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Importance of Geometallurgy in the Siilinjärvi Phosphate Mine

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The 2.61 Ga old Siilinjärvi carbonatite-glimmerite complex in Finland is one of the oldest known carbonatites. The Siilinjärvi complex is a steeply dipping lenticular body which is about 16 km long and 1.5 km in maximum width, and covers a surface area of about 14.7 sq. km. The depth of the complex is unknown; however, the deepest drill hole penetrates ca. 800 m depth and still indicates carbonatite glimmerite type rocks. The whole complex is surrounded by a fenite halo up to 300 m wide [1].

The Siilinjärvi complex consists carbonatite-glimmerite type rocks which has been divided into four classes based on carbonatite mineral modal amounts viz.: >50 % carbonatite minerals = carbonatite, 25-50 % carbonatite minerals = silico-carbonatite, 10-25 % carbonatite minerals = carbonatite-glimmerite, 0-10% carbonatite minerals = glimmerite. The amounts of different rock types vary highly in different areas of the complex [2].

Mining for apatite as a source for phosphorus began in 1979 by Kemira Oy, but since 2007 the deposit has been under the ownership of Yara International ASA, presently producing about 11 Mt of ore per year combined from the main Särkijärvi pit in the south, and the satellite Saarinen pit in the north of the complex.

Geometallurgical knowledge is essential when the ore is processed in the concentrator. The ore has now been processed over 35 years and several empirical limits for the feed material composition has been set. Recently new chemicals and process flow sheet changes in the concentrator as well as changes in mining areas has kept geometallurgical issues on the table. Grindability of the ore has changed easier and more ore is possible to feed through the mills. Higher feed rates brings challenge for end product quality. High gradient magnetic separator (HGMS) is used to take dolomite, amphiboles and micas out from the apatite concentrate. When the feed rates are higher also magnet is working in its top capacity. To get the end product within required limits, precise information about the ore feed mineralogy and amount of the gangue minerals are essential. Massive diamond drilling campaign in the main pit area 2012-2014 gave base for future mine planning. Information utilization is still ongoing and current target is start to use the new XR-automatization system in the mine laboratory to re-assay drill core samples to get precise mineralogical content from our future ore feed. In addition more detailed study about different ore types, especially sheared ones, is ongoing and mineralogical and microprobe analyses are used.

Efficiency is vital for Siilinjärvi mine operations because low apatite content in the ore. The Siilinjärvi carbonatite, with an average in-situ grade of 4.2 wt. %, has currently the lowest mined apatite grade in the world. Harmful elements for fertilizer industry, like heavy metals, are not met from Siilinjärvi deposit.

References:

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