1.1.P02

Water partition coefficients between nominally anhydrous minerals and basaltic melts

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Partitioning of water between peridotite minerals and basaltic magma has a significant influence on the initiation of melting in the mantle and on the rheological structure of the lithosphere. To investigate mineral/melt and mineral/mineral partitioning of H_2O applicable to the mantle, we have conducted multiple saturation experiments consisting of hydrous basalt+ol±opx±cpx in a piston-cylinder apparatus at pressures of 1-2 GPa, temperatures of 1230-1300°C and bulk initial water contents of 4 to 6 wt.%. Minerals are similar in composition to those expected in spinel peridotite. We measured H_2O in melts and minerals (ol, opx, cpx) by SIMS using methods described by [1].

Resulting liquids have 3.6-10 wt.% H_2O and average mineral/melt partition coefficients as follows: $D^{ol\text{-}melt}$=0.0012±0.0003 (n=10), $D^{opx\text{-}melt}$=0.014±0.006 (n=9), and $D^{cpx\text{-}melt}$=0.018±0.008 (n=3). Mineral/mineral partition coefficients are $D^{ol\text{-}opx}$=0.10±0.03 (n=6), $D^{ol\text{-}cpx}$=0.08±0.02 (n=3) and $D^{cpx\text{-}opx}$=1.3±0.1 (n=2). Observed partition coefficients are reproducible between experiments and systematic variations with pressure, temperature or concentration of H_2O are not apparent, possibly because of the relatively small range of pressures and compositions examined. For a peridotite consisting of 58% ol, 30% opx, 10% cpx, and 2% spinel (assumed nominally anhydrous) the calculated bulk sol-liq *D* is 0.007±0.002 confirming that water is highly incompatible in mantle minerals.

Compared to conventional trace elements, water has a behavior between that of La and Ce, in accordance with studies on natural basaltic glasses (e.g. [2]). If this bulk *D* is applicable to the deeper parts of the MORB melting regime, then following [3], we can estimate the effect of H_2O on peridotite partial melting: for a water concentration of the source of 200 ppm, the near-solidus melt would contain 2.9 wt.% water. For a ΔH_{fusion} of 50 kJ/mol, the freezing point depression is ~40°C, which corresponds to initiation of melting 15 km deeper than the anhydrous solidus, somewhat less than previous estimates (~50 km, [4]).

References

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1.1.P04

Solidi of alkaline aluminosilicate system under H_2O/H_2-fluid pressure (P_{total}=2 kbar)

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The vapor-saturated solidi of $NaAlSi_3O_8$-H_2O-H_2, $NaAlSi_3O_8$-SiO_2-H_2O-H_2, and $NaAlSi_3O_8$-$KAlSi_3O_8$-SiO_2-H_2O-H_2 systems at 2 kbar over the entire range of gas phase composition from pure water to pure hydrogen were studied in the internally heated gas-media pressure vessel. In the experiments, various H_2O/H_2 compositions were controlled directly, rather than using a solid media buffers.

At addition of hydrogen to the considered H_2O-saturated systems a pronounced temperature minimum on solidus curves appears at $f(H_2)$=300-500 bars. The solidus temperatures decrease concerning H_2O-saturated systems on 22K for Ab, 30K for Ab-Qz, and 40K for haplogranute (Ab-Or-Qz) system. At the further increase of $f(H_2)$ in H_2O-H_2 fluid the solidus temperatures increase reaching the maximum at pressure of pure hydrogen.

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For an estimation of hydrogen influence on formation granite melts and comparison with published data received with use of buffer reactions in system Fe-O the MW and WI buffers which use as indicators of $f(O_2)$ in natural and experimental processes have been investigated by the same technique. Experimental researches show that in the H_2O presence at MW and WI buffers the high values of $f(H_2)$ are reached. Hydrogen reacts with wustite and iron and the mixed compounds form. The monovariant buffer reactions are transformed in the divariant fields. In the result, the stability of widely widespread in granites magnetite is considerably shifted to the reducing area.