

## Listvenite-Metamorphic sole transition in the Basal thrust of the Oman Ophiolite: Geochemical, mineralogical and reaction path model preliminary results from Oman Drilling Project Hole BT1B.

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Oman Drilling Project hole BT1B drilled 300 meters through the basal thrust of the Samail ophiolite. The first 200 meters are dominated by listvenites (carbonated peridotites) and serpentinites. Below 200 meters the hole is mainly composed of metasediments and metavolcanics. This core provides a unique record of interaction between peridotite in the leading edge of the mantle wedge and hydrous, CO<sub>2</sub>-rich fluids derived from subducting lithologies similar to the metamorphic sole. 55 listvenites and serpentinites, and 19 schists and greenstones were analyzed for major and minor elements (XRF) and for CO<sub>2</sub> and S concentrations (CHNS) aboard DV Chikyu. The composition of listvenites and serpentinites recovered record extensive interactions between CO<sub>2</sub>-rich fluids and the peridotite protolith. Listvenites compositions are on average identical to Oman harzburgite with a mineralogy dominated by magnesite and quartz with molar fractions 0.6 and 0.4 respectively. All samples from the mantle section are enriched in fluid mobile and incompatible trace elements compared to the mean composition of the Oman mantle. These enrichments are up to ~1000 times the Oman mantle for Rb and Ba. They mimic the pattern of the samples from the metamorphic sole. This suggests that the composition of the listvenites in these elements is controlled by that of fluids that may have originated in the same lithologies as those drilled at the base BT1B. Listvenites, ophicalcites and serpentinites also show notable downhole chemical variations, with listvenites showing marked variations in Al<sub>2</sub>O<sub>3</sub> and TiO<sub>2</sub>. Occurrence of Iherzolites and cpx-harzburgites has been reported at the base of the Oman dominantly harzburgitic mantle section. The observed variations in the listvenites (Al<sub>2</sub>O<sub>3</sub> and TiO<sub>2</sub>) could be related to the composition of their protolith, the deepest having more fertile compositions. Alternatively, the observed downhole changes in the composition of listvenites may relate to the progressive equilibration of the reacting ultramafic-rocks with the fluids originating in the subducting metamorphic sole; these variations could be related to heterogeneous reaction kinetics (temperature, reactive surfaces, chemical gradients) and/or to transport (e.g. local variations in permeability) within the listvenite units. To test these hypothesis we used EQ3/6 to simulate a reaction path in which hydrous fluids with different concentrations of dissolved CO<sub>2</sub> reacts with initially fresh peridotite at 100°C (Falk & Kelemen GCA 2015) and 5 kb. CO<sub>2</sub> concentration in the initial fluids was imposed either by equilibrating the fluid with a mineral assemblage similar to the one observed during core description in the metamorphic sole (i.e. Qtz + Calcite + Feldspar + Chlorite) or by manual input in the initial fluid and equilibrating with a metamorphic sole mineral assemblage without carbonates. These fluids were reacted with a bulk composition identical to Oman harzburgite. All model runs at water/rock < 100 produce a mineral assemblage of serpentine and magnetite with minor brucite at water/rock < 10. Model with fluids equilibrated with calcite in the metamorphic sole react with peridotite with a initial C concentration of 120 ppm and do not saturate in magnesite and quartz at even at water/rock > 10000. At least 2800 ppm of C in the fluid is required to stabilize magnesite and quartz in

the proportions observed in the listvenites of BT1B at water/rock  $\sim 4000$ . Further increasing the C concentration in the fluid close to the solubility limit  $\text{CO}_2$  decrease the water/rock ratio required to carbonate the peridotite resulting in molar proportions of magnesite and quartz at molar proportions similar to those observed in the listvenites of BT1B at water/rock between 20 and 200. We hypothesize that decarbonation reactions in the subducted slab are the source of these carbon rich fluids. The results of this model are consistent with the complex chemistry and veining history of hole BT1B.

Keywords: Oman Drilling Project, D/V Chikyu, Scientific Drilling, Reaction Path

