ORTHOPYROXENE/CLINOPYROXENE TRACE ELEMENT PARTITIONING SYSTEMATICS IN THE NATURAL SAMPLE

Stephen T. Wozab (FSU, Geochemistry), Michael Bizimis (FIU, Geochemistry)

Introduction

We report data on trace element partitioning between orthopyroxene (opx) and clinopyroxene (cpx) for natural spinel peridotites from both the oceanic lithosphere (Oahu, Hawaii) and the continental setting (Portillo Maar, New Mexico, N.E. Queensland, Australia). Our data is combined with data from the literature on spinel peridotites where major and trace element data exists together.

Results and Discussion

We show in our data that, for the first time, there is a systematic variation between trace element partitioning between opx and cpx in both the natural and experimental sample in relationship to temperature.

$$T=358.92\ln D^{opx/cpx}{}_{Y} +2012.1 \text{ with } r^2 = 0.91 \quad (1)$$
$$T=427.52\ln D^{opx/cpx}{}_{Er} +2097.3 \text{ with } r^2 = 0.87 \quad (2)$$

Where trace element partitioning data exists for the experimental samples, we find that the data always falls at the extension of the natural sample on a temperature vs. $\ln D^{opx/cpx}$ plot. The temperature that we calculate is from the Brey and Köehler two-pyroxene geothermometer, which is a function of Ca, Na, Mg, and Fe content.

For HREEs (Sm, Er, Lu, Yb), Y, HFSEs (Zr, Hr, Ti), Sc, and Cr we see a positive correlation between the partitioning coefficient and temperature. The opposite trend is observed for the transition elements (Mn, Co, Ni). No trend is observed between partitioning and temperature for the more highly incompatible elements Ba, U, Th, Pb, Nb, La, and LREEs due, most likely, to problems associated with these elements and contamination.

Garnet peridotites are not incorporated into our analysis because they cause the observed systematic variations between the partitioning of trace elements in orthopyroxene and clinopyroxene with temperature to break down. The reason for this is uncertain, but it may be due to orthopyroxene and clinopyroxene being in disequilibrium, where clinopyroxene was added metasomatically at cold enough temperatures to where it did not equilibrate with orthopyroxene.

Conclusions

The conclusion that we draw is that, despite the variability in the data (how well we calculate the temperatures, noise in our measurement techniques, how pure our mineral separates are, etc.), there is a systematic variation in partitioning of elements between opx and cpx dependent upon temperature. The trends are observed in both the natural and experimental samples and the data is not random.

References

[1] Bedini and Bodinier 1999, GCA 63, pp 3883-3900
[2] Brey and Koehler, 1990, J.Pet. 31. pp. 1353-1378
[3] Glaser et al. 1999, Lithos 48, pp. 263-285
[4] Green et al. 2000, Lithos 53, pp. 165-187
[5] Grégoire et al. 2003, J. Pet. 44, pp. 629-657
[6] Hellenbrand et al. 2002, J. Pet. 43, pp. 2305-2336
[7] Johnson et al., 1990, JGR 95, pp.2661-2678
[8] Kinzler 1997, JGR 102, pp. 853-874
[9] Lindsley, 1980, Pyroxenes, MSA, pp 289-307.
[10] Longhi 2002, G^3 3, doi 10.1029/2001GC000204
[11] McDade, et al. 2003, Phys. E. Pl. Int. 139, pp. 129-147
[12] Norman 1998, CMP 130, pp. 240-255
[13] Salters et al. 2002, G^3, 3, doi 10.1029/2001GC000148
[14] Seyler et al., 2003 G^3, 4, doi:10. 1029/2002GC000305
[15] Sietz et al. 1999, GCA 63, pp. 3967-3982
[16] Walter 1998, J. Pet. 39, pp. 29-60
[17] Kelemen et al. 2004, Inside the Subduction factory, AGU mon., v.138, pp223-276
[18] Bizimis et al 2004, EPSL 217, 43-58 0.001 0.010