

Clinopyroxene/orthopyroxene trace element partition coefficients in spinel peridotite xenoliths

G. Dobosi
G. A. Jenner

Department of Earth Sciences, Memorial University of
Newfoundland, St. John's, NF, A1B 3X5, Canada

A. Embey-Isztin

Department of Mineralogy and Petrology, Hungarian Natural
History Museum, Budapest, Pf.: 137, H-1431 Hungary

The distribution of incompatible trace elements between clino- and ortho-pyroxenes from spinel peridotite xenoliths has been investigated. The xenoliths came from three localities within the Pannonian Basin, Eastern Central Europe, namely Szigliget, Szentbekalla and Bondoro-hegy (Embey-Isztin *et al.*, 1989). All upper mantle xenoliths selected for this study are anhydrous and include the following textural types; protogranular, porphyroclastic, equigranular and poikilitic. Both metasomatised and unmetasomatised xenoliths were analysed. However, there were no significant inter- or intra-granular trace element variations in the clino- and orthopyroxenes, and the homogeneity of the major elements in the mineral phases also suggest equilibrium.

The four major mineral phases (clino- and orthopyroxene, olivine and spinel) were analysed by laser ablation microprobe - inductively coupled plasma - mass spectrometry (LAM-ICP-MS) at Memorial University of Newfoundland; for analysis details see Jenner *et al.* (1993). REE, Sr, Nb, Zr, Hf and Ti are above detection limits for the clino- and orthopyroxenes; however, these elements are generally too low in the olivines and spinels for quantitative analysis. The U, Th and Ta content of orthopyroxene was also below detection limits.

The averages and standard deviations of the calculated orthopyroxene/clinopyroxene partition coefficients are given in Fig 1. This figure which is based on the averages of 37 xenoliths strongly confirms the observation of Rampone *et al.* (1991), McDonough *et al.* (1992) and Sun and Kerrich (1995) that the orthopyroxene/clinopyroxene partition coefficients of the HFSE elements (which substitute in the M1 sites in the pyroxenes) are significantly higher than those of the neighbouring REE (substituting in the M2 sites). The figure also illustrates orthopyroxene/clinopyroxene partition coefficients from some spinel peridotite xenoliths from British Columbia (Sun and Kerrich, 1995).

These later data were calculated using solution ICP-MS data on separated clino- and ortho-pyroxenes. The U-shaped pattern for the REE partition coefficients (i.e. the increase of the partition coefficients towards the LREE) is probably the result of impurities in the orthopyroxene separate. Highly incompatible trace elements reside not only in the pyroxene lattice but in fluid inclusions and along the grain boundaries. The REE partition coefficients based on *in situ* analysis show regular variation with ionic radii, e.g. Fig. 2, where there is illustrated an almost linear trend of the logarithm of the partition coefficients in the D (opx/cpx) versus ionic radii.

There is increased scatter of the D values as lower trace element abundances in orthopyroxene are approached. However, the higher scattering in the case of some LREE and Sr (all have relatively large ionic radii) is not simply a result of analytical uncertainty; the orthopyroxene/clinopyroxene partition coefficients of these elements tend to increase with increasing equilibrium temperatures (Fig. 3.). This variation is interpreted to be the result of a temperature dependence of Ca partitioning between

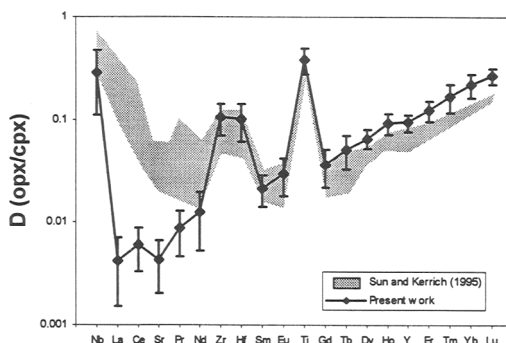


FIG. 1. Trace element partition coefficients between ortho- and clinopyroxenes in upper mantle lherzolite xenoliths.

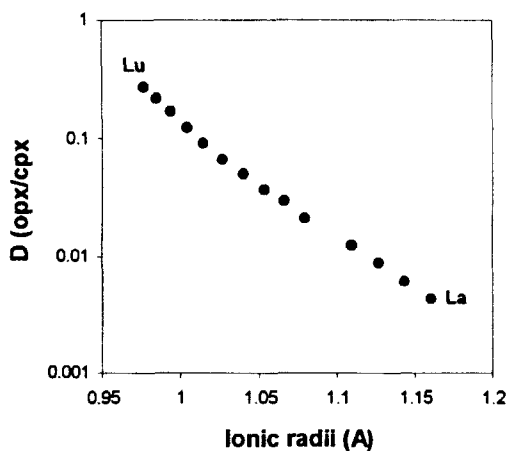


FIG. 2. Plot of REE partition coefficients between ortho- and clinopyroxenes vs ionic radii.

clino- and orthopyroxene. Similar variation between the partition coefficient and the temperature cannot be observed for the HREE.

References

Embey-Isztin, A., Scharbert, H.G., Dietrich, H. and Poultidis, H. (1989) *J. Petrol.*, **30**, 79–105.
 Jenner, G.A., Foley, S.F., Jackson, S.E., Green, T.H.,

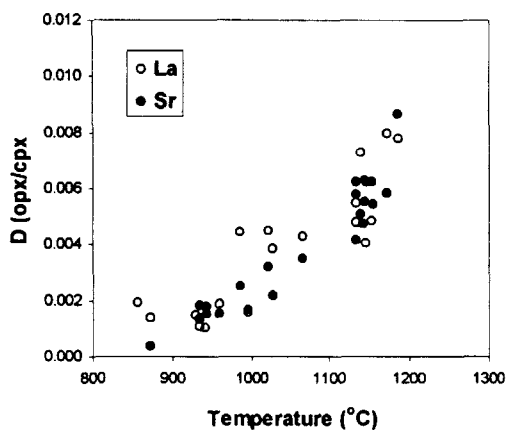


FIG. 3. Temperature dependence of La and Sr partition coefficients between ortho and clinopyroxenes.

Fryer, B.J. and Longerich, H.P. (1993) *Geochim. Cosmochim. Acta*, **58**, 5099–103.
 McDonough, W.F., Stosch, H.G. and Ware, N.G. (1992) *Contrib. Mineral. Petrol.*, **110**, 321–8.
 Rampone, E., Bottazzi, P. and Ottolini, L. (1991) *Nature*, **354**, 518–20.
 Sun, M. and Kerrich, R. (1995) *Geochim. Cosmochim. Acta*, **59**, 4863–79.