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Extraction of thorium from the Fen deposit in Norway

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After the renaissance of nuclear power and thorium breeding in particular, the interest for the Norwegian thorium deposits has revived. However, the economic potential for exploitation is depending on several parameters, i.e. heterogeneity of ore, content of carbonaceous minerals, other valuable elements present, etc.

Fen is the site where the largest Norwegian thorium deposits are found. The thorium minerals at Fen are reported to be oxide and silicate, but experience obtained indicates that some thorium must also be present in carbonate rock. Based on experience from extraction of rare earth elements from red rock ("rødberg") at Fen the possibilities for thorium extraction are assessed.

The Fen complex in Telemark, Norway is a geological region noted for an unusual suite of igneous rocks. Several varieties of carbonatite are present in the area as well as highly alkaline rocks. The Fen complex is a roughly circular area about three kilometers in diameter. It is located just west of the Oslo graben, on the south side of Lake Norsjø, from Ulefoss in NW some three km eastbound. The area covers some 6 km² and has been known for its complex mineralogical composition for almost a century.

Rødberg rock in the local area called Gruveåsen is covered with soil and vegetation. Gruveåsen has the highest concentration of thorium in the area. The thorium concentration in Gruveåsen is reported to reach 0,4%, but ordinarily it is 0,1 –0,2%. Only in Gruveåsen the amount of Th is expected to be of the order of 5 000 tonnes. The whole Fen area is populated and used as residential and recreational areas.

Not only is the heterogeneity large, the mineral grains are small, less than 0.1 mm.

The content of carbonaceous rock requires a high consumption of acid to leach it. In a pilot plant operation to extract rare earth elements (REE) HCl was chosen as the dissolving species. 700 kg HCl per tonne rødberg was consumed to leach a yield of 100% Ca and Mg and 80% of REE. Thorium was also leached indicating that Th is not solely present as silicate or oxide. However, small amounts of silicic acid were also present in the leachate causing severe problems.

To extract thorium also other valuable elements must be cost carriers and the rare earths are an obvious choice. Another possible element present is niobium, but it is not present in the same minerals as REE.

Thorium from Fen will hardly ever be recovered as the main element, but may be a valuable by-product. However, the main obstacle in developing an economic feasible process is the carbonaceous rocks consuming too much acid or energy.

Primary author: Mr ERIKSEN, Dag (Primus.inter.pares as)

Presenter: Mr ERIKSEN, Dag (Primus.inter.pares as)

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