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Thermodynamic modelling of metasomatism and mineralization in the Fe skarn deposit at Zlatý kopec, Erzgebirge

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The Western Erzgebirge hosts a wide range of skarn types and mineral assemblages, but mechanisms of their metasomatic origin, reactive fluid flow and net fluxes remain unclear. Equilibrium titration simulations between granite-equilibrated 1 M NaCl saline fluid and calcitic marble protoliths have been conducted in the system Si-Al-Fe-Mg-Ca-Na-K-O-H-C-Cl at 400 °C and 1 kbar using GEMS and Theriak-Domino phase equilibrium solvers in order to investigate the calc-silicate alteration sequence and magnetite formation in the Fe skarn deposit at Zlatý kopec (Westerzgebirge, Czech Republic). Metasomatic reactions and zoning occur during an interval of fluid-rock ratio between approx. 1:1 and 1000:1. An initially acidic (pH = 2.955 with respect to neutral pH = 5.372) and reduced (ΔQFM = -2.461) magmatic fluid reproduces the observed clinopyroxene-magnetite assemblage at Zlatý kopec upon interaction with pure calcite as well as in precursor varieties with minor dolomite or quartz near fluid-rock ratio ~30 and has been assisted by porosity generation. The skarn assemblage coincides with a garnet and epidote stability gap which extends from ΔQFM -2.5 to +0.5 and T = 390-430 °C. The magnetite ore grade increases with the salinity of the infiltrating magmatic fluid, oxidation state and to a minor extent by dolomitic impurities but is lowered by the SiO_2 content in the marble protolith.

Cite abstract as:
Hintzen, R., Dolej?, D. (2021) Thermodynamic modelling of metasomatism and mineralization in the Fe skarn deposit at Zlatý kopec, Erzgebirge. DMG Sektionstreffen Petrologie und Geochemie, Online (Germany), abstract URL: http://paneth.eu/PanethKolloquium/DMG2021/0012.pdf (abstract #0012).