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Precipitation and dissolution of chromite by hydrothermal solutions: new behavior of Cr and chromi

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Chromite is one of typical refractory igneous minerals, precipitated from mafic magmas at relatively high temperatures. Chromites commonly occur in sedimentary, metamorphic and metasomatic rocks, where they are interpreted as relics of an igneous phase and serve as the source of Cr for low-temperature Cr-bearing minerals. We present evidence for nucleation of chromite within hydrothermal solution. We found minute euhedal chromite grains enclosed by uvarovite in a diopsidite, metasomatically replacing layered gabbro of the Oman ophiolite. The uvarovite shows oscillatory concentric zoning in terms of Cr# (= Cr/(Cr + Al)), and the chromite is embedded only in the high-Cr# zones of the uvarovite. Another diopsidite, replacing peridotite in the underlying upper mantle section, contains xenocrystal chromite, which is in part dissolved. These probably indicate that a hydrothermal solution collected Cr by digestion of chromite within the mantle and precipitated chromite with high-Cr# uvarovite within the lower crust upsection. The metasomatic agent involved was CO2- and SO2-bearing hydrothermal solution containing appreciable silicate components, and could carry Cr via carbonate and/or sulfate complexes. The hyrothemal chromite is similar in chemistry to commonly found igneous one (e.g., Cr# = 0.8, Mg/(Mg + Fe^{2+}) = 0.13, TiO_2 <0.3 wt% and Fe^{3+}/(Cr + Al + Fe^{3+}) <0.2), but its Cr# is clearly different from that (0.6-0.7) of mantle chromite in peridotites and chromitites from the Oman ophiolite. We should re-consider the origin of some chromites in rocks that involved hydrothermal activity in genesis. Even hydrothermal chromitite is possible if chromite grains are effectively concentrated.

Keywords: chromite, hydrothermal solutions, uvarovite, diopsidite, Oman ophiolite