

Late Quaternary paleoenvironmental evolution of southern Caspian Sea (northern Iran) from lagoonal subsurface data

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Integrated sedimentological and geochemical analyses of five cores drilled in the subsurface of Zaghmarz lagoon, Palangan lagoon and Lapoo lagoon of northern Iran (Mazandaran province) has described a facies distribution characteristic of lagoon, shoreline and mixed both of them. Five cores were taken with Auger corer, the maximum depth of cores was 575cm. These samples analyzed on the basis of sedimentology and elemental analysis studies. Sieve analyses, laser particle sizer, calcimetry, mineralogy, morphoscopy, and morphometry, chemical analyses, Clay mineralogy (XRD), Oxygen Isotope and Dating have been done.

The thickness of lagoonal sediments didn't exceed the maximum core length of 1m in all cores. The basal lagoonal sediments are characterized by shell beds and reeds and plants roots. Lens of peats between shoreline sediments developed during flooding of the lands.

Shoreline facies with sand layers and muddy sand sediments increases gradually from top to down of cores.

On the basis of cores observations and well documented reasons these lagoons are most likely the remnants of Gorgan gulf that appear with to go down level of Caspian Sea. It is unlikely that the lagoons will be completely filled during the Holocene sea level highstand cycle.

Introduction

Zaghmarz lagoon and Palangan lagoon and Lapoo lagoon are located in the southern Caspian Sea coast on the northern side of Iran (36° 50' N, 53° 15' to 53° 25' E). The lagoons separated from Caspian Sea by a 1-2 km wide beach ridge, extend East-West for about 9 km and are 800m wide. The average water depth is 2.5 m, while the maximum depth is less than 6m. The lagoons exhibit strong seasonal variations of temperature (ranging from 3°C in winter to 39°C in summer) and salinity (between 9 and 27psu).

The presence of Gorgan gulf along the southern coast in this region to discharged important role for information of lagoons. Two main Holocene aeolian units are recognized along the southern Caspian Sea coasts. Mid-Holocene dune belts formed by beach progradation during a relative sea level highstand.

Detailed facies characterization, based upon sedimentology and geochemical, allows reconstruction of the depositional history of these lagoons during the late quaternary. The late quaternary evolution of coastal systems in the southern Caspian Sea region has been shown to be controlled mostly by relatively sea level changes.

Material and methods

A total of 5 cores were taken from the lagoonal basins of Caspian Sea coast region in February 2009. Cores were taken from landward and seaward of lagoons, maximum length of cores was 5.73m and penetration usually stopped when unmixed sand layers was reached. After drilling, the core tubes were marked at the sediment surface and the tops sealed with plastic caps. In the laboratory, cores were cut open with a portable saw and the sediment split in half using metal wire or knives. Cores

were logged, photographed and, from one core half, 5cm long samples were taken for sedimentologic (texture, composition), mineralogic (XRD), and chronologic (C14-dating) analyses. The other half of the core was sealed and kept for reference. One part was used for XRD analysis, and relative abundances of carbonate minerals were determined using the method of Milliman (1974, pp. 21-29). The other part of the sample was sieved into the common grades >2, 2-1, 1-0.5, 0.5-0.25, 0.25-0.125, 0.125-0.063, and < 0.063 mm. sediments in grain size <0.063 are separated by laser particle sizer and classify to silts and clay groups. Relative amounts of the mud (<0.063 mm) and coarse fractions (>2 mm) were used to assign depositional texture, in addition to the visual description of texture during core logging (followed Dunham, 1962).

Core L1 is located on the Zaghmarz lagoon between Caspian sea and sand dune whereas core L2 is on the opposite and landward side of lagoon. Several sedimentary features (colour, texture, structures, and lamination) and the type and concentration of accessory materials (including paleosols, plant fragments and organic matter) were used to identify major facies associations.

Results

A total 17.36 m of core was recovered where sediment is rich in pore water and therefore has a “soupy” texture. The lagoonal facies succession begins with reeds, roots and shells. Description and nomenclature of the lithofacies encountered of five cores is described in the table.

- Core L1

Depth	Description	Fauna and accessory features	contact	texture	Depositional setting
0-74cm	Light brown with <10% mud	Scattered mollusc shell fragments; roots	gradual	Sand	Shore line
74-86cm	Dark brown/black with mud >10%, by organic-rich silts clays	Mollusc shell fragments	gradual	Muddy sand	Lagoon- Shore line (Lagoon Dominated)
86-90 cm	Light brown with <10% mud	Scattered mollusc shell fragments; roots	gradual	Sand	Shore line
90-99 cm	Dark brown/black with mud >10%, by organic-rich horizon	Mollusc shell fragments	gradual	Muddy sand	Lagoon- Shore line (Lagoon Dominated)
99-194 cm	Light brown with <10% mud	Scattered mollusc shell fragments; roots	gradual	Sand	Shore line

- Core L2

Depth	Description	Fauna and accessory features	contact	texture	Depositional setting
0-7cm	dark brown with organic matter 56-67%	Plant and root remains	gradual	Sandy Mud (Soil)	Agriculture soil
7-17cm	Dark brown/black, agriculture land	Roots, iron oxides	gradual	Muddy sand	Lagoon
17-35cm	dark brown with organic matter horizon	Fresh water gastropods and mollusc shell fragments	sharp	Muddy sand	Lagoon- Shore Line (Lagoon Dominated)

35-573cm	light brown	Mollusc shell fragments	The fall of log wall	sand	Shore Line
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- Core L3

Depth	Description	Fauna and accessory features	contact	texture	Depositional setting
0-21cm	dark brown	Plant and root remains	gradual	Sandy Mud (Soil)	Agriculture soil
21-47cm	light brown in base to black on the top with organic matter 59-79%	Roots, iron oxides, gastropods and peat	sharp	Silt(Down) to Silty Clay(top)	Shore line to Lagoon (Lagoon Dominated)
47-85cm	light brown in base to black on the top,	Roots, iron oxides, gastropods and peat	sharp	Silt(Down) to Silty Clay(top)	Shore line to Lagoon (Lagoon Dominated)
85-542cm	light brown	Scattered Mollusc shell fragments	The fall of log wall	sand	Shore Line

- Core L4

Depth	Description	Fauna and accessory features	contact	texture	Depositional setting
0-75cm	light brown with well sorted sands	Scattered Mollusc shell fragments	gradual	Sand	Shore line
75-91cm	Dark brown/ to black with organic matter	Roots, iron oxides, gastropods and peat	gradual	Sandy Mud	Lagoon
91-102cm	light brown	Scattered Mollusc shell fragments	The fall of log wall	Sand	Shore line

- Core L5

Depth	Description	Fauna and accessory features	contact	texture	Depositional setting
0-10cm	Dark brown	Many bivalve macrofossils and mollusc shell fragments with gastropods, roots and wood fragments	gradual	Muddy Sand	Agriculture soil
10-24cm	Dark brown with organic matter	Mollusc shell fragments	sharp	Muddy Sand	Shore line to Lagoon (Lagoon Dominated)
24-27cm	Dark brown to blackish	peat	sharp	Muddy Sand	lagoon
27-40cm	Light brown	Mollusc shell fragments	sharp	sand	Shore Line
40-59cm	Dark brown to	Scattered mollusc shell	sharp	Muddy	lagoon

59-325cm	blackish Light brown	fragments; roots Mollusc shell fragments	The fall of log wall	Sand sand	Shore Line
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Conclusion

Integrated sedimentological and micropaleontological investigations of five cores from the subsurface of lagoons show a vertical cyclic pattern of facies, including lagoonal, shoreline, mixed both of them. Particularly, the lower part of the study succession is characterized by shoreline sediments. In contrast, the remaining part of the succession was formed in a variety of depositional environments, from lagoon to shoreline.

The overlying sequence of mid-Holocene to late-Holocene age displays two distinct phases of deposition that can be referred to the Holocene sea-level rise and highstand, that enhancing the role of eustacy.