The Geomorphological Evidence of the Caspian Sea Base Level Changes during the Late Quaternary in the Confine of Gorganroud River

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Received: 17/03/2012 Accepted: 28/07/2012

Extended Abstract

Introduction
The Caspian Sea as the largest land-locked water body is susceptible to environmental changes. The Caspian Sea has experienced different sea-level fluctuations with an impact on the rivers mouth and displacement of the mouth, changes in depositional regime, deformation of delta or renewed excavations of channel in mouth location. The south-eastern Caspian sea, as the study area is one of the most appropriate regions for studying and reconstructing the changes in coastal line, changes in river courses, delta displacement, lagoons and coastal barriers. Each of them is important as a result of geomorphologic evidence of the Caspian Sea level changes.

Methodology
The aim of this study is the identification of geomorphologic evidences of Caspian Sea level changes in Gorganroud River confine during the past thousand years. For this purpose, library descriptive method were done to examine theoretical and research background as well as field method to match the data of maps and find geomorphologic evidence, sample sediments and fossils, note-taking from the height coordinates of points. Furthermore, the research used experimental studies to determine the age of marine terraces and examine the sediment of
sections under study, and finally achieves an analytical method. Topographic maps, geological maps, aerial photographs, Landsat and IRS imagery were used. Considering the purpose of this research to achieve the desired results, four marine terraces were found in the region. The location and height of the terraces were noted by an accurate method of measuring height and using Geodetic GPS with (Cm) precision. To identify the age of the terraces, the Carbon 14 method was used and three samples of Bivalve fossils were sent to the Shirakawa laboratory in Japan. To examine Paleontological studies, different samples of marine terrace fossils of the study area were collected and sent to Moscow University to identify their type and living environment. Also, from two sections of Koorosou with the water level -23 meters and Ghomishtappeh with the water level -24 meters, the sediments were sampled. The percentage of organic matter and calcium carbonate were investigated using Walkley and Black and Titration methods respectively. In addition, the granulometry of the particle size distribution was determined using hydrometer method. To assess the spatial and temporal variations in Gorgan Bay and Gorganroud delta, LANDSAT satellite imagery, sensors of MSS October 1975, images TM, June 1987, images of ETM, April 2001 and May 2005 and aerial photos of 1345 were utilized. To examine the changes of the old path of Gorganroud River, field visits, IRS satellite images with the resolution of 5/2 meters and historical resources were used. The research technique is the identification and analysis of geomorphologic evidences of Caspian Sea level changes in Gorganroud River confine during the past thousand and compare changes in Gorgan Bay and Gorganroud delta during 31 years.

Results and Discussion

Generally, The form of coasts and geomorphologic of the study area depends on the Caspian Sea level changes. Geomorphologic evidence of the Caspian Sea level changes in the study area can be divided in to three categories as follows:

- Geomorphologic evidence resulting from the Caspian Sea Level rise in the late Quaternary and the present age, for example: lagoons and sand spit. Lagoon environments are formed as a result of fluctuations of sea water level. Increase of water level before 940±24 and 653±24 years ago led to the formation of an open lagoon in the study area.

- Geomorphologic evidence resulting from the Caspian Sea Level fall in the late Quaternary and present age, for example: marine terraces. Marine terraces are excellent morphological markers and important elements of coastal geomorphology as have been used world-wide to recognize past sea-level changes. The main factor in the formation of marine terraces in Khazar plain is recent tectonic movements and climate changes.

- Sea level changes and its impact on Gorganroud delta and river. Hydrodynamic forces (waves & currents) in Caspian Sea are gradually changing, which affects the low slope of the region, Gorganroud River mouth and its delta; and results in their deformation and displacement. Totally it can be concluded that Gorganroud River mouth morphology and its delta are affected by Caspian Sea water level fluctuations. Also Gorganroud River changed its path during the Quaternary.
Conclusion

South East of Caspian Sea is located on very gentle slope to be strongly sensitive to the fluctuation of the Caspian Sea. The results of satellite image studies indicate that four marine terraces were formed in the height levels of -21, -23, -24 and -26 meters and with the ages of 653±24, 940±24, 478±23 and 32 years respectively. The study of the data from sediments and fossils in two sections of Kooresou and Gomishtapeh corresponding with water levels of -23 and -24 meter indicates that an increase in the water level before 940±24 and 653±24 years ago caused sand spit growth in the study area. Due to the low slope of this area, lagoon is formed behind it. This lagoon, however, is dried in the offshore of the sand spit because of the sea water level fall. Moreover, some changes like changes in the depositional regime, and displacement of delta took place in Gorganroud River during the late quaternary. Also, through the last hundred years, there has been different evidence of changes of water level of the Caspian Sea. Satellite images indicate that Gorganroud delta had a progress of one kilometer toward the sea from 1975 to 2005. Gorganroud delta is only formed during sea level fall and its morphology during sea level rise will be changed. Furthermore, Gorgan bay area was 330 square kilometers in 1975 and, in 2006, this area increased to 458 square kilometers, due to an increase in the water level of the sea.

Keywords: Caspian Sea, Geomorphological evidences, Base Level Changes, Quaternary, Gorganroud.