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Investigation of Organic Matters and their Roles in Deposition and Phosphate Mineralization in the Kuh-e-Sefid Deposit, Ramhormoz

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Introduction

It has been recently stated that phosphorite deposits are in fact marine biogenic materials, due to bacterial activity producing bio-apatite. In addition, Phosphorites contain 15–20 wt.% P_2O_5 (Tzifas et al., 2014). In this deposit, phosphate mineralization has occurred as phosphorite lenses with Eocene age within the Pabdeh Formation, with thickness up to 1.5 meters and width of 15 meters and its hosted rock is black shale. According to the presence of indices of fossils such as Globorotalia, Hantkenina, its age can be attributed to the middle Eocene. The Pabdeh formation is a very rich organic matter in addition to the presence of phosphate (Damiri, 2011). The formation due to planktonic foraminifera rich in organic matter is like the hydrocarbon source rock (Daneshian et al., 2012). In marine basins where upwelling and productivity are limited, phosphates may develop outside of microbial cells and also within bacterial cellular structures, formed by slow bacterial assimilation of phosphorus from assaying organic matter in areas of restricted sedimentation (O'Brine et al., 1981). It is therefore suggested that the upwelling currents did that in the recycling of phosphorus from dead organisms such as fishes and other marine vertebrates. The aim of this study is investigation of organic matter's species and their roles in deposition and phosphate mineralization in the Kuh-e-Sefid phosphate deposit using XRD, FTIR and Rock-Eval pyrolysis.

Materials and methods

In field observations, 12 samples were selected and they were taken from units of phosphate and shale host rock in the Kuh-e-Sefid phosphate ore deposit. Ten cross sections were studied by conventional microscopic methods. Rock-Eval analysis was used in order to determine the organic carbon in the geology Department of the Shahid Chamran University of Ahvaz. The Phosphorite samples were determined by XRD at the Kansaran Binaloud Company in the Science and Technology campus in Tehran. FTIR analyses were carried out on the phosphorite samples in the chemistry department of the Shahid Chamran University of Ahvaz.

Results

Organic matter appears to be essential for phosphogenesis in two ways: 1) as an energy supply for redox change and 2) as a source of phosphate. Similarly, bacteria are important on two levels: 1) they provide a mechanism for the release of phosphorus from phospholipids and other high-energy phosphorus compounds by organic phosphate cracking and organic carbon oxidation, 2) they are capable of concentrating and precipitating phosphate (Jarvis, 1992).The sedimentary organic matter is first decomposed exclusively by aerobic bacteria. When O_2 is completely utilized, further decomposition occurs via sulfate reduction until the oxidants are exhausted, then phosphorus and carbon are released from organic matter during decomposition (Ingall and Cappellen, 1990). Field observation and microscopic studies indicate that phosphate-bearing layers mainly consist of shale, marl, limestone with textures varying from wackestone to packestone forms. Also, phosphate

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components such as plettal, ooid, intraclast, fish skeletal fragments and microfossils are present. In additions to phosphate and biogenic component, nonphosphate minerals such as glauconite, calcite, pyrite, iron oxide and quartz, are present in different forms and sizes. The results of XRD analysis show the mineral phosphate (fluorapatite) besides calcite as one of the nonphosphate components in the Kuh-e-Sefid ore deposit as the main constituents, while the minerals montmorillonite and quartz are minor constituents. FTIR studies reveal qualitative information about the bonding pattern and nature of the components of the organic matters. Thus, phosphogenesis in marine phosphate deposits resulting in the destruction of areas around the continents that contain different components of phosphate and non-phosphate, and the resulting destruction of organic materials as well. Therefore, according to data from the Rock Evil, samples of the deposit represent more continental carbon. In general, it can be shown that, most of the phosphate mineralization in this deposit is mainly of a continental origin, and it is partly as a result of decomposition and oxidation of organic matter by bacteria and microorganisms that occurs.

Discussion

- Since shales rich in organic matter are capable of transferring sedimentary phosphorus as organic materials, it can be concluded that the deposits shale as the phosphate deposits host were the main factors of phosphorus transmission and the most mineralization occurs in parts that are rich in organic matter.
- Rock-Eval results showed that more samples contain continental carbon and this suggests that phosphate mineralization is of continental origin in this deposit and it is partly achieved by biodegradation of organic matter by microorganisms.
- FTIR, XRD studies have proved the frequency of fluorapatite minerals with calcite and organic materials that are most probably associated with phosphate mineralization in the deposit.
- FTIR studies reveal mineral-organic bounds such as OH, Carboxylic OH, Carboxylic acid C=O, C≡C Alkaline, group CH_2, C=C aromatic, CH Aliphatic and aromatic stretching associated with identified mineralization.

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