries have been identified within the larger debitage scatter and probably mark discrete manufacturing events. Upon refitting a portion of the assemblage derived from Cluster 1 (sample includes 1372 artifacts; 160 refit pairs were

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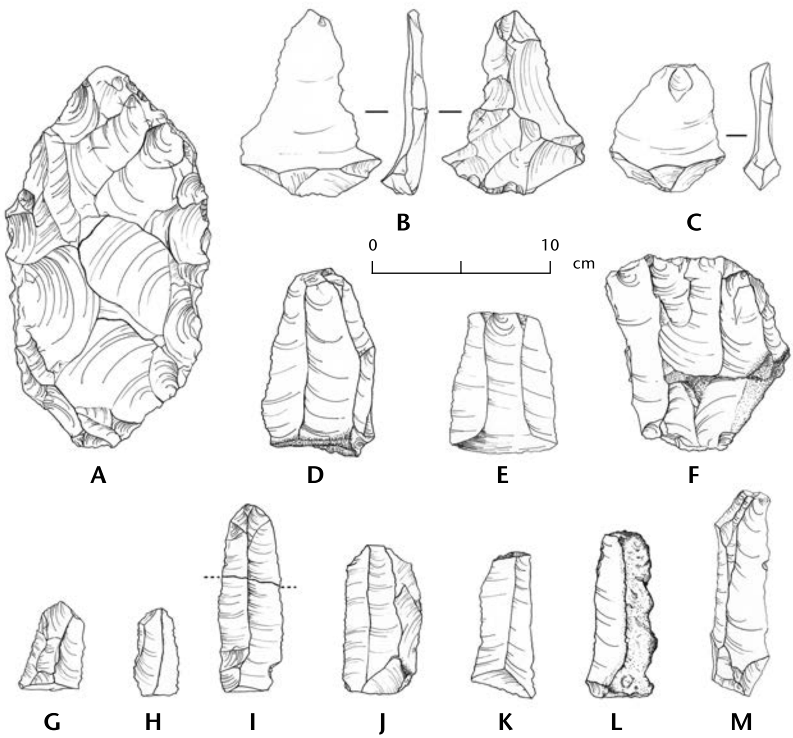

Figure 1. Quartzite artifacts from 5GN149. **A,** biface; **B** and **C**, overshot flakes; **D** and **E**, blade core trimming flake; **F**, blade core; **G–M**, blades and blade fragments.

identified), 77 percent of refits were separated by less than 1 m, suggesting that, although the site is unburied, the horizontal component has not undergone significant post-depositional movement. Quartzite makes up 97 percent of the 5GN149 assemblage, followed by welded tuff (2 percent) and chert (< 1 percent). Quartzite is locally available and might derive from a nearby outcrop source (5GN1), or down-slope of the site, where eroding quartzite cobbles are found. While the full reduction sequence is represented at 5GN149, much of the debitage is large (average weight equals 10 g) and a quarter of the assemblage retains cortex, indicating the earlier stages of production.

Numerous bifaces (n = 158) in various stages of reduction were recovered, suggesting biface production was a primary on-site activity during at least one of the occupations. Among the 5GN149 bifaces are large, thin foliate-shaped bifaces, similar to those found in Clovis contexts (Bradley 1993), though because 90 percent of the bifaces are broken, it is difficult to quantify their original dimensions. Biface-thinning flakes (n = 277) are common and on average are more than 5 cm long, also attesting to the production of large bifaces. Approximately 60 percent of biface-thinning flakes at 5GN149 exhibit ground platforms, a feature diagnostic of Clovis biface reduction (Bradley 1993:254). The site also yielded eight *outre passé* flakes (Figure 1B–C), often cited as a hallmark of Clovis biface thinning (Bradley 1982:207–08, 1993:253; Bradley and Stanford 2004:461; Collins 1999:46; Sellet 1998:67; Tankersley 2004:55; cf. Straus et al. 2005:511). A number of prismatic blades (n = 153) were recovered (Meltzer and Cooper, this volume), along with at least one blade core and seven blade core trimming flakes.

Viewed singly or as a suite, the above artifact types cannot be unequivocally assigned to Clovis, since they also certainly occur in non-Clovis contexts (Collins 1999; Straus et al. 2005). The Clovis projectile point is the only unambiguous indicator of Clovis, but this is problematic because projectile points tend to be preferentially plucked from the archaeological record by collectors. Further, because 5GN149 is dominated by the earlier stages of manufacture, finished projectile points might never have been deposited at the site. What's more, early-stage Clovis localities are rarely identified in the archaeological record (Bradley 1993), particularly where quartzite dominates, thus leaving no Clovis analog with which to compare 5GN149. Absent a projectile point, it is therefore impossible to establish Clovis affiliation at 5GN149.

That said, the co-occurrence of large bifaces and biface-thinning flakes, *outre passé* flakes, blades, and blade-manufacturing debris is at least suggestive of Clovis. Although Clovis is not well represented in the Gunnison Basin, isolated Clovis point finds in the vicinity of the site demonstrate their presence in the area (Stiger 1980).

Many acknowledge that the Clovis toolkit varies greatly by site (Collins 1999; Meltzer 1993; Tankersley 2004). Without a projectile point or radiometrically datable materials, this begs the question, Would known Clovis sites ever have been recognized? Clearly, if Clovis affiliation hinges on the presence of projectile points, then numerous sites will go unrecognized. This is especially true for earlier-stage reduction sites, where projectile points have less of a chance of being deposited. If we focus solely on sites with Clovis projectile points, which represent only a fraction of the products of Clovis technology, we bias our interpretations of Clovis behavior. Equivocal sites like 5GN149 emphasize the need to better define the non-projectile component of the Clovis toolkit.

The QUEST Archaeological Research program at SMU funded this research. The National Park Service, with the assistance of F. Frost and A. Anderson, granted access to the site under permit to D. Meltzer and B. Andrews (NPS Antiquities Permit 03CURE1). Thanks are extended to M. Stiger for bringing the site to our attention and the entire QUEST crew for their help in the field and lab, with special gratitude towards J. Hargrave for her contributions to the artifact illustrations. Many thanks are extended to D. Meltzer and B. Andrews for initiating work at 5GN149 and providing valuable input along the way. I am grateful for the helpful and constructive suggestions made by two anonymous reviewers.

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An Update on the North Carolina Fluted-Point Survey

I. Randolph Daniel, Jr. and Albert C. Goodyear

Continued work on a statewide survey of North Carolina fluted points has yielded 252 fluted points—a 33 percent increase over the 189 specimens initially reported (Daniel 2000).[1] Moreover, recent evaluation of this database in light of the recognition of Redstone points in South Carolina (see Goodyear, this issue) resulted in the reclassification of the entire database (Daniel 2005). Accordingly, both the North Carolina and South Carolina databases are now consistent typologically. North Carolina types include Clovis, Redstone, Cumberland, Gainey, Simpson, and some apparent fluted-point fragments and preforms. Suffice it to say that the reclassification primarily included assigning points previously classified as Clovis or Clovis variants into either Redstone or Gainey categories. Furthermore, the remaining Clovis variants were subsumed under the Clovis type. A significant result of this work is the recognition of the greater ratio of Clovis points to Redstone points in both states, with approximately four Clovis points for every Redstone in South

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[1] The database for the points discussed in this article is available directly from the authors or may be accessed on the Web site for the Paleoindian Database of the Americas: http://pidba.tennessee.edu/northcarolina.htm (Anderson et al. 2005).

Carolina (see Goodyear, this volume) and three Clovis points for every Redstone point in North Carolina.

Clovis points are the predominant Paleoindian form identified in the survey (n = 174, 69 percent). While this category generally corresponds to the Southwestern form and is characterized by a relatively large size, straight-sided base, and shallow basal concavity, there is considerable variability within this class (Haynes 2002:81–93). With respect to geographic distributions, Clovis points were recorded in every physiographic region of the state.

Redstone-like points (Cambron and Hulse 1964; Mason 1962; Perino 1968) represent the second-most frequent category in the survey (n = 53, 21 percent). Redstone points are scattered in the eastern Piedmont and Fall Line. North Carolina Redstones exhibit distinctive full facial fluting, relatively deep basal concavity, and triangular form similar to what is called Redstone in the mid-South. As such, this type likely represents a post-Clovis manifestation in North Carolina.

The Cumberland fluted point (Cambron and Hulse 1964), another distinctive form common to the mid-South, was also identified in the survey (n = 6, 2.4 percent). Like the Redstone, it is characterized by long flutes but has a distinctive eared base. The fact that four of the six specimens were made from chert and cluster in the Mountain region suggests that they originated in Tennessee or elsewhere in the mid-South. Cumberland points are postulated to represent the post-Clovis point type for the Mountains.

Several points (n = 7, 2.8 percent) in the survey were tentatively identified as Gainey-like in form. Gainey points are common in the Great Lakes region (Deller and Ellis 1988) but have been identified in Iowa and Missouri (Morrow and Morrow 2002) as well. In this survey, Gainey points are relatively large- to medium-sized, with relatively deep basal concavities analogous to Redstone points but exhibit an excurvate to parallel-sided rather than triangular blade form. A single long, pronounced flute occurs on at least one face of a few specimens, but just as often shallow multiple flutes are also present. A single Simpson-like point (Bullen 1975), seven broken fluted point performs, and four indeterminate fluted-point fragments round out the point types.

Trends in raw material use noted in the first report are generally enhanced by the additional data. Metavolcanic stone (n = 137, 54.4 percent) dominates raw material types. Stone sources of this raw material likely come from the Carolina Slate Belt in the eastern Piedmont and from the Uwharrie Mountains in particular (Daniel and Butler 1991, 1996). Chert (n = 79, 31.3 percent) constitutes the second-most abundant stone type and represents a variety of cryptocrystalline materials including jasper and chalcedony. These materials almost certainly originated from several sources located outside North Carolina. In any case, most chert specimens probably reflect exchange or mobility originating from outside the state. Quartz, quartzite, and crystal quartz are grouped into a residual category (n = 36, 14.3 percent) and include far fewer points than metavolcanic stone or chert despite their more widespread availability in the state.

In short, the above pattern of stone use supports the notion of two Paleoindian settlement clusters—one centered in the eastern Piedmont and the second in the Mountains—noted previously (Daniel 2000, 2005). Greater than expected frequencies of metavolcanic points occurring in the Piedmont along with fewer than expected occurrences of chert points contrast with the Mountains, where greater than expected frequencies of chert points occur along with lesser frequencies of metavolcanic points. The relative absence, for instance, of Tennessee cherts in the Piedmont and Uwharrie rhyolite in the Mountains bespeaks an absence of movement or contact between the regions. Thus, the occupation of the Piedmont appears unrelated to the Mountains.

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A Middle-Archaic Reutilized Clovis Projectile Point from the Mid-Hudson Valley, New York

Joseph Diamond and Tom Amorosi

While reviewing the mid-Hudson Valley collections at the American Museum of Natural History (AMNH), a Neville stemmed projectile point (ca. 7,740–7015 RCYBP [Dincauze 1976:28-29; Justice 1995]) reworked from an Eastern-style Clovis point was discovered (Ritchie 1997; 1957) (Figure 1). The AMNH collection information records the point as collected in Ulster County on the western side of the Hudson River. This is approximately 32 km south of the Greene County Paleoamerican-period sites of Kings Road (Funk et al. 1969; Weinman and Weinman 1978), Swale (Funk 2004) and West Athens Hill (Funk 2004).

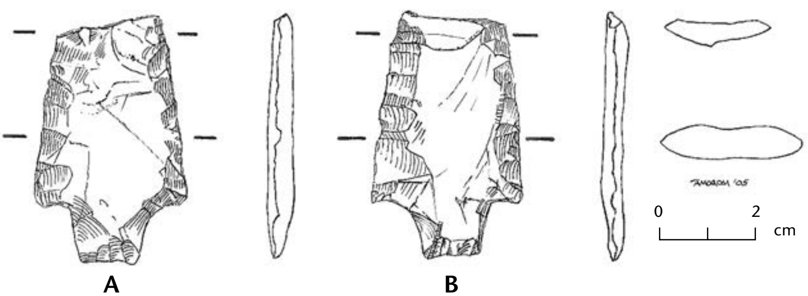

Figure 1. Neville stemmed projectile point reworked from a Clovis-style point (AMNH 20.0/2300). **A,** front aspect; **B,** obverse aspect. All measurements follow Justice (1995:240): shoulder width 28.78 mm, basal width 11.43 mm, stem/haft length 10.32 mm, maximum thickness 6.17 mm.

These records also indicate that this was a surface find collected in 1908 by Henry Booth. The most likely source of this artifact is a large sand terrace at the 150-ft contour interval overlooking Kingston Point. This terrace consists of Plainfield loamy sand (Tornes 1979:Sheet 73). It is probably the same site that yielded the jasper point portrayed in Ritchie (1957:Plate 3B, F), whose provenience is described as "on high sand bluff overlooking Hudson and Mouth of Rondout Creek from c. 4 feet below surface (2 feet dark refuse, 2 feet clear sand)" (Ritchie 1957:84). This sand terrace may be a remnant beach from Glacial Lake Albany. Underneath the sand are deep and substantial clay deposits, which have been mined for brick making since the mid-19th century.

This terrace has also been mined for artifacts by schoolchildren subsequent to Booth's find in 1908. During the 1920s members of the Heye Foundation would travel north to buy artifacts from schoolchildren who dug the site

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during lunch and after school (Frank Parslow, pers. comm. 2003). The site is multi-component; most of New York State's pre-contact archaeological cultures are represented.

The Neville stemmed point was created by modifying a midsection Clovis point. The channel flutes on both faces were reduced by soft hammer percussion. Figure 1B shows a large channel flute with some of the original Clovis edge pattern, although this side has been heavily rejuvenated. The edge was rejuvenated by pressure flaking, which further reduced the channel flutes. No evidence of basal grinding could be seen under microscopic examination. The point is made of Western Onondaga chert. The Archaic edge pattern is still sharp, suggesting a newly eroded find in 1908. Sources of Onondaga chert occur on the western side of the Hudson River in the vicinity of Kingston and also along the Esopus Creek (Holland 2004:25; Luedtke 1992:139–140).

Special thanks are due to Samantha Alderson, Karl Knauer, Judith Levinson, Kirsten Maple, Lori Pendleton, Anibal Rodriquez and Dave Thomas at the Division of Anthropology, AMNH, for making the mid-Hudson Valley collections available for the authors to study.

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Michaud-Neponset–Phase Finds from Canton, Massachusetts

Christopher L. Donta

Recent excavations at the Neponset site (19-NF-70) in Canton, Massachusetts, identified an area of Paleoindian activity referred to as Locus 4. Five previous locations at the site had documented activity that dates to the latter part of the Paleoindian period (Carty and Spiess 1992; Ritchie 1994), the Michaud-Neponset phase (Spiess et al. 1998). The newly found locus was also situated on the southeast side of Signal Hill, in an area of sandy glacial outwash soils.

Excavations resulted in the collection of over 3,000 artifacts from Locus 4, which include Paleoindian, middle-Archaic, late-Archaic, and Woodland components. The basal Paleoindian component is distinguished by the predominant use of a light-olive to yellow-gray volcanic rock with linear inclusions and rusty orange stains, whose origin has been identified as the Mt. Jasper area of New Hampshire (Boisvert 1999:165; Pollock et al. 1996:247). Comparisons with samples from Jefferson area sites (Boisvert 1998; Boisvert and Puseman 2001) found the raw materials to be macroscopically identical, which was confirmed by thin sectioning (Donta 2005).

Excavations produced three fluted-point fragments, all made of Mt. Jasper rhyolite (Figure 1). All three are basal fragments; one is a complete base, one

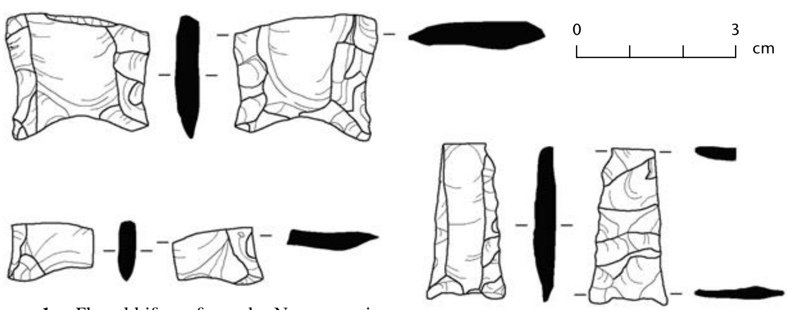

Figure 1. Fluted bifaces from the Neponset site.

a corner fragment, and one a corner fragment that was reworked into a miniature point with re-fluting, the latter similar in form to artifacts described as possible fluted drills from the Vail site (Gramly 1982: 117). Eight unifacial tool fragments were found, seven of Mt. Jasper rhyolite and one of a gray, radiolarian chert. All the unifaces are sidescrapers in form, manufactured from large flakes and retouched around all edges except the platform. At least six channel flakes were also found, all of Mt. Jasper rhyolite.

Although no features were found associated with the Paleoindian compo-

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nent at Locus 4, a charcoal sample from a hearth at nearby Locus D was dated to 10,210 ± 60 RCYBP (Ritchie 1994).

The fluted-point fragments from Locus 4 and earlier excavations at other site loci are consistently flared at the base with large channels, characteristic of the Michaud-Neponset phase (Spiess et al. 1998). The predominance of raw materials from northern sources, particularly northern New Hampshire, may point toward a northern origin for Paleoindian peoples in southern New England, as suggested by Dincauze and Jacobsen (2001). Additional testing of lithic materials from the Neponset site, Jefferson area sites, and others from southern New England will be important in further determining the exact nature of these relationships.

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The Paleo Crossing (33-ME-274) Non-Projectile Point Biface Assemblage

Metin I. Eren

Paleo Crossing (33-ME-274) is a Paleoamerican occupation in northeastern Ohio (Barrish 1995; Brose 1994). Its projectile point and unifacial stone tool assemblages have already been analyzed (Eren 2005; Eren et al. 2004, 2005). The non-projectile point biface assemblage consists of 29 specimens. Of these, 22 are made from Wyandotte chert, which outcrops 600 km away from the site in northwestern Kentucky and south-central Indiana (Tankersley and Holland 1994). Seven are made from non-Wyandotte cherts (Upper Mercer, Ohio Flint Ridge) that outcrop no farther than 200 km away. Six of the bifaces are unbroken, seven are proximal fragments, four are midsections, three are distal fragments, and nine are unclassified broken fragments. Nine bifaces exhibit heat damage. There are 4 definite preforms, 14 possible preforms, and 2 drills. Nine bifaces cannot be categorized as specific tool types. Table 1 lists metric data for the bifaces.

Clarkson's (2002) Index of Invasiveness (I.I.) was applied to the bifaces. In addition to quantifying the extent to which flaking invades a specimen, the I.I. roughly correlates with the extent to which a blank is reduced (i.e., mass loss). The Wyandotte specimens have an average I.I. value of 0.79; the non-Wyandotte specimens have an average I.I. value of 0.74. The greater reduction value for the Wyandotte tools makes sense considering the longer distance traveled to procure raw material, though the difference is not statistically significant ($t = 0.7191$, $p = 0.4852$) and therefore may not be indicative of curation. The unbroken bifaces show a much higher I.I. value (0.92) than any other fragment category (distal = 0.75, midsection = 0.58, proximal = 0.71, unidentified = 0.79). This might indicate either (1) that invasive flaking was a final reduction stage and bifaces broken before this stage were not further modified, or (2) that bifaces exhibiting invasive retouch scars were saved from activities that would result in breakages.

Paleo Crossing has slightly less than a 2:1 ratio of fluted points ($n = 34$) to preforms. While this may be the result of field collection bias, the ratio seems sensible considering the greater effort in procuring raw material. Assuming direct lithic procurement, the Paleoamericans of Paleo Crossing might have converted most of their blanks and preforms to fluted points before arriving at the site. Along with the heavily reduced unifacial tools (Eren et al. 2005), the high I.I. values for bifaces and the ratio of projectile points to preforms support the idea that Paleo Crossing represents a group of people attempting to extend tool use life of an already highly curated and nearly exhausted lithic assemblage.

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Table 1. Metric data of Paleo Crossing non-projectile point bifaces.

Catalog #	Specimen #	Type	Fragment	Chert type	L	W	T	MD	I.I.
1725A02000001	1	unknown	unknown	Wyandotte	38.44	28.08	10.53	52.14	0.72
1725A02000001	2	drill	midsection	Wyandotte	34.93	20.02	6.51	36.60	0.50
1725A02000001	3	unknown	midsection	Wyandotte	26.95	17.15	6.18	29.22	0.66
1725A03000001	4	preform?	unknown	non-Wyandotte	49.66	54.15	12.32	62.46	0.69
1725A02000001	5	preform?	proximal	Wyandotte	38.42	35.91	11.00	43.67	1.00
1725A02000001	6	preform?	unknown	Wyandotte	27.66	29.40	5.88	34.31	0.72
1725A02000001	7	unknown	midsection	Wyandotte	8.90	35.94	10.04	36.14	X
1725A02000001	8	preform?	unknown	Wyandotte	28.12	29.27	5.88	37.96	1.00
1725A02000001	9	unknown	complete	Wyandotte	42.57	25.49	7.98	43.20	1.00
1725A02000001	10	preform?	unknown	Wyandotte	30.73	27.19	7.40	34.88	1.00
1725A02000001	11	preform?	midsection	Wyandotte	23.86	22.91	4.76	31.94	X
1725A02C30001	12	preform	complete	Wyandotte	66.87	30.94	10.72	66.88	0.88
1725A02000001	13	unknown	unknown	Wyandotte	45.52	38.24	9.87	52.21	0.56
1725A02000001	14	preform?	complete	Wyandotte	37.28	23.58	6.61	38.16	0.78
1725A02000001	15	unknown	distal	Wyandotte	27.72	37.62	9.19	40.66	0.59
1725A02000001	16	preform?	unknown	Wyandotte	39.71	30.13	9.47	41.95	0.88
1725A06102401	17	preform?	proximal	Wyandotte	22.67	25.95	8.08	29.86	0.81
1725A06312901	18	preform?	complete	Wyandotte	69.28	31.56	10.08	69.36	1.00
1725A05601	19	preform?	proximal	non-Wyandotte	49.79	23.73	7.34	49.91	0.47
1725A02000001	20	preform	complete	Wyandotte	67.97	31.56	10.09	68.04	1.00
1725A02000001	21	preform?	proximal	Wyandotte	33.65	37.33	10.77	40.30	0.63
1725A02000001	22	unknown	proximal	Wyandotte	20.70	29.12	8.34	35.64	0.69
1725A02A30001	23	preform	complete	non-Wyandotte	62.91	28.15	7.85	64.16	0.84
1725A02B10001	24	drill	proximal	non-Wyandotte	42.52	13.84	7.23	42.86	0.88
1725A06183301	25	preform?	unknown	Wyandotte	52.50	33.69	6.20	55.33	0.88
1725A042104	26	preform	distal	non-Wyandotte	44.72	21.56	8.26	49.33	0.78
1725A042002	27	unknown	distal	non-Wyandotte	21.72	16.66	5.13	24.92	0.88
1725A02000001	28	preform?	proximal	Wyandotte	35.21	26.78	8.04	43.34	0.47
1725A02000001	29	unknown	unknown	non-Wyandotte	23.84	35.14	6.93	40.26	0.63

L length
W width
T thickness
MD maximum dimension
I.I. index of invasiveness

Thanks to Mustafa Eren, Kathleen Eren, Nimet Eren, Brian Redmond, Mark Kollecker, Ann DeFresne, N'omi Greber, David Meltzer, the Department of Archaeology at the Cleveland Museum of Natural History, Department of Anthropology at Southern Methodist University, the Cleveland Archaeological Society (a chapter of the AIA), and Think Computer Corporation.

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Use Wear and Folsom Hafting as Illustrated by a Point Base from Southeast Utah

Phil R. Geib, Winston Hurst, and Stanley A. Ahler

In 2003, excavators under the direction of Winston Hurst and Deborah Westfall recovered the basal section of a Folsom projectile point from a late 8th century A.D. (early Pueblo I period) pit house in southeastern Utah.[1] The point occurred in disturbed sediments that eroded into the house pit after the structure had been abandoned. It does not appear to be a curated artifact, and likely originated from sediments into which the Puebloans intruded their pit house.

The point is made from Chuska chert (formerly known as Washington Pass chert), whose source lies 180 km south of the discovery site. The maximum dimensions of the recovered basal fragment are 26 mm wide, 20 mm long, and 3.5 mm thick.

The point is of local interest because it adds to a small body of evidence for Folsom occupation in this section of Utah. It has larger relevance, though, for examining a proposed model for how Folsom points were hafted. Ahler and Geib (2000, 2002) propose that Folsom points were hafted in a two-piece split-wood foreshaft. In the proposed hafting method, the respective matching pieces of the foreshaft are bound to the parallel flute surfaces starting near the tip, working back to envelop the base, and then beyond, binding together both of the splints and tightly securing the point in place with strong facial friction. The absence of basal abutment, a key feature in this design, allowed the point to slip backward in the haft on impact with a hard object such as

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[4] 42Sa22747, the Jensen site, in Blanding, Utah. Excavation of this multi-pit house site is still in progress.

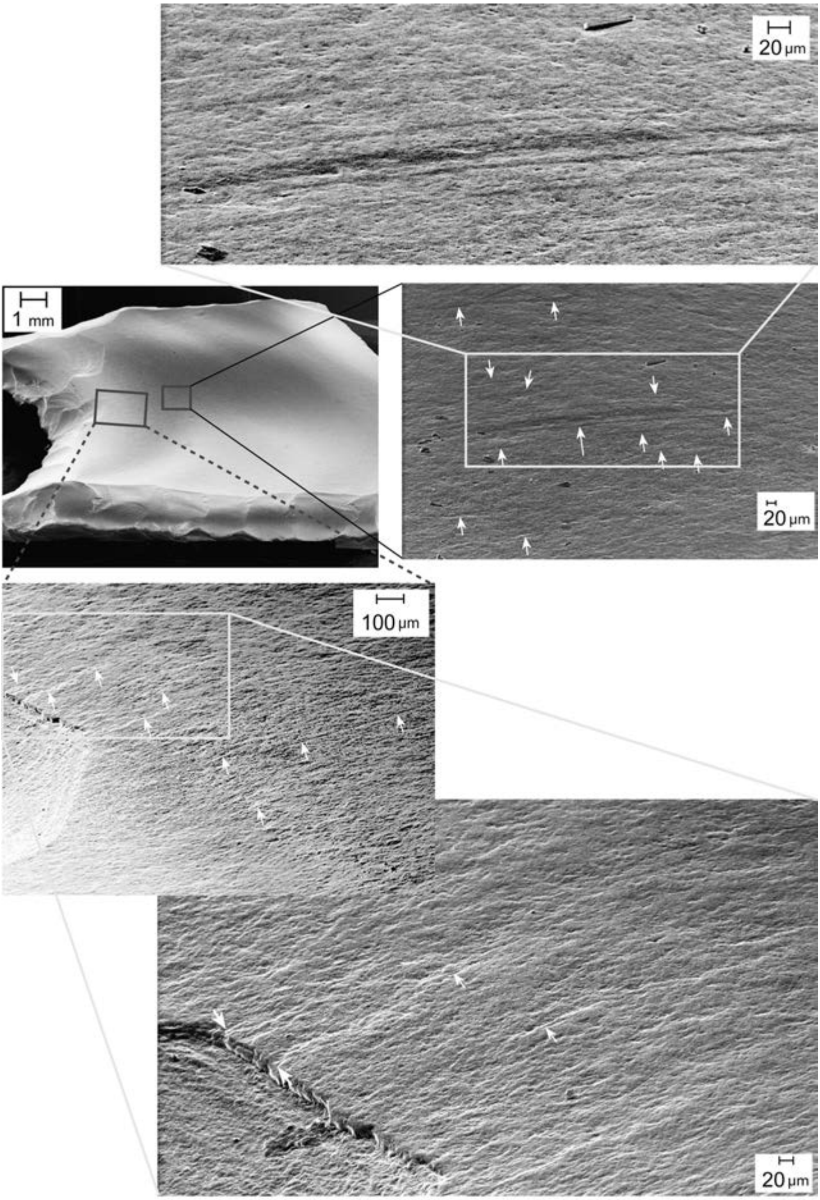

Figure 1. SEM images showing striations within the flute scar on face 1 of the Folsom point from the Jensen site, southeast Utah.

bison rib. Thus the haft functioned as a shock absorber, helping to limit catastrophic point breakage. Other aspects of this hafting arrangement also helped in this regard.

An important archaeological correlate of this suggested hafting arrangement is use wear, specifically striations in the flute scars parallel to the long axis of the point that would indicate backward movement of the point in the haft in the absence of damage to the basal margin of the point. Ahler and Geib (2000:815–16; 2002:376–77) discuss this aspect and illustrate it with a Folsom point of Knife River flint from North Dakota. The Utah point described here is an especially good example of the type of use wear that would be expected from the proposed split-shaft hafting arrangement (Figure 1).

Wear traces on the Utah point occur on the first face fluted, which, as is common, has the widest flute scar. Use wear consists of a series of linear striations parallel to the long axis of the point. The deepest striations are visible to the naked eye under good light. Magnification under a dissecting microscope or a scanning electron microscope reveals numerous parallel striations of variable depth and length. The longest striations are more than 1 mm long and are almost 20 μm wide. They occur in an area where they could not have been abraded by external materials during use; instead, they must have been caused when the point slipped against the hafting elements under tight frictional pressure. The striations are most pronounced on the central part of the flute scar (Figure 1, top), but they also occur at the proximal edge of the scar where minute pressure flakes from trimming the base invaded this feature (Figure 1, bottom). Though more subtle, the striations here are nonetheless quite important because they help to confirm the direction of movement. In the absence of damage to the basal margin of the point, the morphology of the striations is, we believe, consistent with the point's slipping backward in a split two-piece haft, as would be expected if the projectile had contacted something impenetrable.

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Recognizing the Redstone Fluted Point in the South Carolina Paleoindian Point Database

Albert C. Goodyear

Recent evaluation by the author of the South Carolina Paleoindian point database indicates the substantial presence of a suspected middle-Paleoindian point historically known as Redstone (Cambron and Hulse 1964; Mason 1962:239; Perino 1968; Williams and Stoltman 1965)[1]. Because of recent discoveries in South Carolina of large fluted points typical of the Redstone, it became clear that the Redstone had a straight to trianguloid blade configuration from the earliest stage of its use life (Figure 1A–D). Lanceolates with extremely long prominent flutes heretofore had been classified as Clovis (Charles and Michie 1992; Goodyear et al. 1990; Michie 1977). Accordingly, a review of all fluted points yielded a total of 48 Redstones that had previously been misclassified as Clovis.

Redstones were recognized and named starting in the 1960s by an avocationalist in the Southeast (Mahan 1964). They were named Redstone after the Redstone Arsenal in Huntsville, Alabama, near the portion of the Tennessee River Valley where they were originally recognized (Perino 1968:74). However, little attention has been paid by professionals to their cultural and chronological meaning owing to lack of excavated and dated contexts. The type descriptions emphasized the trianguloid blade, deep basal concavities, long multiple flutes, and acute tips (Mahan 1964:A-75; Perino 1968:74). Because of their prominent flutes, they were thought to be possibly related to Clovis or Cumberland. To date, they remain undated.

Based on the fluting technique, Redstones can be related to a post-Clovis, instrument-assisted method where a punch or pressure flaker was placed in the basal concavity to precisely remove the characteristic long flutes. Guide or release flakes similar to those seen on Folsom, Gainey, and Shoop points can be detected on many points. On some the flute can be traced back to the present basal concavity. Like Folsom, Gainey, and Debert points, it is likely that a nipple fluting platform was repeatedly set in the concavity during fluting, resulting in relatively deep basal concavities (Figure 1). Direct percussion fluting would have been impossible without destroying the ears. In contrast, Clovis points would have been fluted by direct percussion, probably from a beveled platform (Goodyear and Steffy 2003). It is known that Clovis points were fluted in multiple stages, often resulting in what Morrow (1995) has referred to as "composite" fluting. Such flutes do not normally originate at

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[1] The primary attribute/measurement data for the 219 points discussed in this article are available directly from the author or may be accessed on the Web site for the Paleoindian Database of the Americas: http://pidba.tennessee.edu/southcarolina.htm (Anderson et al. 2005).

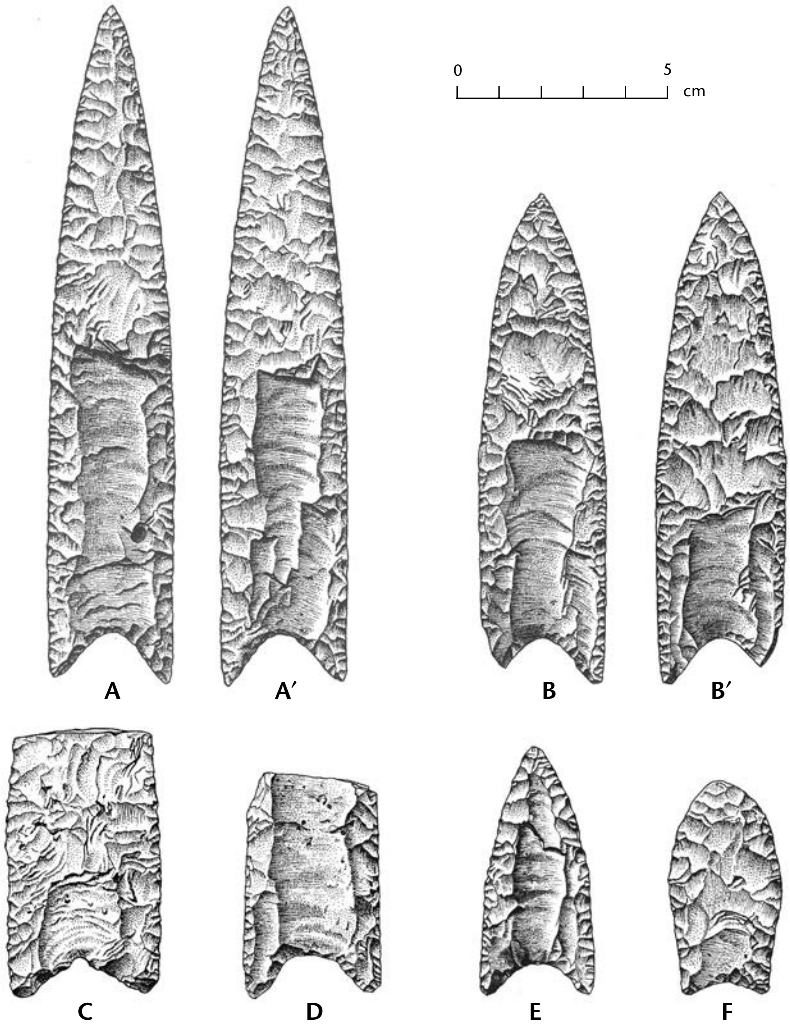

Figure 1. Redstone fluted points from South Carolina, **A** (SC 365), **C** (SC 271), **D** (SC 214), **E** (SC 157); **B** (SGA 2), Burke Co., Georgia; **F,** Clovis (SC 357).

the present margin of the basal concavity (Figure 1F). Redstones differ from Clovis not only in fluting technique but probably in projectile function. Clovis point blades are usually excurvate, wider than their hafts, and resharpened to a nearly rounded tip (Figure 1F). Redstones have narrower, elongated trianguloid blades with sharp tips. Clovis points would appear to be designed for piercing-cutting, Redstones for piercing-penetrating. It is likely that the proboscideans were gone by Redstone times, leaving elk and bison as the largest fauna in the South.

Reclassifying the South Carolina database resulted in approximately four Clovis points for every one Redstone. Using Clovis and Redstone fluted points made from coastal plain Allendale-type chert and high-quality metavolcanics, a total of 179 Clovis were found versus 40 Redstones (4.5:1). Within the Allendale chert cases, 115 were Clovis versus 24 Redstone (4.8:1). Within metavolcanics, it was 64 Clovis versus 16 Redstones (4:1). Assuming Redstones date from 10,800 to 10,500 RCYBP, and Clovis dates from 11,300 to 10,900 RCYBP, a precipitous decline in post-Clovis fluted points is indicated. No other Paleoindian points are known for this area of the Southeast to fill in this time period. Daltons presumably began around 10,500 RCYBP (Goodyear 1982). For the Allendale County region of South Carolina, there are an estimated 20 Dalton points for every Redstone. This apparent decline in projectile points also occurs during the Younger Dryas, a time thought to be colder and dryer than Clovis times. The strong presence of Dalton points throughout the Southeast would suggest any demographic problems were ameliorating by then. As a cross-check on the South Carolina database, the North Carolina Paleoindian point survey was also reclassified as a result of searching for Redstones. It resulted in a Clovis-to-Redstone ratio of 3:1 (Daniel and Goodyear 2006). This pattern of a high Clovis-to-Redstone ratio apparently is not restricted to the Carolinas. In his survey of the Nottaway River drainage in southeast Virginia, McAvoy (1992) found a dramatic post-Clovis drop in what he calls deep concave-based fluted points and sites. He postulates a major population reduction in this region after Clovis times. For the entire Virginia database Johnson (1996:205) notes that the proportion of concave base to presumably Clovis points is 11 percent. More attention should be paid to a possible post-Clovis, pre-Dalton decline in Paleoindian points in the Southeast to determine the archaeological reality of this suggested pattern. Firestone et al. (2005) have postulated that an extraterrestrial comet-like impact event occurred over North America at about 12,900 CALYBP, causing the onset of the Younger Dryas and extinction of dozens of large ice age faunal species. If this is the case, it is possible that the human population decline suggested by the drop in post-Clovis projectile points over much of the Southeast may be related to such a catastrophic event.

I thank Jean Church, Kevin Dowdy, Larry Strong, and Jack Willhoit for sharing information about their Redstones. Thanks also to Darby Erd for the line drawings.

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The JS Cache: An Early-Paleoindian Tool Cache from the Oklahoma Panhandle

Adam C. Graves, Leland C. Bement, and Brian J. Carter

Survey of late-Pleistocene through mid-Holocene deposits along Bull Creek in the Beaver River drainage, Oklahoma Panhandle, has led to discoveries of Paleoindian materials dating to 10,850 RCYBP and 8760 RCYBP (Bement and Carter 2005). The JS cache provides evidence for an even earlier use of the immediate area. The initial find was made by a local collector. Subsequent investigation by Bement documented additional items. The JS Cache includes 112 lithic artifacts including flake tools (69), blades (30), and bifaces (13)

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buried in fine alluvium overlying coarse sands and gravels that mark the terminal-Wisconsinan deposits in the area (Carter and Bement 2004:117). A buried soil overlying similar deposits at the nearby Bull Creek site yielded a radiocarbon age of 11,070 ± 40 RCYBP (Beta-184854), suggesting the cache is at least this old.

The JS cache was in a tight cluster approximately 30 cm in diameter and lying on stacked, level alluvial deposits. No evidence of a pit was found. Items at the top of the pile are heavily patinated on the upper surface, while those at the bottom are encrusted with calcium carbonates on the underside. Items in the middle have neither patina nor calcium carbonate deposits. It may be inferred, then, that the 3.73 kg (8.22 lb.) cache was found in situ. The tight clustering and stacking of items suggests they may have originally been contained in a bag. The differential patination further suggests these items remained exposed or partially exposed before being completely buried by alluvium.

The cache contains 13 bifaces, 66 flakes, 3 large overshot flakes, and 30 blades (Figure 1). All these items display signs of heavy tool use in the form of edge shaping and resharpening. Bifaces range in size from 4.2 cm x 2.9 cm x 0.8 cm, weight 11.1 g, to 14.3 cm x 8.2 cm x 3.1 cm, weight 325.7 g. Flakes, includ-

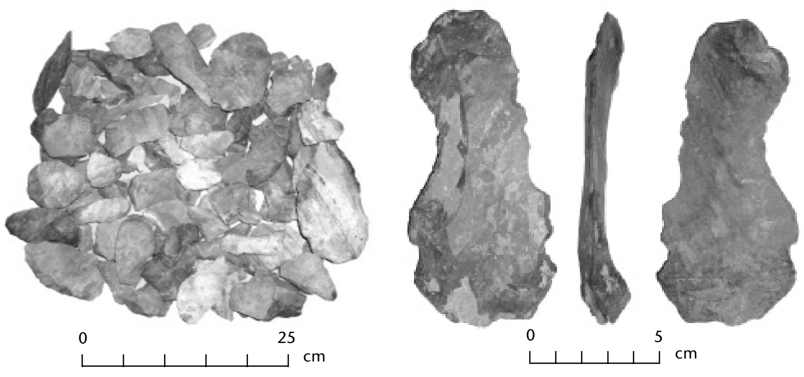

Figure 1. Complete cache and close-up view of largest overshot flake.

ing overshot flakes, range from 3.3 cm x 2.5 cm x 0.6 cm, weight 5.1 g, to 11.4 cm x 5.6 cm x 1.4 cm, weight 74.5 g. Blades and blade segments range from 4.1 cm x 2.1 cm x 0.9 cm, weight 7.5 g, to 13.7 cm x 4.7 cm x 1.4 cm, weight 85.6 g. Many artifacts retain varying amounts of red ocher. The primary stone type is Alibates silicified dolomite (106), followed by Niobrara jasper (4) and Ogallala quartzite (2). Distances to these source areas are 200 km for Alibates, 200 km for Niobrara, and less than 3 km for Ogallala quartzite.

Numerous caches of bifaces (including Clovis points), large flakes, and blades are known from Clovis contexts (Frison and Bradley 1999; Goodyear 1999:458–62; Gramley 1993; Hofman 1995; Jones and Bonnichsen 1994; Stanford and Jodry 1988; Tankersley 1998). Specifically, the presence of blades, overshot flakes, and red ocher in the JS cache is consistent with other Clovis-age caches and technology (Collins 1999, 2002; Green 1963; Hofman

1995; Mallouf 1994:44–46; Young and Collins 1989). The stratigraphic context supports such an age determination.

Special thanks are extended to Terry Dorman and Bob Kerns. This work was supported by the Oklahoma Archeological Survey, University of Oklahoma, and Oklahoma State University.

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Trace Element Analysis of an Obsidian Milnesand Point, Gaines County, Texas

Thomas R. Hester, David Burrow, Frank Asaro, Fred H. Stross, and Robert L. Giauque

This paper reports the trace element source analysis of a fragmentary obsidian Paleoindian point from Gaines County, Texas. David Burrow collected this artifact from the surface of a heavily eroded, sand-filled playa on the northeast side of Cedar Lake, northwest of the town of Seminole in Gaines County, western Texas. A wide array of prehistoric artifacts have been exposed here, including numerous Paleoindian points of types such as Dalton, Scottsbluff, Plainview, Firstview, and Hell Gap. GPS coordinates are on file with the Texas Archeological Research Laboratory, The University of Texas at Austin (TARL).

The artifact described here (Figure 1) appears to be of the Milnesand type, although that attribution is not wholly conclusive (Michael B. Collins, pers. comm., 2004). It is a basal fragment (snap break at the distal end) with a biconvex cross section and heavy dulling of the lateral and basal edges. The obsidian is speckled gray/black translucent material. Length is 28 mm, maximum width 24.5 mm, basal width 21 mm, and thickness 6.5 mm. The specimen was submitted to Hester by David Burrow and was designated TOP 211 in the long-term research known as the Texas Obsidian Project, involving Hester, Asaro, Stross, Giauque, and others.

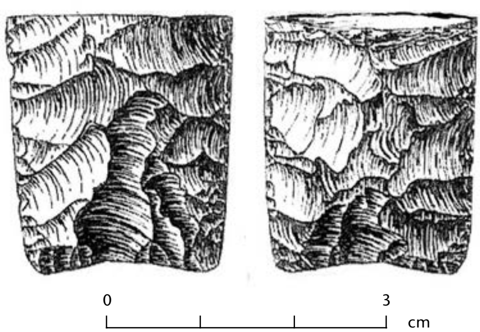

Figure 1. Obsidian Milnesand point base from Gaines County, Texas.

TOP-211 was analyzed using Precise X-Ray Fluorescence (PXRF) (Giauque et al. 1993). In a letter of January 22, 2004, Asaro and Stross (pers. comm. 2004) detailed the PXRF studies and attributed the obsidian to the Cerro Toledo rhyolite source. Reference samples from this source, in the Valles Caldera area of the Jemez Mountains, New Mexico, were available from PXRF

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and neutron activation analysis (NAA). Owing to space limitations, the trace element data have been placed on file at TARL. Cerro Toledo obsidian is found across western, central, and southern Texas (and, of course, in the Panhandle, which is in close proximity), consisting of flakes and bifaces of Archaic and late-Prehistoric date (Hester et al. 1991).

Earlier papers have noted that obsidian Paleoindian points are very rare in Texas (Hester 1988; Johnson et al. 1985). A Clovis base from Kincaid Rockshelter was sourced by neutron activation analysis to a source near Queretaro, Mexico (Hester et al. 1985). A complete Clovis point of obsidian, found near Port Lavaca, Texas, cannot be sourced with existing data. In west Texas, Johnson et al. (1985) report a Paleoindian point from the Lubbock Lake site that was determined to be from the Cerro Toledo source in New Mexico (Johnson et al. 1985), and, from the same source, a Clovis point from Blackwater Draw. A single example of a Folsom point from New Mexico, made of Cerro Toledo material, is noted by LeTourneau (2005:8).

The data, although meager, suggest that obsidian Paleoindian points in the northern half of Texas are made largely from Cerro de Toledo rhyolite. One specimen from southwestern Texas derives from Mexico, and a specimen on the Texas coast is from a currently unrecognized source.

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Rex Rodgers Bone Bed: Reevaluation of Site Formation

Matthew E. Hill, Jr.

For its time, the report by Willey et al. (1978) on the Rex Rodgers site (41BI42 Area 2) was one of the most detailed studies of a Paleoamerican bison bone bed on the Great Plains. The historical importance of this work is unquestionable, but the original interpretation of the site as a single episode, mid-winter kill of six animals dating to at least 9326 ± 83 RCYBP (SMU-274) (e.g., Speer 1978a, 1978b, 1986) is not. I evaluate this interpretation with data from my recent reanalysis of faunal remains and artifacts curated at the Panhandle-Plains Historical Museum (PPHM).

Speer (1978a, 1978b) argued that six bison were dispatched at the site by driving the animals into an arroyo and then turning them at a right angle into the wall of the gully (Willey et al 1978: 64). In this scenario, some animals were killed as they reached the rim of the gully, while the rest were dispatched in the bottom of the nearby arroyo channel. After the kill the human hunters intensively processed the carcasses.

The current taphonomic analysis of approximately 330 identifiable bison bones (NISP = 1885) supports the earlier contentions that at least some bison were killed by prehistoric hunters, but indicates extensive post-depositional alterations to the bone bed limits our ability to fully reconstruct human actions.

Bone distribution patterns at the site suggest the kill area is preserved only on the gently sloping edge of a natural arroyo in the northwestern portion of the site. Here four in situ projectile points were associated with a number of articulated limb units. The southeastern portion of the bone bed contains disarticulated elements and bone fragments, which washed into a 1.2-m thick undifferentiated light-colored laminated sand unit that filled the adjacent arroyo.

Evidence for human modification of the bones is limited, possibly a result of poor cortical surface preservation. Just 10 of the 330 specimens display a total of 26 cut marks with locations consistent with meat removal, skinning, or limb disarticulation. In addition, two specimens had evidence of cultural impact marks (n = 2) from marrow extraction.

Skeletal element representation within the assemblage is very uneven. Mandibles and distal metacarpals are the most common elements, with axis, lumbar vertebra, distal radii, metatarsal shafts, and first phalanges also well represented. The major upper limb bones (i.e., humeri, femora, and tibiae) are poorly represented in the collection, while innominate and sacral elements are entirely absent. Although Speer attributes this pattern to human-induced butchery, transport, and consumption, the current analysis argues that the composition of the Rex Rodgers bone bed appears to be the result of a combination of cultural and non-cultural processes.

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There is a statistically significant negative correlation between skeletal frequency (percent MAU) and Emerson's (1993) economic utility measure ([S]MAVGTP) ($r_s = -0.55$, $p < 0.01$), and a significant and positive correlation between Kreutzer's (1992) volume density (VD) for bison bones and percent MAU ($r_s = 0.56$, $p < 0.0001$). When percent MAU is correlated with VD with consideration for economic utility (Beaver 2004) there is no relationship for high utility ([S]MAVGTP > 25) elements ($r_s = 0.20$, $p = .11$) and just a very weak relationship for low utility ([S]MAVGTP < 25) carcass parts ($r_s = 0.38$, $p < 0.01$). These data suggest the paucity of economically valuable skeletal remains is not a function of their ability to withstand natural destructive processes alone. This indicates that human butchery had at least a limited influence on skeletal element frequencies. However, an even stronger relationship ($r_s = 0.70$, $p < 0.01$) exists between percent MAU and Todd's (2003) standardized settling velocity index (a measure of fluvial transport of bison remains); this suggests that size sorting by water movement was the most important factor influencing skeletal part abundance at the Rex Rodgers site.

The current study of mandibular tooth eruption patterns compares favorably to Speer's (1978a, 1978b) estimates of age structure and season of mortality. Six animals are represented in the assemblage, although the current study assigns them to slightly different age groups than Speer's. Three mandibles (MNI = 2) belong to dental age group 2 (1.6–1.9 years old), four (MNI = 2) to dental age group 7 (6 years old), two (MNI = 1) to dental age groups 9–10 (8 to 9 years old), and one is more than 10 years old (> group 11). Based on the group 2 specimens, the season of mortality occurred sometime between N + 0.6 to 0.9. Based on a mid-April birth pulse for Southern Plains bison (Halloran 1968), this would represent deaths occurring within a three-month period between late fall (November) and late winter (February). This degree of diversity in eruption patterns for the youngest age groups makes it possible that more than one death event is represented at Rex Rodgers.

In summary, Rex Rodgers represents at least one, and probably two, bison kill events dating between 9300 and 10,300 RCYBP. The kills likely occurred between late fall and late winter. Remains of at least six animals are present at the site, but the original number of animals killed could have been much greater. Post-depositional processes such as fluvial movement probably removed an unknown amount of the original bone bed. If more than one kill event did occur, as suggested by seasonality data, there is the possibility that the San Patrice and Plainview points recovered from the site may have been deposited during separate episodes. However, since there is no stratigraphic separation of the projectile point types at the site, this hypothesis is difficult to confirm. The mixing of projectile points and bones at the site may be at least partially due to fluvial sorting.

This paper would not have been possible without assistance of the staff of the Panhandle-Plains Historical Museum in Canyon Texas: Jeffrey Indeck (Curator), Rolla Shaller (Assistant Curator), Linda Mooreland, Mary Moore, and Monica Shaffer. Excavations at Rex Rodgers were conducted under Antiquities Permit #39, and material from the site is part of Held-In-Trust collections at the PPHM. Mark Denton of the Texas Historical Commission is also thanked for granting permission to study the collection. This manuscript was improved through comments from Margaret Beck, Frank Goebels, and an anonymous reviewer.

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A New Stratified Late-Paleoindian Locality on the Clary Ranch, Ash Hollow, Garden County, Nebraska

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The O. V. Clary site (25GD50) was discovered in 2004 during the course of reinvestigations at the Clary Ranch site (25GD106), and was partially excavated in 2005 (ca. 9 m^2). The sites are located 1.4 km apart along Ash Hollow Draw, an intermittent tributary of the North Platte River bisecting the Clary Ranch. Two additional Paleoindian localities have been identified along the draw (also on Clary Ranch property). The first (25GD19) is situated roughly halfway between the aforementioned sites, while the second (25GD51) is located about 200 m east (downstream) of the Clary Ranch site (Figure 1). To date, 25GD19 and 25GD51 have yet to yield time-diagnostic artifacts; however,

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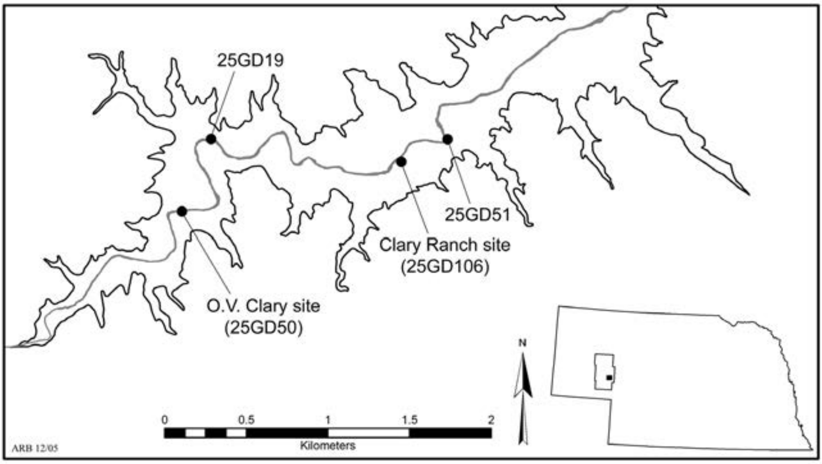

Figure 1. Map of Ash Hollow Draw showing the location of the late-Paleoindian sites on the Clary Ranch.

as with the other two localities, they are encased in early-Holocene alluvium that dates to ca. 9500–8500 RCYBP. The spatial proximity of so many Paleoindian localities is highly unusual, emphasizing the potential significance of the Clary Ranch locale for early-Holocene archaeology.

The Clary Ranch Paleoindian sites occur within the lower portion of a ca. 14-m-thick early-to middle-Holocene alluvial valley fill. The base of this generally silt loam to loam fill is dated to 10,230 RCYBP. Two lithostratigraphic units compose the basal portion of the valley fill and can be readily identified throughout the middle portion of the basin. The lower unit is a massive silt loam varying from brown to dark grayish brown. Locally derived subangular carbonate gravels are scattered throughout. A weakly developed soil is present within this unit at some localities. The second, overlying lithostratigraphic unit is a dark grayish brown horizontally laminated silt loam. At the O.V. Clary site, 16 to 32 individual flood laminae (each 1 to 14 cm thick) have been recognized within this unit, which includes at least three stratified late-Paleoindian occupations. The occupation at the Clary Ranch site is also encased within this unit. Within the Ash Hollow Basin, this stratified unit dates to between 9150 and 8700 RCYBP. Of particular interest is the fact that each of the three identified occupations at the O.V. Clary site, plus the occupation level at the Clary Ranch site, dates to between 9100 and 9000 RCYBP.

Currently, analytical interest is focused on the middle unit of the three stratified occupations at the O.V. Clary site. Artifactual, faunal, and site structural materials strongly suggest the presence here of a residential base camp, situated on the rapidly aggrading floor of Ash Hollow Draw. On-site activities appear to have been organized around an intact hearth area, to which the upper limb bones of at least five bison were transported for processing and subsequent consumption. The remains of several birds were also recovered here, including specimens identified as raven, great horned owl, and at least two passerines. At least one box turtle is represented by 13 shell fragments.

Chipped-stone artifacts include 2 Frederick/Allen points, 6 unifacial tools, and 1,806 unmodified flakes, 95 percent of which are classified as micro-debitage (≤ 1 cm in maximum dimension). All the chipped-stone artifacts appear to be sourced from White River Group silicates, with the exception of four small Hartville Uplift chert flakes. Other hearth-area items include four bone beads (each probable bird bone), two bone needles, one anvil, and one sandstone abrader. Size comparisons of fetal bison bone, plus eruption and wear of teeth in two bison calf dentitions, indicate site use during mid-summer, mid-winter, and late winter/early spring. Proposed 2006 excavations are designed, in part, to determine if the aforementioned archaeological materials were deposited during the course of a single, continuous occupation or over the course of three (or more) separate occupations occurring over a relatively short period of time.

Special thanks are extended to Mrs. Naomi Clary, Robert and Dee Clary, Warren and Jeanne Clary, and Vern and Vivian Kallsen for their continued support and tolerance of our work on the ranch. The 2005 field work was supported by funding from the College of Liberal Arts and Sciences, Iowa State University. The field crew consisted of Iowa State University students Andrew Boehm, Jeremy Hall, Valerie Mayer, Steve Mussmann, Erik Otarola-Castillo, and Scott Sinnott. Jon D. Baker and Paul Parmalee identified the bird remains.

Geoarchaeological Investigations at the Ake Folsom Site, New Mexico

Vance T. Holliday, Robert H. Weber, and James H. Mayer

The Ake site (LA 13423) is a Folsom locality on the Plains of San Agustin in Catron County, west-central New Mexico. The site was excavated in 1978, yielding evidence for Folsom and several later occupations (Beckett, 1980). The Folsom material was recovered from a redeposited context, however. Because the final report on the site (Beckett, 1980) is not widely available, and in an attempt to better understand the site setting, we revisited the site (2003, 2004, and 2005) for additional stratigraphic work, including coring.

The San Agustin Basin consists of the main Horse Springs Basin in the southwest, the C-N basin in the center, and the White Lake Basin in the northeast. During the Last Glacial Maximum (LGM) a lake filled the Horse Springs Basin and part of the C-N Basin to the 2110- to 2120-m shoreline. The lake rapidly declined after the LGM, but this chronology is poorly dated (Markgraf et al. 1984; Phillips et al. 1992). The area attracted repeated Paleoindian occupations (Hurt and McKnight, 1949; Weber, 1980; B. Huckell,

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pers. comm. 2001). Most were in the C-N Basin (Folsom and late Paleoindian) and the White Lake Basin (Clovis, Folsom, and late Paleoindian) (Weber, 1994).

The Ake site, on the northwest side of the C-N Basin, is the only excavated Paleoindian locality in the area. The original site area was on the 2105-m shoreline. Excavations focused on the old shoreline and adjacent eroded surfaces. Among the artifacts recovered by archaeologists and attributed to the Folsom occupation are fragments of seven Folsom points, two channel flakes, and a utilized flake, all made of non-local chert and chalcedony (Beckett, 1980).

Our coring on the beach ridge reproduced the stratigraphy reported by Weber (1980). From the top down, the profile consists of:

Unit E (up to 30 cm thick), a weakly consolidated dark gray brown (10YR 3/2m) eolian sand with A-Bw soil;

Unit D (up to 60 cm thick), a firm, brown (10YR 5/3m), loamy eolian sand with ABtwb soil and containing an extensive and intact Archaic (Cochise) occupation and, at the base, the Folsom occupation;

Unit C (up to 80 cm thick), composing the beach ridge proper, bedded and cross-bedded fine sand and clay;

Older Units B (up to 50 cm thick) and A (> 1 m thick), clayey and muddy lake deposits.

Residue from muds collected at about the C/B contact (108–113 cm below surface) yielded a ^{14}C age of 16,390 ± 130 RCYBP (AA-6418).

Folsom artifacts were recovered from the flank of the beach ridge on the lake-basin side. They were in a mixed zone (Unit X) resting on an unconformity that crosscut Units A and B. Unit X was buried by Unit E and likely represents a wedge of sediment (including Folsom artifacts) eroded from the beach ridge during the middle Holocene.

Coring on the basin floor within ca. 100 m of the Ake site yielded evidence of mud inset against Units A and B and the beach ridge, and buried by sandy clay (possibly Unit X). These muds (ca. 120 cm thick) are a blocky, light brownish gray (10YR 6/2m) silty clay. The residue fraction in the muds yielded ^{14}C ages of 14,935 ± 75 RCYBP (AA-57671) at 150–155 cm depth and 10,345 ± 50 RCYBP (AA-57670) at 100–105 cm depth. The cores that exposed the muds were on the margin of a broad, shallow lake basin. Further, the fine-grained lithology and gray colors of the muds are very similar to playa mud found in small basins in the Albuquerque Basin (Holliday et al. 2006) and on the Southern Great Plains (Holliday et al., 1996). The muds, therefore, likely represent a wet, poorly drained, and densely vegetated depositional environment.

Our research provides data that help to explain the location of the Folsom occupation at the Ake site. Before and during the Folsom period (generally dated ca. 10,900–10,200 RCYBP) a marsh or wetland likely existed along the margin of the C-N Basin adjacent to the 2105-m shore line. The beach ridge would have provided a well-drained setting for living adjacent to a rich resource. A similar setting is reported for Paleoindian sites in the Bonneville Basin of western Utah (Oviatt et al. 2003).

This research was supported by the Argonaut Archaeological Research Foundation, University of Arizona. We thank Dorothy Ake and her family for access to the Ake site and for their generous hospitality. Vera Markgraf and the late Platt Bradbury provided encouragement for this work and kindly shared their considerable knowledge of the San Agustin Basin.

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Archaeological and Geological Test Investigations at the Mockingbird Gap Clovis Site, Central New Mexico

Bruce B. Huckell, Vance T. Holliday, Robert H. Weber, and James H. Mayer

The Mockingbird Gap site, ca. 40 km southeast of Socorro, New Mexico, is one of the largest and perhaps least-known Clovis sites in the southwestern United States. It was discovered in the late 1950s (by RHW) in the desert grassland of the northern Jornada del Muerto. His surface collecting and detailed mapping of the site produced hundreds of Clovis artifacts—projectile point bases, fluted-point preforms, endscrapers, gravers, and other flake tools—from an area 800 m by 80–150 m. The site occupies a northeast- to southwest-trending, gypsite/calcrete–capped sand and gravel ridge bordering the channel of Chupadera Arroyo, which drains southwestward. The ridge is divided into northern and southern segments by a shallow drainage tributary to the broad, flat, untrenched floodplain of Chupadera Wash, and occupations occur on both segments. Weber contacted George Agogino of Eastern New Mexico University about the site in the mid-1960s, and they conducted excavations in the more southerly locus (1966–1968). Trenches 2 m wide were used to explore promising areas, and, where results warranted, blocks of contiguous 2-m units were dug. The site was determined to be largely Clovis, although a scattered Archaic occupation and a small Ancestral Pueblo pithouse component were encountered. During and after the excavations, Weber conducted geological investigations on the site and along Chupadera Wash. Results were reported briefly (Weber 1997; Weber and Agogino 1997).

A 2004 visit suggested to us that there was potentially much to be learned from the site and surrounding area about the Clovis occupation. Accordingly, we made plans for a testing project to 1) determine whether additional buried deposits of Clovis age remained for investigation, and to illuminate the cultural and natural depositional history of those deposits, and 2) investigate the stratigraphic record of Chupadera Wash and nearby landforms for clues to Paleoindian environments and landscapes.

The June 2005 archaeological investigations consisted of facing up portions of the eroded walls of the unbackfilled ENMU excavations. Eight judgementally placed 1.0-by-0.5-m units were excavated in arbitrary 10-cm levels from the point of break-in-slope between the modern surface and the old

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excavations to culturally sterile sediments, typically 0.4–0.6 m below ground surface. All sediments were passed through 1/8-inch mesh screens. Six units were excavated in the largest (ca. 18-by-30-m) excavation area, with one more in an area to the south and the final one to the east of it. Five of the first six units produced from 30–55 subsurface artifacts—almost entirely biface reduction debitage—of probable Clovis origin, given that they are made of the same suite of jasper and chert materials as previously recovered diagnostic Clovis implements. This differentiates them from Archaic and Ancestral Pueblo assemblages. Two of the units yielded fragments of tooth enamel morphologically and metrically consistent with bison. The artifacts and enamel fragments were recovered from a similar suite of soil horizons, consisting of a thin veneer of eolian sand atop a well-developed Bw-Bk-BCk-Km/Ky sequence. Artifacts were vertically dispersed by bioturbation and eolian processes, but tended to be concentrated in the lower Bw and throughout the Bk horizons. The sixth unit, south of the first five, revealed an Ancestral Pueblo pit feature with dark, ashy fill. The final two units produced mixed Archaic/Clovis and Ancestral Pueblo/Clovis assemblages east and south, respectively, of the main area.

Stratigraphic studies in Chupadera Wash adjacent to the site consisted of recovering 15 cores using a Giddings soil-coring rig plus excavating one bucket-auger hole. Three of the cores penetrated > 6.0 m. Above that depth the sediments include middle- to late-Holocene sand, gravel, and very dense clay. Below 6 m are 2–3 m of black, massive to stratified muds—indicating palustrine conditions—that yielded radiocarbon ages (on decalcified humates) of 9925 +155/-150 RCYBP (A-13929) at 635–645 cm depth and 10,590 +95/-90 RCYBP (A-13930) at 898–920 cm depth. More muds are present below 920 cm, but we do not know their maximum depth. These data indicate that a marsh was adjacent to the site, likely providing resources that attracted Clovis occupants.

Our results demonstrate that significant deposits of Clovis age remain in the area of the main ENMU excavations. The concentration of Clovis activity here appears to be due to an accumulation of sand in a shallow depression developed in the much older calcrete/gypsite–capped fluvial sand and gravel that composes the ridge. We hypothesize that the site was a recurrently occupied camp adjacent to a wetland developed along Chupadera Wash. Bison may have been the principal prey exploited by Clovis hunters. Additional research is planned for the summer of 2006.

Our thanks to the New Mexico State Land Office and the New Mexico Historic Preservation Division, Office of Cultural Affairs for their support of our research, conducted under permit AE-112. Christina Sinkovec and William Reitze served as crew members. Investigations were supported by the Argonaut Archaeological Research Fund (University of Arizona), established by Joe and Ruth Cramer.

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Elk Skeleton Associated with Fluted Point in Northern Wisconsin

Jean Hudson

The Silver Beach Elk site (47BA526) is a submerged Paleoamerican site with excellent organic preservation. Discovered in July 2005 by recreational swimmers, it consists of half the skeleton of an elk or wapiti (*Cervus elaphus*) in association with a fluted point of Gainey or Clovis style made of jasper taconite (Figure 1). The site is located in northwestern Wisconsin under 1.5 m of water in Middle Eau Claire Lake. Exploration and analysis are in the early stages. The site has good potential to provide new data about ecological associations, regional distribution, and dates for Gainey/Clovis traditions in the Great Lakes region.

The elk remains belong to a single adult male. The taxonomic identification is confirmed by the antlers and the 54 other elements recovered. This is significant given current data that associate Gainey points with caribou and tundra or spruce parkland (Storck and Spiess 1994). Modern elk are typically associated with open woods, prairies, and wetlands (Bryant and Maser 1982; Holman 2001). Elk are rarely documented in clearly cultural late-Pleistocene contexts this far north. Radiocarbon dating will be critical to interpretations; a sample is being prepared for analysis.

The bones are very well preserved. Preliminary review for butchering marks indicates heavy chop marks at the distal femur, cut marks on humerus, maxilla, and mandible, and scrape marks on ribs. Probable wounding marks were also observed, with two punctures through the left scapula and three nick marks on the adjacent ribs. This pattern is well documented for European Mesolithic hunting of *Cervus elaphus* (Noe-Nygaard 1974) and has been reported for two submerged elk finds from Ohio (Goslin 1961; Murphy et al. 1985).

The fluted point is Gainey-like, with parallel sides and a flute extending more than half the length; this site is further north and west than most Gainey sites (Stoltman 1998). The raw material is jasper taconite; this suggests spatial links to source material in Thunder Bay, Ontario, a Pleistocene foot-travel distance of 300–400 km to the north around the Superior glacial lobe, and to the Red Creek Cedar site about 130 km to the south, which produced a very similar point of this material (Dudzik 1993).

Systematic surface survey was conducted in October 2005. Future research is aimed at dating and subsurface testing. Butchering marks raise the possibility of an associated camp site, and excellent organic preservation provides a rare opportunity to gather information about animal and plant use.

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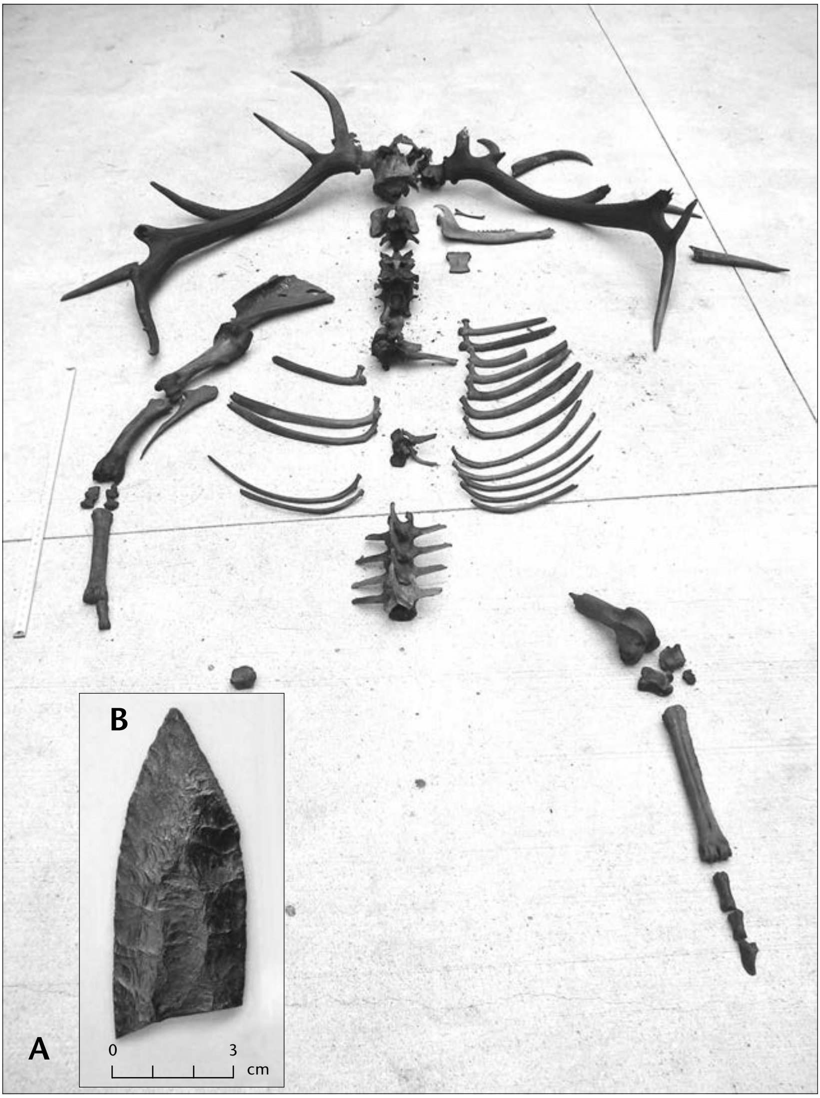

Figure 1. Elk remains (**A**) and fluted point (**B**) from Silver Beach Elk site (47BA526), northwestern Wisconsin. Meter-stick on left side of elk provides scale for skeletal remains.

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New Developments Concerning the Pleistocene Component of the Hiscock Site (Western New York State)

Richard S. Laub

Hiscock is a rich late-Quaternary site in western New York State (Laub et al. 1988). Following are some new developments in its study since the last update appeared in this journal (Laub 2004). All these specimens lay in the Fibrous Gravelly Clay, the productive Pleistocene unit at this site (Laub 2003a).

A fluted biface, the sixth from this site, was found in 2004 (Buffalo Museum of Science C30279, Figure 1A–D). Though most of the proximal end is missing, the distal end of the flute channel remains. The edges are sharp, in contrast with the rather dull edges of the other Hiscock fluted bifaces, and a small spike has been knapped on the point. This suggests that a broken biface was modified into an alternative tool, perhaps a scribe, a pattern consistent with the other fluted bifaces from this site (Ellis et al. 2003). The artifact was made from locally abundant Onondaga chert (John D. Holland, pers. comm.).

A mastodon neural spine (BMS E27515, Figure 1E–H) appears to have been culturally modified. This specimen, from a thoracic vertebra toward the middle of the series, bears a hole centered at its distal end (Figure 1H) and leading to a cylindrical axial lumen (Figure 1E). The object may have served as a socketed handle that held a service element with a narrow cylindrical tang. In this sense, it is reminiscent of another socketed handle from Hiscock (Laub 2000), which, however, featured a much broader lumen at its proximal end.

An unusual discovery was a *Picea* (spruce) twig, still bearing green-colored needles. This preservation may be due to a major mineral spring vent lying 1.5 m away (Ponomarenko and Telka 2003), and to a dense encasement of silt. The specimen, BMS E27516, yielded an AMS date of 9090 ± 40 RCYBP (Beta-199770). The abundant conifer twigs in the Fibrous Gravelly Clay appear to be mastodon digesta (Laub et al. 1994).

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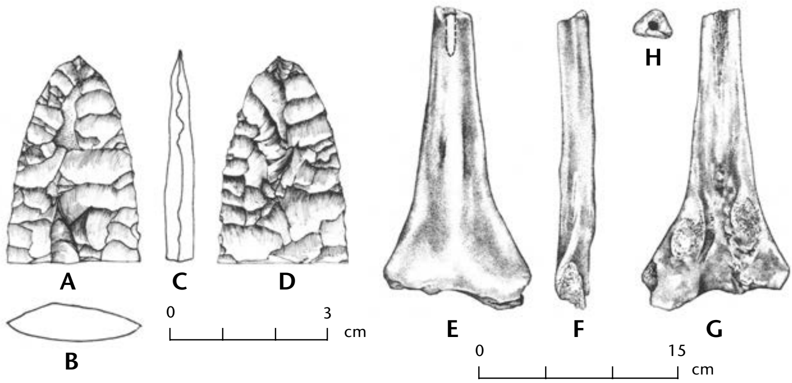

Figure 1. **A–D,** distal end of a fluted biface, Buffalo Museum of Science no. C30279. Upper end of the flute can be seen near the base in **A**. Note spike knapped onto the point. **E–H,** mastodon neural spine, BMS E27515, apparently culturally modified. Outline of lumen is shown by dashes at top of **E**, and circular opening at distal end is shown in **H**. Illustrations by William L. Parsons.

While most of the twigs that were dated are over 10,000 RCYBP, two (besides the present specimen) fall in the 9000 RCYBP range (Laub 2003a, 2003b); this is significantly younger than the generally accepted time of extinction for *Mammut americanum* (Mead and Meltzer 1984) and suggests mastodons may have persisted in this region an additional thousand years or more. The present specimen, whose form and context imply a similar gastrointestinal origin, falls into that younger range.

The masticatory and digestive systems of modern elephants are less efficient than those of ruminants and other ungulates (Benedict 1936:167–73, Shoshani 1992:79), and their feces commonly contain recognizable fragments of soft food items (Haynes 2003:Fig. 3). While the teeth and mode of mastication in mastodons differed from those of elephants, the resulting by-products were physically similar (Laub et al. 1994). If chemical digestion in mastodons was as weak as that in elephants, a possibility suggested by apparent gut contents associated with the Burning Tree mastodon (Lepper et al. 1991), then the survival of needles in the present specimen may be explained.

A female mastodon humerus, BMS E27517, was found with its entire anteroproximal surface scooped out to a depth of 8 cm. The pattern resembles the results of gnawing by a bear, based on the criteria of Haynes (1983).

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The Carrizozo Folsom Site in the Northern Tularosa Basin, New Mexico

Philippe D. LeTourneau and Jan Cummings

The Carrizozo Folsom site, located in the far north end of the Tularosa Basin in southern New Mexico, is distinctive in a number of respects. It is one of only five recorded Folsom sites in the northern basin (Laumbach 1984; Shields and Laumbach 1989), it has a much larger assemblage of Folsom artifacts com-

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pared with a single Folsom point at each of the other sites, and it is notable for the lithic raw materials present in the artifact assemblage.

The site is near the summit of a sandstone mesa with an expansive view of the grazing lands on the floor of the Tularosa Basin to the west. A spring lies a few hundred meters to the northwest, an intermittent wetland is present several kilometers to the south, an intermittent stream empties into the basin north of the site, and the Sacramento Mountains rise to the east. Oscura Gap and Mockingbird Gap, both 50 km to the west-southwest, provide easy passage to the Jornada del Muerto. The Salado Creek–Rio Bonito drainage to the southeast provides passage through the Sacramento Mountains to the Pecos River Valley and the High Plains.

Artifacts at the site are eroding from eolian deposits over a 10,000-m^2 area. There is an early-Archaic component, represented by Jay and Bajada points, that overlaps the Folsom component in one small area, but the two occupations are for the most part spatially discrete. Very different raw material use between the two occupations (early-Archaic reliance on basalt and silicified shale compared with Folsom reliance on chert) makes it easy to distinguish between the two components.

The surface-collected Folsom assemblage consists of one Midland and 6 Folsom points, 2 unfluted Folsom/Midland point tips, 2 Folsom preforms, and 15 channel flakes; all the artifacts are fragments. Also present are a spokeshave, 5 endscrapers, 7 other retouched flakes, and 120 unretouched flakes.

Toolstone in the Folsom assemblage includes several cherts favored by New Mexico Folsom groups: Alibates, Chuska, Edwards, Lake Valley, and Pedernal (Amick 1994, 2002; Huckell and Kilby 2002; LeTourneau 2000). Silicified rhyolite from the vicinity of Socorro and the northern Jornada del Muerto (Dello-Russo 2004) is represented, as is obsidian from the Jemez Mountains (LeTourneau and Baker 2002; LeTourneau et al. 1996, 1999).

Also present in substantial quantities is a variety of chert from the San Andres Formation that has been only briefly reported previously (LeTourneau 2000:430; LeTourneau and Weber 2004). The chert is opaque brown, yellowish brown, gray, or black with abundant light gray spheroidal shapes ranging in diameter from 1 to 10 mm. We refer to this as the "bubble" variety of San Andres chert ("polka dot" chert in LeTourneau [2000:430]). The bubble variety crops out with the well-known fingerprint variety of San Andres chert documented by Banks (1990:70–71); the two patterns can be present together in individual clasts. The bubble variety, though sparse in occurrence, is geographically widespread in the San Andres Formation in New Mexico. We have documented a primary source of the material in the Zuni Mountains and have identified secondary clasts in Torrance and Socorro Counties. This variety has not been previously documented in studies of the San Andres Formation (Banks 1990:70–71; Boyd 1958; Church et al. 1996; Goldsmith 1990; Kottlowski 1963).

The Folsom points include two of Edwards chert, three of Lake Valley chert, and one of unidentified chert. The Midland point is Edwards chert. One of the unfluted point tips is unidentified chert, and one is Valle Grande Member obsidian. Both preforms are San Andres bubble chert. Channel flakes are

Lake Valley chert (n = 6), an unidentified bright orange chert (n = 7), and San Andres bubble chert (n = 2). Flake tools include an Alibates retouched flake and another of silicified rhyolite. Unretouched flakes include 4 of Chuska chert, 2 of Pedernal chert, 5 of Edwards chert, 23 of San Andres bubble chert, and 34 of Lake Valley chert. Of the identified raw materials, only the San Andres chert could have been locally procured; the San Andres Formation crops out extensively in the Sacramento Mountains and around the northern margin of the Tularosa Basin (New Mexico Bureau of Geology and Mineral Resources 2004; Rawling 2004).

Folsom points (n = 2) from the two closest Folsom sites (Laumbach 1984) are both made of Lake Valley chert. Sites farther south in the Tularosa Basin also contain Chuska and Edwards cherts (Amick et al. 1996, 1998). We have identified San Andres bubble chert artifacts at only two other Folsom sites, both in New Mexico: a Midland point from the Jornada del Muerto (LeTourneau and Weber 2004), and debitage from the Milagro site in Guadalupe County (LeTourneau 2000).

In sum, our investigations at the Carrizozo Folsom site provide new information concerning a region with a very sparse record of Folsom settlement. Raw materials include cherts found at other Folsom sites in the Tularosa Basin, as well as a relatively unknown, possibly local, chert from the San Andres Formation. The scarcity of Folsom sites in the northern Tularosa Basin sites may be due in part to the presence of the extensive late-Holocene lava flow that covers the basin floor west of Carrizozo.

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Filling in the Blanks: Early Paleoamericans in the Texas Big Bend

Robert J. Mallouf and John D. Seebach

Constituting the great southern arc of the Rio Grande in the northern Chihuahuan Desert, the Texas Big Bend has been viewed by archaeologists as marginal to early-Paleoamerican subsistence and settlement systems (Campbell 1970; Largent et al. 1991; Mallouf 1981; Marmaduke 1978; Meltzer 1986; Meltzer and Bever 1995). This inference is based on a paucity of fluted projectile point finds and a lack of definitive early-Paleoamerican campsites—despite substantive survey in some areas of the region. At present, Chispa Creek, an extensive Folsom campsite near Van Horn (Amick and Hofman 1999; Seebach 2004), and Bonfire Shelter near Langtry (Byerly et al. 2005;

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Dibble and Lorrain 1968) remain the only confirmed early-Paleoamerican localities in the vicinity. Both these sites, however, are geographically peripheral to the Big Bend proper; Chispa Creek lies to the northwest, and Bonfire lies within the Lower Pecos region to the east.

As of 1995 only three Clovis points had been documented for the Big Bend, all from Brewster County (Meltzer 1986; Meltzer and Bever 1995). Two additional Clovis points, also from Brewster County (Figure 1), have more recently been documented. At least three of these five isolates are from areas

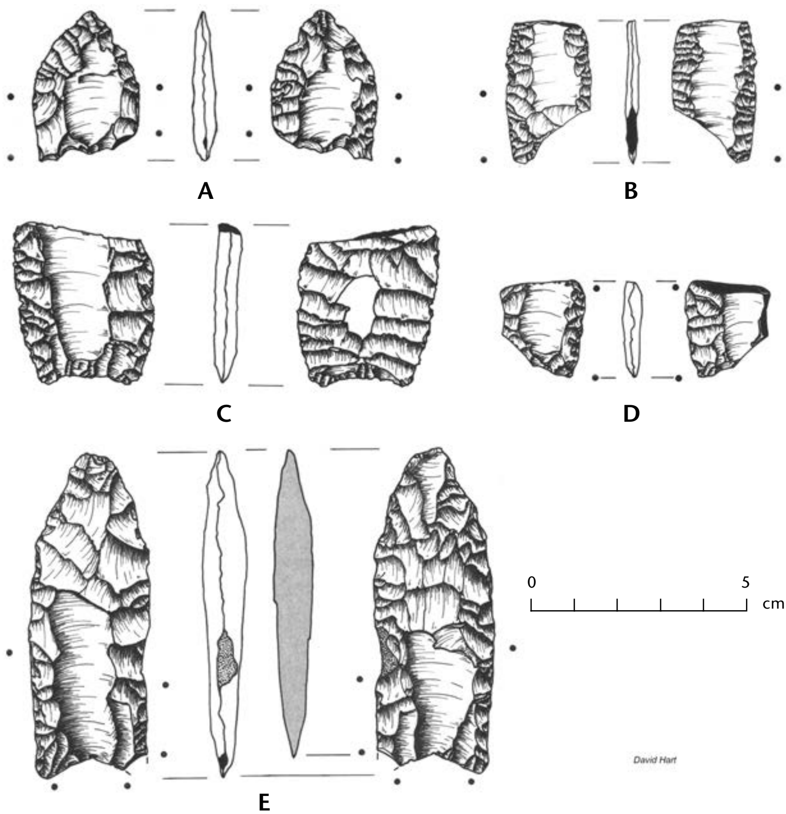

Figure 1. Examples of recently documented early-Paleoamerican projectile points and preforms from the Texas Big Bend. **A,** Folsom point (Davis Mountains); **B,** Folsom point (Puertacitas Mountains); **C,** Folsom preform (Alamito Creek); **D,** Folsom point (Terlingua Creek); **E,** Clovis point (Elephant Mountain).

in or near Big Bend National Park. An attendant lack of substantiated Clovis sites in the Big Bend is particularly frustrating in light of the fact that mammoth remains, and presumably late-Pleistocene strata, are relatively common across the region. It is likely that Clovis settlements are present, but are entombed deeply within basin alluvium (Campbell 1970; Mallouf 1999). This postulate is supported indirectly by recent finds along basin arroyos of early-

Archaic sites buried more than 7 m below ground surface (Mallouf 2004).

With regard to Folsom projectile point distribution in Texas, Largent et al. (1991) and Largent (1995) report an absence of Folsom diagnostics in the Big Bend, with the exception of those from the aforementioned Bonfire Shelter and Chispa Creek sites. Recent research, however, at least partially contradicts this finding; Folsom points and preforms have now been documented—albeit in low numbers—from across the region (Figure 1). These surface finds include two preforms from Presidio County, a point fragment from Brewster County, and four specimens (including two previously reported in Mallouf [2000]) consisting of two preforms and two fragmentary points from Jeff Davis County. The presence of Folsom sites, while also likely, continues unsubstantiated to date.

These recent finds of both Clovis and Folsom diagnostics were recovered from a wide range of environmental settings. These include low-elevation areas adjacent to relict Pleistocene lake beds, the edges of basins at their juncture with valley walls, freestanding ridge and mesa tops within basins, and foothill-mountain settings. While definitive sites remain elusive, cumulative evidence suggests early-Paleoamerican localities are indeed present in the Big Bend. Their detection in low-elevation basin environments is contingent upon a better understanding of the region's complex depositional and erosional episodes during the Holocene. Discovery of deposits in elevated settings can be expected as favorable micro-niches are targeted for intensive surveys.

The authors extend their appreciation to David Hart for excellent pen-and-ink renditions of the illustrated artifacts, and to Betty MacGuire, David Williams, Bobby Gray, Monroe Elms, Kendra Luedecke, J.P. Bryan, Cathy Fulton, Joe Lewis, Mary Bridges, Homer Mills, and Frank Daugherty (deceased) for providing access to specimens for study. The Brown Foundation, Inc. and Houston Endowment of Houston, Texas are gratefully acknowledged for their support of the Trans-Pecos Archaeological Program of the Center for Big Bend Studies, Sul Ross State University.

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On Morphometric Differentiation of Clovis and Non-Clovis Blades

David J. Meltzer and Judith R. Cooper

In an effort to assess the age of 5GN149, a lithic workshop in the Gunnison Basin, Colorado (Cooper, this volume), we investigated morphometric variation in the blades from this assemblage. We followed the analytical lead of Collins (1999), who, in his valuable study of Clovis blade technology, grappled with the question of how to recognize Clovis-age blades in the absence of independent age control or associated diagnostic artifacts.

Collins's solution was to plot on triangular graphs the ratios of length, width, and thickness to the sum of all three measures in blades of unknown affinity—notably, the Keven Davis cache—against comparable data from blades of known Clovis and non-Clovis affinity (Collins 1999:Figures 8.6–8.10). Although Collins was careful to incorporate additional observations, it was primarily from his visual inspection of the scatter of points on the graphs that he concluded the Keven Davis specimens "fit well within the range of known Clovis blades" and were thus of Clovis age (Collins 1999:172).

This approach is more intuitively satisfying than statistically informative, for it requires the analyst to assess visually how well defined a scatter of points from an assemblage might be, and the degree to which the scatter from an unknown sample overlaps the scatter of any known groups. Such an approach cannot give a meaningful measure of the distances between scatters; it also cannot help to determine whether such distances are statistically significant, or identify the variables most effective in sorting blades of different ages.

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There are, however, statistical techniques that yield such data, and we applied one of these—discriminant analysis—to the analysis of Clovis and non-Clovis blades. This technique quantitatively separates qualitatively defined groups. Here, metric variables of blades from *known* groups are used to create statistical classification functions. These are first used to classify the known specimens (thus measuring the reliability of the procedure and within-group homogeneity), then to classify specimens of *unknown* affinity into those groups.

The known groups were blades from Clovis (n = 34), Archaic (n = 54), and Late Prehistoric (n = 35) assemblages (data from Collins 1999:Table 6.1; Mallouf 1989; Tunnell 1978). The variables used in the analysis were maximum length, width, and thickness, and platform width and depth. As Collins (1999) notes, other attributes might be useful in distinguishing blades (e.g. curvature), but these data are rarely available.

Group definitions can be created using either all variables or only those that significantly differentiate the known groups (measured by the F statistic). Initially, our analysis incorporated all five variables; of those, only maximum length, width, and platform width proved to significantly discriminate the known groups. But because we lack data on platform width for the Late Prehistoric blades, we excluded this variable from further analyses. Doing so insures specimens of unknown affinity are not classified as Clovis or Archaic, simply for lack of comparative Late Prehistoric data.

The subsequent analysis revealed that Clovis, Archaic, and Late Prehistoric blades could be differentiated by just length and width; thickness did not significantly aid in sorting the three groups. Using just those two variables, Clovis, Archaic, and Late Prehistoric blades proved significantly different; the Mahalanobis distances between the three group centroids are significant (at $p = .001$).

Overall, 87 percent of the known blades (Table 1a) were correctly classified into their actual groups (if morphometric differences were absolute, the figure would be 100 percent). However, classification was least successful (73.5 percent) for the group of Clovis blades. Although this suggests morphometric variation might be greater in Clovis than in non-Clovis blades, it should be

Table 1. Predicted classification of blades of known and unknown affinity, based on discriminant analysis.

	Clovis	Archaic	Late Prehistoric
a. Blades of known affinity			
Clovis	25 (73.5%)	3	6
Archaic	3	51 (94.4%)	0
Late Prehistoric	3	1	31 (88.6%)
b. Blades of unknown affinity, but suspected as Paleoindian			
5GN149	8	30	4
Anadarko	14	7	0
Brookeen	6	23	10
Cedar Creek	4	2	1
Keven Davis	8	0	1
Pelland	5	0	2

noted that the majority (6/9) of the misclassified Clovis blades derive from workshops (Pavo Real and Yellow Hawk), where blades occur in various stages of reduction, and which in one case (Yellow Hawk) lack other technological attributes of Clovis (Collins 1999:159, pers. comm. 2006).

As for the blades of unknown affinity (Table 1b), almost all the Keven Davis specimens (89 percent) are assigned to the Clovis group (except Blade 11 [Collins 1999: Figure 6.13]). The Anadarko, Brookeen, Cedar Creek, and Pelland blades, suspected by various authors to have Paleoindian affinities, all include specimens that fall into the Clovis group. However, Brookeen has relatively few in that group, is statistically less likely to be Paleoindian, and is in a geological context indicative of much younger age.

The 5GN149 specimens were mostly classified with the Archaic blades. Although this suggests this is not a Clovis assemblage, other factors must be considered. This sample is dominated by early-stage forms, discarded blades, and manufacturing failures. The assemblage has fragments of later stage, and more "Clovis-like" blades (in curvature and other non-metric attributes), but for lack of completeness they were not included in this analysis. Presumably the unbroken versions of these were transported elsewhere. Finally, the 5GN149 blades are manufactured of quartzite; its quality and fracture mechanics may have required alterations in the blade technology and may have contributed to morphometric differences from Clovis-age blades made of high-quality chert (and found in caches).

We hope to further this analysis by incorporating data on quartzite blades of known ages and by continuing to investigate the age of 5GN149 and other blade-yielding sites.

We would like to thank Michael Collins for discussions about Clovis blades in general, and the 5GN149 blades in particular. Brian Andrews helped to direct the fieldwork and contributed to the artifact analysis. Work at 5GN149 was funded by the Quest Archaeological Research program at SMU, under permit from the National Park Service; for help with the permitting, we are grateful to Forrest Frost and Adrienne Anderson.

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Paleoindian Quartz Points in Northern Minnesota and Adjacent Ontario

Susan C. Mulholland

Paleoindian projectile points, especially fluted points, are generally made of high-quality lithic materials; most other tool types as well as much debitage from Paleoindian sites are also composed of high-quality materials (Goodyear 1989:1). Specific lithic types can include obsidian, flints, and cherts, and other siliceous rocks, all of which can be flaked with a relatively high degree of control. Quartz crystal also exhibits these characteristics. A few fluted points made from quartz crystal have been reported in Clovis sites such as Lehner and caches like Fenn and Simon as well as later sites (Reher and Frison 1991).

In contrast, bull or vein quartz, in spite of its high silica content, is often considered to be a low-quality lithic material. The massive crystalline nature does not promote uniform and consistent flaking; instead, quartz often fractures along crystal planes and is notoriously hard to work in a uniform manner (Bakken 1997:53). Quartz lithics are often reduced by bipolar technology in order to make expedient flake tools, which are used and then discarded (Bakken 1997:57, 59, 63). Bipolar technology is used to achieve maximum utilization of scarce raw materials and to reduce small nodules to form suitable edges for flaking (Andrefsky 1998:120, 149, 227).

A few fluted quartz points are known from the upper Midwest; most are of quartz crystal. A fluted quartz crystal point is reported from Newcastle from southern Ontario (Roberts 1985:209–11). Another example is reported from Withington in southwestern Wisconsin (Stoltman 1991:257). In contrast, a fluted point in the Neubauer collection in Pine City, Minnesota, is of high-quality vein (not crystal) quartz (A. D. Romano, pers. comm. 2003, courtesy of J. Neubauer). A fourth fluted quartz point from Clark County in central Wisconsin may be crystal quartz or high-quality vein quartz (R. Howell, pers. comm. 2006, courtesy of K. Scearce).

Several examples of unfluted late-Paleoindian points from vein quartz have been reported in northern Minnesota and adjacent Ontario (Mulholland 2003). These unfluted lanceolate points include:

- a base (Figure 1A) from Stonewall Island in Rainy Lake, Minnesota (W. Okstad, pers. comm. 2001);
- a base/midsection (Figure 1B) from Knife Lake, Minnesota (W. Clayton, pers. comm. 2002);
- a complete point (Figure 1C) from Pickerel Lake, Ontario (J. Nelson, pers. comm. 2001);
- a complete point (Figure 1D) from northern Minnesota or northwestern Ontario (William Ross, pers. comm. 2002, courtesy of Muriel Sievert);

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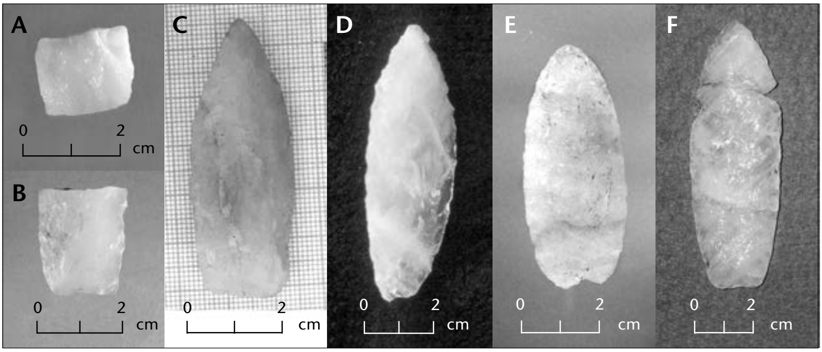

Figure 1. **A,** Point base from Stonewall Island, Superior National Forest collection; **B,** Point base/midsection from Knife Lake, Superior National Forest collection; **C,** Point from Pickerel Lake, Quetico Provincial Park; **D,** Point from northern Minnesota or Northwest Ontario, Muriel Sievert collection; **E,** Point from Basswood Lake, Norman Saari collection; **F,** Point from Sandmoen site, Ministry of Culture collections.

- a complete point (Figure 1E) from Basswood Lake, Minnesota (S. L. Mulholland, pers. comm. 2000, courtesy of Norman Saari);
- a complete point (Figure 1F) from the Sandmoen site on the east side of Rainy Lake, Ontario (Reid 1980:34; K. Sandmoen, pers. comm. 2002; W. Ross, pers. comm. 2005);
- a second complete point from near the Sandmoen site (K. Sandmoen, pers. comm. 2002);
- a complete point from the Rainy River near Baudette, Minnesota (K. Sandmoen, pers. comm. 2002).

These unfluted points, like the Pine City fluted point, are made of higher-quality vein quartz. Some are partially translucent, others are completely opaque, but none are of quartz crystal. These examples demonstrate that some varieties of vein quartz can be flaked to produce fine tools and that crystal is not the only type of quartz that was used by Paleoindians.

Vein quartz can vary greatly in color, translucency, impurities, and arrangement of the constituent quartz crystals. Some types or sources of vein quartz can therefore be expected to have better flaking characteristics than others. Given the general abundance of quartz in the lithosphere, the use of higher-quality types of vein quartz should not be discounted for any time period. The consideration of quartz sources would be especially useful in areas that lack better types of lithic material, such as portions of northeastern Minnesota (Mulholland 2002:71).

The following people provided information on or access to various quartz projectile points: A. D. Romano, Joseph Neubauer, Kevin Sandmoen, William Ross, Jon Nelson, Stephen Mulholland, Walter Okstad, William Clayton, Muriel Sievert, Norman Saari, Ryan Howell, Keith Scearce, Phillip Hyde. Access to the Superior National Forest collections was granted by Walter Okstad, Forest Historian. Information on quartz points in private collections was shared by Joseph Neubauer, Kevin Sandmoen, Muriel Sievert, Norman Saari, and Keith Scearce. This manuscript as well as the preceding oral presentation were greatly enhanced by a review by Stephen Mulholland; discussions with Dillon Carr and Ryan Howell following the presentation were also very helpful. Photographs of points were provided as follows: Stephen L. Mulholland (Figure 1A, 1B, 1E), Jon Nelson (Figure 1C), William Ross (Figure 1D, 1F).

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The James W. Cambron and David C. Hulse Collections: An Avenue for Understanding Paleoindian Occupation in the Mid-South

Meta G. Pike, Scott C. Meeks, David G. Anderson, and Elijah C. Ellerbusch

In late 2004 the University of Tennessee's McClung Museum received a donation of over 38,000 prehistoric chipped-stone artifacts that constituted the bulk of the private collection belonging to James W. Cambron (1920-1982), a well-known and accomplished avocational archaeologist working in the mid-South region of North America (Cambron 1955, 1956; Cambron and Hulse 1960a, 1960b, 1964, 1967, 1975; DeJarnette et al. 1962). In late 2005, the family of David C. Hulse, Cambron's longtime colleague and collaborator,

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followed suit and donated several thousand artifacts from his collection to the McClung Museum. Although avocational collections are sometimes viewed by the professional community as having limited research potential, that is decidedly not the case in these instances. Cambron and Hulse employed high professional standards during their 30-plus years of artifact collecting, including the labeling of each artifact with a binomial catalog number tied to specific site maps, field notes, and/or other detailed locational information (Ellerbusch 2004). Research with the Cambron collection has been underway for about a year, while work with the Hulse collection is just beginning.

The Cambron collection, dating from the Paleoindian through Mississippian periods, contains a total of 404 collections distributed among eight states in the southeastern United States, including Alabama (n = 339), Georgia (n = 3, Florida (n = 1), Kentucky (n = 2), Louisiana (n = 1), Mississippi (n = 1), North Carolina (n = 13), and Tennessee (n = 44) (Figure 1). A total of 54 collections contain bifaces diagnostic of the Paleoindian period, including early (Clovis and Redstone), middle (Cumberland and Wheeler), and late (Beaver Lake, Quad, and Dalton) Paleoindian bifaces (Figure 1). The density of Paleoindian sites in northern Alabama has been well documented (Futato 1982; Meeks 2001) and is considered a core area for the initial colonization of eastern North America (Anderson 1990, 2004; Anderson and Faught 1998).

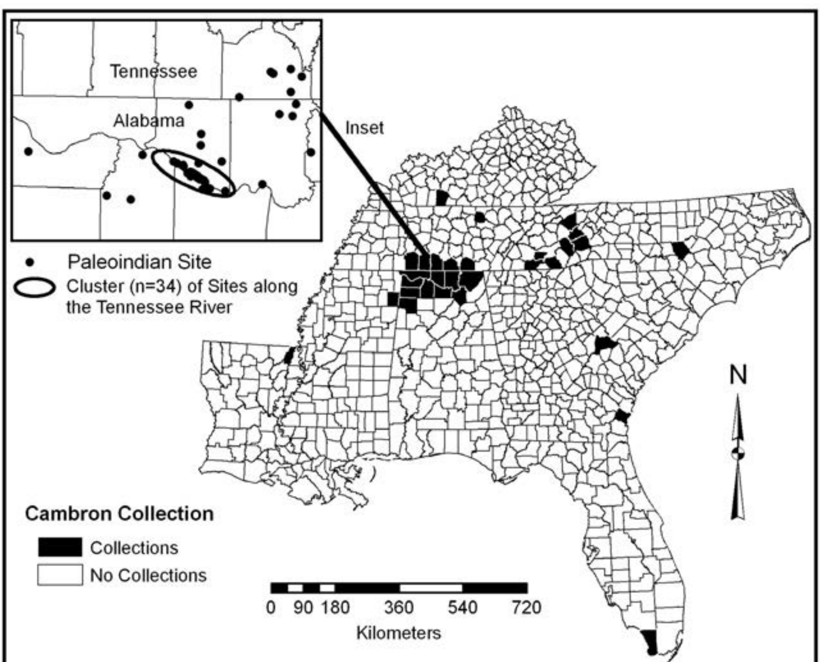

Figure 1. Map illustrating the distribution of the Cambron collections and the locations of collections containing Paleoindian diagnostics (Note: the spatial unevenness in the collections is due to the fact that Cambron concentrated his efforts in northern Alabama during an early survey of the state; adapted from Meeks [2006: Figures 2 and 4]).

Preliminary data for counts of unifaces and bifaces from 102 of the Cambron sites reveal an interesting pattern relating to the organization of lithic technology (Pike 2006). Sites containing Paleoindian diagnostics have much higher average uniface:biface ratios (1:6) compared with sites lacking Paleoindian diagnostics (1:23). These ratios suggest a major shift in the organization of lithic technology through time and are consistent with recent work at Dust Cave in northwestern Alabama, where well-dated shifts in uniface technology between late-Paleoindian and early-Archaic occupations have been documented (Meeks 1994; Randall 2001; Sherwood et al. 2004).

In sum, initial assessment of the Cambron and Hulse collections, with assemblage data encompassing hundreds of sites, verifies their integrity and utility for addressing numerous research questions, including diachronic changes in lithic technological organization, functional organization, land-use practices, and settlement patterning. These collections are particularly important, since Paleoindian assemblages from the mid-South are poorly documented, and unfortunately those in the hands of avocationals are commonly sold or otherwise dispersed upon the death of their owners. This example offers a far better legacy for these materials and for their owners. Ongoing analysis of the collections will be integrated with the Paleoindian Database of the Americas (PIDBA; http://pidba.tennessee.edu) (Anderson et al. 2005), thereby providing a powerful analytical tool for exploring initial human colonization and settlement in the mid-South.

The authors would like to thank Randy George and Bette Hulse Steele for donating the Cambron and Hulse collections, respectively, to the McClung Museum. Funding for the analysis of the Cambron collection was provided, in part, by a grant from the University of Tennessee's Scholarly Activity and Research Incentive Funds (SARIF), awarded to Anderson, Lynn Sullivan, and Jefferson Chapman of the McClung Museum. Jan Simek provided advice and assistance throughout the project, including use of his personal truck to haul the Cambron materials from Alabama to Tennessee.

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Sourcing Quartzites from the Early-Holocene Chance Gulch Site, Gunnison Basin, Colorado: A Pilot Study

Bonnie L. Pitblado, Carol M. Dehler, and Stephen T. Nelson

We initiated a pilot study to evaluate analytical methods for their utility in sourcing quartzite artifacts from the 8000-RCYBP Chance Gulch site, southern Rocky Mountains (Pitblado 2002). Eight quartzite artifacts and twelve quartzite source samples were subjected to techniques that have proved effective in sourcing other stone types: ultraviolet fluorescence (UVF); petrography; X-ray fluorescence (XRF); instrumental neutron activation (INAA); and inductively coupled plasma mass spectrometry (ICP-MS). Over the long term, we aim to use

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quartzite sourcing data to assess how Paleoamericans moved across the quartzite-rich southern Rocky Mountain landscape.

Geochemical techniques have a long track record of accurately assigning obsidian artifacts to their volcanic sources. XRF (Hughes 1994; Shackley 1995) and other techniques (most often INAA, but increasingly frequently, ICP-MS [Speakman and Neff 2005]) have likewise been used to source microcrystalline artifacts, with sometimes excellent results (Lyons et al. 2003; Roll et al. 2005; Warashina 1992). Quartzite tools and debitage have *not* often been subjected to sourcing experiments (but see, for example, the promising case studies of Church [1996], Julig et al. [1987], and Schneider [2004]). Two reasons may be that (a) conventional wisdom suggests quartzites are inherently unsourceable due to their homogeneous and ubiquitous nature, and (b) many archaeologists have sufficient chert or obsidian in their assemblages and therefore have not needed to source quartzite.

With the help of numerous researchers, we analyzed 20 quartzite samples using the 5 aforementioned techniques to explore their power to detect variability among our samples. The Chance Gulch site contributed 8 artifact samples to the study. The remaining 12 samples represent 6 natural quartzite localities. Three of the localities (Quarries 1, 3, and 4) are quartzite gravel deposits within 2 km of the Chance Gulch site (all prehistorically quarried). One locality is a non-quarried Precambrian quartzite outcrop less than 1 km from the site. The other two localities are a gravel deposit in Montrose County, Colorado, and outcrops in the Uinta Mountains, Utah (ca. 100 km and 450 km, respectively, from Chance Gulch).

Our pilot study revealed the following:

- Petrography, INAA, and ICP-MS register differences among Gunnison Basin quartzites and show excellent potential to contribute to larger-scale quartzite sourcing efforts;
- INAA and ICP-MS measured 22 trace elements in common and yielded comparable results; however, ICP-MS detected an additional 38 trace elements that INAA did not;
- UVF and XRF did not register differences among the samples and appear to lack potential to contribute to future quartzite sourcing efforts in the Gunnison Basin;
- although similar in physical appearance, two Chance Gulch flakes are petrographically and geochemically different from all the geologic samples;
- six of the eight Chance Gulch flakes are indistinguishable from geologic samples from local Quarries 3 and 4;
- Quarry 3 and 4 samples are similar to each other, but differ from samples from Quarry 1; yet all three quarries occur in similar depositional settings and in close proximity;
- none of the artifacts or geologic samples remotely resembles a sample from the local Precambrian quartzite outcrop.

The data that underlie our conclusions take two forms: microscopic (qualitative and quantitative) and geochemical (quantitative). Petrography records similarities and differences in sample composition and texture. For example, a point-count of the Precambrian quartzite shows a composition of 62 percent quartz, 35 percent matrix, and 3 percent plagioclase. No other sample had a composition akin to this (most had quartz percentages > 95 percent). Geochemical data derived from INAA and ICP-MS consist of measures of detected trace elements. To compare sample profiles, we developed a statistic "*M*" (Pitblado et al. 2006), which represents an average difference in composition standardized for the mean of each element present. The *M* value for the Precambrian quartzite—for both the INAA and ICP-MS data and vis-à-vis all other samples—was extremely high, indicating a unique trace-element profile.

This is not the venue to present details of our petrographic and geochemical findings (for some of them, see Pitblado et al. 2006). It is important here to emphasize that the results of our pilot study challenge, as a handful of other studies have done, the perception that quartzite is unsourceable. Future investigations must first identify and characterize the range of variability in and among Gunnison Basin quartzite sources through field reconnaissance, sampling, and petrographic and geochemical profiling. Once this has been accomplished, quartzite *artifacts* can be compared with profiled sources to try to determine where tool makers obtained their raw materials. The archaeological goal, of course, is to eventually use the sourcing data to evaluate how Paleoamericans moved across the quartzite-rich southern Rocky Mountain landscape.

The research reported here was funded by National Science Foundation grant SBE-0244922. For their expert analytical and theoretical contributions to our project, we thank Caroline Myer (Department of Geology, Utah State University), Christopher Merriman (Department of Sociology, Social Work and Anthropology, Utah State University), Scott Hughes (Department of Geosciences, Idaho State University), Craig Skinner (Northwest Research Obsidian Studies Lab, Corvallis, Oregon), and Dennis Eggett (Brigham Young University).

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CIEP Residue Analysis of an Alaskan Archaeological Conundrum

Joshua D. Reuther and S. Craig Gerlach

From the beginnings of Alaskan archaeology and the study of the Bering Land Bridge, much of the archaeological research in Alaska has been focused on finding the remains of the initial inhabitants of the New World. The earliest of this research concentrated on establishing the presence of a cultural connection to the oldest archaeological materials found in the southwestern regions of the United States, such as Yuma, Arizona, and Folsom and Clovis, New Mexico. Several finds were reported as having been recovered from late-Pleistocene geological contexts or associated with the remains of extinct mammals, such as mammoth or mastodon (Dixon 1998). However, the archaeological and geological context of these discoveries was often uncertain and the association between extinct fauna and artifacts were highly ambiguous. Archaeological enigmas such as these are present throughout the early Alaskan prehistoric record.

One such conundrum is the case of two lanceolate points reported by Rainey (1939:397, 1940:305) as found in the muck deposits of Ester, Alaska, in association with extinct Proboscidean remains. Peter Maas, an employee of a local mining outfit, the Fairbanks Exploration Company, discovered the artifacts in the Ester Creek area near Fairbanks. Maas reported finding one of the artifacts in situ in a frozen layer of muck, with the butt of one point "embedded" in a maxillary bone of a "mastodon" (Rainey 1939:397-399, 1940:305). This artifact is illustrated in Figure 10, Number 4 in Rainey (1939:395). Dixon

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(1998:54) has reported four ^{14}C dates on two sections of the Proboscidean maxillary bone that range between 11,310 and 12,380 RCYBP. The muck deposits of central Alaska are composed of thick organic-rich silt (loess) deposits that were retransported or redeposited from higher to lower points in a valley throughout the Pleistocene and early Holocene (Pewe 1975). Much of our knowledge on the existence and lifeways of late-Pleistocene and early-Holocene mammals in central Alaska is derived from faunal remains recovered from these deposits (Guthrie 1990).

Hydraulic mining techniques enabled placer miners to cut through thick silt deposits in order to reach the gold-bearing gravels beneath them, exposing numerous late-Pleistocene and early-Holocene faunal remains in the process. Several archaeological specimens were also found within the muck deposits and among faunal material that were originally thought to be of late-Pleistocene age (Dixon 1998; Rainey 1939, 1940). Due to the nature of the hydraulic mining techniques, several deposits are usually crosscut and a potential mixture of materials from older and younger deposits can occur in the wash on the floors of the placer mining excavations; consequently, the stratigraphic placement and ecological context of most of this material are ambiguous.

N. C. Nelson, of the American Museum of Natural History, earlier noted that the mastodon bones showed no signs of modification from butchering or processing activities, and that the association between the bone fragments and the artifact is based solely on Maas's original observation (Rainey 1939:398, Footnote 1). Furthermore, a handwritten note by an unknown author (Anonymous n.d.) located in the archaeological collection files at the Department of Archaeology, University of Alaska Museum of the North, states: "Spearhead and baby mastodon tusks: Found by Pete Maas in Ester Stripping Pit embedded in muck in bottom of drain; all were found within an area of 2 square feet but not together." The note appears to be older than 50 years based on the deterioration and discoloration of the paper and was possibly written during the late 1930s or early 1940s when Rainey was conducting his central Alaskan research. The note calls into question the association of the point with the maxillary bone fragments.

In 1999, the artifact was sent to Margaret Newman, then of Bioarch, Inc., and the Department of Archaeology at University of Calgary, Alberta. Newman employs the crossover-immuno-electrophoresis (CIEP) technique; her laboratory procedures are clearly presented in Newman and Julig (1989) and Newman et al. (1998). Antisera used within the CIEP study included bear, bovine, cat, deer, dog, guinea-pig, mouse, rabbit, sheep, chicken, duck, elephant, horse, rat, caribou, and moose. CIEP analysis resulted in an antibody-antigen reaction between deer and caribou antisera to protein residues adhering to the artifact, but no reaction between elephant and the residues. The reaction of Cervid antibodies to residues adhering to the point adds further support to the observation on the archived handwritten note that the artifact and maxillary bone fragments were not likely associated with one another and suggests that the point was not used in hunting or processing proboscidean. While the reaction of Cervid antisera to residues on the point does not unequivocally prove the association of the point and bone fragments to be false, the results from the CIEP analysis has improved our knowledge on an enigmatic question within the Alaskan archaeological record.

We would like to thank the Otto Geist Memorial Fund Grant and the University of Alaska Museum of the North.

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Revising the Number of Reported Clovis Points from Tulare Lake, California

Michael F. Rondeau

The Tulare Lake locality has long stood as an anomalously large concentration of Clovis points in the Far West (Riddell and Olsen 1969; Wallace and Riddell 1988). In fact, the number of reported Clovis points from Tulare Lake has grown significantly over time to 214 (Hopkins 1991), more than 250 (Hopkins 1993), more than 325 (Jerry Hopkins, as quoted in Stepp [1997]), and more than 370 (Hopkins 1999). Given their importance to research on the peopling of the New World, and given that these specimens are undated surface finds, such claims need to be strongly supported with clear descriptions and with explicit criteria of what precisely makes a Clovis point. Here I present a

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preliminary test case of this issue by evaluating one of the larger Tulare Lake Clovis collections, that of Jerry Hopkins.

A review of the available literature for Tulare Lake (Dillon 2002; Hopkins 1991; Riddell and Olsen 1969; Wallace and Riddell 1988; Wilke 1991) found that criteria for labeling Clovis or Clovis-like points have received little explicit consideration. For the present study, I used a set of criteria to define a Clovis-like point that was based on an extensive literature review (e.g., Collins 1999; Haury 1853; Haury et. al 1959; Hester 1972; Howard 1990; Wormington 1965).

Although the review found that there was significant variability in Clovis points across North America, the following criteria are consistently used to define the Clovis type of projectile point: (1) fluting; (2) lanceolate shape; (3) concave base (deep or pronounced concave base as non-Clovis-like); (4) basal grinding; (5) maximum width at or below the midline; (6) diverging-flute morphology (flutes diverge towards tip in longitudinal view as Clovis-like); (7) fluting platform type (beveled or excurvate margin as Clovis-like versus tiny nipple inset within a concave base as non-Clovis); (8) flute length (two thirds or less the length of the point as Clovis-like); and (9) point size (length at or greater than 45 mm as Clovis-like). These criteria were established, recognizing that it might be necessary to revise this polythetic set as the result of future studies. The logic, details, and application of these criteria are beyond the scope of this brief summary.

Of the 103 reported Tulare Lake Clovis specimens, 8 (7.8 percent) were found to be Clovis-like, according to the above criteria. A ninth specimen was also deemed to be Clovis-like except that it was not fluted. Two other Clovis-like specimens (which show fluting) were from a collection whose origin could not be proved to be Tulare Lake, and a non-fluted specimen turned out to be a flake worked by bipolar percussion. The remaining 91 specimens include 74 non-fluted specimens and 17 fluted specimens that do not appear to be Clovis-like.

These preliminary findings agree with Wilkie (1991), who previously analyzed approximately half of the Tulare Lake collection. Of the 46 specimens that he studied, only three were found to be fluted and only another three were labeled as Clovis-like; ultimately he determined that the collection had closer affinities with the Great Basin Stemmed Series (Wilkie 1991). The collection does not generally fit known California point types; specimens of tapering stemmed and shouldered types are similar to the Stemmed Series and lanceolate-like points found further east, such as Plainview and Midland. The non-Clovis fluted specimens are either too fragmentary to be diagnostic or appear to display features of post-Clovis fluted points found elsewhere in North America.

It thus appears that the reported number of Tulare Lake Clovis points should be revised significantly downward. This in turn means that the actual number of fluted points found in California is likely much fewer than has been reported. There is a strong need to review and reevaluate reported Clovis collections from the Tulare Lake locality.

Jerry Hopkins is commended for his long-term support. Thanks for wide-ranging help with this study goes to Tammara Norton, Darrell Cardiff, Bill Silva, and John Dougherty. Any errors or deficiencies are the responsibility of the author.

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A Possible Folsom-Midland Association in the Northern Rocky Mountains

Matthew J. Root and Leslie B. Davis

Over 30 years ago, George Agogino (1969) questioned whether Midland was a valid complex, arguing that Folsom flintknappers were also the makers of Midland points. Though Midland points are commonly found in Folsom sites

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(Bradley 1982; Frison 1982; Frison and Bradley 1980; Hofman et al. 1990:239; Root et al. 2000; Wilmsen and Roberts 1984), the Midland question lingers (Sellet 1999:108–109, 2001:51–52).

The King site (24GA214) lies along Bear Creek in the East Gallatin River Valley east of Bozeman, Montana. George Arthur (1968) and others (Darroch 1974; Davis 1972) have surface-collected and test-excavated the site since the 1960s, recording thousands of artifacts scattered over a 12-ha cultivated field. All artifacts are from the surface or plow zone. Collections include hundreds of projectile points and thousands of tools and flakes. Most artifacts are made of Madison chert, which crops out 40 km to the west. George Arthur surface-collected a Folsom preform and a Midland point found only 2 m apart, though he did not report the finds. These are the only two early-Paleoamerican diagnostic artifacts from the site.

The Midland point (Figure 1A) conforms closely to the type specimens from the Midland (Sharbauer) site, and all measurements fall within the upper range of the type specimens (Wendorf and Kreiger 1959; Wendorf et al. 1955). The point is of heat-treated Madison chert. It is characterized by

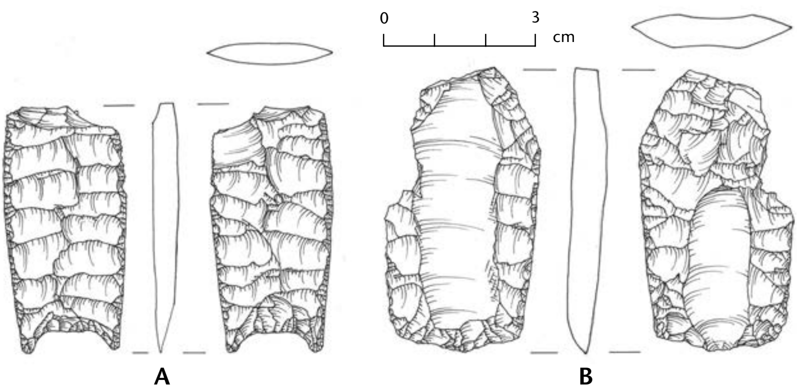

Figure 1. Points from the King site. **A,** Midland point; **B**, Folsom preform.

collateral to slightly transmedial lateral pressure-thinning, pronounced ears, a deeply indented base, marginal microflaking along lateral edges, and heavy lateral edge polish on the haft element. These attributes indicate a close relationship to Folsom technology. The point broke on impact, as evidenced by a snapped tip and flakes that run down both blade faces.

The Folsom preform broke when the knapper detached the second channel flake (Figure 1B). This Madison chert preform is similar in size to large preforms recorded in the Knife River Flint quarry area, another region of abundant toolstone (Root et al. 2000; William 2000). The preform is burnt and dusky red (10R 3/3), but it is unclear whether the red hue is the result of post-depositional burning or heat treatment.

Though the Folsom preform and Midland point are the only two early-Paleoamerican points from this large site, their close spatial association could be coincidental and the points could be from different occupations. Therefore we cannot demonstrate their cultural association with certainty. The Midland point has all the attributes of the type specimens, and technological and morphological attributes are similar to Folsom technology. This is good evidence that Midland points are present in the northern Rocky Mountains, where they may be part of the Folsom complex.

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Clovis Blade Manufacture: Preliminary Data from the Carson-Conn-Short Site (40Bn190), Tennessee

Dennis J. Stanford, Elmo León Canales, John B. Broster, and Mark R. Norton

Excavations at the Carson-Conn-Short (CCS) site in Tennessee have revealed an in situ Clovis horizon yielding over 226 blade cores and 1956 blades and tools made on blades (Broster and Norton 1990, 1993; Broster et al. 1994, 1996; Nami et al. 1996). Since few specific data have been published on the CCS blade technology, this paper provides results of a preliminary analysis of a small reference collection stored in the Smithsonian Institution (NMNH), Washington D.C.

The reference collection contains two "wedge-shaped cores"[1] (cf. Collins 1999) and three sub-conical cores (Figure 1B)[2], all made of locally available sub-rectangular cobbles eroded from the Buffalo River Fort Payne Formation. Flintknappers selected cobbles with natural surfaces suitable for initial core platforms and corners needed to produce primary blades. When necessary, horizontal or oblique flakes were removed to regularize the vertical edge to ensure successful production of long, straight guide blades. Secondary corner blades, identified by cortex on one side of the dorsal surface, were removed sequentially from either side of the guide blade facet. Cortical surfaces remain on the posterior face of the cores, denoting blade production only on the anterior face and sides, and producing a "D," or hoof-shaped, cross section. Platforms for blade production were prepared by removing centripetal flakes from the dorsal surface of the core. Both negative bulbs and blade scars on the core faces are the result of final-stage removals of small blades. Diving blades that truncated the core length terminated blade production on the sub-conical cores in our sample. These cores are 72–82 mm long and 50–70 mm wide.

The largest blade in this collection retains cortex and natural facets on the dorsal face, suggesting it was a primary crest blade removed from an unmodified cobble corner. This blade is 188 mm long, 52 mm wide, and 24 mm thick. Five other blades are 81–164 mm long, 22–52 mm wide, and 8–29 mm thick.

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[1] We use the term "wedge-shaped core" after Collins (1999). They should not be confused with Arctic wedge-shaped cores.

[2] We thank Marsha Bakry for the illustrations.

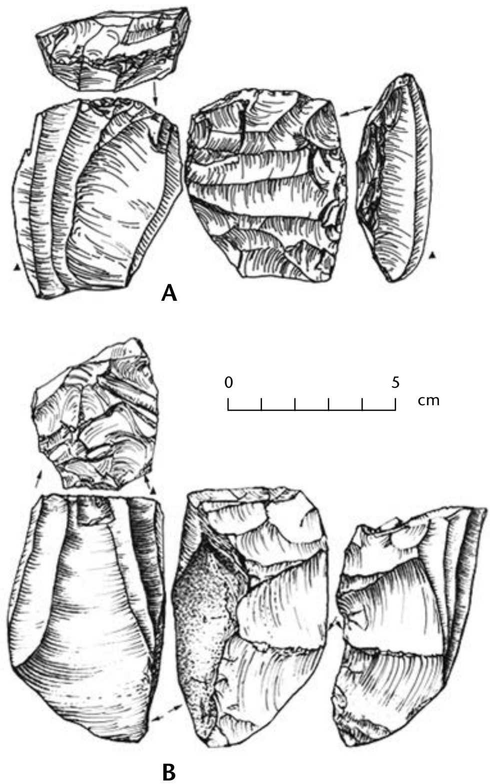

Figure 1. Conical and wedge-shaped cores from the Carson-Conn-Short site (40Bn190), Tennessee.

All primary blades are strongly curved longitudinally, while secondary blades are relatively flat. The blades are triangular to trapezoidal in cross section. The scar patterns observed on the blades and core faces suggest that the CCS flintknappers used a unipolar technique for blade removals.

One of the wedge-shaped cores was possibly modified for tool use (Figure 1A). After bladelets were removed from its anterior face , the core was rotated 90° and thinned by striking additional bladelets from the posterior face. Two of the intersecting acute edges were heavily crushed, suggesting its use as a tool such as an adz. The bladelet scars on this core are 39–59 mm long and 9–15 mm wide.

Although the CCS assemblage fits well within the Clovis assemblages illustrated by Collins (Collins 1999:Table 6.1; Collins and Lohse 2004), further *chaîne opératoire* studies are necessary to assess the complexity and characteristics of the larger sample of Clovis blade cores represented at Carson-Conn-Short.

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Clovis Macro Blades from the Topper Site, 38AL23, Allendale County, South Carolina

Kenn Steffy and Albert C. Goodyear

Because of annual excavations beginning in 1998, the Topper site has provided a wealth of both Clovis and pre-Clovis archaeological data (Goodyear 2005). As of the 2005 season, a total of 444 m^2 of Holocene-age sediments have been excavated. The Clovis occupation lies in the bottom of the deposit dated by two OSL ages of 13.6 ka taken from two different locations. Clovis artifacts have been found in every area of the Topper site including the terrace, hillside, hilltop, and even the Savannah River, where chert was also available (Goodyear et al. 2005). In the 2004 and 2005 seasons, excavations were concentrated on the hill overlooking the terrace, revealing an extraordinarily dense and extensive Clovis lithic assemblage. Several excavation units with Clovis artifacts still in place were viewed during a tour as part of the 2005 Clovis in the Southeast conference (www.clovisinthesoutheast.net). In a previous article (Goodyear and Steffy 2003), we reported on the typological evidence of Clovis points at Topper. Since Topper is a quarry-related site, few Clovis points have been found. However, numerous point preforms in various stages of reduction have been found throughout the site. The recent hilltop excavations have recovered over a dozen point preforms, along with overshot flakes and other artifacts such as prismatic blades, end- and sidescrapers, denticulates, and utilized flakes. These flake tools indicate that craft activities related to habitation were also taking place and not just lithic extraction.

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Here we report on the presence of large prismatic blades which have come to be as diagnostic as Clovis points in Clovis lithic assemblages (Collins 1999). A few cores for the removal of these blades have also been found, which thus far indicate fairly informal reduction strategies. Formal polyhedral-type cores have not been found. Rather, the cores have three or four parallel scars taken from one or more faces resembling a horse's hoof. Large pieces of high-quality homogeneous chert (> 20 cm) may not have been common in the outcrops at Topper, thus restricting somewhat the size of large blade cores and their products.

The blades are typically straight and not curved, have wide striking platforms, and usually have heavy platform grinding. Blade removals are primarily unidirectional. Numerous blade proximals have been recovered with heavily ground platforms, probably indicating failures during detachment. Utilized blade segments are rare. Blade lengths range from 75 to 140 mm (Figure 1). Most of the macro blades appear to be rejects or starter blades for core preparation and are not retouched. Whole macro prismatic blades of Allendale chert have been found in surface collections in Allendale County that have fine unifacial retouch on their margins (Goodyear 2002/2003:Fig.8). The macro blades from Topper link this site to other prominent

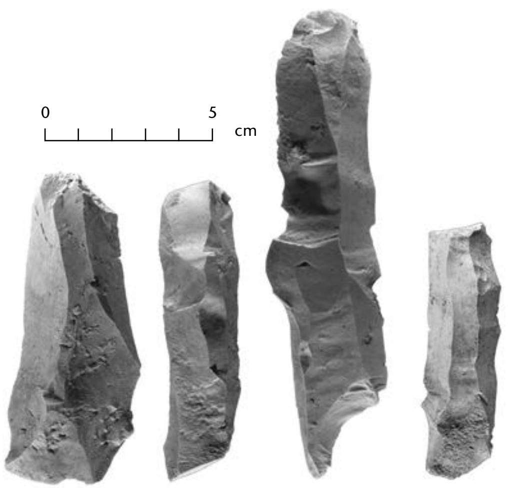

Figure 1. Examples of Clovis macro prismatic blades from the Topper site, 38AL23, Allendale County, South Carolina. Photo by Daryl P. Miller, SCIAA.

quarry-related Clovis sites such as Carson-Conn-Short in Tennessee (Broster and Norton (1996: Fig. 14.3), the Adams site in Kentucky (Sanders 1990), and Gault in Texas (Collins 1999). Excavations planned for the hilltop occupation at Topper in 2006 will no doubt produce many more examples of Clovis prismatic blades, adding to an already impressive and analytically important assemblage of Clovis in this part of the southeastern United States.

We thank the Clariant Corporation, owners of the Topper site, for continued interest and support of our field investigations. The members of the Allendale Paleoindian Expedition who have helped gather these data are gratefully acknowledged. A number of colleagues have examined these blades, and their comments are appreciated. These include Dennis Stanford, Pegi Jodry, Rob Bonnichsen, Mike Waters, Julie Morrow, and David Anderson.

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Late-Paleoindian Occupation of the Gault Site, Central Texas: The Lithic Evidence from the 1991 and 1998–2000 Investigations

John J. Taylor-Montoya

The Gault site is a stratified prehistoric site in central Texas (Collins 2002; Collins and Brown 2000; Collins, et al. 1992). Perhaps best known for the Clovis deposits at the site, Gault also yielded significant late-Paleoindian material. This article reports on late-Paleoindian chipped-stone tools recovered during the 1991 and 1998–2000 field seasons. A total sample of 153 stone tools has been attributed to the late-Paleoindian period at the Gault site. Late-Paleoindian artifacts were found primarily within and immediately overlying an ancient soil (the Royalty paleosol, zone 4). The paleosol is considered to be early Holocene in age (Nordt 2004) and is comparable to similar geological features in the area, such as the early-Holocene Leanne soil at the nearby Wilson-Leonard site (Bousman, et al. 2002; Collins 1998, 2002; Collins and Brown 2000).

Nearly all the early-Holocene-age projectile points (97 percent of 102 total)

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at Gault are made from varieties of Edwards chert. The two exceptions are manufactured on reddish orange jasper and purple quartzite (sources undetermined). Late-Paleoindian points at Gault include five examples of St. Mary's Hall and one point that fits within the Milnesand-Firstview range of variation. Eight Scottsbluff points were also recovered as well as nine Wilson points (an early side-notched variety [Bousman et al. 2002; Collins 1998]). Golondrina-Barber (18) and Angostura (28) points are also prevalent at the site. Most of the Golondrina-Barber and Angostura points show evidence of heavy use and reworking (Figure 1B). Three points that fit the Thrall type were also recovered (see Collins 1998 for a description of the type).

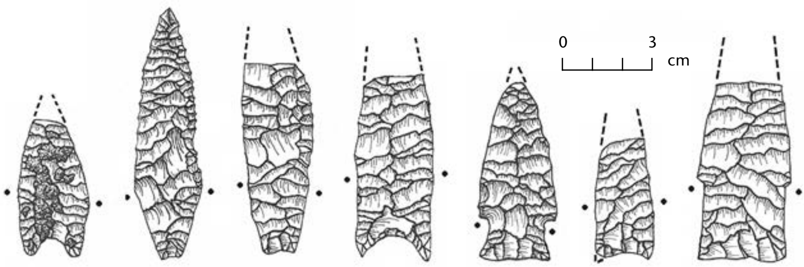

Figure 1. Examples of early-Holocene diagnostics from the Gault site. **A,** Golondrina-Barber (note carbonate encrustation); **B–C,** Angostura; **D,** unique variety of unfluted lanceolate; **E,** Wilson; **F,** St. Mary's Hall; **G,** Scottsbluff. Dots mark extent of lateral grinding.

In addition to the projectile points listed above, 30 specimens (of which 38 percent are fragments) are not easily placed within a particular typological category. These include a set of points that possibly represent a previously unnamed class of projectile point (Figure 1D; see also Collins 2002:37). These points are unique among the late-Paleoindian assemblages at Gault and Wilson-Leonard. More analyses must be completed before any kind of typological definition can be completed.

Other chipped-stone artifacts associated with late-Paleoindian diagnostics are primarily (39 of 51 total) products of Edwards chert available at or near the site. Bifaces and preforms (16) are most numerous, modified flakes (12) are also prevalent; formal bifacial and unifacial tools (e.g., adzes and endscrapers) are relatively rare.

Based on radiometric dates associated with these various point types (Bousman et al. 2002; Collins 1998; Holliday 2000), we can tentatively conclude that late-Paleoindian occupation of the Gault site occurred from approximately 10,000 to 8000 RCYBP. Comparisons of lithic tools and debitage from Gault with assemblages from other Paleoindian sites suggest that the site was used primarily as a lithic workshop during the late-Paleoindian period (Taylor-Montoya 2005). However, on-site use and discard of tools made from local chert implies some level of occupation at or nearby the site. Comprehensive analyses underway promise to shed more light on this topic.

Many people deserve thanks for making this and future analyses of the Gault material possible.

Michael Collins, Jon Lohse, Clarke Wernecke, and all the Gault Project staff provided access to the material, lab space, sage advice, stimulating conversation, and much needed assistance along the way. Thanks to the anonymous reviewers for comments that improved the clarity of this manuscript. Any and all errors or omissions are the sole responsibility of the author. Artifacts from the Gault site are curated at the Texas Archeological Research Laboratory at the University of Texas at Austin. Research for this project was partially funded by an ISEM student research grant.

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A Late-Stage Fluted Biface from the Central Ohio Valley

Andrew A. White

A late-stage fluted biface (Figure 1) was recovered from backdirt contexts during CRM excavations at the Miles site (12-Cl-158) in Clark County, Indiana (White 2002). The biface was discarded subsequent to attempted fluting on both faces, thus preserving information about techniques used during manufacture.

The biface is made from an unidentified chert. The basal edge is beveled and has a well-defined nipple. The distal end is rounded, lightly ground, and beveled. The biface is slightly narrower in the haft area, and at least one of the lateral edges immediately distal to the basal edge has been ground. A conspicuous longitudinal ridge is present on each face. Portions of this ridge are

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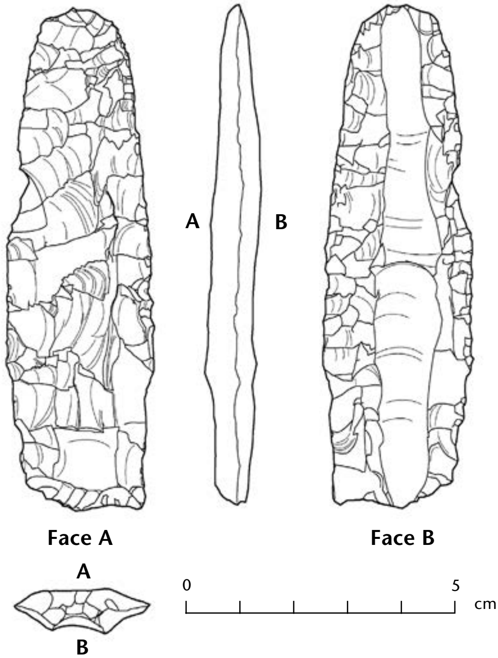

Figure 1. A late-stage fluted biface from the central Ohio Valley (maximum length 86.1 mm; maximum width 28.9 mm; maximum thickness 9.8 mm).

defined by a series of step fractures. The ridge is presumed to demarcate the area intended for removal by fluting.

The flute on face A terminates in a step fracture well short of the midpoint of the biface. Following this failure, the basal edge was beveled and shaped to produce a nipple for fluting face B. This flute extends to about the middle of the biface, where it terminates in intersection with a reverse or "anvil" flute. Based on what is left of the nipple and the ridge, the flute on face B was probably shallower, thus narrower, than intended.

Both the reverse flute and the distal morphology suggest the tip of the biface was placed against an anvil during fluting (Deller and Ellis 1992:32–33; Morrow and Morrow 2002). The distal margin is beveled in the opposite direction one would expect for fluting face B (Flenniken 1978:475), essentially creating a platform for detaching the reverse flute. Based on experimental studies, use of an anvil is generally associated with indirect percussion (Crabtree 1966; Flenniken 1978). The absence of a deep basal concavity, however, suggests fluting could have been accomplished through direct percussion.

The "Folsom" fluting technique (fluting from a central basal nipple) used on the Miles biface is similar to that observed among several varieties of Eastern fluted points (Deller and Ellis 1992; Morrow and Morrow 2002; Roosa 1963; Sanders 1990; Storck 1983). This technique, used to produce points with relatively long flutes, such as Gainey, Barnes, and Cumberland, is generally thought to indicate a post-Clovis age (Deller and Ellis 1992). The overall size and shape of the biface, the fluting techniques employed, and the morphology of the flute scars and intended area of flute removal are consistent with a Cumberland affinity.

The lateral margins of face B have been trimmed by unifacial flaking. The biface may have been used as a knife following the unsuccessful fluting attempts. Such a secondary use, either by Paleoamericans or later peoples, would be consistent with its presence in a site assemblage that has produced no other evidence of Paleoamerican fluted biface production. The dominant component at the site is late Archaic.

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Westfall: Non-local Lithics at a Folsom Workshop/ Camp Site

Emily G. Williams, Shannon R. Ryan, and Jack L. Hofman

The majority of documented Folsom site assemblages are dominated by non-local, exotic lithic materials (Hofman 1991). Exceptions include Folsom components near lithic source areas such as reported in North Dakota and Colorado (Root et al. 1999; Stiger 2006; Surovell et al. 2003). The Westfall Folsom site is a workshop/camp site dominated by a local source of Black

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Forest silicified wood (BFSW) in Elbert county, Colorado. This material composes 94.7 percent of the assemblage (n = 2,122), with the remaining 5.3 percent (n = 113) composed of non-local, non-BFSW materials. Therefore the Westfall Folsom site provides an important opportunity to evaluate toolkits and possible activities of people at a source of high-quality lithic material, and to examine the use and representation of non-local lithic materials in such a setting. Research at other camp/quarry sites, such as those at the Knife River Flint source area near Lake Ilo, North Dakota (Root 2000; Root et al. 1999; William 1999), can serve as a comparison for analysis of the Westfall Folsom site's non-local lithic materials. This paper provides an inventory of the non-local lithic materials at Westfall, which sheds light on how these Folsom peoples were moving across the landscape.

The non-BFSW lithic materials at the site include the following: Alibates (5.6 percent); basalt (0.8 percent); clear chalcedony (6.4 percent); Dakota quartzite (16 percent); White River Group silicates (WRGS) (16 percent); quartz (1.6 percent); quartzite and ortho-quartzite (19.2 percent); Tongue River silicified sediment (TRSS) (0.8 percent); unidentified cherts (22.4 percent); and "probable" WRGS (11.2 percent). Background information on most of these materials can be found in Banks (1990), Holen (2001), and Hoard et al. (1993).

The non-local and non-BFSW lithic materials that occur predominantly as Folsom tools in the Westfall Folsom site assemblage are Alibates (6 modified pieces/1 flake), clear chalcedony (4/4), WRGS (15/5), and ortho-quartzite (2/0). All the other non-local lithic materials are primarily represented at the site as debitage and non-diagnostic flake tools.

Non-local artifacts at the Westfall Folsom site are derived from source areas located to the north/northeast and southeast (Table 1). From the north/northeast the nearest source of WRGS is Flattop Chalcedony near Sterling,

Table 1. Origin of lithic materials from the Westfall Folsom site.

Source	Distance (km)	Direction from site	Folsom diagnostics	Post-Folsom diagnostics
Alibates	440	southeast	2	—
Dakota quartzite	240	southeast	—	—
clear chalcedony	?	?	2	—
WRGS	190	north/northeast	7	2
"probable" WRGS	200+	north	1	—
BFSW	local	—	48	1

Colorado. The source areas for Alibates and Dakota quartzite are southeast of the site (Alibates in the central panhandle of Texas, and Dakota quartzite from southeast Colorado). All these sources lie about 200–400 km from the Westfall Folsom site. This is in contrast to the remaining non-BFSW lithic materials, which are represented primarily by debitage and occur at shorter distances from the Westfall Folsom site. We assume that these non-BFSW materials, which include Folsom diagnostics, are primarily the product of Folsom activity at Westfall. Later components are represented by a stemmed dart point (of silicified wood) and two notched arrow points manufactured from WRGS. These later components, judging by the rare diagnostics (Table 1), are assumed to have been ephemeral.

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Paleoenvironments: Plants

Poaceae Pollen Grain Size Frequency Data Infer the Probable Presence of Wild Rice in Northeast Minnesota during the Late-Paleoindian Period

James K. Huber

As part of a continuing study of a core from Shannon Lake, St. Louis County, Minnesota, to aid in understanding Native American occupation in the area, new palynological data were discovered indicating the probable presence of wild rice during the late-Paleoindian period (10,500–7000 yr B.P.). Shannon Lake is approximately 40 km west-northwest of Virginia, Minnesota (92° 58′ 18″ N, 47° 37′ 48″ W). A prehistoric archaeological site is located on Shannon Lake.

The lowermost portion of the Shannon Lake pollen diagram has been divided into two pollen-assemblage zones representing the late glacial and early postglacial vegetational history of the area (Huber 2000). Zone SL-1 is comparable to the Compositae-Cyperaceae Assemblage Zone (< 10,500 yr B.P.) of Cushing (1967), indicating a tundra-type environment. Zone SL-2 is comparable to the *Picea-Pinus* Assemblage Zone of Cushing (1967) suggesting a boreal forest. The age of Zone SL-2 is 10,500 yr B.P. to approximately 8000 yr B.P.

McAndrews (1969) used the wild rice grain-size frequency in addition to percentage data to establish the expansion of wild rice in Rice Lake, Becker County, Minnesota. For comparison of size frequencies between wild rice (*Zizania aquatica*) pollen and fossil grass (Poaceae) pollen in a manner similar to that of McAndrews (1969), 100 wild rice grains were measured in each of seven reference slides. Pollen grain-size frequency was calculated for the 700 wild rice grains, and 90-percent confidence limits were determined. Based on reference pollen grains, the average size of a wild rice pollen grain is 35 µm, range is 28–46 µm, and 90-percent confidence limits are 28 µm and 41 µm. In northern Minnesota, the majority of wild grasses other than wild rice are less than 30 µm in diameter but range from 15 to 70 µm. Following McAndrews (1969), the long axis of each grass pollen grain identified in the Shannon Lake slides was measured, and size frequencies for each slide were calculated (Figure 1).

From 14 to 77 percent of grass pollen grains fall within the 90-percent confidence limits range, except for the 710-cm and 785-cm levels, which have

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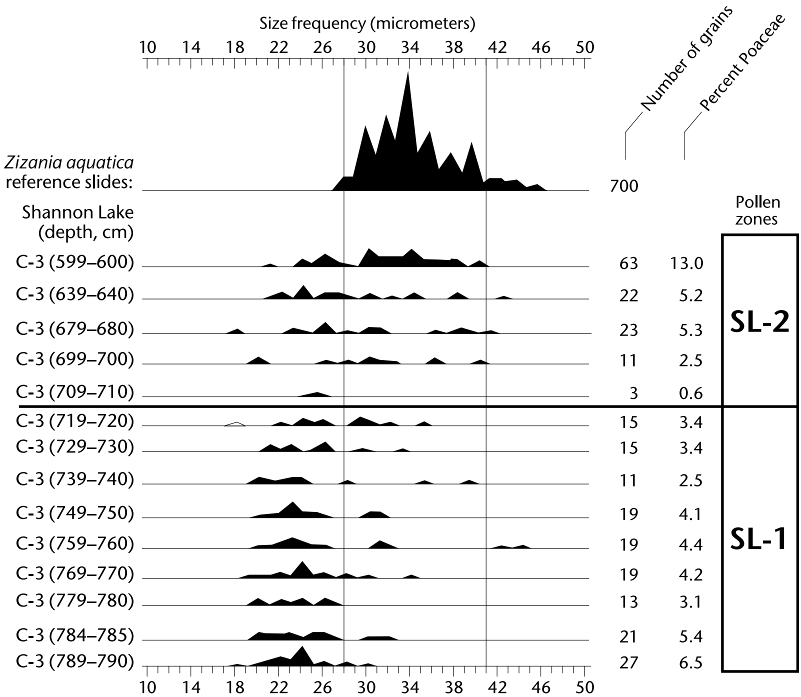

Figure 1. Comparison of *Zizania aquatica* (wild rice) with fossil Poaceae (grass) pollen grain-size distributions of core samples from Shannon Lake, St. Louis County, Minnesota. Poaceae percentages and pollen zones are also shown.

no pollen grains of either wild rice or grass within the 90-percent confidence limits. The grain-size distribution data for Shannon Lake indicate that it is highly probable that many of the grass pollen grains were derived from wild rice beginning at the base of the core (Figure 1). Wild rice was probably present in small stands in Shannon lake by the 770-cm level, where the quantity of grass grains within the 90-percent confidence limits exceeds 20 percent. Based on correlation of the Shannon Lake pollen zones to those established by Cushing (1967), wild rice was probably established in Shannon Lake and available for human consumption by the late-Paleoindian period at approximately 9000 yr B.P.

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Paleoenvironments: Vertebrates

Perote, A New Mammoth Locality in Veracruz, Mexico

Joaquín Arroyo-Cabrales, Luis Morett A., Mario Navarrete, and Agustín Ortega

Since the 1960s the National Institute of Anthropology and History (INAH by its Spanish initials) has focused on investigating mammoth findings brought to its attention in order to determine possible association of those remains with human presence, evidenced by either the existence of lithics or bone modifications (Arroyo-Cabrales et al. 2003a; Lorenzo and Mirambell 1986). By 2003, 271 localities had been reported with mammoth remains. Only two were from the state of Veracruz (Arroyo-Cabrales et al. 2003b), but recently remains from an adult mammoth were reported from Maltrata (Serrano L. and Lira L. 2005).

A new finding reported in 2005 is from near the small town of Sierra de Agua, about 9 km east of Perote, Veracruz. The locality is located in the foothills of the Cofre de Perote volcano that constitutes the northeasternmost border of the Mexican Transvolcanic Axis. It is at the rim of the Oriental Basin, an area potentially important for investigating Pleistocene peopling (L. Mirambell, pers. comm. 2006). The current vegetation is pine and oak forest.

Local people discovered the specimen when using a backhoe to search for loose volcanic ash deposits used to produce construction bricks. They recovered several complete bones as well as fragments. Eventually part of that collection was deposited at the office of the Municipality president. Personnel from Universidad Veracruzana and later from INAH were invited to visit the locality.

The fossiliferous deposit seems to have been formed in an old channel, whose course can be followed in the field (Figure 1). A similar channel exists about 100 m east of the locality. The material is in the middle of large ash deposits formed by a lahar (a mud flow caused by volcanic activity). The mammoth may have been an isolated individual caught in the channel and transported by the lahar flow.

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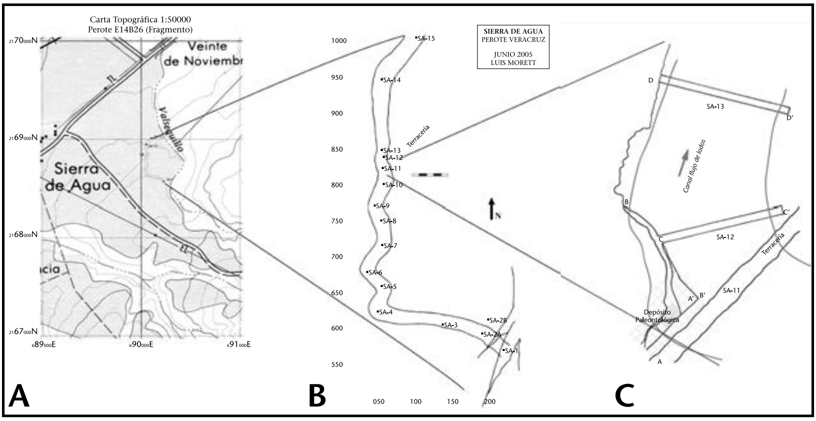

Figure 1. A, Topographic map (INEGI, E14B26) showing the excavation site at Sierra de Agua, Perote, Veracruz, México; **B,** Paleochannel reconstruction based on several topographic stations (SA); **C,** Excavation unit.

The individual is a young adult identified as the plains mammoth *Mammuthus columbi.* It is represented by two mandibular rami, two tusk segments, a left femur, both tibiae, a right humerus, and several vertebrae and ribs. The specimen was lying over its ventral portion; most likely, the left front limbs are still buried in situ. Currently, the elements are being preserved and prepared for a temporary exhibition in Perote.

We are grateful for support from personnel of the Municipality of Perote personnel and archaeology students from the National School of Anthropology and History.

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Faunal Remains from Lime Hills Cave, SW Alaska

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Lime Hills Cave is located in the Kuskokwim drainage near Lime Village, Alaska. Excavations in 1993 and 1995 produced about 55 artifacts, primarily associated with an early-Holocene Denali-period occupation dating between about 10,000 and 8000 RCYBP (Ackerman 1994, 1995, 1996). Over 30,000 faunal remains were also recovered. Most of these specimens are from mammalian taxa with smaller numbers of bird, fish, and gastropod remains.

The 43 radiocarbon dates cluster roughly into five sets at ca. 38,500–28,000, 16,000–12,500, 11,000–7500, 5000–2300, and 500–200 RCYBP. The first group is part of the middle-Wisconsinan or Karginski interval (Anderson and Lozhkin 2001), or the late part of oxygen isotope stage 3 (Van Andel 1998). These dates were recovered only from stratum 5, the deepest of the cave's five strata. The second cluster falls within the cool Oldest Dryas to warm Bølling-Allerod intervals (Stuiver et al. 1995) and is associated with both strata 5 and 4. The third group corresponds to the pre-Boreal and Boreal periods of the early Holocene (Iversen 1973; Stuiver et al. 1995) and is associated mostly with stratum 3, which yielded 44 of the site's 55 artifacts. The fourth and fifth set of dates come from strata 2B, 2A, and 1, with the most recent dates obtained on disbursed charcoal dated 220 to 490 RCYBP. The AMS dates on bone are more consistent with the inferred depositional chronology of the cave's five strata: middle Wisconsinan and the early part of late Wisconsinan for stratum 5, late Wisconsinan for stratum 4, early Holocene for stratum 3, and middle to late Holocene for strata 2B, 2A and 1. Gaps in the ^{14}C chronology occur from about 28,000–16,000, 7500–5000, and 2300–500 RCYBP. It is unclear if these gaps reflect actual depositional hiatuses or result from the ^{14}C sampling strategy, which focused on dating the archaeological components.

In all, 39 mammalian taxa were identified. Extinct taxa include: horse (*Equus* sp.), bison (*Bison* sp.), western camel (*Camelops* cf. *hesternus*), and woolly mammoth (*Mammuthus primigenius*). Six species occur in other parts of the arctic/subarctic but are no longer found near Lime Hills Cave: collared lemming (*Dircrostonyx torquatus*), yellow-cheeked vole (*Microtus xanthognathus*), boreal red-backed vole (*Clethrionomys gapperi*), northern flying squirrel (*Glaucomys sabrinus*), tundra hare (*Lepus othus*), and arctic fox (*Aloplex lagopus*). Also identified were 14 avian, 9 fish, and 3 gastropod taxa.

Tundra/alpine mammalian species are more abundant in the lower strata and decrease over time in relation to boreal taxa. This pattern results from reduced tundra/alpine habitat and expansion of shrubs and boreal forests during deposition of strata 3 and the lower portion of stratum 2.

Greater taxonomic richness associated with the early-Holocene Denali occupation of stratum 3 suggests a more stable, predictable, and productive environment (Karieva 1994; Pielou 1975) with a complex vegetation mosaic and a larger

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number of niches available for mammalian taxa than occur in the region today. This paleoecological setting would have provided a productive hunting territory for the Denali-period occupants of Lime Hills Cave and facilitated the expansion of terrestrial-adapted hunters across the arctic interior.

We owe debts of gratitude to too many individuals to list here, but wish to thank the staff of those institutions that provided comparative material for our identifications. These institutions are: 1) the Conner Zoological Museum at Washington State University; 2) the Burke Museum at the University of Washington; 3) the University of Alaska Museum; 4) Pacific Identification; and 5) the zooarchaeology laboratory in the Department of Anthropology, Washington State University. Anthony Ruter's (1999) work on the site stratigraphy and pollen sequence is invaluable for our understanding the cave's depositional history. Diana Georgina (2001) did the preliminary identifications on a portion of the data presented here.

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Dietary Diversity of *Hippidion* in Western Argentina

Alejandro García, Eduardo Martínez Carretero and María A. Dacar

Within a plan of studies on paleodiet and the extinction of Pleistocene fauna of western Argentina (Dacar et al. 2001; García 1999, 2003), analyses of coprolites attributed to *Hippidion* sp. from the sites Los Morrillos (31° 43′ S, 69° 42′ W, 3000 m a.s.l.) and Gruta del Indio (34° 45′ S, 68° 22′ W, 660 m a.s.l.) contributed important information about the diet of this extinct species. Microhistological studies were made of 3 coprolites from Los Morrillos and 12 from Gruta del Indio, and results were compared in order to determine the level of coincidence of the dietary components. Feces were extracted from sedimentary levels of relatively similar age: the lowest level of Los Morrillos, dated to 27,530 ± 1800 RCYBP (A-2930) (Gambier 1985); and level 9 of Gruta del Indio (García 2003), dated to between 28,670 ± 720 (Level 8; LP 1072) and 30,200 ± 800 (Level 10; LP 929) RCYBP.

The paleoecological records of Los Morrillos and Gruta Del Indio show vegetation reflecting conditions of the Puna-Monte transition and Monte, respectively, both of them very similar to those visible at present around the two sites. Therefore diets were expected to be alike, at least at the functional-type level (woody or herbaceous). Nevertheless, results indicate a marked intrasite similarity and intersite difference in the diets of individuals of the same species.

The feces of Gruta del Indio (Table 1) indicate a diet based mainly on

Table 1. Specific composition of analyzed coprolites of *Hippidion*.

	Gruta del Indio	Los Morrillos
■*Senna aphylla*		
■*Prosopis flexuosa*		
▼*Pappophorum caespitosum*		
■*Acantholippia seriphioides*		
■*Capparis atamisquea*		
■*Schinus fasciculata*		
▼*Chenopodiaceae*		
■*Fabiana peckii*		
■*Ephedra breana*		
▼*Descourania* sp.		
▼*Stipa frigida*		
▼*Hordeum* sp.		

■ woody plants
▼herbaceous plants

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ligneous plants such as *Prosopis flexuosa* and *Senna aphylla*, complemented by other woody plants (e.g., *Schinus fasciculata* and *Capparis atamisquea*) and, to a lesser extent, some herbaceous plants (*Pappophorum caespitosum* and *Chenopodiaceae*). As expected, these data indicate a strong dependence on the woody plants that predominated the environment.

Coprolites of Los Morrillos, however, show a preferential consumption of grasses (mainly *Stipa frigida* and *Hordeum* sp., which constitute 70 percent of the analyzed samples). This correlates with a more humid microenvironment, presumably wetlands (*vega)* (Martínez Carretero et al. 2004).

According to our results, on a regional scale *Hippidion* did not have a specialized diet. Instead, its feeding habits varied a great deal over a few hundred km (the distance between the two sites is ca. 300 km)of the extant environment. In the case of Los Morrillos, it has been suggested that there could have been a differential, non-competitive use of the environment by *Hippidion* sp. and *Megatherium* sp. (Martínez Carretero et al. 2004), which might have affected the composition of the diet of *Hippidion* on a local scale.

In any case, the ability to diversify its diet would be an adaptive advantage that would help to explain the survival of *Hippidion* in Gruta del Indio until ca. 9000 RCYBP (García and Lagiglia 1999). It also suggests the feeding habits of Pleistocene megafauna were more varied than is commonly thought.

This research is supported by grants from UNSJ and UNCuyo.

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Taphonomic Processes Associated with the Merrell Local Fauna (Pleistocene, Rancholabrean) in the Greater Yellowstone Ecosystem, Centennial Valley, Southwestern Montana

Christopher L. Hill

The Merrell Local Fauna (MLF), recovered from sedimentary deposits near the Red Rock River within Centennial Valley in southwestern Montana, comprises four classes of taxa: Osteichthyes (bony fish), Aves (waterfowl), Amphibia (amphibians), and Mammalia (Dundas et al. 1996; Hill and Davis 2005; Hill 2006). The locality demonstrates the diversity of the Rancholabrean fauna within the Greater Yellowstone Ecosystem. Finite radiocarbon ages obtained from 13 direct radiocarbon measurements made on bone range from 49,350 ± 1500 RCYBP (Beta-116519) to 19,310 ± 90 RCYBP (Beta-77826). Several measurements indicate some remains are > 52,800 RCYBP (see below). The faunal assemblages that form the MLF have been affected by a variety of taphonomic processes resulting from pre-burial deposition, burial, and post-burial events.

Stratigraphic contexts and sedimentologic facies associated with the MLF reflect variability in depositional and post-depositional processes, providing information on the factors leading to the accumulation of the fossils. Five strata have been recognized (Figure 1). Vertebrate remains found within stratum A are usually rare and isolated, except near its contact with stratum B. An example of an isolated find within stratum A is a patella of a proboscidean

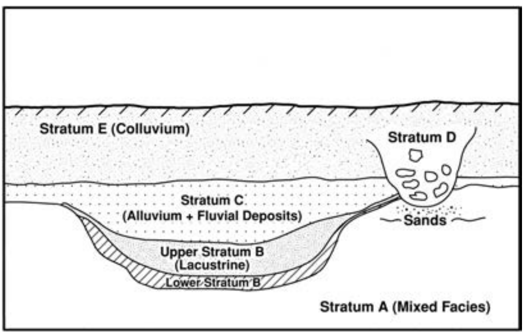

Figure 1. Generalized stratigraphy at the Merrell locality. The oldest set of deposits is stratum A, which contains alluvial, lacustrine, and possibly colluvial sediments. Stratum B consists of organic-rich sediments deposited in a bog or swamp. Silts, sands, and gravels from Stratum C mostly represent alluvial deposition. Stratum D is chiefly composed of a debris flow; it overlies a sandy facies of stratum A. After strata A–D were deposited, they were affected by soft-sediment deformation—liquefaction, and faulting. The youngest depositional unit, designated stratum E, consists of colluvium. There is evidence of extensive bioturbation in stratum E and in parts of stratum C.

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(cf. *Mammuthus*). It is likely that some of the fossils found within stratum A, especially near its upper contact with stratum B, have been moved by post-depositional events.

The first taphonomic context in which there are higher frequencies of vertebrate bones is along the interface of strata A–B and in the lowest part of stratum B. There are no articulated specimens, but there are concentrations of bones, tusk, and teeth of mammoth. Other faunal materials from this taphonomic context include *Ondatra zibethecus* (muskrat) and bivalves. These may include bones that first accumulated on the surface of stratum A then were buried within stratum B, as well as elements that accumulated during the deposition of stratum B. Radiocarbon measurements, if reliable, suggest that this taphonomic context contains a temporally mixed assemblage. Fragments of mammoth teeth were dated at > 52,800 RCYBP (SR-6012, SR-6013), while ^{14}C ages on tusk fragments are 32,470 ± 270 RCYBP (Beta-111325) and 23,120 ± 1190 RCYBP (SR-6014). These could reflect a taphonomic context associated with surface exposure within a small basin and burial in or incorporation into a marsh.

The alluvial deposits of stratum C also contain vertebrate remains, including limb bone, tooth, and tusk fragments of mammoth, and fragments from *Camelops* (camel), *Equus* (horse), *Canis latrans* (wolf), a large artiodactyl, *Lemniscus curtatus* (sagebrush vole), Pisces (fish), and Anatidae (duck). The ^{14}C age on camel is 30,400 ± 590 RCYBP (SR-6018). These fossils are distributed throughout the sequence of stratum C, within gravels and sands interleaved with silt-dominated sediments. Thus these vertebrate remains represent a taphonomic context primarily associated with fluvial transport and burial.

A third taphonomic context is associated with the faunal assemblage from stratum D, consisting of a fine-grained matrix with cobbles and bones, interpreted as a debris flow. Most of the faunal material consists of remains of mammoth (tusk, teeth, and bones) as well as some elements of *Equus* (horse) and *Bison* (bison). Based on the ^{14}C ages, this assemblage is temporally mixed. Fragments of mammoth and horse bone have measurements indicating ages of > 52,800 (SR-6016, SR-6017). Bone collagen ages range from 26,630 ± 190 RCYBP (SR-6015) to 19,310 ± 90 RCYBP (Beta-77826).

The depositional variability reflected in the stratigraphic record indicates that the MLF consists of faunal assemblages that are the result of at least three different taphonomic contexts. The dispersal, scattering, and accumulation of bones associated with strata A–B appear to have occurred in a marsh-pond basin. Transport, deposition, and burial of skeletal parts recovered within stratum C were the result of hydraulic events associated with fluvial conditions. The concentration of mammoth fossils in stratum D occurs within a debris flow. Subsurface movements—post-depositional crushing by sediment overburden along with liquefaction and faulting—have also affected the character of the MLF. Horse remains are associated with both fluvial and debris flow deposits. Camel and wolf remains have been identified from alluvial contexts, while bison was recovered only in association with the debris flow. All three taphonomic contexts contain evidence of mammoth.

These findings suggest that the Pleistocene faunal assemblages are the product of shifting local depositional environments and erosional events. Some animals may be directly linked to paludal or lacustrine contexts (e.g., stratum B). Taphonomic contexts also indicate some faunal materials have been affected by erosion, transport, and redeposition, resulting in temporally mixed assemblages (within strata B–C, Figure 1). Based on the radiocarbon measurements and stratigraphy, the vertebrate remains indicate that some fauna may have been part of the Greater Yellowstone Ecosystem since at least the Last Glacial Maximum. The faunal inventory includes extinct taxa (e.g., *Mammuthus*, *Camelops*, *Equus*) as well as biotic elements that are found in the present Greater Yellowstone Ecosystem, for example, trumpeter swan (*Olar buccinator*), sagebrush vole, muskrat, beaver (*Castor canadensis*), coyote (*Canis latrans*), wolf, bear (*Ursus* sp.), and bison.

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Evidence of a *Bison antiquus*–size Cline on the Southern Plains

Patrick J. Lewis, Eileen Johnson, Briggs Buchanan, and Leland Bement

Editor's Note: This paper was originally submitted for publication in 2003 (Vol. 20, pp. 103–105). At some point during the review and editing process, however, the text of this paper was inadvertently exchanged with that of an already published paper by the same authors. This earlier paper was published in 2001 (Vol. 19, pp. 108–110).

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A north-to-south morphocline for late-Quaternary bison has been proposed by different researchers (McDonald 1981; Wilson, 1974), who suggest this morphocline extends from the modern species *Bison bison* (van Zyll de Jong 1986) into the past to late-Pleistocene *Bison antiquus/occidentalis* (McDonald 1981). Changing climates, small sample sizes, questionable dates, and widely dispersed samples associated with the bison, however, have made it difficult to determine the extent and magnitude of this size cline, particularly in regional detail. Research on size variation through the late Quaternary in bison metatarsals from the Lubbock Lake Landmark and Cooper sites on the Southern Plains, however, suggests that a north-to-south size cline may be detectable (Lewis et al. 2002).

This research examines three *Bison antiquus* populations from the Southern Plains to determine size variation in the region at ca. 10,200 yr B.P./early Holocene. The bison populations are from Bonfire Shelter (10,230 yr B.P.) from southwestern Texas (Dibble and Lorrain 1968), the stratum 2 population from the Lubbock Lake Landmark (10,800–8600 yr B.P.) on the Southern High Plains (Johnson 1987), and Cooper (10,050 yr B.P.) from western Oklahoma (Bement 1997). Sample sizes are: Bonfire Shelter, n = 5; Lubbock Lake stratum 2, n = 19; Cooper, n = 13. These populations provide examples of ancient bison from the northern and southern extremes of the Southern Plains, as well as from a point between the two extremes.

Metacarpals were used for this analysis due to large sample size, functional significance, and morphological conservatism. The use of metacarpals also tested the pattern found in the metatarsals in prior research (Lewis et al. 2002). Only length was used to examine size variation in the three populations. The sample was limited to males (Lewis et al. 2005) owing to the lack of intact metacarpals representing females in the Bonfire Shelter sample. Length was measured at the extremes using an osteometric measuring board. A boxplot was then generated, and data were tested with ANOVA for significant differences in size.

The most southerly population, from Bonfire Shelter, was the smallest of the three populations examined, and the Cooper site population was the largest (Figure 1). Using an α of 0.05, the three sites were found to be significantly different ($P = 0.05$). A post-hoc pairwise ANOVA for the three

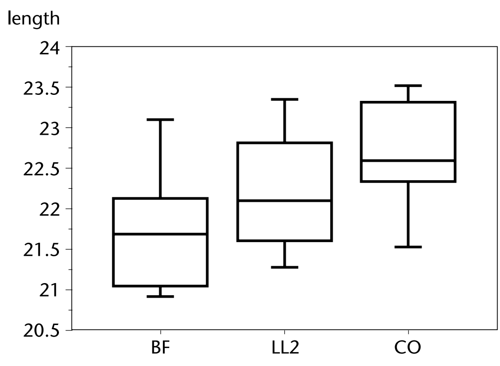

Figure 1. Male metacarpal lengths (cm) for the three ancient bison populations studied, with median, 75th percentiles, and 90th percentiles depicted (**BF,** Bonfire Shelter; **LL2,** Lubbock Lake stratum 2; **CO,** Cooper).

sites showed this result to be due to the difference between Cooper and Bonfire Shelter (P = 0.02), but no combination of sites was significant when using the Bonferroni correction (Sokal and Rohlf 1995) for multiple tests ($\alpha = 0.017$). This result underscores a size gradient among the three localities.

Results indicate that a north-to-south size cline existed during the early Holocene on the Southern Plains. Significantly smaller bison were present at the southern edge of the Southern Plains, while increasingly larger bison were present farther north. Current research is expanding on these results to look at ancient bison of both sexes at several Southern Plains localities using a variety of measurements.

Thanks are due to the VP Lab of the Texas Memorial Museum (Austin) for the loan of Lubbock Lake stratum 2 bison metacarpals recovered during the Evans and Meade explorations in the late 1940s to early 1950s and access to the bison remains from Bonfire Shelter. The additional Lubbock Lake stratum 2 bison metacarpals were collected under TAC permit #36 to the Museum of Texas Tech University (Lubbock). They are housed at the Museum of Texas Tech University and held-in-trust for the people of the State of Texas. The Cooper material is housed at the Oklahoma Archeological Survey (Norman). Research was funded by the Museum of Texas Tech University as part of the ongoing Lubbock Lake Landmark regional research program into late Quaternary climate and paleoecology of the Southern Plains.

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Sexing Cooper Bison Metapodials: A Test of the PCA Method

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Several published methods of sexing bison metapodials are available (e.g., Bedord 1974, 1978; Duffield 1973; Lewis et al. 2005; Walde 1985), but none has been tested on fossil specimens of known sex to assess their accuracy. In a recent examination of sexing methods using metapodials (Lewis et al. 2005), element length, mid-shaft width and breadth, and proximal width have yielded a confident assessment of *Bison bison* sex employing a principal components analysis (PCA). While PCA appears reliable for distinguishing male from female bison metapodials in modern *B. bison,* it remains untested whether the method works for distinguishing the sex of *B. antiquus* metapodials. The ability to test the PCA method on extinct bison necessitates specimens of known sex such as at the Cooper site in Oklahoma (Bement 1999). Many of the individuals are known from articulated skeletons that allow an independent assessment of sex from cranial characteristics.

A total of 41 *Bison antiquus* metacarpals and 34 metatarsals recovered from the Cooper site formed the sample for this analysis. Four male and four female metacarpals and two female metatarsals were of known sex based on associated material. One side of each element was used per individual to avoid weighting those individuals with both sides present; the right element was selected when both were available. Distal width, mid-shaft width, and proximal width and breadth measurements were generated for each specimen using sliding digital calipers. Only complete specimens could be included in the multivariate analysis due to the requirements of the tests, and all specimens were from individuals at least three years old based on epiphyseal fusion patterns (Bement and Basmajian 1996).

A principle components analysis (PCA) based on metacarpals has found distinct clusters for each sex (Figure 1). As with modern bison, the sexes differ primarily according to size and, therefore, along PC1. The known male specimens form one cluster, while the known female specimens form a distinct second cluster. Specimens with positive PC1 values are females, while all males in the test have negative values for PC1. The male and female clusters are distinct and non-overlapping, allowing the unambiguous assignment of

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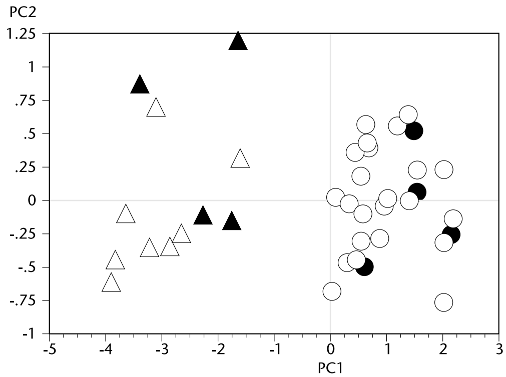

Figure 1. A plot of PC1 scores on PC2 scores, indicating distinct clusters of male (triangles) and female (circles) specimens based on metacarpals. Solid points indicate specimens of known sex, while hollow points are unknown.

sex to each specimen. A test employing the same measurements on metatarsals also produces distinct clusters for each sex. Metapodials from the same carcass are in agreement. This analysis indicates that the PCA method reliably distinguishes male from female metapodials in *Bison antiquus*. When taken with prior results sexing modern bison metapodials (Lewis et al. 2005), it appears that the PCA method will be useful in sexing metapodials from any site through the late Pleistocene.

The Cooper material is housed at the Oklahoma Archeological Survey (Norman). Research was funded by the Museum of Texas Tech University as part of the ongoing Lubbock Lake Landmark regional research program into late Quaternary climate and paleoecology of the Southern Plains.

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Late-Pleistocene Biodiversity in the Central Plains

Larry D. Martin and Daniel R. Williams

Twenty-nine ^{14}C-dated sites covering the last 35,000 CALYBP in the Central Plains (Figure 1) provide local biodiversities for snails, small mammals (< 10 kg) and large mammals (Burres 1993; FAUNMAP working group 1994; Hillerud 1970; Miller 1975; Rousseau and Kukla 1994; Wells and Stewart 1987;

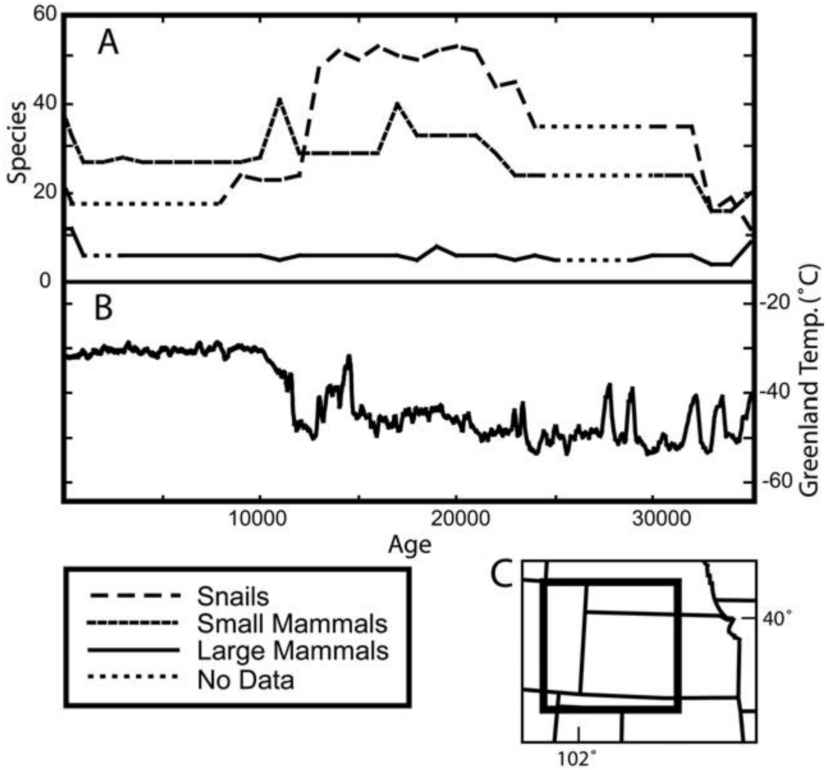

Figure 1. **A,** Local biodiversity for the Central Plains; the fine dotted lines represent time for which no data are available; **B,** Alley's (2000) GISP2 ice core reconstructed temperature record is shown as a reference; **C,** study area in the Central Plains.

Wyckoff et al. 2003). A species was considered present during an interval if that time was bracketed by appearances. The biodiversity record was compared with the ice-core temperature reconstruction of Alley (2000). Snail diversity, which was low in the earliest sites, increased during the Last Glacial

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Maximum (LGM). This increase mostly results from the introduction of boreal species that now occur at higher altitudes in the Rocky Mountains. These boreal species were extirpated from the Central Plains during the Allerod-Younger Dryas, resulting in a depauperate modern snail diversity that consists mostly of species with wide physiological tolerances. A peak in diversity of boreal small mammal species during the LGM is matched in the late Holocene through introduction of widespread eastern woodland, southwestern, and prairie forms. The second boreal mammal peak at 11,000 CALYBP is mostly species with wider climate tolerances than the full-glacial fauna, which may account for the absence of a simultaneous snail rebound. The mammals do suggest a partial return to glacial conditions, most likely influenced by the Younger Dryas. The large mammal diversity is stable throughout, with the end-Pleistocene extinction invisible due to replacement of extinct large mammal species with more cosmopolitan taxa. If we exclude the proboscideans, the size structure of the Pleistocene vertebrate community in the Central Plains may not have been as different from the Holocene as has been supposed.

Total large mammal diversity was greatly reduced globally at the end of the Pleistocene, but the high Pleistocene diversity often results from amalgamation of diversity over time and across wide geographical areas. If Pleistocene biodiversity was compartmentalized into regionally defined "faunal provinces" (Martin and Hoffman 1987; Martin and Neuner 1980; Martin, et al. 1985) then the continental diversity could have been large while regional diversity was simultaneously similar to recent pre-European contact diversity. In the modern regional faunas, extinct species were replaced locally by Holocene range extension of modern species into additional geographic regions, so that local diversity remained nearly constant.

This work was supported by NASA Astrobiology grant NNG04GM41G.

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Preliminary Comments on the Pleistocene Vertebrate Fauna from Clark Quarry, Brunswick, Georgia

Alfred J. Mead, Robert A. Bahn, Robert M. Chandler, and Dennis Parmley

Recent excavations at a new fossil locality, Clark Quarry, near Brunswick, Georgia, have produced abundant in situ Pleistocene vertebrate fossils. This material significantly adds to the understanding of Georgia's late-Pleistocene coastal plain faunas recently discussed by Hulbert and Pratt (1998). Clark Quarry is situated adjacent to the abandoned Brunswick Canal, a man-made waterway constructed between 1838 and 1839 (Hurst 1957). Geographically, Clark Quarry lies within 2 km of the late-Pleistocene Watkins Quarry described by Voorhies (1971). Historically, the Brunswick Canal is significant as the site of Lyell's 1846 collection of the type specimen for *Mammuthus columbi* (Falconer 1863; Lyell 1849).

The most recent geologic mapping of the region suggests that Clark Quarry lies within the Princess Anne Terrace of the Satilla Formation, a heterogeneous unit characterized by riverine, marsh, and barrier island deposits (Huddlestun 1988). The fossiliferous horizon at Clark Quarry is approximately 1 m thick and composed of a well-sorted, sub-rounded to subangular, medium- to coarse-grained quartz sand lacking muddy sediment. Directly below this horizon is a marine sand layer containing fossil bivalves and gastropods.

The majority of large fossils belong to the Columbian mammoth (*Mam-*

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muthus columbi) and the giant bison (*Bison latifrons*). *Mammuthus columbi* material includes a juvenile partial jaw, adult tooth plates and tusk fragments, numerous cervical and thoracic vertebrae, sternal elements, ribs, long bones, podials, and metapodials. *Bison* material includes a skull with an intact left horn core and a partial right horn core. The estimated horn core spread (tip to tip) is 162 cm, and the left horn core length on the upper curve is approximately 77 cm; these dimensions indicate the species is *Bison latifrons* (Robertson 1974:Table 10.1). Additional *Bison* material includes numerous vertebrae and ribs, three scapulae, six humeri, two radio-ulnae, one femur, one tibia, and numerous podials. White-tailed deer (*Odocoileus virginianus*) and arvicoline rodents also are represented.

Birds are represented by partial major long bones and vertebrae of five orders, seven families, and two subfamilies (Pelecaniformes: Sulidae and Phalacrocoracidae; Anseriformes: Anatidae, Anatinae and Anserinae; Gruiformes: Rallidae; Charadriiformes: Laridae; and Passeriformes: Turdidae and Icteridae). Most of these birds are aquatic species found in coastal, riparian, or standing-water environments (lakes and ponds). The sulid, cf. Northern gannet (*Morus bassanus*), is a winter migrant to the coastal area of Georgia today. A large cormorant (cf. *Phalacrocorax auritus*) is an East Coast and Gulf Coast species, but also may be found inland. This is also true of the larid (cf. *Larus delawarensis*). The anseriform birds (cf. Canada goose, *Branta canadensis,* and a teal-sized duck cf. *Anas crecca*) also may represent migrants. The American coot (cf. *Fulica americana*) can be found year-round across Georgia. The two passerine birds, a thrush (cf. *Turdus ustulatus*) and a blackbird (cf. *Sturnella magna*), represent families that have resident and migrant species in Georgia.

Herpetofaunal material includes fragments of turtle shells and osteoderms. At least one species of large tortoise (cf. *Hesperotestudo crassiscutata*) and two species of emydid turtles are represented. *Alligator mississippiensis* is represented by osteoderms and teeth. The natricine snakes *Nerodia* sp. and *Thamnophis* sp. are represented by numerous vertebrae. Lacertilian vertebrae are present. Ranid frog vertebrae, ilia, and a maxilla also have been recovered as well as vertebrae of the aquatic salamander *Amphiuma.*

Radiocarbon (^{14}C) dating on a partial radio-ulna of *Bison latifrons* produced a date of 12,350 ± 70 RCYBP (UGA-14601). This date compares favorably with 10,000 RCYBP reported for nearby Watkins Quarry (Voorhies 1971). Prior to the discovery of *B. latifrons* at Clark Quarry, the last known occurrence of this taxon had been late Wisconsinan, between 21,000 and 30,000 years ago (Kurtén and Anderson 1980), bringing into question the timing of horn core reduction in the genus *Bison.* Since previous geologic mapping indicates that Clark Quarry lies within the Princess Anne Terrace of the Satilla Formation, the age of the Clark Quarry fossils indicates that the timing of the Princess Anne and Silver Bluff deposits (Markewich and Markewich 1994) may need to be reconsidered. An alternative possibility is that the coastal plain sediments represent a more complex association of asynchronous deposits, and the Clark Quarry sediments represent a more recent episode of fluvial cut and fill within the older sediments of the Princess Anne and Silver Bluff Terraces.

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Spatial Distribution of *Mammuthus primigenius* in the United States

Michael R. Pasenko

Most researchers agree that *Mammuthus primigenius* (Proboscidea, Elephantidae) migrated across the Bering Land Bridge to North America in the late Pleistocene (Agenbroad 2005). Agenbroad (1984) found a high frequency for *M. primigenius* in areas around the Great Lakes up to the Hudson Bay area, the Northern Great Plains, and Alaska. I reviewed data from 28 sites in the United States (Indiana, Illinois, Michigan, Minnesota, and South Dakota) to test a hypothesis that there was a unique correlation between latitude, longitude, and elevation of *M. primigenius* localities.

Figure 1 contains scatterplots and r-squared values for comparisons of elevation-latitude, longitude-latitude and longitude-elevation. The data were acquired primarily through the FAUNMAP (1994) database, which only includes sites from the United States containing 10 or more taxa. Additional data were collected through the use of topographic maps. All identifications of taxon utilized here were assumed to be correct.

The correlation between latitude and elevation was fair with only one

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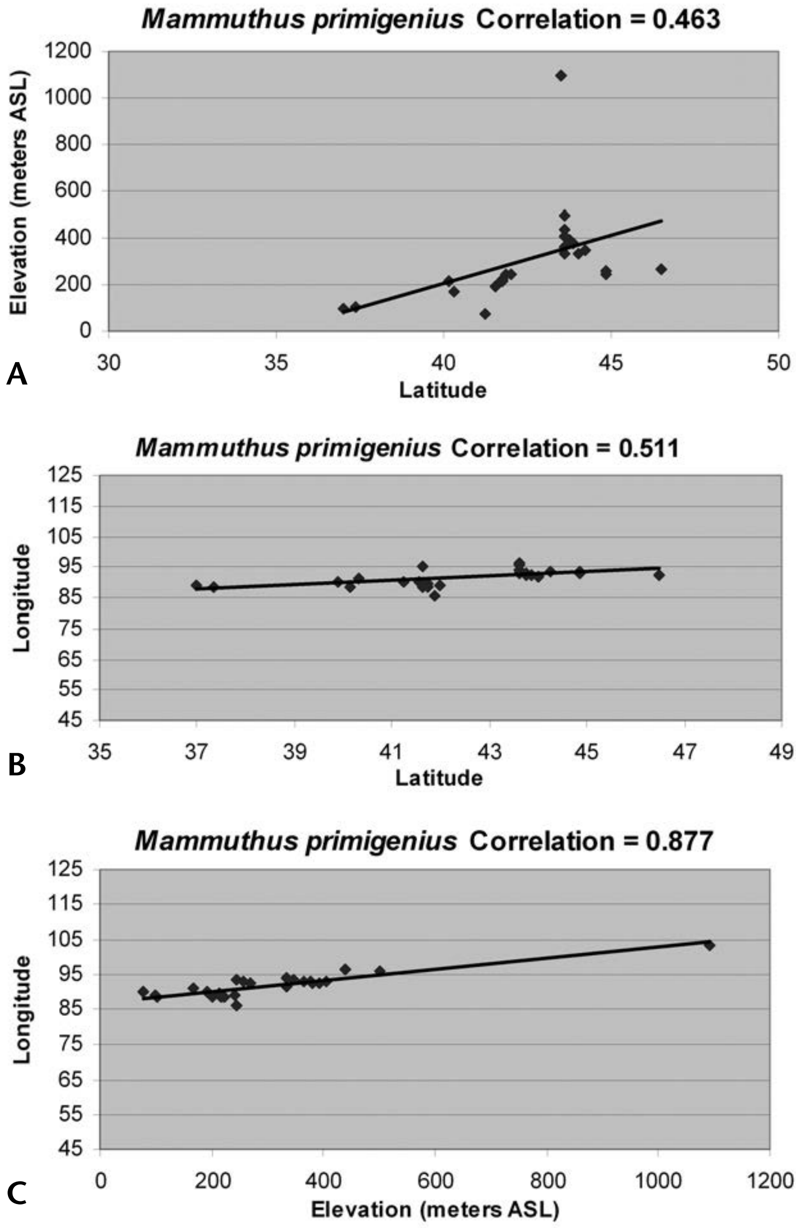

Figure 1. Scatterplots of **A**, latitude vs. elevation; **B**, latitude vs. longitude; **C**, elevation vs. longitude (elevation is in meters a.s.l., and latitude and longitude are in decimal degrees).

outlier. The one outlier is the Mammoth Site at Hot Springs, where two specimens of *M. primigenius* have been found (Agenbroad et al. 1994). There were no sites with *M. primigenius* south of 37° latitude, and a concentration of sites between 40° and 45° latitude. The correlation between latitude and longitude was slightly better (r-squared = 0.511). There were no sites with *M. primigenius* west of 103° or east of 85° longitude, and a concentration between 88° and 96° longitude. The correlation between elevation and longitude was highest and suggests a strong correlation between 88° and 96° longitude and elevation. Even the outlier at approximately 1100 m a.s.l. follows this pattern. This analysis demonstrates that there was some correlation between these variables (particularly longitude-elevation) with regards to the distribution of *M. primigenius* in the United States, and suggests a tendency for *M. primigenius* sites to be higher in elevation the further west and north they are found. Since mammoths have hypsodont teeth and were grazers, this restricted environmental gradient shows a relationship with the northeastern United States being dominated by deciduous and boreal forests during the late Pleistocene, and the west being dominated by more open steppe-grasslands (Graham 1990). As well, the northern limits were probably restricted by the advancing and retreating glaciers. Given a restricted environmental gradient, *M. primigenius* may have been unsuccessful adapting to changing environments, which included elevational changes for some plants, at the end of the Pleistocene. Comparison of these data to sites in Canada and Alaska are needed to support this hypothesis.

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Pleistocene Record of Marsh Rats of the Genus *Lundomys* in Southern South America: Paleoclimatic Significance

Pablo Teta and Ulyses F. J. Pardiñas

Lundomys is a large orizomyine rodent, semiaquatic in habit and mainly herbivorous in diet (Hershkovitz 1955). The recent distribution of the single recognized species, *L. molitor* (Winge 1887), includes mesic microenvironments such as humid lowlands near streams and grassy marshes in subtropical and temperate regions between 20° and 35° S (Uruguay and southern Brazil [Figure 1]) (Voss and Carleton 1993). Populations of this rat are associated with high mean winter temperatures (> 12° C), elevated mean annual rainfall (> 1,100 mm) and a prolonged humid season (> 200 days/year). The southern limit of its distribution apparently is determined by the mean annual temperature isotherm of 18° C (Bilenca 1993). Contrasting with the restricted geographic distribution of the populations existing today, during the Pleistocene *Lundomys* reached southern latitudes as far as 38° S in the Pampean region of

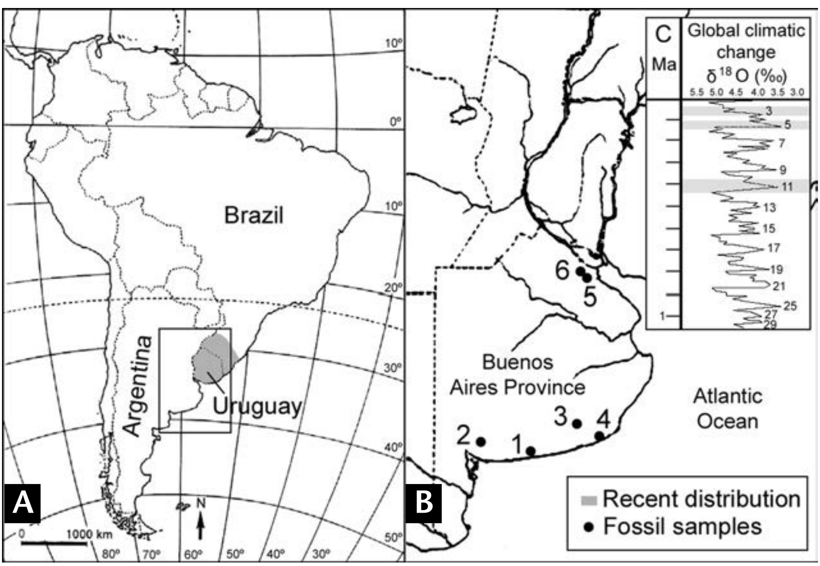

Figure 1. **A,** Present (gray area) and **B,** past (solid circles) distribution of *Lundomys* in Argentina (**1,** Cueva del Tigre; **2,** Bajo San José; **3,** Paso Otero; **4,** Centinela del Mar; **5,** Río de la Reconquista; **6,** Pilar). **C,** Isotopic curve indicating the presence of *Lundomys* in the Pampean fossil record (gray lines).

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Argentina. In this note we summarize the fossil record of *Lundomys* and provide some comments concerning the paleoenvironmental implications of its extended southern range.

New fieldwork carried out in the Pampean region of Argentina and a repeated study of the available material housed in several collections showed Pleistocene records of *Lundomys* in the following localities in Buenos Aires Province, Argentina (arranged by decreasing latitude [Figure 1]): Cueva del Tigre (38° 49′ S, 60° 32′ W [this note]), Bajo San José (38° 34′ S, 61° 41′ W [Pardiñas and Deschamps 1996]), Paso Otero (38° 34′ S, 58° 42′ W [Pardiñas and Lezcano 1995]), Centinela del Mar (38° 26′ S, 58° 13′ W [Bond and Massoia 1981]); Río de la Reconquista (34° 41′ S, 58° 49′ W [Pardiñas and Lezcano 1995]), and Pilar (34° 27′ S, 58° 58′ W [this note]). Additional fossil occurrences for this rodent are from Brazil and Uruguay (Ubilla et al. 2004; Voss and Carleton 1993).

Fossil remains of *Lundomys* in the Pampean region are indicative of more humid and warmer conditions than exist at present (mean annual temperature ca. 15–17° C; mean annual precipitation ca. 614–1,000 mm, 1981–1990 period). The fossil samples from Bajo San José, including *Lundomys*, suggest warmer environments, probably correlated with middle-Pleistocene OIS 11 (see also Verzi et al. 2004). On the other hand, the samples from Río de la Reconquista and Pilar (middle to late Pleistocene) are characterized by mammals associated with temperate grasslands near water and fish that currently inhabit warm temperate waters, suggesting a more humid and warmer climate (Pardiñas and Lezcano 1995), probably related to OIS 5 (see also Fucks et al. 2005). Similar conditions can be inferred for the mammalian samples from Centinela del Mar, Cueva del Tigre, and Paso Otero (referable to La Chumbiada member of the Luján Formation, ca. 30,000 RCYBP). Tonni et al. (1999) suggest that these conditions may correspond to a short warmer period during the last glacial cycle of about 30,000 to 25,000 RCYBP, or to OIS 3 (ca. 60,000–35,000 RCYBP).

An overview of the fossil record of *Lundomys* in the Pampean region suggests a complex pattern of population expansions and contractions in relation to interglacial-glacial cycles during, at least, the middle to late Pleistocene. This pattern appears to be common to other tropical and subtropical small mammals, for example echymid rats, that showed a similar response to Pleistocene climate variability (Pardiñas 2004).

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Potential New Irvingtonian Microtine Fauna from Sullivan County, Tennessee

Steven C. Wallace and Blaine W. Schubert

Recent summaries of cave resources within Tennessee (Corgan and Breitburg 1996; Grady and Garton 1998; Schubert 2005) have highlighted the importance of these understudied fossil deposits to our understanding of the Pleistocene. Ongoing efforts to locate and sample such deposits in this region are producing a number of new Pleistocene faunas. Here we introduce an intriguing new cave site in Sullivan County with multiple fossiliferous deposits. Among these is a small (100 x 25 cm) “bridge” of fossil-bearing sediment and cemented roof fall representing a former floor of that portion of the cave. The height above the current floor (ca. 2.5 m) and deposition of flowstone over the deposit suggest that it is a fairly old feature. Samples of the sediments eroding from under the flowstone have yielded a diverse microfauna including salamander, frog, snake, squirrel, bear, a large deer, and many microtine rodents. In particular, *Synaptomys* sp., *Clethrionomys* sp., *Microtus pennsylvanicus*,

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M. ochrogaster, *Microtus* sp., and *Allophaiomys* sp. have been recovered in sufficiently great numbers to warrant description.

The presence of *Allophaiomys* (Figure 1) indicates that the deposit is Irvingtonian (Bell 2000); however, the extant taxa *M. pennsylvanicus* and *M. ochrogaster* (Figure 1) constrain the age to the late Irvingtonian (ca. 350,000–400,000 yr B.P., early stage III [Bell 2000; Bell et al. 2004; Repenning et al. 1990]). Irvingtonian stage III is important in the evolution of microtine rodents, as it marks the first appearance of many extant species of *Microtus* (including *M. ochrogaster*) and the disappearance of less-derived taxa such as *Allophaiomys*. Consequently, the presence (in this sample) of many "*Microtus*" specimens that seem to represent primitive, undifferentiated (perhaps transitional) species is consistent with this age. Perhaps more important, Martin and Tesakov (1998) recommend discontinuing the use of "*Allophaiomys*," stating that the genus is polyphyletic. Therefore, if the age of this deposit can be confirmed, it would prove useful not only in improving our understanding of the faunal changes that were occurring at that time, but also in providing insight into the history of this important group of rodents.

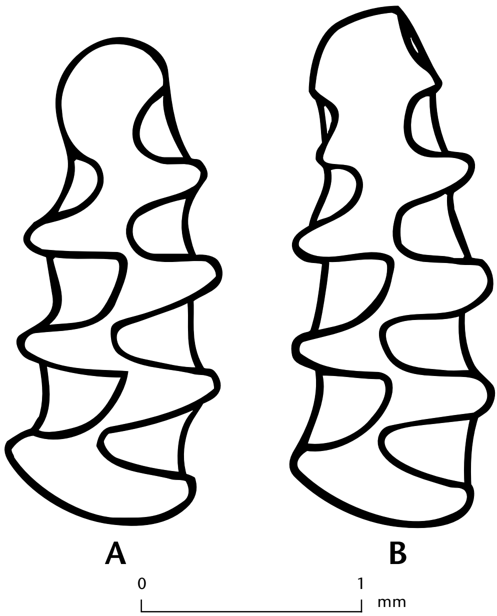

Figure 1. **A,** Left lower first molar of *Allophaiomys*; **B,** left lower first molar of *Microtus ochrogaster*.

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Paleoenvironments: Geosciences

Estimating Pleistocene Shorelines and Land Elevations for North America

J. Christopher Gillam, David G. Anderson, Stephen J. Yerka, and Shane Miller

Estimating paleo-shoreline extents for the late Pleistocene and early Holocene has traditionally been a difficult task to accomplish even at local scales. This fact is highlighted by the common use of the approximate Last Glacial Maximum (LGM) shoreline contour in the literature when regional or continental scale distributions are illustrated. While useful as a heuristic, the LGM shoreline is not accurate for most of the Paleoindian Period and can present problems for geographic information system (GIS) and other spatial analyses of site distribution and land use.

Fortunately, GIS data and sea-level depth estimations are now available that make modeling ancient shorelines and land elevations more practical at the continental scale. The ETOPO2 dataset of the National Geophysical Data Center (NGDC) is a 2-minute latitude/longitude grid (approximately 3.7-km spatial resolution at the equator) representing land elevations and seafloor bathymetry derived from the Global Land One-km Base Elevation (GLOBE) digital elevation model (Hastings and Dunbar 1998) and satellite altimetry and ship depth soundings for bathymetry (Jakobsson et al. 2000; Smith and Sandwell 1997). These data, which are easily integrated into a raster GIS environment for analysis, are distributed free online as raw data or customizable grids for specific areas (http://www.ngdc.noaa.gov/mgg/image/2minrelief.html).

Using published sea-level curve estimates (Lambeck et al. 2002), it is relatively simple to use map algebra techniques in a raster GIS to reclassify the ETOPO2 grids to represent paleo-shorelines and land elevations. For example, the digital elevation model (DEM) for 13,000 CALYBP uses the sea level depth estimate of -75 m (Figure 1). To adjust the ETOPO2 DEM data, you

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simply add 75 to the z-values of the DEM and then reclassify all negative values to zero or “no data” to represent the oceans and water bodies. An obvious caveat to the use of sea-level curve estimates is that local variation in sea level due to glacio-isostatic deformation and other glacial influences are not accounted for in higher latitudes and could be a source of error at local scales of analysis in affected regions. However, most of the habitable landscape of the Pleistocene was not affected by such localized processes, and the scales of analysis appropriate for a 4-km resolution grid are regional to continental in scope.

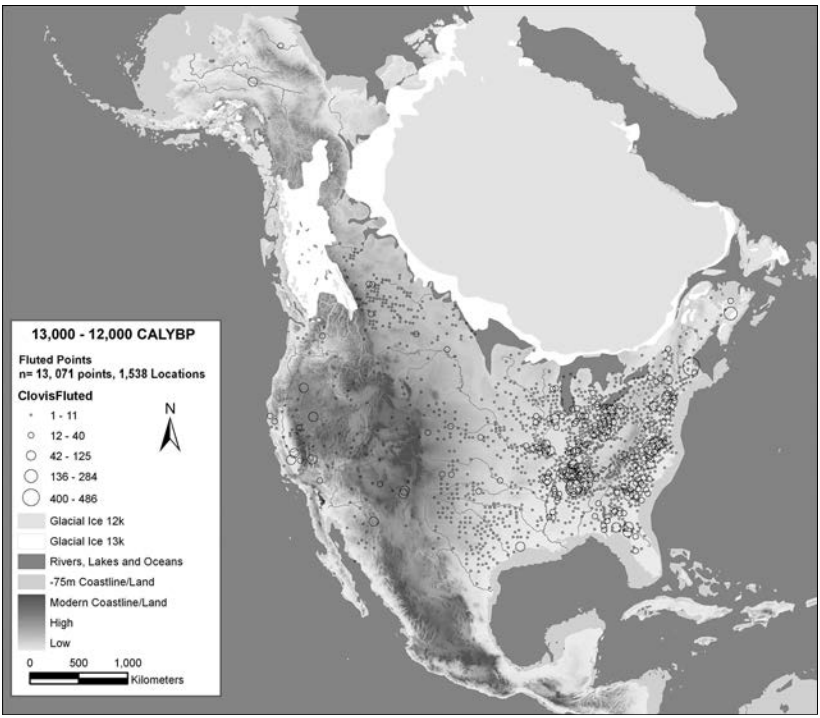

Figure 1. Paleo-shoreline for 13,000 CALYBP with fluted-point density distributions, excluding known post-Clovis types, in North America.

The authors have estimated paleo-shorelines and land elevation models for the late Pleistocene and early Holocene from 14,000 to 9000 CALYBP in 1000-year intervals for use with the Paleoindian Database of the Americas (PIDBA) and other research projects in North America (Anderson et al. 2005a, 2005b; Gillam et al. 2005). Example maps with archaeological distributions are available for viewing and downloading at the PIDBA Web site (http://pidba.utk.edu/maps.htm). The time-sliced DEMs for the late Pleistocene and early Holocene have many applications beyond heuristic distribution maps. For example, the DEMs may be used to improve extant models of Paleoindian migration, interaction, and exchange networks across North America (Anderson and Gillam 2000). Mapping the paleo-coastal zone also illustrates how extensive and changing it was and how little we currently know about the coastal adaptations of early hunter-gatherers in North America (Faught 2004).

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Magnetic Expression of the Late-Pleistocene La Sena Mammoth Site, Southwestern Nebraska

William C. Johnson, David W. May, Steven R. Holen, and Karen L. Willey

The La Sena mammoth site (25FT177) (Holen 2006; Holen and May 2002), located in a wave-cut bluff of Medicine Creek Reservoir (SW Nebraska), has been ^{14}C-dated and has undergone taphonomic analysis. A partial adult mam-

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moth skeleton was excavated from within late-Wisconsinan Peoria loess mantling a terrace composed of fine-grained alluvium temporally equivalent to the upland, middle-Wisconsinan Gilman Canyon Formation. Bones were situated on a weakly expressed B horizon within Peoria loess ca. 230 cm above the terrace fill (Figure 1). AMS ^{14}C ages of 18,000 ± 190 (Beta-28728) and 18,440 ± 145 (AA-6972) RCYBP from collagen and an overlying bulk organic carbon ^{14}C age of 18,860 ± 360 (Tx-7006) RCYBP date the event to ca. 22,100-22,500 CALYBP (Fairbanks et al. 2005).

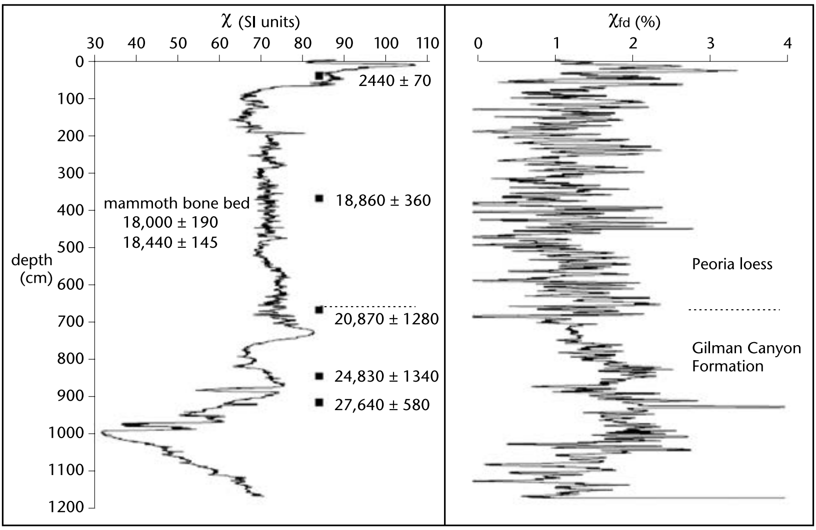

Figure 1. Magnetic susceptibility (χ) and frequency dependence of susceptibility (χ_{fd}) as measured on 1-cm slices of a 6-cm-diameter core taken at the La Sena mammoth site.

Susceptibility (χ) and frequency dependence of susceptibility (χ_{fd}) are two rock magnetic parameters that indicate the relative concentration of magnetic mineral grains (e.g., magnetite) and the percentage of the population that is extremely fine-grained, respectively (Evans and Heller 2003). Variations in the magnetic signal may reflect pedogenic enhancement (Dearing et al. 1996) or a change in character of the parent material through changes in wind velocity (particle size) and direction (source).

Within the Gilman Canyon Formation, χ is at its minimum at ca. 1,000 cm within the core (Figure 1), reflecting a sand zone within the alluvium. Silty, melanized sediments above produce two maxima representing discrete episodes of pedogenesis. The basal Peoria loess (ca. 690–575 cm) is moderately enhanced, apparently from pedogenesis partially suppressed by increasing loess deposition during the early part of the late Wisconsinan. Above that, four spikes (ca. 470, 270, 230, 120 cm) suggest minor episodes of pedogenesis. The bone bed (ca. 393–403 cm), however, is not one of these spikes, suggesting that soil development was insufficient to impart a detectable magnetic signature to the loess. Surface soil expression begins at about 90 cm, with the dramatic decrease in the upper 15–20 cm due to signal dilution by humus and the root mat.

Even after smoothing (5-point), χ_{fd} data exhibit the high variance typical of this parameter (Figure 1). B horizons of the two soils within the Gilman Canyon Formation are indicated, however, by increased concentration of ultra-fine magnetic material. Owing to reduced homogenization by pedogenic processes and to greater variability in winds (Aleinikoff et al. 1999), variance within the Peoria loess is remarkably greater than in the Gilman Canyon Formation. Again, no clear expression of the bone-bed soil is evident within the core sample.

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Isotopic Fluctuation and Climate Change in the Great Plains

Daniel R. Williams and Larry D. Martin

Comparisons of δ^{18}O and cosmogenic ^{10}Be production recorded in the Greenland Ice Sheet Project 2 ice core (GISP2) are correlated with the formation of paleosols in the late Pleistocene of the Great Plains, indicating that factors related to isotopic fluctuations had an environmental impact in central North America (Wang et al. 2003). The ^{10}Be record, thought to be a

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proxy for solar activity, suggests the possibility of a solar component for the temperature change indicated in the $\delta^{18}O$ and paleosol record (Finkel and Nishiizumi 1997). Changes in solar output may be usefully studied as a trigger for environmental change in the late Pleistocene of the Great Plains, once the signal has been separated from the noise. ^{10}Be is formed in spallation reactions caused by cosmic radiation in the upper atmosphere, which is eventually incorporated into precipitation. The amount deposited depends on four variables: atmospheric shielding by the solar magnetic field, atmospheric shielding by the geomagnetic field, changes in the base cosmic ray flux, and atmospheric mixing shifts.

The GISP2 ice core ^{10}Be stack is an exceptionally precise record covering 3288–40,056 CALYBP (Alley et al. 1995; Davis et al. 1990; Finkel and Nishiizumi 1997). ^{10}Be flux was made independent of snow accumulation by multiplying concentration by the GISP2 ice accumulation record (Cuffey and Clow 1997; Cuffey et al. 1995). The GISP2 $\delta^{18}O$ data provide a concurrent set of local Greenland climate values for ^{10}Be (Grootes and Stuiver 1997; Grootes et al. 1993; Meese et al. 1994; Stuiver et al. 1995). Guyodo and Valet's (1999) SINT-800 magnetic record was used to determine ^{10}Be flux correlation with geomagnetic field intensity. The time-series program ASTSA was used to perform the analysis (Shumway and Stoffer 2000).

A cross-correlation time series analysis of the ^{10}Be stack determined that variability in production, through solar forcing or cosmic radiation, was the primary cause of ^{10}Be variation during the glacial period recorded in GISP2. During the glacial period, the ASTSA analysis shows that ^{10}Be cross-correlates negatively with the paleomagnetic intensity record but lagged behind by 3,000 years, meaning that a particular ^{10}Be flux change could only be correlated with a geomagnetic intensity change 3,000 years ahead. Therefore geomagnetism is probably not the controlling factor in production. ^{10}Be glacial flux changes are also negatively correlated with $\delta^{18}O$, but without a time lag. According to McCracken's (2004) ^{10}Be production model, a positive correlation would be expected if atmospheric mixing were driving ^{10}Be deposition. The negative correlation found in the GISP2 record between ^{10}Be and $\delta^{18}O$ during the last glaciation indicates a solar or cosmic ray climate forcing.

Geomagnetic and climate variables obscure the ^{10}Be signal during the deglaciation and Holocene (3288–15,000 CALYBP). ^{10}Be cross-correlated positively with $\delta^{18}O$, consistent with atmospheric mixing profoundly influencing deposition (McCracken 2004). Charles et al. (1994) detailed in a series of Global Climate Model (GCM) experiments glacial-interglacial precipitation changes for Greenland that might have produced the positive post-glaciation correlation between ^{10}Be and $\delta^{18}O$. The GCM experiments indicated that the center of Greenland's Last Glacial Maximum (LGM) precipitation was from more southern latitudes and migrated northward during the interglacial (Charles et al. 1994). Drawing precipitation from northern latitudes includes ^{10}Be production proximal to the northern geomagnetic pole. Magnetic force lines are nearly vertical at the geomagnetic pole, rendering shielding from cosmic rays relatively ineffective and increasing overall ^{10}Be production (McCracken 2004).

Solar forcing currently has more probable physical mechanisms than cosmic radiation to explain climate change. Haigh (1996) constructed a GCM with a possible solar forcing mechanism of climate applicable to the Pleistocene Great Plains. The GCM predicts the pole-ward movement of storm tracks and broadening of the tropical Hadley cells, key movers of warm equatorial air north, during periods of increased solar irradiance and stratospheric ozone. This model agrees with the ^{10}Be and δ^{18}O glacial correlation. Further evidence for warmer climate intervals during the last glaciation has been found in Peoria Loess of Illinois. Wang et al. (2003) published a description of well-developed A-horizon paleosols formed within the more typical glacial loess. The development of an A-horizon paleosol requires the accumulation of plant organic matter under stable conditions. The darkest horizons, requiring the most prolonged moisture and warmth, were dated as contemporaneous with GISP2 δ^{18}O glacial interstadials (Wang et al. 2003). The ^{10}Be data analyzed here suggest that the warm climate conditions shown in the GISP2 δ^{18}O record and in Great Plains paleosols were possibly solar forced.

This work was supported by NASA Astrobiology grant NNG04GM41G.

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