Contribution ID: **51** Type: **Oral**

Separation of rare earths from uranium and thorium

Thursday, 26 June 2014 10:15 (25 minutes)

Kvanefjeld is an emerging multi-element deposit hosted within marginal phases of the Ilimaussaq Intrusive Complex, located near the southwest tip of Greenland. The deposit is exposed at surface along a series of undulating bluffs on a broad peninsula surrounded by deepwater fjords that run directly out to the Atlantic Ocean.

Delineated resources to date include 956 million tonnes at 273 ppm U3O8, 1.08% TREO and 0.24% Zn. The project is a truly world class resource for the strategic future metals of uranium and rare earth elements. In addition the deposit typically contains thorium concentrations of 600 ppm.

The Project is currently Feasibility Study stage with process development essentially complete. The Feasibility Study is evaluating a concentrator and refinery treating 3 million tonnes year of ore. The concentrator will produce a rare earth mineral concentrate which increases the grade of the rare earths by an order of magnitude.

The mineral concentrate is refined using an atmospheric sulphuric acid leach which extensively leaches the uranium from the concentrate. Additional atmospheric treatment stages are used to allow the extensive extraction of rare earths while controlling other radionuclides. Refining of this mineral concentrate is expected to produce approximately 23,000 tonnes per annum of contained Rare Earth Oxide (REO) in a mixed carbonate and 1.1 million pounds per year of U3O8.

Rare earth elements are commonly associated with naturally occurring radioactive materials. In particular Thorium is often found in the same minerals as rare earth elements making their combined treatment necessary. This paper discusses the metallurgical flowsheet developed for the Kvanefjeld rare earth and uranium deposit located in southern Greenland.

Metallurgical studies have been successful using flotation to produce a high grade concentrate which consists of 14% REO, 0.25% U3O8 and 0.8% Thorium. Due to the unique nature of the minerals contained within the deposit a customised hydrometallurgical flowsheet was developed to treat the concentrate. The hydrometallurgical flowsheet has been well tested and is capable of producing a high grade mixed rare earth product which is very low in uranium and thorium. A separate uranium oxide product can also be produced using commercially established solvent extraction.

Process engineering designs of both the concentrator and hydrometallurgical plant are well advanced and suitable for Feasibility level studies. The paper and presentation will discuss the customised metallurgical flowsheet and show how uranium is selectively recovered away from the rare earth elements. The issues of NORM deportment and strategies for removal and safe disposal are also discussed.

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Session Classification: Thorium and rare-earth element-associated resources

Track Classification: Thorium and rare-earth element (REE)-associated resources