

BAKER *ET AL.* REPLY — Falloon *et al.* assert that the melts generated in our near-solidus two-stage diamond-aggregate experiments<sup>1</sup> represent disequilibrium liquids. Although space limitations prevent us from describing our current experimental work, we address each of their points below.

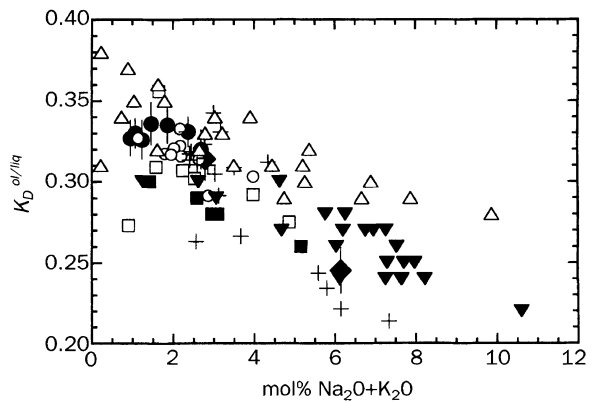
(1) At the onset of a single-stage diamond-aggregate experiment, low pore pressure in the diamond layer could affect the composition of liquid initially filling these pores<sup>2</sup>. Our two-stage diamond-aggregate experiments were designed to overcome this problem, as the first liquid mobilized in the second stage is expected to be the remobilized 1-GPa-equilibrated melt from the first stage of the experiment. The small amount of clinopyroxene (cpx) in the glass from the diamond layer and the residual cpx in the peridotite layer at 1,250 °C<sup>1</sup> have the same compositions — analyses of all oxides overlap at the 1–2 $\sigma$  level (analytical uncertainties are similar to those reported for cpx in ref. 3). This similarity in cpx compositions provides strong evidence for a close approach to equilibrium between melt in the diamond layer and residual cpx in the peridotite layer.

(2) Single- and two-stage experiments at 1,270 °C yield nearly identical melt compositions<sup>3</sup>; therefore, for two-stage runs, any quench modification at the end of the first stage is erased during the second stage. Further, mass-balance calculations show that liquids from our 1,250 °C experiments cannot be produced from more ‘typical’ melts of peridotite (for example, the 1,270 °C liquids) by crystallization of any combination of quench cpx and olivine.

(3) The initial melting of natural minerals or synthetic oxides is nearly always expected to be a disequilibrium process — the important point is whether the liquid subsequently approaches equilibrium with the residual solid phases over the course of the experiment. To our knowledge, pyroxene premelting phenomena<sup>4,5</sup> occur only within single phases and are unlikely to affect melt formation along multiphase grain boundaries. Even if such melts did form on grain boundaries, it is difficult to understand how they could persist in intimate contact with the spinel–lherzolite assemblage on the timescales of the first stages of our two-stage experiments.

Falloon *et al.* plot the results of MELTS calculations on MM3 against temperature. We have not suggested that silica-rich partial melts of peridotite form through low temperature, but rather that they form at low melt fractions when the alkali content of the melt is high, and in this regard the experiments and calculations are in excellent agreement (see Fig. 2a of our paper<sup>1</sup>).

FIG. 3 Olivine–liquid Fe\*–Mg  $K_D$  values versus the total alkali content (in mol%) of the liquid from the 1-GPa experiments in refs 1,3 (●, single-stage runs; ◆, two-stage runs). Error bars are 1 $\sigma$ , based on uncertainties in the liquid and olivine compositions. Also plotted are 0.9–1.3-GPa experimental results on natural compositions from the literature (+, refs 6, 10; □, ref. 9; ○, ref. 11; all runs were conducted in either graphite or graphite/Pt capsules). We have also plotted all the data from ref. 12 for 1-atmosphere experiments in the system MgO–FeO–K<sub>2</sub>O–SiO<sub>2</sub> (MFKS; △, CO<sub>2</sub>/H<sub>2</sub>~1; ▼, CO<sub>2</sub>/H<sub>2</sub>~10) and with natural basalt compositions (■). Many of these starting mixes were doped with wt% levels of MnO, CoO and in some cases 0.1–1.0 wt% levels of NiO and ZnO; however, comparing experiments with similar base glass compositions but variable amounts of the doped oxides shows no effect of these oxides on the olivine–liquid Fe\*–Mg  $K_D$ . A CO<sub>2</sub>/H<sub>2</sub> gas ratio of 1 is slightly more oxidizing than the iron–wüstite buffer, while a gas ratio of 10 is slightly more reducing than the wüstite–magnetite buffer.



Although they agree with our suggestion from our data<sup>1</sup> that olivine–liquid Fe\*–Mg  $K_D$  decreases with increasing liquid-alkali content (Fe\* denotes all Fe as FeO), Falloon *et al.* use data selectively to conclude that our results are anomalous. Figure 3 here shows a more complete data set on olivine–liquid Fe\*–Mg  $K_D$  versus liquid-alkali content for both simple and complex melts, and it is clear that our 1,250 °C  $K_D$  value is within the range of experimental values. Olivine–liquid  $K_D$ s calculated from 16–20-kbar experimental data<sup>6,7</sup> also show low values (<0.26) for liquids with total alkali contents of >5 mol%.

(4) As we stated in point (1) above, two-stage experiments greatly minimize the need for diffusion-controlled re-equilibration in the second stage. The presence of small amounts of cpx in the diamond layers of some of our experiments is unlikely to have affected the ‘reacting composition’, because the compositions of these pyroxenes are similar to those in the residual peridotite. Similarly, zoning in residual cpx cannot have a significant effect on partial melt compositions because core and rim compositions overlap at the 1–2 $\sigma$  level for all oxides (analytical uncertainties are similar to those reported for cpx in ref. 3).

(5) Nowhere have we claimed that our experimentally produced glasses are anhydrous. Small amounts of water are present even in nominally anhydrous peridotite<sup>8</sup>, and this water can become concentrated in melt at low melt fractions. We therefore deliberately used the expression ‘nominally anhydrous’ when describing our results (page 311 of our paper). However, although it is likely that our lowest-temperature experimental glasses contain 0.5–1.0 wt% H<sub>2</sub>O, this is insufficient to have significantly influ-

enced the trends observed in the glass compositions in the lowest-temperature experiments.

In summary, the various tests of our technique and comparisons with the MELTS calculations we have presented previously support our view that the compositional trends displayed by all our 10-kbar partial melts<sup>1,3</sup> are correct.

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