

GEOCHEMISTRY OF SPINEL LHERZOLITE XENOLITHS FROM XALAPASCO DE LA JOYA, MEXICO: MELTING AND METASOMATISM; Liang Yan (1) and Don Elthon (1,2). [1: Department of Geosciences, University of Houston, Houston, TX 77004; 2: Lunar and Planetary Institute, 3303 NASA Road One, Houston, TX 77058]

The Cenozoic spinel lherzolite xenoliths from Xalapasco de La Joya, San Luis Potosi, Mexico [1,2], are divided into two distinct subgroups according to their major and trace element characteristics. Group Ia xenoliths are characterized by LREE depletion ( $La/Lu = 0.10$  to  $0.77$ , normalized to chondrites, in CPX) and linear major element and compatible trace element relations interpreted to be a result of partial melting and basalt extraction. Group Ib xenoliths are characterized by Na, Fe, and LREE enrichment ( $La/Lu = 0.8$  to  $4.1$  in CPX) and complex major element relations interpreted to result from mantle metasomatism.

The Mg# ( $100 * Mg / (Mg + Fe)$ ) of the (XRF) bulk rock analyses varies from 87.1 to 89.7. As the MgO increases from 38.5 to 44.7%, Al<sub>2</sub>O<sub>3</sub> decreases from 3.5 to 1.7%, CaO decreases from 4.2 to 1.4%, SiO<sub>2</sub> decreases from 44.3 to 42.6%, Cr<sub>2</sub>O<sub>3</sub> decreases from 0.42 to 0.19%, and NiO increases from 0.213 to 0.259%. FeO\* is higher in Group Ib xenoliths (9.0-10.2%) than Group Ia (8.5-9.2%). Al<sub>2</sub>O<sub>3</sub> and SiO<sub>2</sub> contents in Group Ib xenoliths are lower than those of Group Ia at the same MgO contents.

Olivines (OL) in the Group Ia xenoliths range from Fo<sub>89.4</sub> to Fo<sub>90.4</sub> compared to a range of Fo<sub>87.8</sub> to Fo<sub>89.3</sub> in the Group Ib olivines. Orthopyroxenes (OPX) in the Group Ia xenoliths also have higher Mg# (89.9 to 91.2) than the Group Ib OPXs (88.6 to 89.8). The Al<sub>2</sub>O<sub>3</sub> contents of OPXs range from 4.3% to 5.4%, with no difference between the two groups. There is no detectable zonation in either OL or OPX in these samples. The Mg/(Mg+Fe<sub>2</sub>) and Cr/(Cr+Al) of spinel range from 0.708 to 0.784 and 0.091 to 0.179, respectively. Clinopyroxenes (CPX) from the two groups differ compositionally, with Mg# of the Group Ia CPXs (89.8 to 91.4) higher than for the Group Ib CPXs (88.0 to 88.4). Al<sub>2</sub>O<sub>3</sub> contents of CPXs range from 6.7 to 7.3%. Clinopyroxenes from Group Ib xenoliths are always reversely zoned, whereas only a few CPX grains in Group Ia xenoliths have this feature. In core to rim comparisons of Group Ib CPXs, Al<sub>2</sub>O<sub>3</sub> decreases by 10 to 40% (relative), Na<sub>2</sub>O decreases by 36 to 60%, MgO increases by 7 to 14%, and CaO increases by 5 to 10%. The compositions of Group Ia CPXs are quite homogeneous in terms of electron microprobe analyses, but the Group Ib CPXs are highly variable in composition. Phlogopite is found in two of the Group Ib xenoliths. OPX is often characterized by coronas of olivine plus glass, especially in the Group Ib xenoliths.

INAA analyses of high-purity mineral separates of these xenoliths indicate further differences. The Na<sub>2</sub>O contents of the Group Ia CPXs are 1.43% to 1.78%, versus 1.89% to 2.46% in the Group Ib CPXs (Na<sub>2</sub>O in OPXs is also lower in Group Ia [0.09-0.17%] than in Group Ib OPXs [0.21-0.23]). FeO\* is also

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higher in the Group Ib CPXs (3.16% to 3.42%) than Group Ia (2.63% to 3.24%). The La/Lu (normalized to chondrites) is 0.1 to 0.77 in the Type Ia CPXs versus 0.8 to 4.1 in Group Ib CPXs. The heavy REE are similar for all CPX samples (generally 8.5 to 12.4 x chondrites). La/Lu is negatively correlated with the CaO content in Group Ia CPX, but positively correlated with CaO content in Group Ib CPX.

Thin (10-40 microns wide) glass veins are found in all Group Ib xenoliths and in a few of the Group Ia xenoliths [compare with references 3-4]. Electron microprobe analyses of these veins indicate that they have unusual compositions with 52.5-57.4% SiO<sub>2</sub>, 18.1-19.4% Al<sub>2</sub>O<sub>3</sub>, 4.1-4.8% Na<sub>2</sub>O, 2.2-2.8% K<sub>2</sub>O, 1.1-1.5% P<sub>2</sub>O<sub>5</sub>, and 2.6-3.6% TiO<sub>2</sub>. The Na:K:P:Ti (oxide) in these glass veins (1.4:0.78:0.41:1) and the host alkali basalt (1.32:0.78:0.43:1) are almost identical, which suggests that these elemental abundances are dominated by contributions from the host alkali basalt.

It is clear that these xenoliths have had a complex history involving both partial melting and mantle metasomatism. The Group Ia xenoliths appear to have had a history dominated by partial melting and basalt extraction, followed by subsolidus equilibration and annealing. The minerals in these xenoliths have the highest Mg# in the suite; the CPXs are homogeneous and are LREE depleted. In a few of these xenoliths there appears to be vestiges of incipient metasomatism, but metasomatism has not substantially influenced them.

The Group Ib xenoliths have had a substantial component of mantle metasomatism that dominates partial melting and basalt extraction effects. Broadly similar metasomatic effects (i.e., LREE, Na, and Fe enrichments) have been previously described by several investigators of other mantle xenolith suites [e.g., 5-8]. In addition to this (apparently common) style of metasomatism, we believe that some of these xenoliths have experienced leaching with an alkaline-element-enriched fluid [refs. 9-10] derived from the host basalt in the phlogopite stability field to form the observed mineral zonations in CPXs and the leaching coronas around OPXs and some spinels.

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