Sequential geochemical extractions and mineralogy of Fe-bearing minerals of mantle rocks in the Samail Ophiolite, Oman

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Within the Samail Ophiolite, Oman, there are intervals of listvenite outcrops between layers of serpentinite zones above the basal thrust zone, atop the metamorphic sole. Near the base of the ophiolite mantle section, some peridotites underwent 100% carbonation from metasomatic introduction of CO₂-bearing fluids (~100°C) to form listvenites during the time of emplacement (97 ± 29 Ma, Falk and Kelemen, 2015). The carbonate rocks comprise mostly magnesite and/or dolomite, quartz, spinel, and Fe-(hydr)oxides; with carbonates as the sole Mg-minerals and quartz as the only silicate phase. The aim of this study is to chemically and petrographically investigate the Fe-bearing minerals within the fluid-altered mantle rocks in drill core samples from hole BT1B of the ICDP Oman Drilling Project. We investigated the quantities of Fe-oxide/hydroxide phases through a series of chemical extractions (Poulton and Canfield, 2005) via atomic absorption spectroscopy in addition to optical microscope/SEM/EDS analysis. Sequential chemical extractions are useful for recognizing iron pools based on the mineralogy. Extractions preformed at room temperature show varying proportions of carbonate-associated Fe (sodium acetate), reducible oxides (citrate-dithionite), magnetite (oxalate), and HCl-extractable Fe(II). The amount of Fe in carbonates based on sodium acetate extraction ranges from 17-54% of the overall extracted iron (12-28 %) in the samples. The same extraction performed at 50°C for twice as long resulted in higher proportions of carbonate-associated Fe extracted with a range of 44-85% of the total extracted iron (15-35 %). Easily reducible iron quantities from a diluted HCl solution extraction display the lowest overall Fe fractions at 6.2-25% following the room temperature acetate and 2.6-6.2% after the 50°C acetate extraction. Reducible oxides extracted by dithionite were wide ranging (8.3-49%) as a proportion of the overall extracted iron, with similar results following the 50°C acetate step (5.3-48%). Oxalate extraction succeeding the room temperature acetate revealed magnetite proportions of 13-28%, while the increased temperature and time in the first step (acetate extraction) resulted in significantly lower proportions of Fe extracted by oxalate (3.1-10%). Falk and Kelemen (2015) suggest significant amounts of poorly crystalline Fe-phases or amorphous oxides within the listvenites not detected by X-ray diffraction, but we do not see evidence of this based on the relatively small HCl fractions. Further examination of the total elemental compositions of the individual solutions and electron microprobe analyses will reveal more details about the Fe-minerals dissolved in each extract and weather they represent separate Fe-oxide/hydroxide phases.