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Rock magnetic properties and their correlation with mineralogy / geochemistry for the serpentinite sequence of the OKU drillhole (Eastern Finland)

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Within the Outokumpu Deep Drilling Project, a 2516 m deep borehole into a strongly magnetic anomaly zone within Paleoproterozoic rocks in eastern Finland was drilled in 2004-2005 by the Geological survey of Finland (GTK). Mainly paramagnetic mica schists and black schist interlayer units dominate until 2013 m, which are intercalated by a serpentinite sequence from 1314 - 1515 m. Below 2013 m dia- to paramagnetic pegmatitic granite was found. We focus our study on the serpentinite sequence of the Outokumpu assemblage, which mainly consists of serpentinites, diopside skarn, quartzite and black schist, whereby serpentinites and black schists are the host rocks of the Outokumpu-type massive Cu-Co-Zn deposits of the area. Magnetic susceptibility measurements every 20 cm along the cores revealed that the rocks of the Outokumpu assemblage vary significantly from dia- and paramagnetic behaviour with values below $1*10^{-3}$ SI to ferromagnetic behaviour with values above $10*10^{-3}$ SI. We measured a significant scattering of magnetic susceptibility within the serpentinite, which indicate variable degrees of serpentinization. Curie temperatures of 580°C indicate magnetite, which has been formed as a reaction product during serpentinization process. Secondary magnetite occurs along veins together with sulfide- and oxide minerals, nickelite and chlorite. But there are also relicts of pyrite-magnetite grains embedded in secondary pyrite. NRM values of mica schist, skarn rocks and black schist are generally weak (0.1 mA/m) and rarely increase to 6 mA/m in black schist due to increasing content of pyrrhotite. Some serpentinites show notable high remanence values up to 45 A/m. Generally a positive correlation between susceptibility and NRM of the ferromagnetic serpentinites can be observed, suggesting that amount of magnetite controls the strength of the magnetic anomalies. Wavelength dispersive X-ray fluorescence analyses indicate that the Fe_2O_3 content of serpentinites vary between 4 and 16 wt-per cent, independent of magnetic properties or grade of serpentinization. There is also no correlation of magnetic properties with other elements like SiO_2, Co, Ni, V and Cr that can be related to the serpentinitization process. Only MgO content and density show a negative correlation in agreement with an increasing degree of serpentinization. While we observed nearly no correlation between magnetic properties and major and trace elements, there is a strong relationship between the formation of secondary magnetite and the degree of serpentinization. We will further discuss this relationship between mineralogy / geochemistry and rock magnetic properties in our contribution.