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In Situ Infiltration Experiments of Basalt- San Carlos Olivine Couple Based on the Electrical Resistance Measurements

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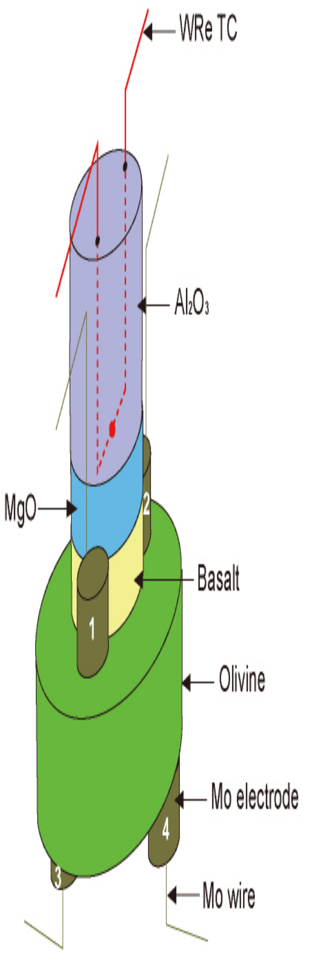

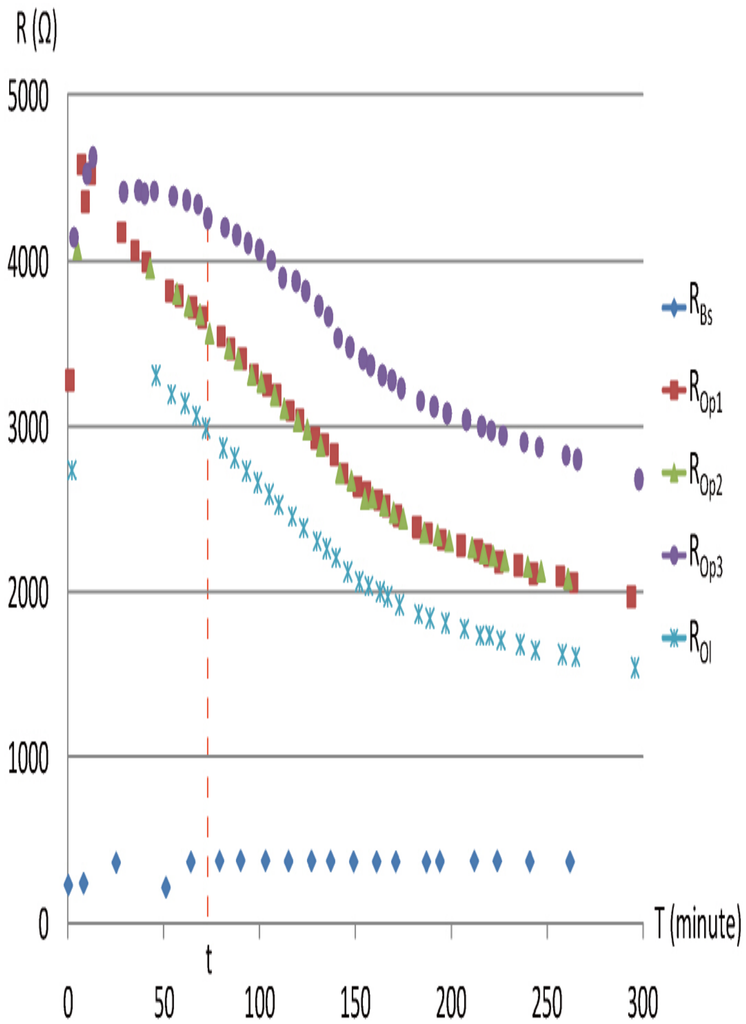

Figure 1 Schematic diagram of infiltration couple

RBs: R of basalt (R between electrode 1 and 2)

ROl: R of olivine (R between electrode 3 and 4)

ROp: R between the electrodes set opposite sites of olivine

Figure 2 Resistance signals for MORB/ Ol couple (Run 2220)

t: the time melt has penetrated from the top of olivine to the bottom of olivine

0 in the X axis: the time that basalt melts occurs at 1400℃

The melt infiltration experiments can give much information about the melt segregation and mobilization and magma evolution. All the previous infiltration experiments are based on observation of the experimental products after quench (E. B. Watson, 1992; G.N. Riley Jr., D.L. Kohlstedt and F.M. Richter, 1990; T. Hammouda and D. Laporte, 2000; M. Nakamura and E.B. Watson, 2001). We provide a new technique: in situ monitoring of infiltration couple based on the electrical resistance measurement.

Melt infiltration couples were formed by disks of MOR-basalt glass and polycrystalline San Carlos olivine. The infiltration experiments were conducted at 1673K and 1GPa, using a cubic pressure cell in a DIA-type high-pressure apparatus. Two electrodes were set between the basalt sample and the olivine sample. Another two electrodes contact with the bottom of olivine sample (Fig. 1). Six circuits were established to estimate the infiltration rate. At room P/T condition the resistance R_{Bs}, $R_{Ol}$and $R_{Op}$are relatively high and similar. When we quickly heat the couple to 1673 K, basalt starts melting and infiltrates into the olivine aggregates. The R_{Bs}will decrease sharply to around 10 0 ohm, while R_{Op}will decrease gradually and R_{Ol}relatively unchanged. When the basalt melt reaches the electrode site in olivine aggregate, the electrodes will be connected by melt resulting in the huge decrease of R_{Ol}. Based on this principle we can get accurate infiltration time and infiltration rate also. At 1673K, 1 GPa, the infiltration rate of MOR-basalt in the San Carlos olivine is about 2. 8e-7 m/s (Fig. 2), which is one order higher than Watson's study (1992).

The reduction of the surface energy is considered as the driving force of melt migration in the dry sink. All the runs have shown the chemical changes of basalt melt during the infiltration process. The infiltration front of basalt is Si-richer than the melt reservoir, and the reservoir is getting Mg-richer compared with original composition. No obvious enhancement of grain growth by melt infiltration was observed over the entire experiments. The melt fraction decreases with infiltration distance. The olivine precipitation can be observed in the top of the melt reservoir, suggesting that the infiltration progress is controlled by the solution- precipitation mechanism. The infiltration of melt in the non-porous solid surrounding materials suggests that small dikes and veins can disperse by infiltration their wall rocks. Silicate melts may be important metasomatizing fluids in the upper mantle.

Keywords: Infiltration rate, basalt melt, San Carlos olivine, mantle, electrical resistance