

Probing basalt–5.75H₂O–CH₄ system by *in situ* vibrational spectroscopy

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Introduction: Volatile components released from sediments in subduction zones are involved in melting, island-arc volcanism, and the chemical alteration of the mantle wedge above subducting plates. Increase of melt fraction triggered by the presence of volatile components has a major effect on seismic velocities [1-3] and should be considered in construction of geodynamic models. Experimental data on fluid and rock interaction can provide essential information for understanding of these processes and interpretation of observed seismic parameters.

Experimental: Experiments were carried out in an externally heated Mao-type diamond anvil cell [4] with modified cell assembly and increased opening angle. Doubly-polished MORB glass pieces were loaded into the sample chamber of DAC together with methane hydrate fluid source [5], pressurized, then heated in the temperature range to 1000 °C. Phase relationships were monitored during heating under the optical microscope, employing *in situ* micro-Raman and infrared spectroscopy [4,6]. During experiments temperature was measured by the thermocouple, attached to the gasket, and pressure was determined using the Raman spectrum of optical pressure sensor [4,7].

Results and Discussion: Microphotographs taken during experiments are shown on Fig. 1. During heating above 100 °C, a decomposition of solid methane hydrate into methane and water took place (Fig. 1b). Upon further heating to 700 °C, crystallization of coesite crystals in the fluid was observed (Fig. 1c). At temperatures above 800 °C clinopyroxene and garnet crystals were coexisting with homogeneous fluid phase (Fig. 1c).

Figure 1 Microphotographs of the phases observed during DAC experiments in the system basalt–5.75H₂O–CH₄: (a) starting basaltic glass with solid methane hydrate at room temperature; (b) basaltic glass with decomposed methane hydrate; (c) crystallization of coesite crystals during heating; (d) fine-grained clinopyroxene and garnet, surrounded by supercritical fluid.

Observed mineral phases are in consistency with the subsolidus association described in the dry basaltic system with the similar MORB composition [8]. Though previous studies, which employed quenching techniques, reported the presence of immiscibility gaps in the basaltic systems with C–O–H components at temperatures below 1600 °C and pressures below 6 GPa [9,10], results of this study showed stability of homogeneous silica-rich fluid phase at temperatures above 800 °C and pressures above 3.2 GPa, with separation of supercritical fluid into several components during quenching.

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