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Sedimentary and geochemical characteristics of coastal deposits in Hormoz Island in the south of Iran

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Abstract
Hormuz Island at the entrance of the Persian Gulf and Oman Sea is a symbol of Iranian diapirism and the Hormuz series. In considering the location of the island and the development plans for Hormuz Island, it is important to know the composition and characteristics of the island's coastal sediments. This study was conducted to study the sedimentary, mineralogical, and geochemical properties of the coastal sediments of this island. For this purpose, In this study, 20 thin sections were made from gravelly rock samples as well as 27 surface sediment samples from nine stations has been collected. Routine sedimentologic tests have been done on these samples including quantitative mineralogy by XRD, separation, and identification of heavy minerals using bromoform solution and magnetic property, heavy metals and primary oxides were analyzed by XRF and petrographic study using a polarizing microscope. The results indicate that the sediments are sandy to gravel in terms of grain size. The average amount of calcium carbonate is 32 to 62 percent. The mineralogy of sediments shows that suite of calcite, quartz, feldspar, plagioclase, dolomite, aragonite, clay minerals (Kaolinite and Illite) and heavy minerals (magnetite, hematite, oligiste, epidote, pyroxene, pyrite, goethite, limonite, apatite, barite,) are other components of superficial sediments. The study of thin sections under the polarizing microscope shows that most gravels on the coast have an igneous origin (rhyolitic and trachytic). The findings of this study indicate that the main source of these sediments is the alteration and erosion of the Hormoz Serie (the Late Precambrian–Cambrian) in the center of the island under wet, humid conditions.
Keywords: Hormoz Island, Sedimentology, Mineralogy, Geochemistry.

Introduction

Studying the sediments of coasts and seabed, examining their constituent elements and minerals are among the important goals in marine geology (Prins et al. 2000). It should be mentioned that beaches provide many advantages in service, construction, environment, and welfare activities. Understanding the composition and physical and chemical properties of coastal sediments will help to formulate coastal development plans. Geologically, the Hormuz Island is located at the entrance of the Persian Gulf and Oman Sea between 56˚30′ 80″ and 56˚ 25′ 10″ east longitude, 27 ˚ 02′ 07″and 27˚ 06′ 25′ north latitude. Hormoz Island lies at the southeastern end of the Zagros sedimentary-structural zone (Aghanabati 2006). In this study, we tried to identify the sedimentology, mineralogy, and geochemistry of coastal sediments of Hormoz Island to identify the origin of these sediments.

Materials & Methods

To investigate the sedimentological, mineralogical, and geochemical characteristics of the coastal deposits of Hormoz Island and to achieve the objectives of this study, surface sampling (point-random sampling) was performed. For sedimentological, geochemical, and mineralogical analysis, 27 surface sediment samples were collected (three samples per station for sedimentology, heavy metals, and heavy mineral studies) from 10 to 40 cm depth using a cylindrical container made of polycarbonate in Autumn 2012. Also, 20 samples were taken at stations that had gravel and some outcrops close to the shore for providing thin sections and studying lithology. The depth of water in the sampling was unaffected. Field sampling was performed at the distance between land and water in the tidal zone. For this purpose, two samples from the outcrop and rubble of the existing rocks have been taken from each station to prepare thin sections for mineralogical and provenance studies. It should be noted that the station number four was boulders beach and the ochre of mine adjacent to this station has been taken for

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measuring heavy metals and bulk mineralogy. The most important experiments on sediments include grading, calcimeter, mineralogy, XRD analysis to identify clay minerals (Tucker 1989), and separation of heavy minerals using bromoform solution (Arzani 1997; Khodabakhsh and Sahrarou 2013). Classification of the type of sediments is done based on Folk triangular classification (Folk 1974). Analysis of major and minor elements with XRF method and the preparation of thin sections of gravels have been done in three laboratories including Geological Survey, Hormozgan University and Kansaran Binalod, Tehran. To determine the size of the sedimentary particles, sediments larger than 63 microns were screened by sieve, and sediments smaller than 63 microns were analyzed using a hydrometer. The amount of calcium carbonate (calcite) and dolomite in sediments was analyzed by autocalcimeter. Identification and study of heavy minerals in coastal sediments of Hormoz Island using bromoform solution (CHBR3 separate heavy from light minerals and with the employing magnetic properties by VSM vibration sampling method with magnetometer Magnetism has been done). Physical properties were identified at the University of Hormozgan Laboratory (the study of minerals with Binocular microscope) and the Geological Survey of Iran (separation of heavy minerals by bromoform). To increase the accuracy of the detection of silicate minerals, six thin sections of medium sand size were prepared and studied by light microscopy.

Discussion of Results & Conclusions

Based on the results obtained from particle size analysis (granulometric analysis) and using the Folk triangular classification (Folk 1974), Hormoz Island sediments are often sand, sandy gravel, gravel, and gravelly sands. The sediments of this island have mesiokurtic to leptokurtic kurtosis, indicating the influence of waves and tidal performance. Sediments have low sphericity and they are angular. The skewness results in the sediments indicate that the particle size of the coastal sediments of Hormoz Island is in the range of medium-grained sand and deposited in a relatively high energy environment . Besides, the skew of sediments is negative. These sediments are mainly composed of carbonate, quartz, dolomite, halite, feldspar, and mica, respectively. The results of the experiments show that the amount of calcite in the studied samples varies from 32% to 62%. The results of XRD show the presence of calcite, quartz, hematite, plagioclase, clay minerals (illite and kaolinite) and halite in all sediments of the coastal island of Hormuz. The results show that halite is the most prominent evaporite mineral in these sediments. Due to the solubility of this mineral, it seems that a considerable part of samples was formed by secondary sea-level fluctuations. The abundance of evaporites in the Hormoz series can also be considered as a source of the evaporite minerals.

Light minerals of the samples include carbonate, quartz, feldspar, dolomite, aragonite, and halite. Examination of heavy minerals indicates the presence of magnetite, hematite, olivine, pyroxene, apatite, martite, fluorite, limonite, goethite, barite, and zircon. The study of thin sections under the polarizing microscope showed that most of the gravel in the shore are rhyolitic and trachytic in composition, so these igneous rocks could be the source of sediment on the coast of Hormuz. Correlation coefficient analysis and cluster analysis showed that except for chromium and calcium oxide, other heavy metals and their major oxides originate from erosion of the exposed rock units on the island. The placement of calcium oxide in a separate branch over other oxides indicates a different origin for this element and its biological origin. Comparison of the abundance of minerals such as heavy minerals and evaporite minerals in Hormoz Island sediments with the exposed rocks of this island indicates that weathering and erosion of these exposed rock units under warm-humid climatic conditions can be the source of these elements in coastal sediments. The findings of this research can undoubtedly help to formulate and implement coastal and economic development on the island of Hormuz.