Gangue mineralogy of titanium (Ti) in the Kiirunavaara iron ore deposit, Northern Sweden

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ABSTRACT

The Paleoproterozoic Kiirunavaara Fe oxide-apatite ore deposit has long been known as the most productive iron ore deposit in Europe operated by Luossavaara-Kiirunavaara AB (LKAB). The understanding of the deposit from a mineralogical and geochemical point of view, but also from a mineral processing perspective is increasingly important as the production in the mine is advancing toward deeper levels. It is of great significance to characterise the abundance and chemical composition of ore and gangue minerals in terms of their variable impact as potential Ti-bearing hosts, which might be a critical element for production in the future.
Three minerals with stoichiometric Ti-content have been identified in the Kiirunavaara iron ore deposit: titanite, ilmenite, and rutile. Ilmenite and rutile are the major Ti-bearing minerals in Fe-rich and P-poor parts of the ore deposit, whereas titanite is predominant in the zones with slightly lower Fe-content and higher SiO_2-content. Moreover, a significant amount of titanium may be incorporated in phlogopite. Magnetite, which is the only ore mineral of economic value in the deposit, has not revealed any significant Ti-content in its crystal structure. However, titanium is associated with magnetite in the form of Ti-rich exsolution lamellae, being restricted to magnetite crystals in P-poor ore types.
Inferred from exploration and grade control drilling, the titanium grade increases in general with depth in the Kiirunavaara deposit. Consequently, also the amount of Ti-bearing silicates (titanite, phlogopite) and oxides (ilmenite, rutile) increases. Currently, the methods of mineral processing in the beneficiation plants are comprised of a sequence of two-stage comminution, wet low intensity magnetic separation and reverse apatite flotation. Magnetic separation is regarded as the crucial part in separating gangue minerals besides apatite from the ore. However, in the future, additional flotation steps may be required to ensure efficient elimination of Ti-bearing minerals during the beneficiation process.

KEYWORDS

Fe oxide apatite deposit, magnetite, LKAB, Kiirunavaara, titanium