Archean and Early Phanerozoic Serpentinization Environments – Insights from Chromium isotope and REY systematics of stichtites ($Mg_6Cr_2(OH)_{16}[CO_3]\cdot 4H_2O$)

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Serpentinization is a low-temperature metamorphic process in which mafic and ultramafic rocks are oxidized and hydrolyzed due to interaction with (sea)water. Serpentinizing environments may have provided habitable zones for early life and serpentinization is also considered an alternative process for methane production, for example on Mars, where the presence of methane as an indicator for the presence of methanogenic bacteria is intensely discussed. The magnesium-chromium hydroxycarbonate stichtite which forms during serpentinization, may have recorded the environment of past serpentinization systems and its trace element and isotope compositions may represent promising tools for deciphering these past conditions. Cr stable isotopes and specific REY signatures are used as proxies for the presence of oxygen in the atmosphere, but may also indicate strong organic complexation and/or serpentinization.

We analyzed Cr stable isotopes and REY compositions of stichtite minerals and associated serpentinite from Archean and Early Phanerozoic formations in Australia, Tasmania and South Africa. Our first results indicate different extents of Cr isotope and REY fractionation in serpentinite and stichtite. Whilst some stichtites are not isotopically fractionated from bulk earth ratios and from their associated serpentinites, others, both from the Archean and Early Phanerozoic, are isotopically fractionated with positive $\delta^{53}Cr$ up to +0.25. The stichtite-serpentinite pairs show similar REY signatures, but stichtite is depleted in REY by three orders of magnitude and is enriched in HREY relative to the associated serpentinite. Specific REY signatures, such as anomalies of redox-sensitive REY, are found in both serpentinite and stichtite. In Archean and Early Phanerozoic serpentinizing environments, therefore, stichtite formation was associated with a fractionation of Cr isotopes and REY.