Ophiolite Peridotites as Analogues for Supra-Subduction Zone Mantle

JOHN W. SHERVAIS[1] AND MARLON M. JEAN[2]

[1]Dept Geology, Utah State University, Logan UT 84322, (john.shervais@usu.edu)

[2]Leibniz Universität Hannover, Institut für Mineralogie, (m.jean@mineralogie.uni-hannover.de)

It is now commonly recognized that most ophiolites form in the upper plate of nascent or reconfigured subduction zones [1-2]. Over the last several years we have studied outcrops of lithospheric mantle that underlie crust formed by supra-subduction zone (SSZ) magmatism in order to understand geochemical flux in the mantle wedge during subduction, which is critical to our understanding of the subduction factory process and arc volcanism.

Most peridotites of the Coast Range ophiolite (California) are harzburgites but lherzolites occur in 2 locations. We have analyzed mineral chemistry in the peridotites by EMPA and by high-precision laser ablation ICP-MS [3-5]. Trace elements include 13 REE along with 7 fluid mobile elements *(FME: Li, Be, B, Rb, Ba, Pb, Th)* and 8 other trace elements *(Sc, Ti, V, Sr, Y, Zr, Nb, Hf)*. We use MREE-HREE to assess melt extraction, and the other elements to assess fluid flux and melt enrichment in the mantle wedge.

Melt models show that harzburgites have undergone high degrees of melt extraction (15-23%), starting in the garnet field and continuing into the spinel facies, while lherzolites typically record <4% melt extraction [3-6]. The melt models result in FME concentrations that are essentially zero, but, observed FME concentrations often exceed primitive mantle. Similar FME enrichments are observed in the lherzolites. We derived an alogrithm that may be used to calculate the enrichment of FME [6]:

$$C_{wr,add}=[C_{cpx\text{-}obs}/[[D_{cpx}/(D_{bulk}–PF)]*[1–(PF/D_{bulk})]^{(1/P)}]]–[C_{0,wr}]$$

Where $C_{wr,add}$ = concentration of FME added to mantle wedge, $C_{cpx\text{-}obs}$= observed pyroxene, D_{cpx} and D_{bulk} = mineral and bulk partition coefficients, P=melt proportion, and F=melt fraction. Our results show that high concentrations of fluid-mobile elements in supra-subduction peridotites result from a continuous flux of aqueous fluid or fluid-rich melt phase derived from the subducting slab, and allow us to quantify the composition of the fluid added.

[1] Shervais 2001 G^3 #2000GC000080, [2] Metcalf and Shervais 2008 *GSA SP* **438** 191–222, [3] Choi *et al* 2008 *Cont Min Pet* **155** 551-576, [4] Choi *et al* 2008 *Geology* **36** 595-598. [5] Jean *et al* 2010 *Cont Min Pet* **159** 113-136, [6] Shervais & Jean 2012 *Geochim Cosmochim Acta* **95** 270-285.