Comparison of the picrite evolution from East and West Greenland (melt inclusion data)

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The melt microinclusions in phenocrysts of high-magnesium rocks (picrites, komatiites etc.) provide evidence for primary magma composition generated during partial melting of mantle material. We have studied the temperature of homogenisation and composition of heated, homogenised microinclusions in Ol, CPX, and SP phenocrysts of picrites from East and West Greenland. During the early Tertiary, voluminous volcanic activity took place in West and East Greenland and was accompanied by rifting and separation from Canada and North Europe (Brooks, 1973; Holm *et al.*, 1993). High magnesium lavas of picritic composition make up high proportion of the West Greenland province, but are substantial in East Greenland. Quantitative modelling of homogenised melt inclusion compositions indicates the more deep seated origin of West Greenland pirites (Upper Naujanguit, Nussuaq) as compared to picrites from East Greenland (Lower Lavas, Vandfaldsdal Formation) Ion microprobe data demonstrated a more depleted composition of primary melts from the West Greenland picrites.

Results and discussion

We investigated melt inclusions in phenocrysts (olivine, spinel and clinopyroxene) from 13 picrite samples from East and 4 from West Greenland. Most microinclusions are partly crystallised. They contain glass, spinel, orthopyroxene, plagioclase, albite, titanomagnetite, amphibole, ilmenite, potassium feldspar, apatite and sometimes fluid.

The comparison of compositions of homogenised microinclusions has shown that the picrites of West Greenland were generated under much higher temperatures compared with picrites from East Greenland. The East Greenland melts are much more Ti, Ca and K-rich and have lower contents of Al and Fe. The plot of homogenised melt inclusion compositions (recalculated as primary melts being in equilibrium with mantle olivine (Fo 90) projected on dry Ol-PL-Q and OL-CPX-Q triangles demonstrates that primary East Greenland picritic melts were generated at around 18–10 kilobar or 54–30 km. West Greenland picrites formed at much higher

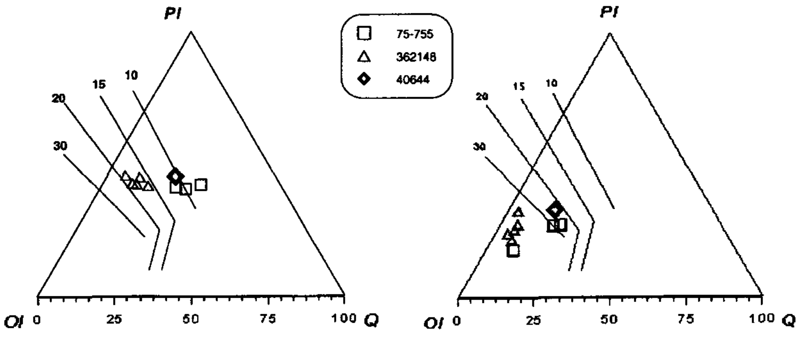

FIG. 1. Plot of homogenised microinclusion composition before (left) and after (right) recalculation as the primary melt on the diagrams Ol-Pl-Q with 2% H_2O.

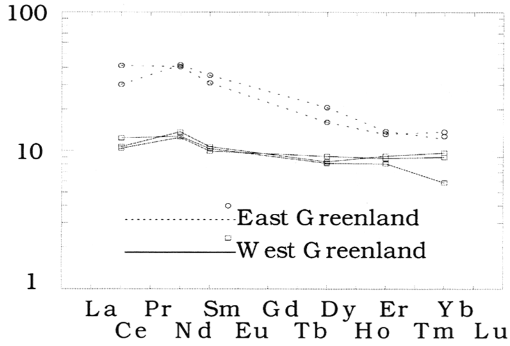

FIG. 2. Chondrite normalized patterns for homogenized melt inclusions in Ol and CPX.

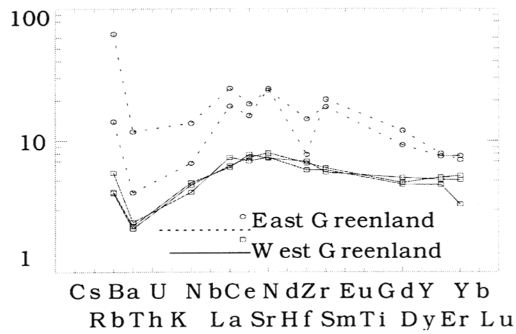

FIG. 3. Spider diagram for the homogenized melt inclusions in OL and CPX. Primary mantle normalized.

pressures more than 20–25 kb (60–75 km.)

We plot the same compositions also on projections OL-PL-Q with 2 % of water. The presence of volatile components in picrites is supported by the existence of amphibole in groundmass and the extremely evolved glasses in some late spinels. The plot on water-bearing diagrams demonstrates that the picrite generation may be shifted to even higher pressure: East Greenland picrites up to 20–30 kbar (60–90 km), (samples 75-755, 40644) West Greenland much higher than 30 kbar (more than 90 km) (sample 362148) (Fig. 1).

We have calculated the fractional crystallisation of the melt with rock composition 75-755 (East Greenland) using COMAGMAT program (Ariskin *et al.*, 1993). These calculations demonstrate that compositions similar to homogenised microinclusions have liquidus temperatures between 1220 and 1280°C which is in fairly good agreement with the measured homogenisation temperatures. These data also show that the compositions of trapped melt inclusions are controlled by the fractionation of olivine as the only solid phase down to 1151, when CPX comes onto the liquidus.

Using the ion microprobe we have managed to analyse 5 homogenised microinclusions from picrites of East and West Greenland (Figs. 2,3). It is interesting to note that the melt from East Greenland is more enriched in incompatible elements compared to West Greenland. These data are in good agreement with the geochemical data (Brooks and Nielsen, 1982) demonstrating stronger enrichment of picrites from East Greenland.

Conclusion

The comparison of picritic magmatism of West and East Greenland (ion microprobe) points to the more deep seated source of the generation of ultramafic melts in West Greenland. Geohemical data demonstrate the considerably more enriched character of primary picritic magmas in the East Greenlande province, which is possibly related to the processes of contamination of the plume with much thicker (at East Greenland) enriched Archaean lithosphere. This hypothesis is in accordance with isotope data.(Holm *et al.*, 1993).

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References

Ariskin, A.A., Frenkel, M.Y., Barmina, G.S., Nielsen, T.D.F. (1993) *Comput. Geosci.*, **19**, 1155–70.

Brooks, C.K. (1973) *Nature (Phys. Sci)*, **244**, 23–5.

Brooks, C.K. and Nielsen, T.F.D. (1982) *J. Geol. Soc., London*, **139**, 265–75.

Holm, P.M., Gill, R.C.O., Pedersen, A.K., Larsen, J.G., Hald, N., Nielsen, T.F.D., and Thirlwall, M.F. (1993) *Earth Planet. Sci. Lett.*, **115**, 227–44.