

## ANHYDROUS PARTIAL MELTING OF SPINEL LHERZOLITES FROM 3.5 TO 20 KBAR: COMPOSITION OF PARTIAL MELTS

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The partial melting behaviour of spinel peridotites has been investigated in a number of experimental studies to explain the origin of mid ocean ridge basalts (MORB). One class of experiments is concerned with the direct determination of melt compositions from partial melting of peridotite whereby Jaques and Green (1980) utilized constraints from mass balance calculations and Hirose and Kushiro (1993) and Baker and Stolper (1994) trapped the melts in the pore space of diamond powder. The second class uses the sandwich method (Stolper, 1980; Takahashi and Kushiro, 1983; Fuji and Scarfe, 1985; Falloon and Green, 1987, 1988) where quenching problems are avoided. The differences in obtained melt compositions may be related either to equilibrium problems, to differences in bulk chemical composition or to specific details of the methods used. Melt composition in sandwich experiments significantly depends on the composition and amount of the basalt added to peridotite.

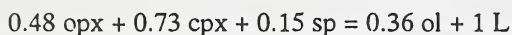
Our experimental approach combines advantages of the sandwich and direct partial melting methods by modal redistribution of spinel lherzolite minerals within a sample volume (Bulatov et al., 1991). Minerals (ol, opx, cpx, sp) from two different spinel lherzolite xenoliths from Mongolia (79/1 and ShT-1 - Seck et al., 1986) were separated, acid leached and milled to less than 20  $\mu\text{m}$  grain size. These separates were recombined and pressed into a disk consisting of clinopyroxene and spinel alone and two cylinders made from olivine, orthopyroxene and the remaining cpx and sp. The cpx-sp disc was placed into a cylindrical hole in one of the cylinders and the sandwich into a graphite capsule which was welded into a Pt-capsule. The bulk composition was that of the original lherzolite as was the cpx/sp ratio in disc and cylinders. This method allowed us to obtain large homogeneous melt pools in the central part of the sample without chemical modification of the system.

The experiments were carried out in a graphite -  $\text{CaF}_2$  furnace assembly (Bulatov 1989) in a  $\frac{1}{2}$  " piston-cylinder apparatus. The equilibrium melt compositions were determined by electron microprobe analysis with a defocused beam of quenched glass discs from the central part of the melt pool. Normally, 5 - 6 points were analysed and the 1  $\sigma$  standard deviation was 1 % (rel.) for  $\text{SiO}_2$ , 2 - 3 % for  $\text{Al}_2\text{O}_3$ ,  $\text{MgO}$ ,  $\text{FeO}$  and  $\text{CaO}$  and 0.1 % for  $\text{Na}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$  and  $\text{TiO}_2$ .

At the initial stages of melting close to the solidus we did not obtain coherent melt layers but melt pools both in the centre and the outer parts of the sample. Pools with more than 30  $\mu\text{m}$  size were analysed. When melt pools were even smaller we calculated the melt composition from the temperature dependence of  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$  and  $\text{FeO}$  according to the expression  $1/T = A + B \ln c$ . A and B are constants which were obtained from higher

temperature experiments by least square methods for each pressure and the concentration of the element under consideration. MgO contents were calculated on the basis of the FeO contents, the composition of the measured olivine and the  $K_{Do/L}^{Fe/Mg}$  after Takahashi and Kushiro (1983). CaO, Na<sub>2</sub>O, Cr<sub>2</sub>O<sub>3</sub> and TiO<sub>2</sub> were calculated from mass balance equations.

The results for the slightly depleted starting composition 79/1 are shown in Fig. 1. SiO<sub>2</sub>, MgO and FeO contents of the melts decrease with pressure and increase with temperature. Al<sub>2</sub>O<sub>3</sub>, CaO and Na<sub>2</sub>O increase with pressure and decrease with temperature at conditions above the stability of cpx. CaO contents are at a maximum where cpx disappears. The melts from the more fertile composition ShT-1 are slightly lower in Al<sub>2</sub>O<sub>3</sub> at a given P and T (higher degrees of partial melting) and higher in CaO and Na<sub>2</sub>O when cpx has disappeared. From our work we obtain a melting equation at 10 kb as follows:



The coefficients for cpx and sp are very similar to those given by Baker and Stolper (1994) and also Kinzler and Grove (1992) whereas our coefficient for opx and ol appear somewhat higher.

The mg number of primitive MORBs is always lower than that of the melts from the partial melting experiments, indicating that MORBs with 8-10 wt% MgO could not be produced by the direct melting of mantle peridotites. However, the addition of 10-20 wt% olivine to the primitive MORBs results in the compositions essentially identical to the glasses from our experiments at 13-20 kbar near the boundary of clinopyroxene disappearance from the solid residua. They contain 13-17 wt% MgO and may be considered as the initial mantle melts from which the primitive MORBs are derived by olivine fractionation.

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