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Geochemistry of Chromium-Silicate Minerals

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Water-rock interactions at elevated pressures and temperatures may mobilize chromium from chromite to produce a variety of Cr-silicate minerals. Common Cr-silicates include fuchsite ($KCr_2(AlSi_3O_{10})(OH)_2$), kämmererite ($(Mg_5Cr)(AlSi_3)O_{10}(OH)_8$), tawmawite ($Ca_2CrAl_2Si_3O_{12}(OH)$), and uvarovite ($Ca_3Cr_2Si_3O_{12}$). Here we assess the geochemistry and calculate the thermodynamic properties of a variety of Cr-silicates to elucidate their formation as well as how they may contribute chromium to the environment. Chromium-silicates follow an idealized 1:1 relationship with regards to Cr(III) and octahedral Al, except for kämmererite. Kämmererite can have Al in excess of 1:1 to Cr(III), substituting into the Mg site. FTIR and Raman analyses demonstrate that Cr(III) enrichment is distinguishable between respective end member minerals. Thermodynamic properties were calculated using established estimation algorithms and unit-cell measurements. Overall, we provide an extensive assessment of Cr-silicates that addresses the formation of Cr-silicates and fate of chromium in the environment.