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Sequential geochemical extractions and mineralogy of Fe-bearing minerals in carbonatized 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 <200°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, Cr-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. Sequential chemical extractions are useful for recognizing iron pools based on the mineralogy. 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, EPMA/WDS and ICP analysis. Extractions performed at room temperature and one at 50°C included: carbonate-associated Fe (sodium acetate) targeting siderite, HCl-extractable Fe(II), reducible oxides (citrate-dithionite) targeting hematite and possible goethite, and magnetite (oxalate). Carbonate-based Fe in the listvenites from a sodium acetate extraction ranges from 12-28 mg/g, while the same extraction performed at 50°C for twice as long resulted in higher proportions of carbonate-associated Fe (15-35 mg/g). Easily reducible iron quantities from the diluted HCl solution extraction display the lowest overall Fe fractions (0.75-5.5 mg/g) following the room temperature acetate and 0.63-1.7 mg/g after the 50°C acetate extraction. Fe in reducible oxides extracted by dithionite ranged from 1.4-15 mg/g with similar result after both a room-temperature acetate and a 50°C acetate step. Oxalate extraction succeeding the room-temperature acetate yielded magnetite concentrations of 1.9-8.0 mg/g, while the increased temperature and time in the first step (acetate extraction) were followed by significantly lower amounts of Fe extracted by oxalate (0.47- 3.6 mg/g). Additionally, the same extractions were performed on a pure siderite sample from Greenland. For siderite samples crushed a week prior to analysis, the carbonate-associated Fe in sodium acetate extract was 165±17 mg/g; the siderite yielded 42 wt% of overall extracted Fe (392±33 mg/g). This is only slightly lower than the expected 48.2 wt% of Fe for a pure siderite sample. Dilute HCl extractions display results of 126±5.4 mg/g, dithionite solution extracted 25±0.5 mg/g and oxalate proportions

were 76 ± 9 mg/g. Due to possible oxidation of siderite to magnetite occurring during the time between powdering the samples and analysis, the full dissolution of siderite may not be fully represented in only the acetate. Microprobe data shows a total amount of FeO in carbonates as 1.3-10.8 wt%. This is more than or similar to the acetate and HCl proportions of Fe which represent carbonate associated minerals in the listvenites. Data obtained from EMPA and ICP will additionally be discussed in relation to the Fe-oxide phases with relation to the listvenites mineralogy.