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Uranium/Thorium Resource Assessment in Saudi Arabia

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ABSTRACT

As part of the ambitious Saudi's vision 2030, the minerals sector has been considered as one of the key industries in the Kingdom. Uranium, among all minerals, has received an intensive attention due to its strategic value in securing the nuclear fuel for future reactors.

Uranium occurrence was indicated by prospecting surveys made in 1979-1984. These surveys have identified 9 nominated exploration areas, with 35 inner sites. Studies also revealed five important geological environments of uranium resources.

The project "Uranium/Thorium Resource Assessment in the Kingdom" was launched in April 2017 as a collaboration between K.A.CARE and the Saudi Geological Survey. It is two phase's project; general exploration and detailed exploration. Beside the self-sufficiency in fuel production, the project aims to encourage investment in uranium mining and enhance the human and technical local content in this area.

The work includes the following activities: radiometric and magnetic airborne survey, geological survey, image processing of remote sensing interpretation, anomaly verification and evaluation, gamma-ray spectrometer and radon surveys, geophysical survey, trenching, borehole drilling, sampling, chemical analysis mapping, radiometric analysis mapping and Geo-database construction. Also, a systematic exploration drilling and core sampling will be developed in the prospecting targets.

INTRODUCTION

The project aimed to evaluate uranium and Thorium resources in the kingdom of Saudi Arabia according to JORC standards through two exploration Phases, the first phase is planned to be accomplished in two years to evaluate Uranium and Thorium resources (Inferred definitions) started in April 2017. The second phase will utilize the results and recommendations from the previous exploration phase to reach resources estimation according to indicated and measured definitions, in three years. In the first phase, the project activities will concentrate on the nominated exploration areas and 35 inner sites defined from previous prospecting exploration 1965-1987. The Project Partners are King Abdullah City for Atomic and Renewable Energy (KACARE) as project owner, Saudi Geological Survey (SGS) as exploration program manager, China National Nuclear Corporation (CNNC) as exploration contractor. The project scope of work and JORC compliance will be supervised for quality assurance and control by Geological Survey of Finland (GTK).

DESCRIPTION

Saudi Arabia Geology is consisting of two major units: Arabian Shield and sediment cover rocks that contributed to the existence of different geological environments and led to the presence of variety uranium and thorium Ores deposits.

Uranium and Thorium ores deposits are found in different geological environments, and divided into several types based on their geological setting, therefore uranium and thorium may presences as major minerals in ores deposits and/or in other as secondary minerals with some precious metals ores such as copper, silver and rare earth metal elements.

There are several studies and reports related to radioactive ores deposits and contamination phenomena have been done by many government institutes such as (Mineral Resources Ministry (DGMR), Saudi Geological Survey (SGS), King Abdulaziz City for Science and Technology (KACST)) and universities and consultants (Minatome, BRGM, USGS) more than 50 years ago.

These studies show that the presences of uranium/Thorium ore deposits in the kingdom can be classified as follow:

- Sandstone deposit
- Veins deposit (Granite related deposit)
- Intrusive deposit
- Volcanic and caldera related deposit
- Surficial deposit
- Phosphorite deposit

Airborne spectrometric survey was incorporated into Phase 4 of the prospection for uranium mineralization by MINATOME on behalf of the Ministry of Petroleum and Mineral Resources of the Kingdom of Saudi Arabia. The survey covered a surface area of approximately 26000 km² divided into 9 areas.

The airborne field operations were carried out by the Arabian Geophysical and Surveying Company (ARGAS) between December, 1981 (first flight) and March 26th, 1982 (last flight).

During these field operations 28519 kilometers were flown: 26083 km along the 1 km line spacing grid initially scheduled, and 2436 km with a 0.5 km line spacing over areas where more detail was considered necessary on the basis of spectrometric results obtained during the survey or after geological reconnaissance. Measurements were made with a 256 energy channel spectrometer GR800D from GEOMETRICS with a detector of 2048 cubic inches.

The spectrometric survey used in the prospecting stage records radioactivity in the uranium, potassium and thorium channels, to ascertain the uranium potential of these 9 areas and to contribute geological and radiometric information for their further study, and for another, to discover possible uranium anomalies or anomalous areas.

In the first Phase of the project, CNNC the exploration contractor, plans to verify prospecting anomalies and uranium resources exploration in these 9 areas (35 inner sites) over three stages. In Stage (1), CNNC has been conducted the following technical work:

- (1) Geological route survey (1:50,000), cross section and mapping (Scales 1:10,000~1:5,000);
- (2) Gamma ray spectrometric measurements at different scales (1:10,000~1:5,000), on plane or along geological section;
- (3) Soil radon survey at different scales (1:10,000~1:5,000), on plane or along geological section;
- (4) The uranium/thorium or radioactive anomalies' verification and evaluation;
- (5) In some places, the geological route survey, XRF and gamma ray spectrometric measurement and/or soil radon survey are integrated in profiles;
- (6) Remote sensing image processing, interpretation and field evaluation ;
- (7) Geo-database construction ;
- (8) Major and trace elements analysis, Microscopic analysis, SEM, EPMA and data processing of rock/ore samples ;
- (9) Map compilation.

Based on the geological conditions and previous work, CNNC plans detail investigations for stage (2); this include carrying out remote sensing interpretation, geological survey and anomaly verification, to find out the regional metallogenic conditions and preliminarily assess the U/Th mineralization potential. Next, is to perform the 1:10,000 or 1:5,000 geological mapping, ground gamma-ray spectrometric survey and radon survey in soil in key sectors, in order to evaluate the scale and U/Th contents of the mineralization and provide the basis for further geophysical, geochemical, drilling and borehole logging work arrangements. After the field work, the indoor laboratory analyses, map compilation and comprehensive research work need to be conducted.

DISCUSSION AND CONCLUSION

The current reconnaissance exploration reveal on discover of many uranium anomalies inside the nominated exploration sites and a discovery of a number of new uranium anomalies nearby the boarder of the exploration areas. In addition to the above success discoveries, the exploration program fails to verify some of uranium anomalies nominated in the previous prospection exploration and radiometric airborne survey. This failure may refer to the poor accuracy of GPS used in the previous prospecting program which leads to error in coordinates, beside the contribution of the combined effect of the relatively lower survey instrumentation sensitivities and their efficiency of the surveying parameters like airborne survey line spacing. The difficulties of the mountains topographies and wide speared of the exploration areas will add some limitations to verification of the uranium anomalies discovery, beside the complexities of the geological structures.

In attempts to resolve these exploration difficulties and for more accurate uranium resources estimation, the following recommendations is to be implemented:

- A new planned airborne survey radiometric (four channels radiometry spectrometry) combined with magnetic survey may be implemented.
- Maintain/support the role of QA/QC supervisor to fulfill JORC code compliance.
- Exploration contractor CNNC must plan the drilling program with higher precision, because diamond drilling are expensive and time consuming, so it should start only after comprehensive studies have been completed, that cover all prospective areas to allow targets to be ranked in terms of economic potential, and to ensure that no viable target is overlooked.
- The project timeline may expand, if necessary.

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Country or International Organization

Saudi Arabia

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