

Holocene sedimentary environment of Maharlou Lake by sedimentological and mineralogical evidences

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Extended Abstract

Introduction

Playa is considered as a dry inland with dry negative water balance which is dry in more than $\frac{3}{4}$ of a year. Its capillary margins are so close to the surface that evaporation resulting from these margins leads to water discharge and evaporates formation. Paleophysical and paleochemical changes of a playa make significant changes in type of sediments which can be applied to determine paleosedimentary environments and their effective sedimentary processes. Sediments and minerals of salty lakes are changed by seasonal and temporal variations of sea level, so by studying sediments and minerals especially evaporate minerals in the past, sedimentary environments can be reconstructed. The present study is aimed to reconstruct and determine Holocene sub-environments in Maharlou Lake as a playa sedimentary environment which is exactly related to input– output balance of water. Maharlou is a salty ephemeral lake. It is located between $29^{\circ}17'00''$ and $29^{\circ}23'30''$ northern latitudes and $52^{\circ}41'00''$ and $52^{\circ}49'00''$ eastern longitude. The Lake has maximum area equals to 28 km^2 situated in 18 km from southeastern of Shiraz town. The greatest length of the lake is nearly 35 km, maximum width about 15 km and average width 7 km. The Lake's height from sea level is 1455m. There is no permanent river in catchment basin of Maharlou Lake and basin's flooding is entered in the Lake by several flood plains and seasonal (monsoon) rivers.

Materials and Methods

In the present study, 13 undisturbed cores (sub-surface) were taken from different parts of the Lake up to 170cm under Lake Floor by gravity corer. At first, the cores were described completely based on field evidences. Regarding to texture structure, color and type of sediment, the sub-environments were distinguished 85 samples preparing from the obtained cores. Granulometric analysis, mineralogy by XRD, studying sedimentary components by binocular microscope (Nikon) and Scanning electron Microscope (SEM) were performed.

Results and Discussion

The results from macroscopic and microscopic characteristics, granulometric analysis and mineralogy of cores were combined and stratigraphical column was plotted. Based on sub-environments determination, sea level of the Lake has been relatively plotted. In other words, from sub-environment of temporal Lake, salt pan, muddy salt pan and mud flat, the sea level of the Lake is reduced. Considering sedimentation rate from 0.13 to 0.3 mm in a year, the sediments under the Maharlou floor, up to the depth of 170 cm, is about the last 5000 years (Lak, 2007), indicating three

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origins for the sediments: clastic, chemical and evaporative origins. The sediments of central part of the Lake are nearly all chemical type (evaporative and carbonated) and marginal sediments of the Lake are clastic – chemical type. The results from XRD indicate that the minerals in Holocene sediments of Maharlou Lake include quartz, feldspar, calcite, dolomite, aragonite, magnesite, natron, gypsum, basanite, polyhalite, glauberite and clay minerals. Clastic or detrital sediments are consisted of clastic calcareous fragments (calcite and dolomite), gypsum, quartz, feldspar, muscovite and illite. The percent of clastic carbonated sediments is more than the others. Illite is the most common clay mineral in the Lake. In some horizons (layers), there are also phlogopite and polygorskite. Illite is occurred in the outcrops of the Lake's vicinities. Polygorskite and phlogopite isn't occurred in the vicinities and have intra-basinally formed. They are formed because of high concentration of Mg ion in the basin. The highest value of clastic sediments occurs in margins of the Lake especially southeastern and northwestern parts. Towards the center of the Lake, the presentation of clastic sediments is reduced and reaches to 2-3 percent of total sediments. In wet periods, the Lake extent is increased and sedimentary sub-environment of ephemeral Lake is developed and clastic sediments will be dominated due to high charging (input) of water. Chemical sediments of Maharlou Lake include carbonated and evaporative minerals. Carbonated minerals are deposited in carbonated zone at the beginning of brine evaporation. They are consisted of aragonite, calcite, dolomite, Magnesite, Natron. Evaporative minerals are gypsum, halite, basanite, glauberite, polyhalite, bischofite. In Maharlou Lake, in addition to magnesite, there is basanite in horizons related to dry periods. Biochemical sediments of Maharlou Lake include fecal pellets related to one of the shrimps called *Artemia* which is occurred in ephemeral Lake. These pellets are often aragonitic. In general, Maharlou Lake has no sub-environment of permanent Lake and the extension of alluvial fan, sand flat, mud flat and saline mud flat is small like a narrow strip. Mud flat includes silty clay containing sedimentary structures such as mud cracks and sand dunes. In this area, there are gypsum, glauberite and halite. The sediments of muddy-salty pan are clay silt having no sedimentary structure and their color is brown red or black. Aggregation of euhedral crystals of gypsum, glauberite and halite are occurred as replacement. In some parts, sandy dunes and layers are observed. There is halite chevron form and fluid inclusions and vertical solution pipes and mixture of mud and salt. In salt pan, there are poor bedding halite and halite mixed with mud (rarely occurred with bedding) and transparent halite. Solution pipes indicate sub-environment of ephemeral Lake. Alternative cycles of evaporative- clastic (more often evaporative) are occurred in the area.

Conclusion

The study of sub-surface sediments of Maharlou Lake, from recent to nearly 5000 years ago, indicates three types of sediments in the Lake: clastic, carbonated (chemical and biochemical) and evaporative sediments. The sediments of central part are nearly all evaporative and carbonated and marginal sediments of the Lake are clastic-chemical. The sediments contain some minerals such as clastic minerals, quartz, feldspar, clay minerals, calcite and dolomite. Carbonated sediments include intra-basinal carbonated minerals like calcite, dolomite aragonite, maganesite, natron, and evaporative minerals such as gypsum, halite, bischofite, glauberite, polyhalite and basanite. Intra-basinal clay minerals are polygorskite, phlogopite and sodoeite. Biochemical sediments include *Artemia* pellet which is mostly aragonitic. The type of sub-surface sediments is usually sandy clay silt. The Holocene reconstructed sedimentary sub-environments of Maharlou Lake are made of mud flat, saline mud flat, salt pan and ephemeral Lake.

Keywords: core, environment reconstruction, evaporite, Holocene, lake.