PHYSICAL, GEOCHEMICAL CHARACTERISTICS AND URANIUM EXTRACTION FROM URANIUM BEARING PHOSPHATES EAST_LUXOR

By

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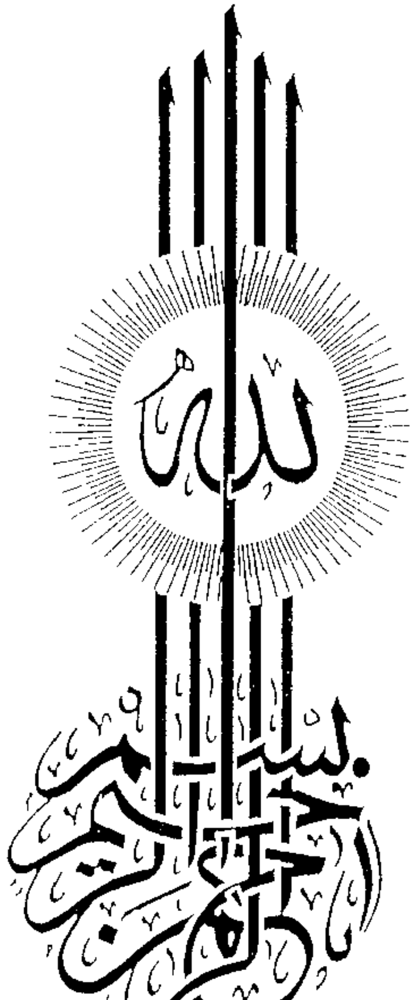
To my Wife, Laila and to my
Child Ahmed.


بسم الله الرحمن الرحيم

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CHAPTER I

INTRODUCTION

The investigated phosphates occur some 100 km to the east of Luxor City and they occupy mainly Wadi El Gidami area to the north as well as Wadi El Mushash area to the south (Plate I). The Phosphate Formation belongs to the Campanian-Maestrichtian age (Upper Cretaceous) and are composed of both phosphatic bands and coprolite bone beds interbedded in marls, shales, and limestones. According to their radioactivity, the phosphates of East Luxor area could be classified into two distinct types: a highly radioactive type including essentially the coprolite bone beds with a maximum attained activity of 350 uR/h. The second type is represented actually by soft (normal) phosphate beds in which the distribution of radioactivity is ranging from 50 - 120 uR/h. In both types the tricalcium phosphate ranges from 40 to about 70% and its cementing material is composed mainly of calcite and/or silica.

The present work deals with the mineralogy as well as the geochemistry of East Luxor phosphates with special emphasis on the geochemistry of uranium

in these ores. This has actually involved the study of the effects of other constituents which would prove as effective parameters or creators of favourable media for the uranium precipitation in phosphate deposits. Furthermore a detailed study about the actual distribution of uranium in different grain sizes is done using selective disintegration of the carbonate-cemented phosphate with acetic acid.

The performed mineralogical studies include different methods of investigation; namely the petrographical examination of microscopic thin sections, X-ray diffraction and infra red absorption techniques. Also, the different modes, manner of occurrences as well as associations and features of phosphates are treated. Besides, the physico-chemical factors which control phosphate precipitation in sea water are discussed. From this discussion and in the light of petrographical and mineralogical investigations, the genetic aspects of East Luxor phosphates are presented.

On the other hand, the geochemical investigations involved the complete chemical analysis of some (36) representative samples. Major elements analyzed by wet chemical methods include P_2O_5, CaO, Al_2O_3, MgO,

Fe_2O_3, CO_2, SiO_2, SO_3 and organic matter beside the contained U and F values. Also X-ray fluorescence analysis has been used for the determination of some significant trace elements such as V, Mn, Zr, Cr Y, Sr and U, for twenty eight samples. The latter obtained results have been plotted on scatter diagrams to show any mutual relationship with uranium. Furthermore different correlation coefficients of the mentioned results have been calculated in order to express numerically the order of correlation of different components. ...

The present thesis also deals with an applied technological study for the possible recovery of uranium as a by-product during phosphate processing for fertilizers (superphosphate, triple superphosphate) or essential phosphate chemicals. This has necessitated actually a detailed study of the behaviour of leachability of both uranium and phosphate using hydrochloric acid. Due to the fact that uranium leaching is based upon its oxidation state, the leaching experiments have been performed under different conditions including oxidizing, normal or reducing conditions. Sulphuric acid has not been used in the present study since it is produced mainly from imported pyrite beside the fact that some of the dissolved uranium values are lost in the resultant gypsum.

As far as the author is aware no geochemical, mineralogical or leachability tests have been conducted on the phosphates in the investigated area. The stratigraphy of some phosphate localities in the Nile Valley including the investigated area is given by Ghanem et al (1970), while the detailed geology of East Luxor area is carried by the Atomic Energy Authority, geological party. However, several mineralogical and geochemical studies have been carried out on phosphate deposits from other areas in Egypt.

CHAPTER II

PETROGRAPHICAL AND MINERALOGICAL INVESTIGATIONS OF EAST LUXOR PHOSPHATES

The mineralogical composition of phosphate deposits has been treated by several authors, however the subject is still actually a matter of confusion. Apatite, the major constituent of these deposits, denotes a group of minerals and is chemically a basic tricalcium phosphate with F or OH ions in the lattice.

According to Rogers in 1922 (McConnell, 1950), fossil bones are composed of the mineral collophane and he also believed that collophane is the principal constituent of rock phosphates. Later on, the same author (1924), has demonstrated that most fossil teeth and bones are principally composed of varieties of apatite. This was later ascertained actually both by Stauffer in 1938, as well as by Ellison in 1944 (McConnell, 1950)from their work on conodots.

McConnell (1950) suggested the usage of collophane to denote a natural microcrystalline phosphatic material which by X-ray diffraction, gives a pattern similar to that of apatite. On the other hand, Mckelvey et al (1952) have pointed out that colloform carbonate-fluorapatite is the