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

Severin, Zena[1] , Till, Jessica L.[1] , Oman Drilling Project Phase 1 Science Party

[1] *Institute of Earth Sciences, University of Iceland, Reykjavík, IS*

Introduction

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 CO_2-bearing fluids (~100° C) to form listvenites during the time of emplacement 97 ± 29 Ma [1] . 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[1] .

Objective

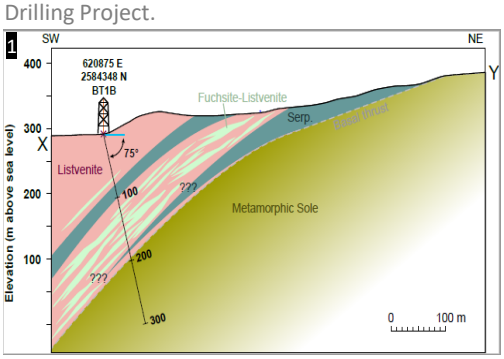
The aim of this study is to chemically and petrographically investigate the Fe-bearing minerals within the fluid-altered mantle rocks in drill core samples from hole BT1B of the ICDP Oman Drilling Project.

Methods

We investigated the quantities of Fe-oxide/hydroxide phases through a series of chemical extractions[3] via atomic absorption spectroscopy in addition to optical microscope/SEM/EDS analysis. Sequential chemical extractions are useful for recognizing iron pools based on the minerology: (a) *Sodium acetate:* Carbonate-associate Fe; b) *HCl*: Extractable Fe(II) in easily reducible oxides; c) Sodium dithionite: Reducible oxides; d) *Ammonium oxalate:* Magnetite extractant.[3]

Results

Variation in the procedure of the first Acetate extraction yielded dissimilar Fe amounts throughout extractions (Fig. 3). Carbonate-associated Fe and reducible oxides on average resulted in the highest extractable Fe amounts. EDS results display an abundance of Fe within magnesites. The majority opaque phases are hematite and magnetite throughout the BT1B core (Fig. 4).



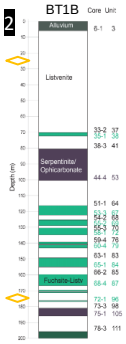


Fig. 1. Cross Section of BT1B[2] **Fig. 2.**Stratigraphic column of BT1B[2] relative to core samples by depth from the surface. Studies samples between orange triangles.

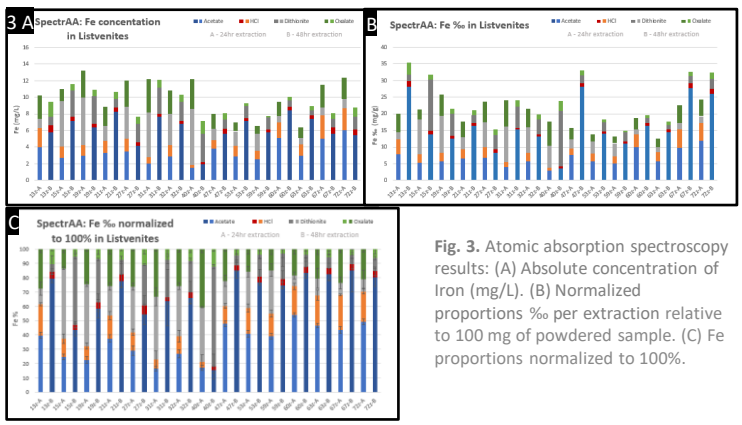


Fig. 3. Atomic absorption spectroscopy results: (A) Absolute concentration of Iron (mg/L). (B) Normalized proportions ‰ per extraction relative to 100 mg of powdered sample. (C) Fe proportions normalized to 100%.

Conclusions and discussion

- Increasing the temperature and time of the Na-Acetate extraction may result in an overestimate of carbonate associated Fe.
- Relatively small HCl extraction values do not suggest significant amounts of poorly crystalline Fe-phases or amorphous oxides previously stated by Falk and Kelemen (2015).
- Upon further investigation, if a significant siderite component within the carbonate phase is detected, some of the magnetite and/or hematite may have formed from the oxidation of that Fe-carbonate component.

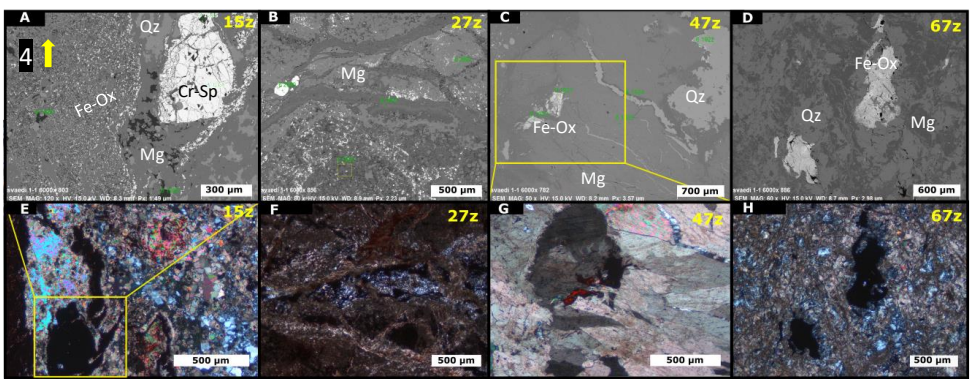


Fig. 4. SEM Backscattering electron (A-D) images of listvenites at varying depths. (E-H) Corresponding X-polarized though microscopy. (A-H) all with same orientation direction, indicated by the yellow arrow. Cr-Sp: Cr-spinel, Mg-magnesite, Qz- quartz, Fe-Ox: iron oxide

References:

[1] Falk, E. S., & Kelemen, P. B. (2015). Geochemistry and petrology of listvenite in the Samail ophiolite, Sultanate of Oman: Complete carbonation of peridotite during ophiolite emplacement. *Geochimica et Cosmochimica Acta*, 160, 70-90

[2]Oman Drilling Project Phase 1 Science Party

[3]Poulton, S. W., & Canfield, D. E. (2005). Development of a sequential extraction procedure for iron: implications for iron partitioning in continentally derived particulates. *Chemical Geology*, *214*(3-4), 209-221.

UNIVERSITY OF ICELAND
FACULTY OF EARTH SCIENCES

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