



A Chlorine and Hydrogen Isotope Study of Metasomatized Peridotites from the Finero Body, Ivrea Zone, Italy

Zachary Sharp (1), Jane Selverstone (1), Melissa Halick (1), and Jaime Barnes (2)

(1) Dept. Earth and Planet. Sci., University of New Mexico, Albuquerque, NM 87131, USA (zsharp@unm.edu), (2) Dept. Geol. Sci., University of Texas at Austin, Austin, TX 78712, USA

The fluid sources, pathways and length scales of fluid infiltration responsible for mantle metasomatism are not well understood, with a number of different sources and mechanisms having been proposed. Here we use Cl and H isotope geochemistry of depleted spinel-facies peridotites from the Finero Body of the Ivrea Zone, Italy to resolve whether a chemically and isotopically homogeneous fluid or multiple and chemically distinct fluids were responsible for the observed metasomatism of the Finero body. A second goal is to use the length scales over which isotopic heterogeneities might exist to identify whether fluids were sourced from a subducting slab, a rifting environment or plumes, each of which has been proposed as the source of the metasomatic fluid at Finero. Metasomatism of the Finero peridotites led to the development of phlogopite and amphibole throughout much of the body. Three rock types were identified and analyzed for bulk chemistry and stable isotope compositions: 1) phlog and/or amph peridotite, 2) coarse-grained crosscutting phlog+amph segregations and 3) crosscutting phlog+opx segregations. P-T from *Perple_X* modeling for group 1 samples indicates equilibration at P of 1.2 to 1.4 GPa and T of ~800-900°C, consistent with deformation microstructures in the studied samples.

The $\delta^{37}\text{Cl}$ values cover a range from -2.1 to +3.3 permil, the largest spread yet reported for rocks of mantle origin. There is no correlation with minor element composition (Na, K, Al, Ti, and Cr concentrations), modal abundance of hydrous phases or bulk Cl content. However, the combined Cl and H isotope data lead to clustering of each sample type: Group 1: $\delta^{37}\text{Cl} = +1.1, +3.3$ permil, $\delta\text{D} = -42, -36$ permil; Group 2: $\delta^{37}\text{Cl} = -2.1, -1.7$ permil, $\delta\text{D} = -49, -40$ permil; Group 3, $\delta^{37}\text{Cl} = -0.1$ permil, $\delta\text{D} = -80$ permil. Group 3 has a distinct mantle signature for both isotopes, group 2 is consistent with a seafloor alteration-derived fluid, and group 1 has high δD values consistent with dehydration of seafloor altered material but also anomalously high $\delta^{37}\text{Cl}$ values. To our knowledge, such high $\delta^{37}\text{Cl}$ values have not been observed in any other rock type, but have been found in hydrothermally altered seafloor vent fluids. If vent fluids interacted with a rock prior to subduction, they could impart the high $\delta^{37}\text{Cl}$ values observed in the group 1 peridotites.

The large variation in Cl and H isotope data cannot be reconciled with a homogenous fluid source unless large Cl isotope fractionations occurred during fluid-rock interaction. However, no known fractionation mechanisms have been proposed that could explain the wide range of $\delta^{37}\text{Cl}$ values. Instead multiple sources are indicated, with heterogeneities preserved on a meter scale. A heterogeneous fluid source is not compatible with a rift or plume setting. Instead it suggests distinct episodes of hydrous fluid/melt introduction from different rock types in a subduction setting.