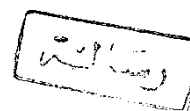


Ain Shams University  
Faculty of Girls for Art,  
Science & Education

STUDIES ON

APPLICATION OF GAMMA-RAY AND X-RAY FLUORESCENCE  
TECHNIQUES AND PHYSICAL SEPARATION METHODS ON  
STUDYING MONAZITE MINERAL

A THESIS  
SUBMITTED IN PARTIAL  
FULFILMENT OF THE REQUIREMENT FOR THE  
MASTER DEGREE IN PHYSICS



BY  
MAGDA MOHAMED IBRAHIM KHALIL

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N.M.A.



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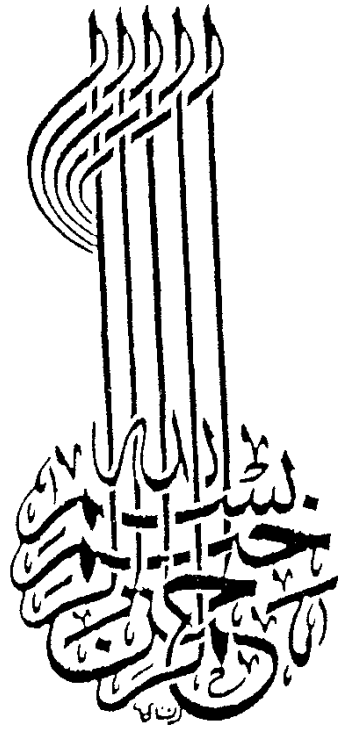
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**Ain Shams University**  
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## ABSTRACT

\*\*\*\*\*

The monazite is strategic and economic mineral which is suitable for profitable industrial exploitation as this furnish many raw materials for atomic energy and other aspects of our growing and expanding metallurgical and engineering industries.

For obtaining concentrated monazite, Physical separation methods depending on the physical properties of minerals are used to eliminate the great light minerals. These methods are gravitative, magnetic and electrostatic separation.

The aim of this work is to select an accurate, easy and rapid analytical technique, by which the control and adjustment of monazite and other natural ore samples during dressing practice can be successfully achieved.

In this study, three techniques have been carried out to determine monazite content at different stages of up-grading. These techniques are sized-grain counting, gamma-ray spectrometric and X-ray fluorescence spectrophotometry techniques.

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# CHAPTER 1

## *INTRODUCTION*

## GENERAL INTRODUCTION AND OUTLINE OF WORK.

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The black sands concentrates are composed mainly of ilmenite, magnetite, zircon, rutile, garnet and monazite. Great reserves of these minerals in the Egyptian beach deposits which are unique in their quantities and tenors of valuable economic and strategic minerals.

The monazite can be considered as a major source for thorium and uranium in Egypt. To start with, the beach sands, contain an average of 10 % heavy minerals ranging between 5 and 60 percent over the beach littoral deposits north of Delta, this will necessitate the elimination of the great percentage of the light minerals admixed with the heavy ones. It is well established in the technology of beach sand treatment to start with the gravitative separation to bulk concentrate the heavy minerals. This will be followed by magnetic separation for separating the magnetic impurity minerals from the non magnetic monazite. Electrostatic separation was finally used for obtaining the magnetic concentrate having the suitable purity reasonable to be used for leaching for the production of U and Th.

Monazite is essentially an anhydrous orthophosphate of the cerium and the lanthanum group of the rare earth elements represented by cerium, lanthanum, praseodymium and neodymium.

Various methods have been and are still used in monazite analysis such as chemical analysis. This method is slow and needs a skillful ore analyst. It involve the assaying of thorium, rare-earths, phosphate and a correction for the uranium, calcium and silicon present in monazite.

The aim of the present study is to select an accurate, easy and rapid analytical technique, by which the control and adjustment of monazite distribution during the dressing practice can be successfully achieved.

In this study three techniques have been carried out to determine the concentration of monazite content at different stages of upgrading. To check the validity of these techniques, triplicate representative unknown samples were prepared from each stage of upgrading monazite.

The first technique is the sized-grain counting by using stereo-microscope. During this study the sized-grain counting was carried out for the different products from each stage.

Several rocks and minerals like monazite contain small amounts of thorium and uranium, the tracing of these elements is of interest and can be used to control the efficiency of different stages of upgrading. The present work discusses the use of gamma ray spectroscopy and X-ray fluorescence spectrophotometry for determining the abundances of natural

thorium and uranium in monazite mineral.

There are two long-lived isotopes in natural Th and U namely  $^{232}\text{Th}$  and  $^{238}\text{U}$ , with half-lives of  $1.41 \times 10^{10}$  y and  $4.51 \times 10^9$  y respectively. In natural material, these isotopes and their decay products are in radioactive equilibrium. In the Th-series, the radioactive isotopes suitable for  $\gamma$ -ray spectroscopy are  $^{228}\text{Ac}$  (emitting the 1588 KeV ) and  $^{208}\text{Tl}$  (emitting the 585 and 2614 KeV  $\gamma$ -rays), in the U-series the  $^{214}\text{Bi}$ -isotope is the most suitable (emitting the 610 KeV, 1760 KeV and 2200 KeV  $\gamma$ -rays).

In the present measurements of the  $\gamma$ -ray spectra obtained in the decay of the isotopes in the Th and U series, use has been mainly made of NaI scintillation detector for its high efficiency. The 2614 KeV  $\gamma$ -line from the decay of  $^{208}\text{Tl}$  was used to determine the absolute Th abundance and 1764 KeV  $\gamma$ -line was used for the determination of the absolute U. Also the total activity of the samples was measured by the integral counts from  $^{40}\text{K}$ , U, Th.

The third technique is the energy dispersive x-ray fluorescence [ED-XRF]. Quantitative analysis is based on the location of the spectral lines characteristic of the elements. The major components of monazite samples are: Ce, La, Nd, Th, Pr, Sm, Gd, Y, U, P, Si and Ca. The interference free  $\text{Th}(L\alpha)$ , with energy of 12.808 KeV, and the  $\text{U}(L\alpha)$  with energy 13.438 KeV,