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Experimental approach to constrain second critical end points in fluid/silicate systems: Near-solidus fluids and melts in the system albite-H_2O

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ABSTRACT

Experimental investigations in the system albite-water have been carried out to evaluate the accuracy of a new procedure to determine major-element solubilities in fluid phases and water solubilities in melts. The system albite-water had been examined previously and some consensus has been achieved with respect to phase relations, solidi, and water solubilities in the melts. Above 15 kbar the system approaches a second critical end point, where a distinction between fluid and melt no longer can be made and the term solidus has to be reconsidered.

All experimental runs were carried out at near-solidus conditions at 5–17 kbar and 625–775 °C. Experimental charges contained albite, water, and a layer of diamond crystals (grain size 50 μm). The pore space between the diamonds is preserved during the run indicating that the fluid was able to circulate throughout the entire capsule. During quenching, the material dissolved in the fluid precipitated between the diamond crystals and, as a result, could so be separated from the solid residue. The recovered capsules were directly embedded in epoxy and the diamond layers were analysed by laser ablation microprobe (LAM-ICP-MS).

The new method allows the determination of a broad range of silicate/water ratios in aqueous fluids and hydrous melts. In some experimental runs at 15 and 17 kbar, fluids with approximately 40 wt% solute could be trapped leading to the conclusion that supercritical conditions were reached.

Results furthermore indicate that albite dissolves non-stoichiometrically at 5 kbar producing a higher Na/Al and Si/Al in the solute than in the melt. Dissolution and melting at 10 kbar and higher pressures appears to be congruent within the limits of this method.