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Genesis and Potentiality of Radioactive Minerals and Rare Metals in the Adediya Formation, Southwestern Sinai, Egypt

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DEDICATED TO

THE SOUL OF MY DEAR MOTHER WHO I WILL NEVER FORGET

TO

MY FATHER,

MY HUSBAND MOHAMED

AND

MY LOVELY SONS

ZEYAD & YUSIF

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Abstract

The uppermost part of the Adediya Formation (Cambro-Ordivician) exposed in southwestern Sinai represents a very interesting succession. It contains mineralizations which are exceptionally rich in radioactive and rare metals as well as heavy metals. In the present work, These mineralizations and their host rocks were subjected to comprehensive studies in order to determine their detailed geologic, petrographic, mineralogic, geochemical and radioactive characteristics as well as their genetic history and economic potential.

These studies comprised a detailed field work and several laboratory examinations and analyses which were carried out on the upper part of the Adediya Formation exposed in a number of stratigraphic sections distributed in a geographically wide area in southwestern Sinai.

The obtained results showed that the mineralizations exist in ferruginated clastic rocks and ironstone bodies. The former are represented by sandstones and, much less commonly, siltstones having a relatively wide range of textural characteristics. Also, their mineral assemblages consist of a large number of essential and accessory minerals including the radioactive and REE-bearing species. The study of these mineral constituents involved their classification, description and separation and identification of the heavy-mineral species. Also, the major, minor and trace element contents of the mineralizations and their host rocks were quantitively determined and the geochemical data were statistically treated. The inter-relationships of these elements were assessed applying binary and ternary diagrams and several calculated geochemical parameters. Sequential extractions were conducted to identify the modes of occurrence of the various elements. In addition, the chemical compositions of the host rocks were compared with those of a number of related reference rock types. This helped in the identification of the recorded minerals and their qualitative and quantitative lateral variations among the studied stratigraphic sections.

The results obtained in the present study were implemented to determine the genesis of the various mineral species which constitute the mineralizations as well as the sedimentary history of their host rocks. The latter involved the elucidation of their provenance including the nature of source rocks and the type and extent of the weathering processes as related to the paleoclimatic conditions in the source areas. Also, the nature of the transporting agents of transportation of the weathering products and the types and characteristics of the depositional environments were determined. In addition, the results obtained were used to identify the types and effects of the various diagenetic processes and a possible hydrothermal activity as well as their relative roles in determining the final mineral, chemical and radioactive characteristics of the mineralizations and their host rocks. These roles resulted in the post-depositional and redistribution of the various elements especially the radioactive and rare species during the epigenetic phase which involved the action of supergene processes. Based on the results obtained in this study, a genetic model for the studied mineralizations is proposed.

Keywords: Sinai, Cambro-Ordovician, Adediya Formation, sandstones, siltstones, ironstones, radioactive mineralizations, rare metals.

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