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In-situ trace elements and Sr isotopes in plagioclase in the Koillismaa intrusion, Finland, and implications for the formation of Fe-Ti-V oxide ores

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Mafic layered intrusions are well-known hosts of base- and precious metal deposits throughout the world. The formation of Fe-Ti-V deposits in layered mafic intrusions remains a subject of interest to petrology and to the extractive industries. The 2.44 Ga magmatism in the Fennoscandian shield was caused by a mantle plume event and the initiation of rifting of the Archean craton, causing the emplacement of several mafic-ultramafic intrusions, mafic dykes and volcanic rocks. Many of these 2.44 Ga intrusions host significant mineralizations, including occurrences of Cr, PGE and V. The Koillismaa intrusion belongs to this group of intrusions, and hosts significant contact-, and reef-type PGE mineralization in the lower and middle portions of the intrusion, respectively, and an Fe-Ti-V oxide deposit in the upper part. The Mustavaara Fe-Ti-V deposit is a historically important source of V, having accounted for a significant portion of global V production from 1976-1985. The deposit contains an estimated 64 Mt of proven reserves, and 35 Mt of probable reserves, grading 14 wt. % ilmenomagnetite of 0.91 wt% V (Karinen et al., 2022, and references therein). The oxide ore zone is dominated by magnetite gabbro with disseminated vanadium oxide of about 30%, without significant massive ores, which is different from the Bushveld complex, but similar to some other Finnish intrusions (e.g., Akvanvaara). The clinopyroxene grains are intensely altered, but fresh plagioclase domains are normally present. In this study, systematic *in situ* analysis of trace elements and Rb-Sr isotope of plagioclase from samples taken across the whole stratigraphy of the Koillismaa intrusion has been conducted. These new data, together with published bulk rock geochemical and mineralogical data will be used for constraining the parental magma composition, and elucidating the fractionation of magma, magma replenishment and oxygen fugacity, and thus a better understanding of the genesis of the Fe-Ti-V deposit in Mustavaara.

Karinen, T., Moilanen, M., Kuva, J., Lahaye, Y., Datar, B. and Yang, S., 2022. Mustavaara revisited: A revised genetic model for orthomagmatic Fe–Ti–V mineralisation in the Koillismaa intrusion. p414.

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