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A comparison of sedimentological, environmental and fauna between two regions, NW of the Arabian Gulf

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Abstract - Marine environment is considered one of the richest environments in fauna of benthic marine micropaleontology because of the suitable conditions for living requirements like food, oxygen, sediment texture and salinity. In the current study, a fauna and their distribution were studied according to the depths of subsurface marine sediments from two regions at the NW Arabian Gulf, the first region at Khor Shytanah (Core 1) at the north of the study area representing a sever environment with high currents, and contain more than 95% sand grains, it is of light color, large size, rounded to sub-rounded grains and clean due to the continuous washing and water movement, whereas the second region was near the oil Basrah Port (Core 2) at the south of the study area, where the quite environment with weak currents and fine sand of dark color due to the activity of non-anaerobic bacteria , the region has angular to sub-angular grains. The type of sediment texture was determined at each depth and consisted of silt, sand silt, sand and silty sand. On the other hand, the percentage of calcium carbonate was determined in the sediments to correlates that with the size and density of fauna that live in this area.

Key words: Sedimentological, fauna, shells, sediments texture, marine environment, NW Arabian Gulf and**.**

Introduction

Most of the sediments of the bottom in the Arabian Gulf are belonging to the Quaternary of the Holocene period and are considered to be modern sedimentary environments (Yacoub, 2011). Salinity and grain size are important factors in determining the environment of the modern species in marine environment (Shareef *et al*., 2015). Al-Ali (2007) suggested that there are two environmental facies in the Arabian Gulf depending on the salinity and the distribution of the affected fauna groups. The present study illustrates the difference in two marine environments depending on the quantity, size and species of the fauna present in each environment. In addition, the reasons for differences in $CaCO_3$ percentages are explained in depth in both environments. On the one hand it was also found that there was an increase in the number of species in the fauna with depth, and a positive relationship between calcium carbonate and shells weight.

Al-Ghadban (1980) indicated that the increase in organic matter is due to the abundance of shell fragments. These shells cause a change in the size of the sediments and may become closer to the size of sands or gravels, this is an important factor in increasing calcium carbonate, regardless whether the sediments are sandy or silty.

Study Area:

Tow subsurface core sediments were taken from the north of study area, the first site is located at N 30°01'44.7´´ and E 48°06'41.9´´, represented by Core 1 (Khor Shytanah), the second is located at N 29°43'56.5´´ and E 48°37´02.4´´ and represented by Core 2 (Basrah Oil Port, open sea) (Fig. 1).

Materials and Methods

In the laboratory, the core samples were divided into two equal parts of each of a length of 5 cm, after that, the texture of sediment was determined by using the Master Sizer instrument (Model UM 2000). Fifty grams of the crude dried sample was washed with a 0.063 mm sieve in wet sieving with distilled water carefully to preserve the fauna forms and dry the remaining part on the sieve in drying Oven on 105°C. Diagnosis of the fauna was based on the latest approved classification established by Keen and Coan (1974), Moore (1969) for Mollusca Loeblich and Tappan (1988) for the identification of Foraminifera and Peiris (1969) for the Ostracoda. Determination of Calcium Carbonate was done according to Nelson (1982).

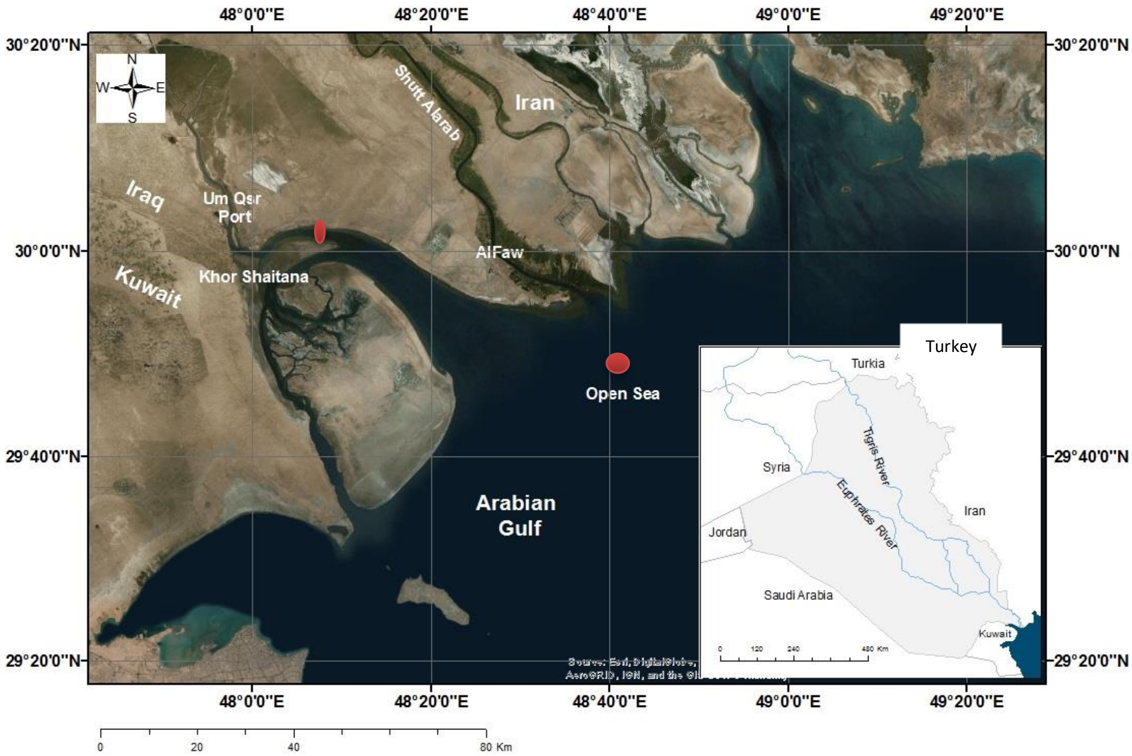

Figure 1. Map of the study area.

Results

Grain Size and $CaCO_3$ (%):

Sediments texture was determined by measuring the percentage of sand, silt and clay, according to Folk (1974) (Fig. 2). Table (1) explains the texture of sediments and shells weight.

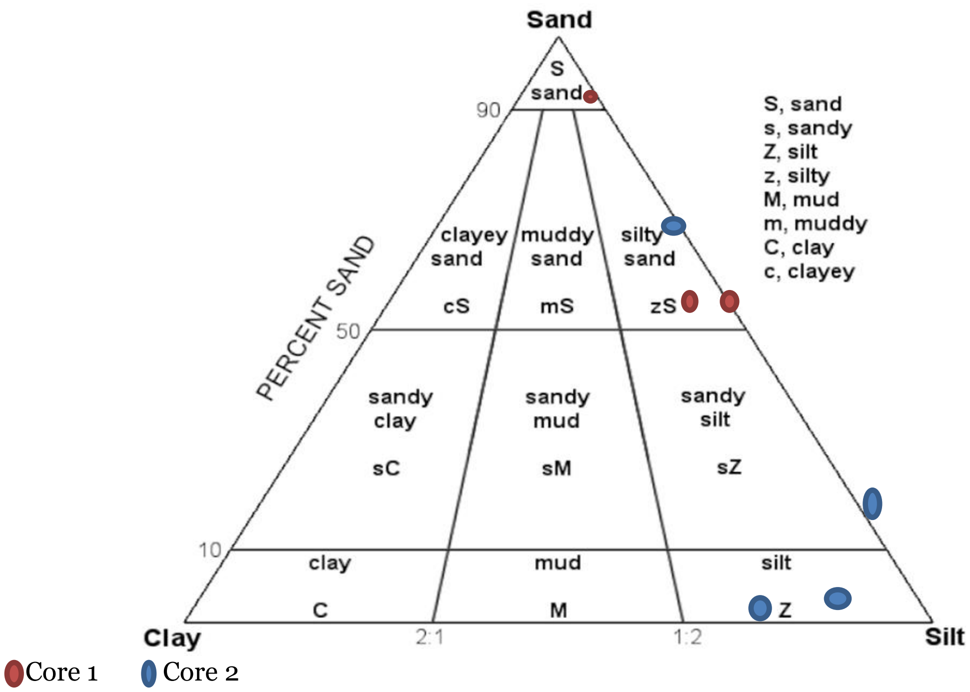

Figure 2. Classification of texture in sediment cores according to Folk (1974).

Table 1. Percentages of shells and sediments texture.

Cores	Sample Name	Depth (cm)	Sand %	Silt %	Clay %	Texture	Shells Wt %	Original Sand %	$CaCO_3$ %
Core 1	1A	0-5	95	4	1	Sand	5	90	9.08
	1B	5-10	70	20	10	Silty Sand	8	62	12.11
	1C	10-15	69	27	4	Silty Sand	9	60	13.59
Core 2	2A	0-5	4	75	21	Silt	0.7	3.3	20.65
	2B	5-10	7	82	11	Silt	1	6	25.68
	2C	10-15	31	56	13	Sandy Silt	15	16	32.27
	2D	15-20	63	31	6	Silty Sand	37	26	35.56

Table (1), the weight of the shells was calculated in the sand fractions, where the percentages were increased in Core 2 and increased with depth. There was a significant difference in the amount of $CaCO_3$ % in study area, where as the highest of these parameters in Core 2 compared with Core 1.

Moreover, there was a positive relationship between the observed $CaCO_3$ contents and the shell percentage, whereas the amount of shells increased with the amount of calcium carbonate, this relationship is illustrated in Figures (3 and 4). This indicates that most shells consist mainly of $CaCO_3$, since the study area is a marine environment with high amount of $CaCO_3$, which were used in the construction of shells (White *et al.*, 2007).

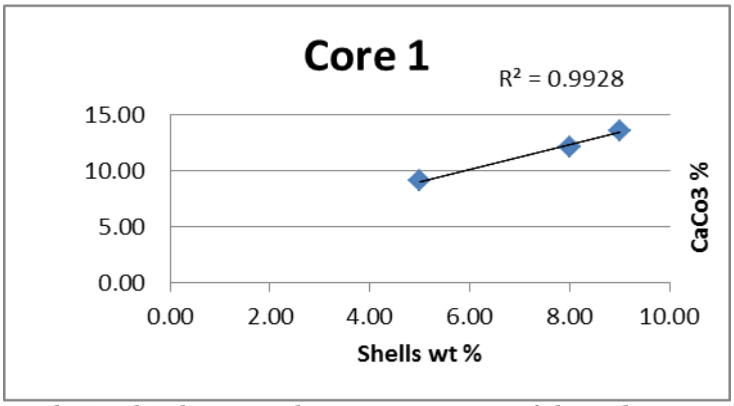

Figure 3. Positive relationship between the $CaCO_3$ content of the sediments and the Shells in Core 1.

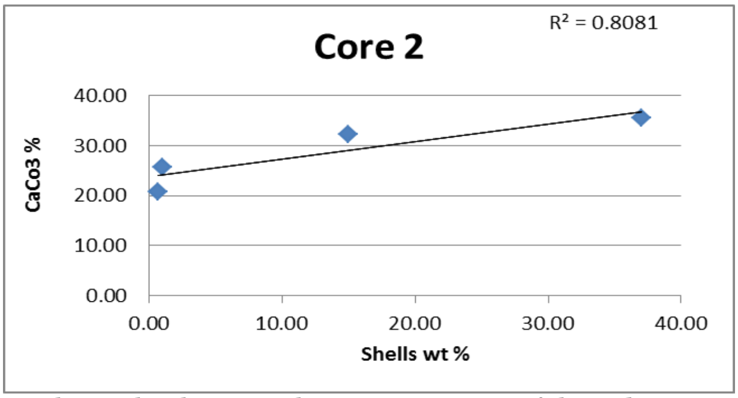

Figure 4. Positive relationship between the CaCO3 content of the sediments and the Shells in Core 2.

The Gulf region expands at the end of Khor Abdallah, thus reducing the velocity of marine currents then the level of sedimentation is decreased (Albadran *et al.*, 1996). Core 2 is characterized by high amount of fauna assemblages present with large size compare with fauna assemblages in Core 1.

Fauna Distribution:

Mollusca, Foraminifera and Ostracoda are important component of the fauna in the study area, also Bryozoa (Tables 2, 3, 4, 5 and 6) were also occurred in the region. It is apparent that there was a difference in the quantity and size of the fauna with depths and this is because of the difference of sediment texture, speed of marine currents and hydrodynamic nature of the water (Fig. 5).

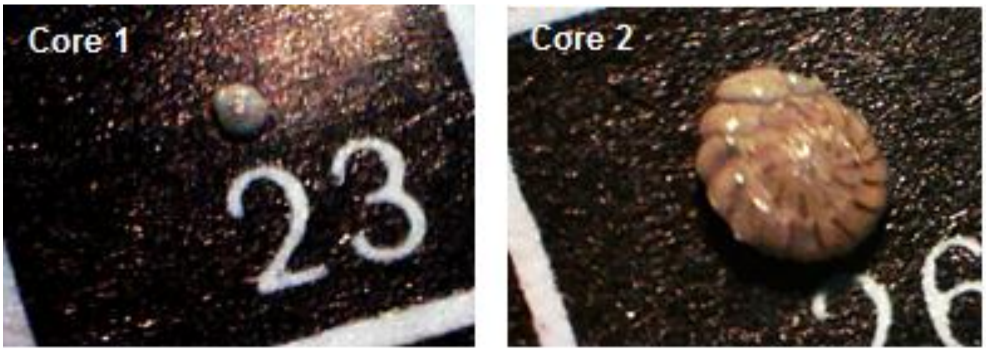

Figure 5. *Ammonia baccarii* (20X) in Core 1 and 2.

The paleontological study showed that the fauna in Core 1 are small in size, few in numbers, white to transparent in color and of limited species, while in Core 2 the fauna were large in size, increased in number with various colors and several species.

Table 2. Distribution of Foraminifera in Core 1 and 2.

Species	Core 1			Core 2			
	1A	1B	1C	2A	2B	2C	2D
Adelosina sp.	-	-	-	***		*	*
Ammonia beccarii	***	**	**	***	**	**	**
Ammonia bradyi	-	-	-		*	-	-
Ammonia detanta	-	-	-	*		**	**
Ammonia parkinsoniana	-	-	*	*	-	-	-
Ammonia tepida	-	-	-		**	**	***
Asterorotalina dentata	-	-	-	*	*	*	**
Buccella frigida	-	-	-	*		-	-
Elphidium advenum	-	-	*	-	-	*	*
Elphidium craticulatum	**	-	-	-	-		
Eponides respandus	-	-	-			*	*
Heterohelix globulosa	-	-	-	*	*	**	
Marginopora vertebralis	-	-	-	-	-		
Milliolovella sp.	-	-	-		*	-	-
Nonion incisum	-	-	-	*	*	*	*
Quinquelocolina sp.1	-	-	-	-	-	*	
Quinqueloculina candeiana	-	-	-	-	-	-	**
Quinqueloculina lamarckina		***		*	***	***	***
Quinqueloculina poeyana	***	*	**	**	**	*	*
Quinqueloculina semnula	-	-	-	-	-	*	*
Quinqueloculina venusta	-	-	-	**	-	**	**
Rosalina globularis	-	-	-	*		-	-
spiroloculina eximia	***	**	**	***	**	**	*
Spiroloculina laevigata	**				***	***	*
Textularia agglutinans	-	-	-	-	-	*	**
Trilocolina oblonga	-	-	-	**	-	-	-
Trilocolina trigonul	-	-	-	*	-	-	-
Triloculina earlandia	-	-	-		*		**
Triloculina rotunda	-	-	-		-	*	

*Rare **Rich ***Abundant - Absent

Table 3. Distribution of Ostracoda in Core 1 and 2.

Species	Core 1			Core 2			
	1A	1B	1C	2A	2B	2C	2D
Agrenocythere pliocenica	-	-	-	-	-	*	**
Alocopocythere reticulate	***	-	-	*	**		*
Candona compressa	-	-	-	-	-	**	*
Candona holmesi	-	-	-	-	-	*	*
Candonilla simpsoni	***	-	-	-	-	-	-
Candonilla wanlssi	-	-	-	**	**	*	*
Carinocythereis indica	-	-	-	-	*		
Chrysocythere Keiji	-	-	-		*	*	
Condona neglecata				-	-	**	-
Condona ohrida	-	-	-		*	*	**
Cyprideis torosa	***	***	***	*	*	-	-
Cytherelloidea pracipua	-	-	-	-	-	**	-
Darwinula Stevensoni	-	-	-	-	-	*	**
Haplocytheridea Keyseri		**	**	-	-	**	*
Ilyocypris bradyi	-	-	-		*	*	*
Lancacythere coralloides	-	-	-	-	-		*
Loxoconcha sp.		-	-	-	-		*
Macrocyprina decora	-	-	-	*	-		-
Neocytheretta murilineata	-	-	-			**	-
Neocytheromoroha reticulate	-	-	-		-	**	-
Tanella gracilis	-	-	-	-	*	*	*

Table 4. Distribution of Gastropoda in Core 1 and 2.

Species	Core 1			Core 2			
	1A	1B	1C	2A	2B	2C	2D
Aclis minor	-		-	-	*	*	
Alvania rykelii	-	-	-	-	*	**	*
Alvania lacteal	-	*	-	-	*	***	***
Bellamya bengalensis	***	**	***	*	**	**	***
Bullia tranquebarica	-	-	-	-	-	*	*
Calliostoma coppingeri	-	-	-	-	-		**
cerithidea fluviatillis	-	-	-	-		*	**
Cerithidium diplx	-	-	-	-	-	*	**
Cerithium pfeifferi	-	*	-	-	-	**	**
Circulus striatus	-	-	-				**
Colubraria monroei	-	-	-	-	-	-	*
Epitonium occidentale	-	-	-	-	-	*	
Gibberula granum	-	-	-		*	**	*
Gibborissoa virgate	-	**		-	*	*	*
Hydrobia neglecta	-	-	-	-	-	*	
Melina sp.	-	**	*	-		*	*
Minolia caifasii.jpg	-	-	-	-	-	*	*
Odostomia leavis	**		*	-	*	*	*
Odostomia Serenei	-	*	**	-	*	-	*
OMalogyra atomus	-	-	-	-	-	*	
Polynices ampla	***	*	**	-	-	-	-
Polynices mamilla	**	*	**	*		-	***
Pyramidellidae gen. sp.	-	-	-	-	-	*	--
Scaliola sp.	-	-	-	-	*	*	*
Terebra maculata	-	-	-	-	-	*	**
Tornatina persiana	-	-	-	-	-	-	**
Turbonilla umbrina		-	-	-	*	**	***
Turriteiia foltoni	**			-		*	*
Umbonium vestiarium	-	-	-		*	***	***

*Rare **Rich ***Abundant - Absent

Table 5. Distribution of Pelecypoda in Core 1 and 2.

Species	Core 1			Core 2			
	1A	1B	1C	2A	2B	2C	2D
Angulus sp.	-	-	*	-	-	*	
Arca foltoni	*			-	-	-	*
Asaphis voilascens	-	-	-	-	-		*
Bassina yatei	-	-	-	-	-	-	*
Bassina callophyla	-	-	-	-	-	-	*
Bentharca sagrinata	-	-	-	-		-	*
Brachyodontes variabilis	-	-	-	-		-	*
Calyptraea chinensis	-	-	-	-	-	*	**
Carbula subquadrata		**	**	-	-	**	***
Carditella pallid	**	*		-	*	-	*
Codakia orbicularis	-	-	-	-	-	-	*
Corbicula fluminalis				-	-	***	***
Corbula pulchella	-	-	-	-	-	-	***
Corbulata itensis		*		-		*	
Crassostrea iridescens	-	-	-	-		**	***
Dosinia Laminata	**	*	-	-	-	-	
Idasola argentea		-	-	-	-		*
Kellia suborbicularis	-	-	-	-	-		**
Mactra dissimilis	**		**	-	-	**	**
Mactra sp.	*	*	***	-	-	-	
Musculus niger	-	-	-	-	-	-	*
Paphies ventricosa	-	-	-	-	-	*	*
Platyodon cancellatus	-	-	-	-	-	*	
Striarca lacteal	-	-	-	-	-	-	*
Tellina sp.	**	-	-	-	-	*	*
Theora sp.	-	-	-	-	-	*	*
Thracia nitida			-	-	-	-	*
Unio tigridis	*		**	-	*	-	**

*Rare **Rich ***Abundant - Absent

Table 6. Distribution of Scaphopoda in Core 1 and 2.

Species	Core 1			Core 2			
	1A	1B	1C	2A	2B	2C	2D
Dentalium octangulatum	-	-	*	*		*	*
Dentalium quadrapicale	-	*		-	-	-	*

*Rare **Rich ***Abundant - Absent

Table 7. Distribution of Bryozoa in Core 1 and 2.

Species	Core 1			Core 2			
	1A	1B	1C	2A	2B	2C	2D
Brayozoa 1	**	*	**		*	*	*
Brayozoa 2	-		*		*	*	*
Brayozoa 3	-	-	-		*	*	**
Brechites penis	**	-		-	-	*	**
Cadonluse uloides		-	*	-	-	*	*

*Rare **Rich ***Abundant - Absent

Discussion

The results of sedimentological study indicated that the texture of sediments are sand, silt, silty sand and sandy silt, and the percentage of sand is between 69-95% in Khor Shytanah (Core 1), while Core 2 (open sea) reached 63-4%, this increase may be attribute to two reasons; the first may be influenced by Kuwait marine current during tide, and the second may attributed to bended shape of Warbah Island caused to narrowest of the navigation channel in this area (Darmoian and Lindquvist, 1988). It is worth noting that there is a negative relationship between the depth and the amount of sand in Core 1, while the relationship is positive in Core 2, this difference due to the variation of marine currents speeds in both regions.

The shells percentage in Core 2 were very high when sieved through 0.063 mm sieve, so the shells were separated from the sand and the original sand percentage was calculated (Table 1). The results showed a positive relationship between the amount of shells and calcium carbonate, and this is confirmed by White *et al.* (2007) who found that the Mollusca shells consist of 95-99% $CaCO_3$.

Moreover, Al-Ghadban (1980); Issa (2006) proved that the increase in organic matter is due to the abundance of shell fragments. These shells caused a change in the size of the sediments and may attained sizes of sands or gravels, this is an important factor in increasing calcium carbonate, regardless whether the sediments are sandy or silty. The study of the fauna showed the presence of many marine species, especially in the marine environment that represented by Core 2.

These fauna were characterized by large sizes, variety and different species and colors. Alternatively, Core 1 expressed a reduction of fauna, small size, white and transparent colors. The species of the family Miliolidae are the most common in the study area in almost all of the cores where marine and brackish waters are located (Boltovskoy and Wright, 1976). *Ammonia* species were characterized by their spread in the study area, especially *Ammonia beccarii,* which lives in high and low salinity water (Phleger and Parker, 1951). *Ammonia beccarii* and *Ammonia tepida* are a brackish and marine species. This species may reflect the brackish estuarine conditions of shallow environments such as lagoon and intertidal flats (Murray, 1991).

Textularia agglutinans: This species was found in Core 2, so it generally preferred silt sediments, and it was found in very small sizes that were shown predominantly under the polarized microscope, it generally favors muddy bottom sediments with a certain preference for a low input of clay oxygenated sediment layer (Mojtahid *et al.*, 2010). *Heterohelix globulosa*: These planktonic species was found in Core 2, it is small in size and found under a polarized microscope only, the tiny size and presence of this species in these cores particularly is an indication of the quiet marine environment, generally considered as tolerant of low oxygen conditions and thrived within the oxygen minimum zone (Pardo and Keller, 2008).

It is increasing in TOC% generated anaerobic bottom water conditions during the time (Nwojiji *et al.*, 2014). The most important species of Ostracoda in the study area are *Cyprideis torosa* that live in the marine and fresh water environment and found in most of the study area (Carbonel, 1988). *Cyprideis torosa* may be considered as a brackish-water species although, it also lived in saline and pure freshwater lakes and can survive abnormally high salinities (Whatley and Maybury, 1990; Al-Jumily, 1994; Holmes and Chivas, 2002 and Karanovic, 2012).

Candonilla wanlssi and Condona ohrida: The species of this family are found in mixed water to saline environment and it is within the sublittoral environments (Morkhoven, 1963). *Darwinula stevensoni*: It is a freshwater species within the supralittoral-eulittoral environments (Mourguiart, 1992).

Alocopocythere reticulate: It is a marine species, and has a complex ornamentation and depends on salinity and is present in the depths.

Agrenocythere pliocenica: This species was not recorded in the study area before. This is a rare species especially in the open sea area. It is characterized by the spread of thorns on the outer shell.

Mollusca, on the other hand is considered to be the most common and highly diversified and having large size and this is an indication of the environment suitability and the abundance of organic matter and a high absorption of calcium carbonate especially in Core 2. Gastropoda reflected the higher productivity of this water body (Shareef and Mahdi, 2015).

Polynices mamilla, *Bellamya bengalensis*, *Polynices ampla*: They are the most common species in the study area, they are marine, brackish, fresh and terrestrial species found in Khor Shytanah (Shareef *et al.*, 2015). They are marine species found in the Arabian Gulf and Hicham coast island (Ahmed, 1975).

Alvania lacteal, *Cerithium pfeifferi*, *Polynices mamilla, Turbonilla umbrina, Alvania rykelii*, *Umbonium vestiarium and Gibberula granum*: These marine species were found in abundance and large sizes in the Arabian Gulf (Ahmed, 1975).

The most common species of Pelecypoda in the study area are: *Mactra dissimilis*, *Carbula subquadrata*, *Mactra* sp. which are marine species and found in most depths.

Carbula subquadrata: It is abundant in sandy silt deposits and brackish to marine waters. In addition to species: *Corbicula fluminalis and Crassostrea iridescens* which are spread in the Arabian Gulf region.

Scaphopoda and Bryozoa, which were found in good quantities, especially in Core 2, with multiple sizes and colors. These species favored the shallow marine environment, where many of them are moderately found close to the coast (Moore *et al*., 1952). It is worth noting that the species found in the present study are having different colors, especially black and this indicates that it was affected by the deposition of pyritized, that is, the environment is subjected to reduction period and this process is approximately observed at the last depth of Core 2. On the other hand, in most depths there were positive relationships between the number of species with increasing depth and increase of $CaCO_3$.

Conclusion

1- Sand, silt, sandy silt and silty sand are the most prominent types of sediments texture in the study area, the study showed an increase of sand with depth in Core 2 (open sea) and a decrease of sand with depth in Core 1 (Khor Shytanah).

2- There are two types of environment, the first, environment with high currents, which represented in Khor Shytanah (Core 1) and characterized in high sand, round to semi-round grains, light color and large size of grains. Second, the environment with quiet currents, which represented in the open sea (Core 2), and is characterized by low sand, angular to semi-angular grains, dark color due to the reduction process and small size of grains.

3- Foraminifera, Ostracoda and Mollasca are the important fauna in the study area, in Core 1; the fauna was characterized by low number, small size, white to transparent colors because of the high currents that made the environment unsuitable for the diversity of fauna. While Core 2 was characterized by large numbers of species, large sizes and multi colors, where the weak currents and the environment is more suitable for living.

4- The abundance of diversity in Core 2 is due to the increase in the percentage of calcium carbonate, which increases in fine grains.

5- Fauna increase with depth due to the availability of appropriate conditions and lack of competition and silty sand texture is the preferred bottom of benthic fauna.

6- *Heterohelix globulosa*; planktonic Foraminifera found under the polarized microscope, which favors the silt texture and refers to the quiet environment with weak marine currents. Miliolidae family is the predominant species of Foraminifera in addition to other species.

7- Molluscs are the most widespread in the study area, especially in the open sea.

8- *Agrenocythere pliocenica*, this species was not recorded before in the study area where salinity and conditions are suitable for living. While *Cyprideis torosa* is the most common species in the study area, it is characterized by the presence of nodes which are an indication of low salinity.

References

Ahmed, M.M. 1975. Systematic study on Mollusca from Arabian Gulf and Shatt Al-Arab, Iraq. University of Basrah, Iraq, 23p.

Al-Ali, R.A. 2007. Study of recent faunal assemblages and their ecology in northwestern part of Arabian gulf and southern of Mesopotamia. Ph.D. Thesis, University of Basrah, 135p.

Albadran, B.N., Al-Beyati, F. and Abdllah, Y. 1996. Heavy minerals distribution in the lower part of the Shatt River. Marina Mesopotamica, 11(1): 17-26.

Al-Ghadban, A. 1980. Recent shallow-water sediments in the area between Ras Al-Jalayah and Ras Al-Zour (Southern Kuwait). University of Kuwait. Master Thesis. Geology, 204p.

Al-Jumaily, W.A.K. 1994. Quaternary Ostracoda in southern Iraq. Baghdad University, 117p.

Benson, R.H. 1972. The Bradleya Problem, with Descriptions of two New Psychrospheric Ostracode Genera, Agrenocythere and Poseidonamicus (Ostracoda: Crustacea. Smithsonian Contributions to Paleobiology, (12): 1-138.

https://repository.si.edu/handle/10088/1879
Boltovskoy, E. and Wright, R. 1976. Recent foraminifera. Springer Netherlands. Dr. WJunk b.v.-Publishers-The Hague, 515 p.
Carbonel, P., Colin, J.P., Danielopol, D.L., Löffler, H. and Neustrueva, I. 1988. Paleoecology of limnic ostracodes: A review of some major topics. Palaeogeography, Palaeoclimatology, Palaeoecology, 62(1–4): 413-461.
Darmoian, S.A. and Lindquist, K. 1988. Sediments in the estuarine environment of the Tigris/Euphrates delta, Iraq, Arabian Gulf. Geological J., 23(1): 15-37.
Folk, R.L. 1974. Petrologie of sedimentary rocks. Texas, USA: Hemphill's, Austin, PP: 128-182.
Holmes, J.A. and Chivas, A.R. 2002. The Ostracoda: Applications in Quaternary Research. Washington, D.C.: Library of Congress Cataloging Library of Congress Cataloging, American Geophysical Union, 314p.
Issa, B.M. 2006. Sedimentological and Palaeontological study of Tidal Flats-Northwest of the Arabian Gulf. M.Sc. Thesis, University of Basrah, 136p.
Karanovic, I. 2012. Recent freshwater Ostracods of the world: Crustacea, Ostracoda, Podocopida. Springer, Heidelberg/Dordrecht/London/New York, 608p.
Keen, A.M. and Coan, E.V. 1974. Marine molluscan genera of western North America 2nd ed. Stanford, California: Stanford University Press, 208 p.
Loeblich, A.R. and Tappan, H. 1988. Foraminiferal Genera and Their Classification. Von Nostrand Reinhold,. New York: Springer US.970 p.
Mojtahid, M., Jorissen, F., Lansard, B. and Fontanier, C. 2010. Microhabitat selection of benthic Foraminifera in sediments off the Rhône River mouth northwest Mediterranean. The Journal of Foraminiferal Research, 40(3): 231-246.
Moore, R.C. 1969. Treatise on invertebrate paleontology/Part N, Mollusca 6 Bivalvia. Geological Society of America and The University of Kansas, 989p.
Moore, R.C., Lalicker, C.G. and Fischer, A.G. 1952. Invertebrate Fossils. McGraw-Hillbook. 766p.
Morkhoven Van, F.P. 1963. Post-palaeozoic Ostracoda: Their Morphology, Taxonomy and Economic Use. Elsevier Publishing Co., 343p.
Mourguiart, P. 1992. Los Ostracodos. In Dejoux, C. and Iltis, A., El Lago Titiaca, Synthesis Del Conocimiento Limnologico Actual. Monogrphiae Biologicae, 68: 337-345.
Murray, J.W. 1991. Ecology and palaeoecology of benthic foraminifera. New York: Longman Scientific and Technical, 407p.
Murray, J.W. 2006. Ecology and Applications of Benthic Foraminifera. Cambridge University Press, UK, 426p.
Nelson, R.E. 1982. Carbonate and gypsum. pp: 181-197. In A.L. Page (ed.) Methods of soil analysis. Part 2, 2nd ed. Agron. Monogr. 9. ASA and SSSA, Madison, WI.
Nwojiji, C.N., Osterloff, P., Okoro, A.U. and Ndulue, G. 2014. Foraminiferal Stratigraphy and Paleoecological Interpretation of Sediments Penetrated by Kolmani River-1 Well, Gongola Basin, Nigeria. Journal of Geosciences and Geomatics, 2(3): 85-93.
Pardo, A. and Keller, G. 2008. Biotic effects of environmental catastrophes at the end of the Cretaceous and early Tertiary: Guembelitria and Heterohelix blooms. Cretaceous Research, 29(5–6): 1058-1073.
Phleger, F.B. and Parker, F.L. 1951. Ecology of Foraminifera, Northwest Gulf of Mexico. Geological Society of America Memoir, 46(1): 64.
Shareef, N.F. and Mahdi, M.M. 2015. Studying of recent environments in Faw, Khor Al-Zubair and Um-Qaser areas, Southwestern Arabian Gulf, Basrah, Iraq. Journal of Basrah Researches (Sciences), 41(2): 1-14.
Shareef, N.F., Khalifa, Q.U. and Shubar, I.Y. 2015. The salinity effect and sedimentary types for the fauna distribution during the Holocene in Southern Iraq. Mesopot. J. Mar. Sci., 30(2): 124-141.
Whatley, R. and Maybury, C. 1990. Ostracoda and global events. London: Chapman and Hall, 611p.
White, M.M., Chejlava, M., Fried, B. and Sherma, J. 2007. The concentration of calcium carbonate in shells of freshwater snails. American Malacological Bulletin, 22, (1): 139-142.
Yacoub, S.Y. 2011. Stratigraphy of the lower Mesopotamia Plain. Iraqi Bull. Geol. Min. Special Issue, No.4, Geology of the Mesopotamia Plain, pp: 47-82.

مقارنة رسوبية وبيئية واحيائية بين موقعين في شمال غرب الخليج العربي

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المستخلص - تعد البيئة البحرية واحدة من أغنى البيئات في الأحياء البحرية الصغيرة القاعية البحرية بسبب الظروف المناسبة للعيش من الغذاء والأوكسجين ونسيج الرواسب والملوحة. في الدراسة الحالية. تمثل الاحياء (fauna) التي درست ووزعت على أساس أعماق الرواسب البحرية تحت سطح الأرض من منطقتين، الأولى في خور شيطانة (كور 1) في شمال منطقة الدراسة حيث البيئة العنيفة مع التيارات العالية، وتحتوي على أكثر من 95٪ من الحبيبات الرملية، وهي تتميز بالألوان الفاتحة، والحجم الكبير، والحبيبات نظيفة، مستديرة الى شبه المستديرة بسبب الغسل والحركة المستمرين، والثانية بالقرب من ميناء البصرة النفطي (كور 2) في جنوب منطقة الدراسة، حيث البيئة ذات التيارات الضعيفة والرمال الناعمة واللون الداكن بسبب نشاط البكتيريا غير اللاهوائية في المنطقة والحبيبات الزاوية إلى شبه زاوية. تم تحديد نوع نسيج الرواسب عند كل عمق ويتكون من (رملي، رمل غريني، غرين، غرين رملي). ومن ناحية أخرى، كان من المهم تقدير نسبة كربونات الكالسيوم في الرواسب لتحديد حجم وعدد الحيوانات التي تعيش في هذه المنطقة. فضلاً عن دراسة الاحياء الحديثة بصورة تفصيلية. شخصت في هذه الدراسة العديد من الانواع التي لها اهمية في دراسة البيئات.

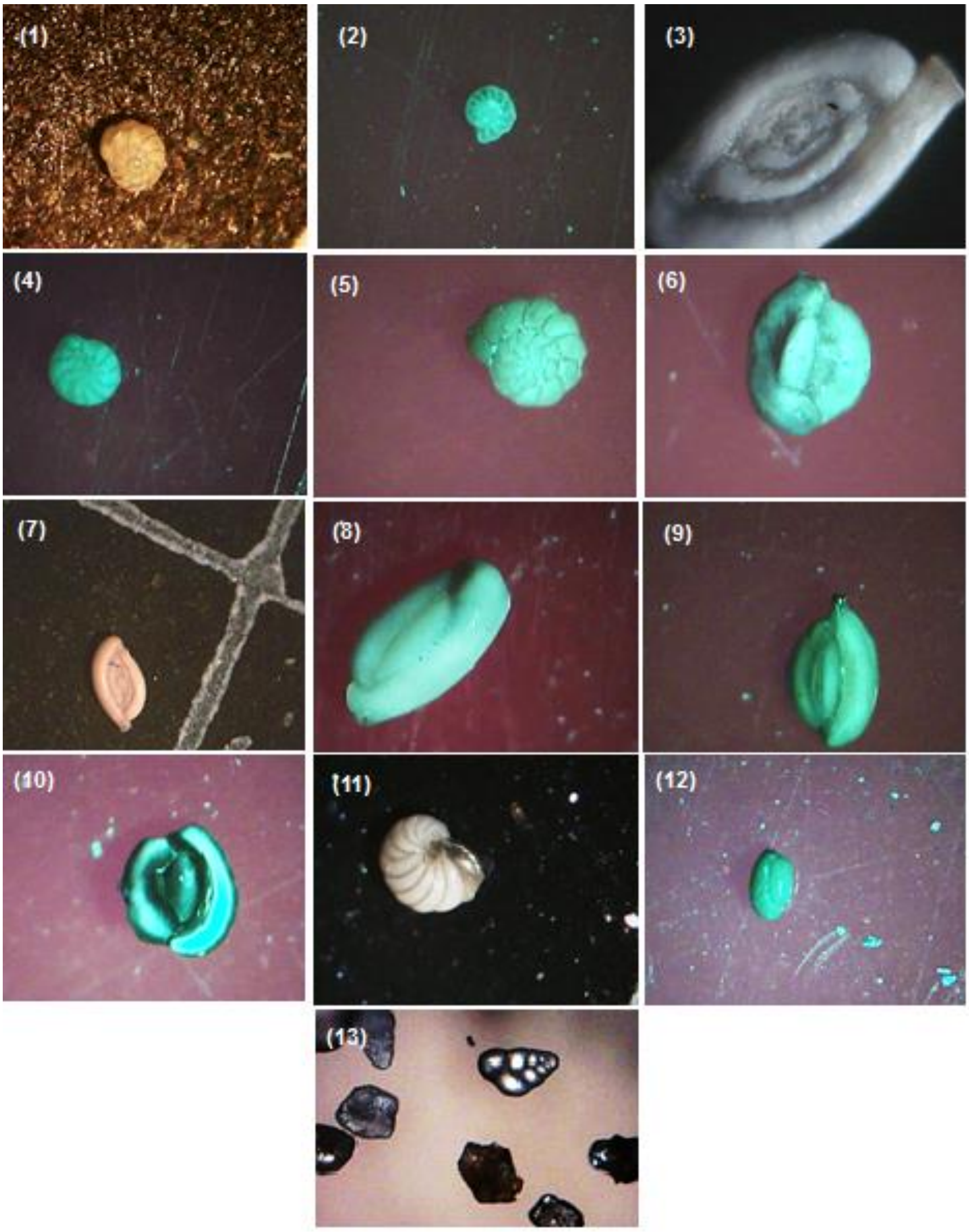

Plate 1. Foraminifera.
1- *Ammonia parkinsoniana* (d'Orbigny, 1839) (40X)
2- *Elphidium advenum* (Cushman, 1922) (40X)
3- *Spiroocolina eximia* (Cushman, 1922) (40X)
4- *Elphidium craticulatum* (Fichtel and Moll, 1798) (40X)
5- *Ammonia baccarii* (Linne, 1758) (40X)
6- *Quinqueloculina lamarckina* (d Orbigny, 1930) (40X)
7- *Spiroloculina laevigata* (Cushman & Todd, 1922) (40X)
8- *Quinqueloculina poeyana* (d Orbigny, 1839) (20X)
9- *Quinqueloculina venusta* (Karrer, 1868) (20X)
10-*Quinqueloculina candeiana* (20X)
11- *Nonion incisum* (Cushman, 1926) (40X)
12-*Trilocolina oblonga* (Montagu, 1803) (40X)
13-*Heterohelix globulosa* (Ehrenberg, 1840) (100X)

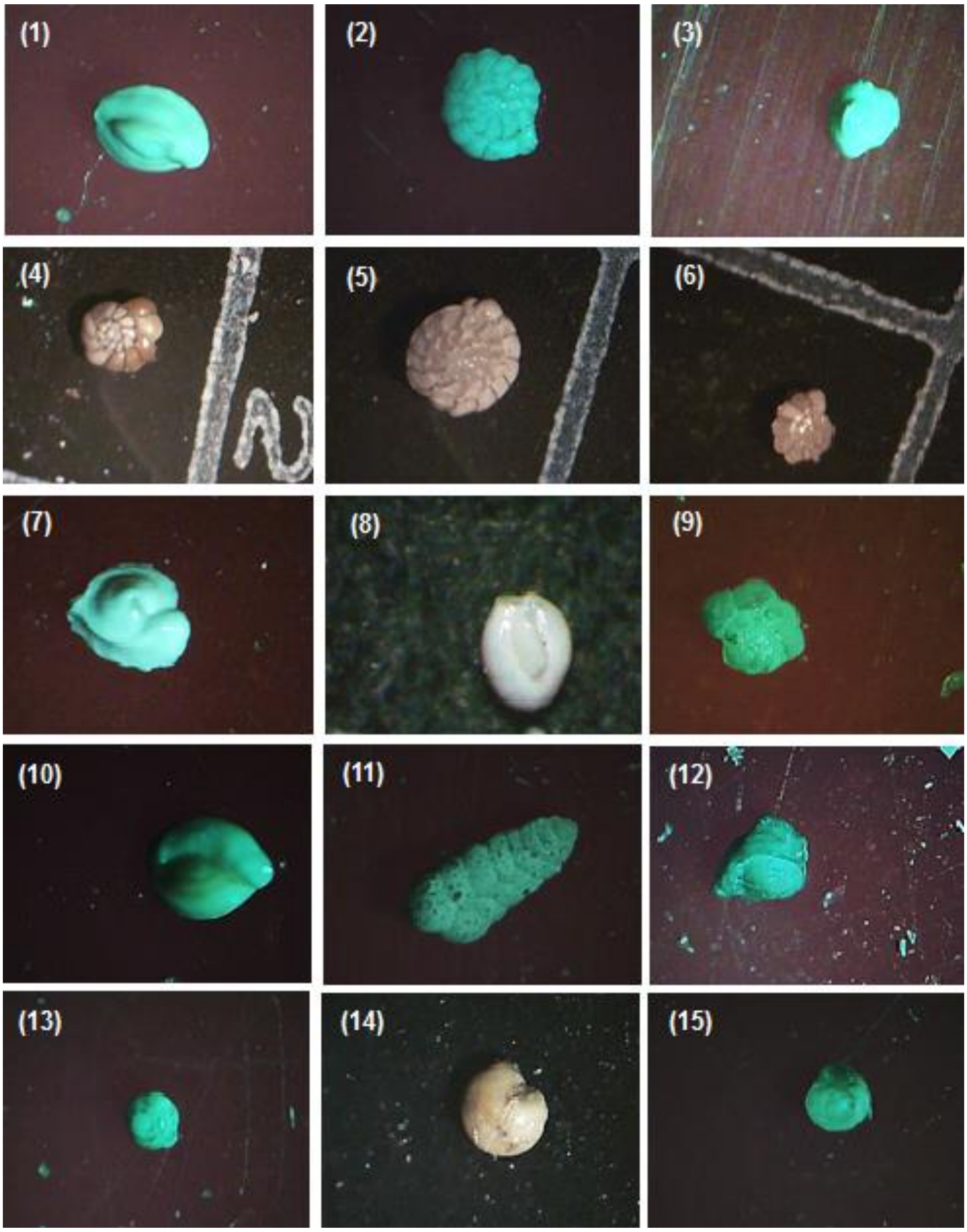

Plate 2. Foraminifera.

1- *Quinqueloculina seminula* (Linnaeus, 1758) (40X)
2- *Ammonia detanta* (Cushman, 1926) (40X)
3- *Triloculina rotunda* (d'Orbigny in Schlumberger, 1893) (40X)
4- *Ammonia tepida* (Cushman, 1926) (40X)
5- *Ammonia bradyi* (Trauth, 1918) (40X)
6- *Asterorotalina dentate* (d'Orbigny, 1839) (40X)
7- *Adelosina* sp. (40X)
8- *Trilocolina trigonula* (Lamarck, 1840) (40X)
9- *Asterorotalia* sp. (40X)
10- *Triloculina earlandia* (Cushman, Todd & Post) (20X)
11- *Textularia agglutinans* (Cushman, J.A. 1911) (20X)
12- *Quinquelocolina* sp. 1 (40X)
13- *Buccella frigida* (Cushman, 1922) (40X)
14- *Milliolovella* sp. (40X)
15- *Rosalina globularis* (d'Orbigny, 1826) (40X)

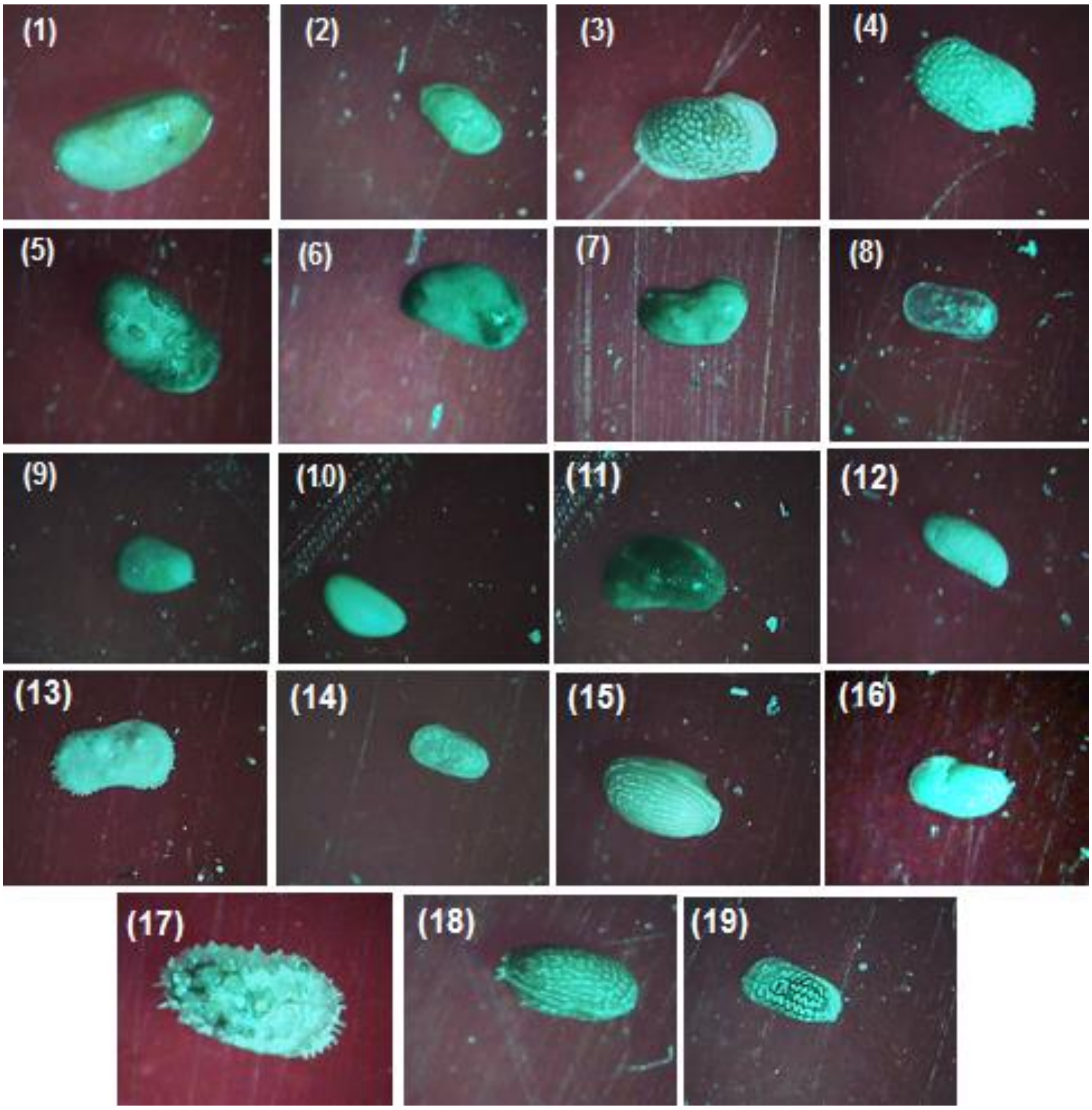

Plate 3. Ostracoda.
1- *Candonilla simpsoni* (Sharpe) (40X)
2- *Haplocytheridea keyseri* (Jain, 1978) (40X)
3- *Alocopocythere reticulate* (Hartmann) (40X)
4- *Neocytheretta murilineata* (Zhao & Whatley, 1989) (40X)
5- *Cyprideis torosa* (Jones), Kelinyi, 1972) (40X)
6- *Candonilla wanlssi* (Staplin, 1963) (40X)
7- *Condona ohrida* (Baird, 1845) (20X)
8- *Cytherelloidea pracipua* (Vanden Bold, 1963) (40X)
9- *Candona compressa* (Koch) Brad, 1868 (40X)
10- *Condona neglecata* (Sars, 1887) (40X)
11- *Candona holmesi* (40X)
12- *Darwinula stevensoni* (Brady and Reberston, 1870) (40X)
13- *Carinocythereis indica* (Jain, 1978) (40X)
14- *Chrysocythere keiji* (Jain, 1978) (40X)
15- *Loxoconcha* sp. (40X)
16- *Neocytheromoroha reticulate* (Mohan *et al.*, 2001) (40X)
17- *Agrenocythere pliocenica* (Seguenza, 1880) (40X)
18- *Lancacythere coralloides* (Brady, 1886) (40X)
19- *Tanella gracilis* (Kingma, 1948) (40X)

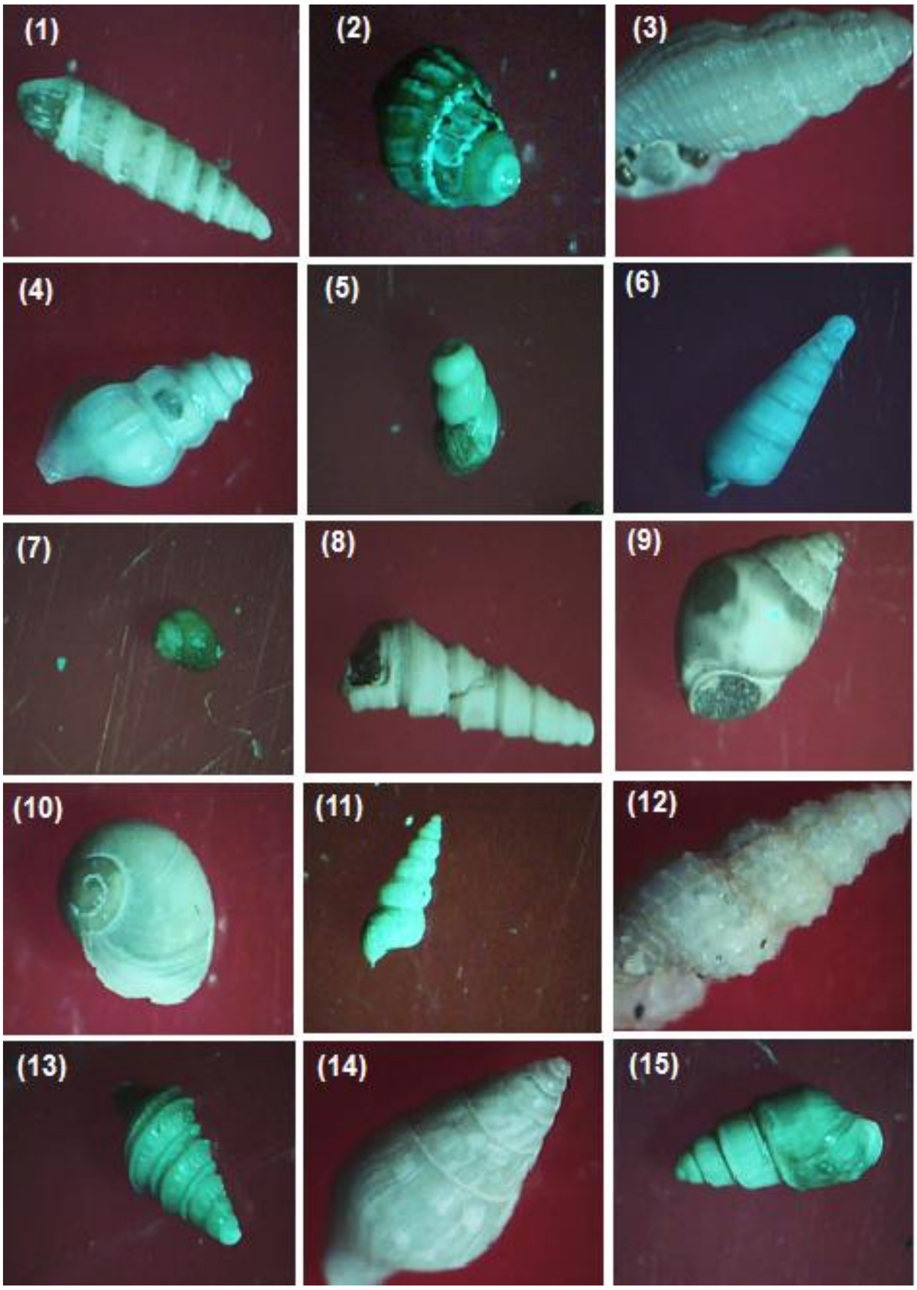

Plate 4. Gastropoda.

1- *Odostomia leavis* (Angas) (20X)
2- *Alvania lacteal* (40X)
3- *Cerithium pfeifferi* (Dunker, 1882) (20X)
4- *Gibborissoa virgate* (Philippi, 1849) (20X)
5- *Melina* sp. (20X)
6- *Odostomia serenei* (Saurin, 1959) (20X)
7- *Polynices mamilla* (Linnaeus, 1758) (40X)
8- *Turriteiia foltoni* (Melvill) (20X)
9- *Bellamya bengalensis* (Lamarck, 1822) (20X)
10- *Polynices ampla* (Gmelin) (40X)
11- *Scaliola* sp. (20X)
12- *Cerithidea fluviatillis* (Potiez et Michaud) (20X)
13- *Aclis minor* (Brown, 1827) (20X)
14- *Bullia tranquebarica* (Röding, 1798) (20X)
15- *Colubraria monroei* (Mc Ginty 1962) (20X)

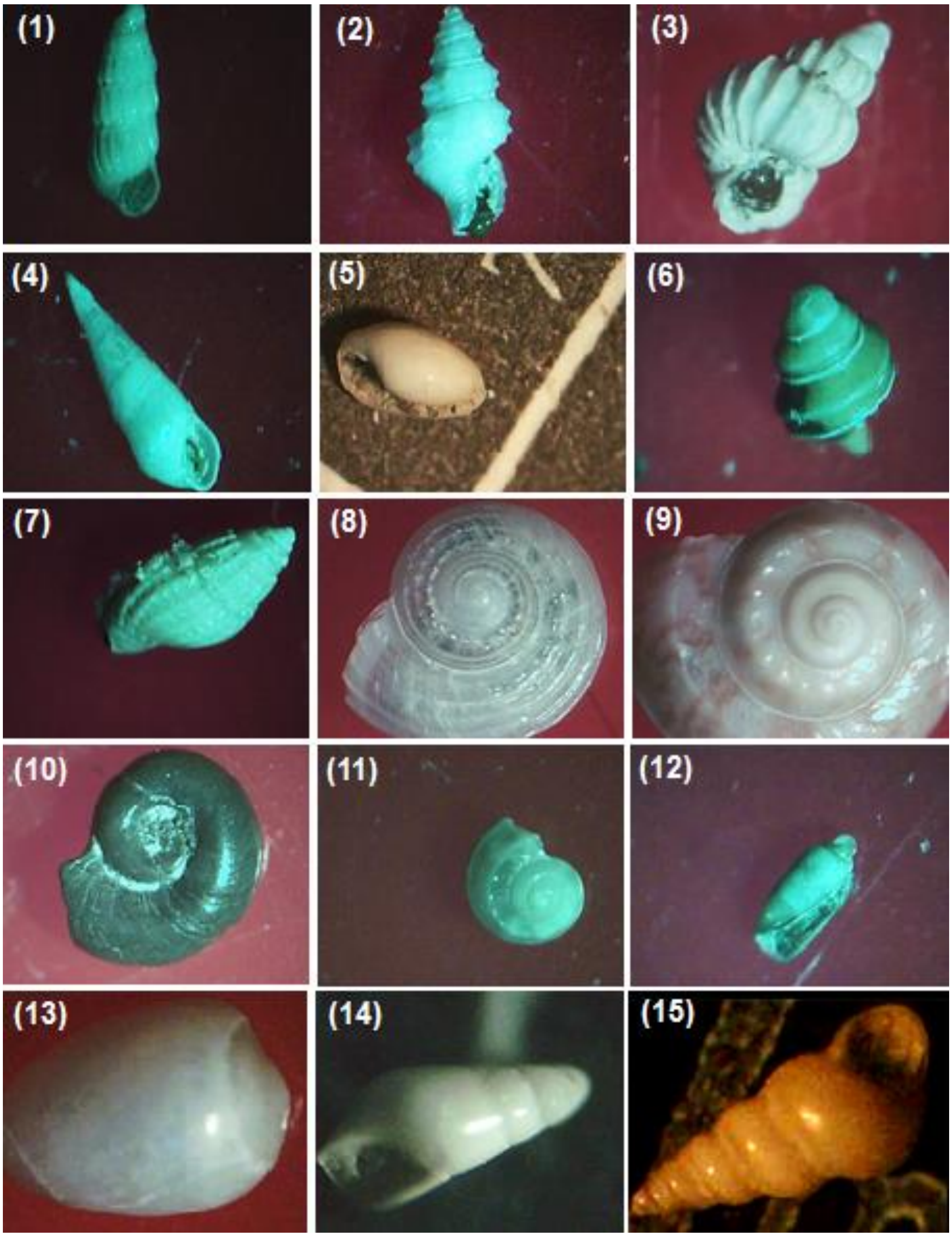

Plate 5. Gastropoda.
1- *Turbonilla umbrina* (Melvill, 1918) (20X)
2- *Cerithidium diplx* (Philippi, 1849) (20X)
3- *Epitonium occidentale* (Nyst, 1871) (40X)
4- *Terebra maculata* (Linnaeus, 1758) (20X)
5- *Ancilla ampla* (Gmelin) (20X)
6- *Calliostoma coppingeri* (E.A. Smith, 1880) (40X)
7- *Alvania rykelii* (Risso, 1826) (20X)
8- *Circulus striatus* (Philippi, 1836) (20X)
9- *Umbonium vestiarium* (Linneus) (20X)
10- *OMalogyra atomus* (Philippi, 1841) (20X)
11- *Minolia caifasii* (Caramagna, 1888) (20X)
12- *Tornatina persiana* (Gaimard, 1833) (20X)
13- *Gibberula granum* (Philippi) (20X)
14- *Hydrobia neglecta* (Muus, 1963) (20X)
15- *Pyramidellidae gen*. sp. (20X)

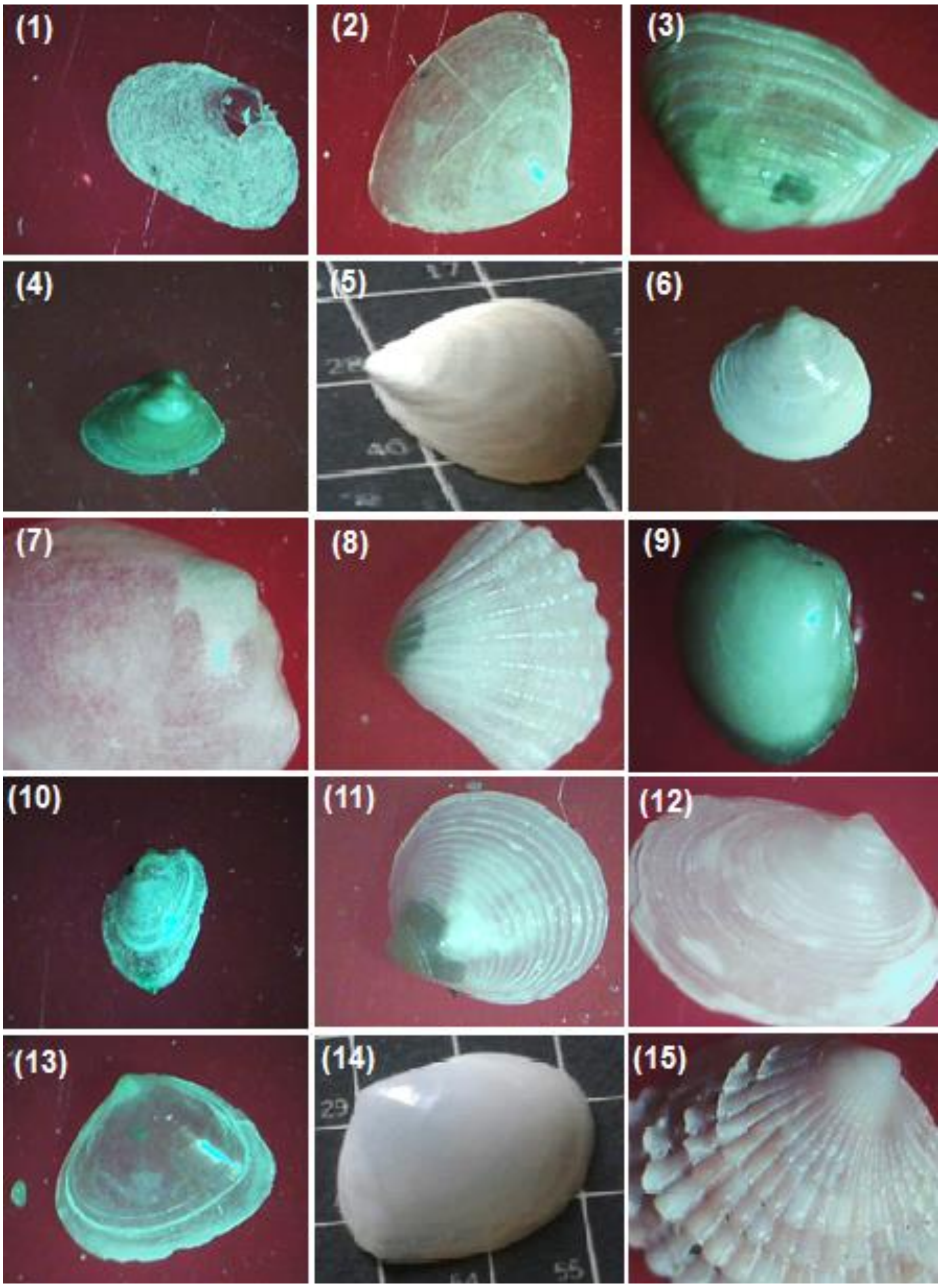

Plate 6. Pelecypoda.

1- *Tellina* sp. (20X)
2- *Mactra dissimilis* (Deshates) (20X)
3- *Corbula subquadrata* (Melvill, 1907) (20X)
4- *Arca foltoni* (G. B. Sowerby III, 1907) (20X)
5- *Mactra* sp. (5PX)
6- *Dosinia laminate* (Reeve) (20X)
7- *Unio tigridis* (Bourginat, 1852) (20X)
8- *Carditella pallid* (Smith, 1881) (20X)
9- *Corbulata itensis* (Lamarck, 1818) (20X)
10- *Idasola argentea* (Jeffreys, 1876) (20X)
11- *Corbicula fluminalis* (Muller) (20X)
12- *Paphies ventricosa* (Gray, 1843) (20X)
13- *Kellia suborbicularis* (Montagu, 1803) (20X)
14- *Angulus* sp. (5PX)
15- *Asaphis voilascens* (Forskal, 1775) (20X)

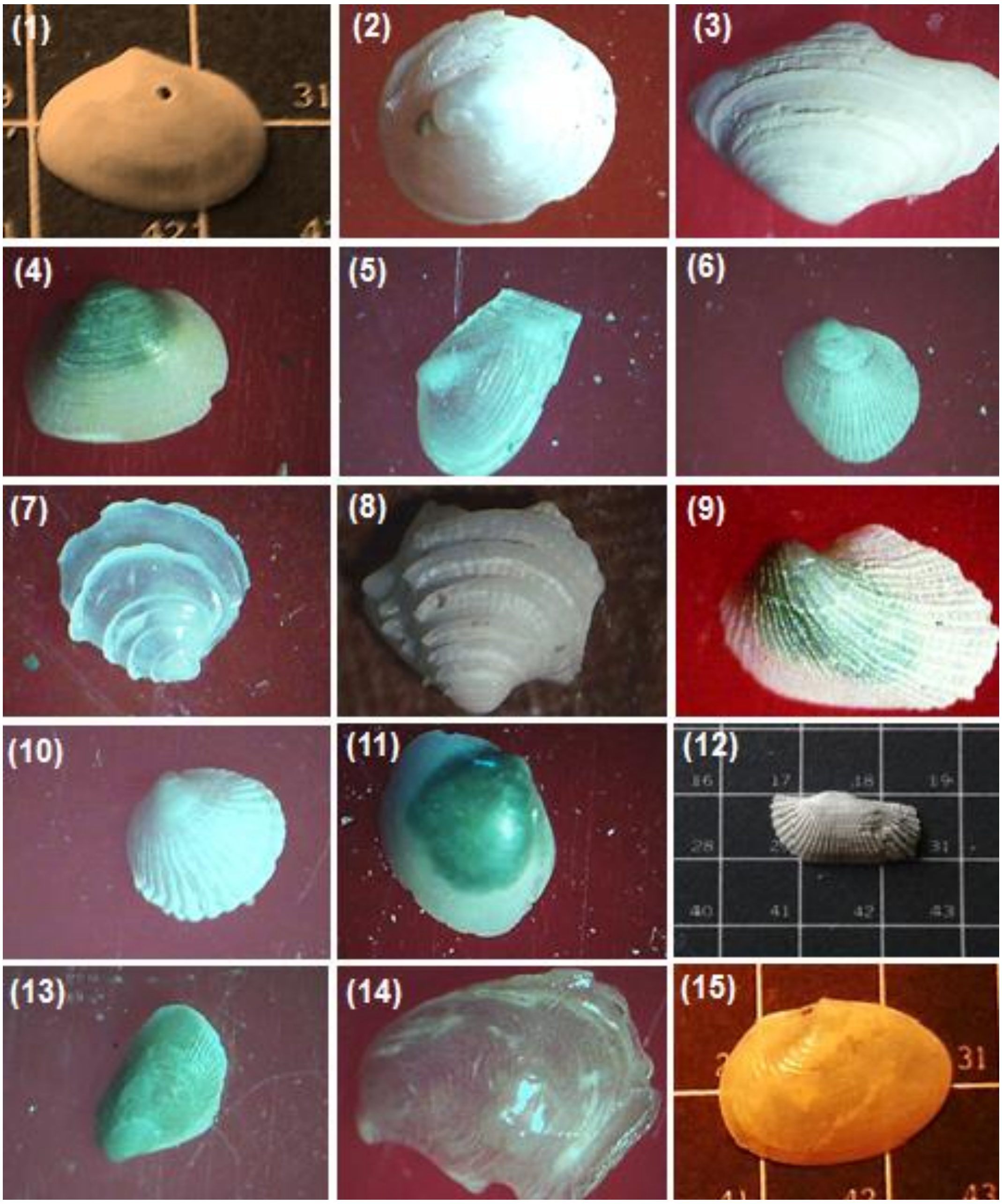

Plate 7. Pelecypoda.
1- *Theora* sp. (5PX)
2- *Calyptraea chinensis* (Linnaeus, 1758) (20X)
3- *Platyodon cancellatus* (Conrad, 1837) (20X)
4- *Arca foliata* (Forskal) (20X)
5- *Corbula pulchella* (Philippi, 1893) (20X)
6- *Musculus niger* (J.E. Gray, 1824) (20X)
7- *Bassina yatei* (Gray, 1835) (20X)
8- *Bassina callophyla* (Philippi, 1836) (20X)
9- *Striarca lactea* (Linnaeus, 1758) (20X)
10- *Codakia orbicularis* (Linnaeus, 1758) (20X)
11- *Thracia nitida* (Virrill, 1884) (20X)
12- *Bentharca sagrinata* (Dall, 1886) (5PX)
13- *Brachyodontes variabilis* (Krauss, 1848) (20X)
14- *Crassostrea iridescens* (Hanley, 1854) (20X)
15- *Theora mesobotimia* (Annandale, 1918) (5PX)

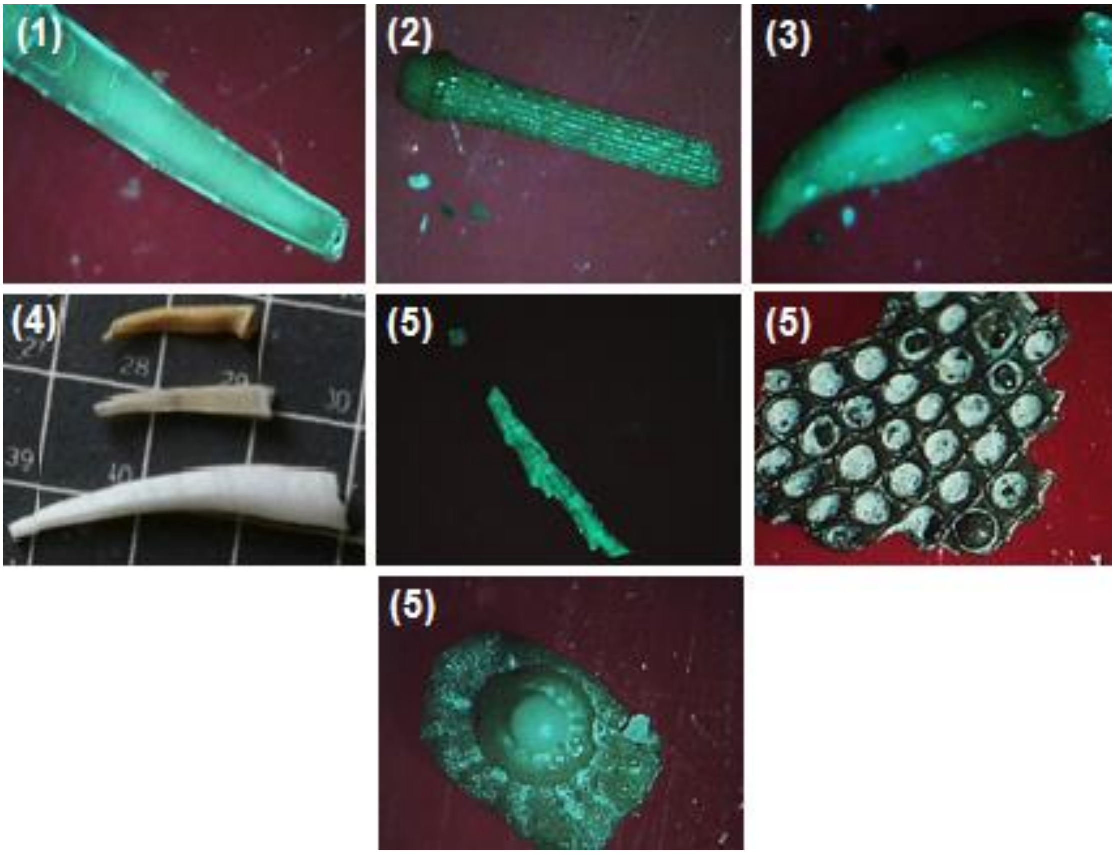

Plate 8. Scaphopoda and Bryozoa.
1- *Brechites penis* (Linnaeus, 1758) (20X)
2- *Cadonluse uloides* (Melvill and Standen, 1901) (20X)
3- *Dentalium octangulatum*. Scaphopoda (Donovan, 1803) (20X)
4- *Dentalium quadrapicale*. *Scaphopoda* (Donovan, 1803) (5PX)
5- *Bryozoa* 1, 2, 3 (20X)