

## NATURAL AND EXPERIMENTAL CONSTRAINTS ON HIGH-PRESSURE FLUIDS

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Recent experiments have shown that in felsic compositions the complete miscibility of aqueous fluids and hydrous melts leads to a termination of the wet solidus in a second critical end point at about 25 - 30 kbar. This caused considerable confusion surrounding the nature of fluids at conditions encountered by high pressure (HP) and ultra-high pressure (UHP) rocks. We argue that mineral-saturated fluids at pressures above the upper critical point are in most cases compositionally well defined. For example, the diamond-facies quartzo-feldspatic rocks of the Kokchetav massif and Erzgebirge equilibrated at temperatures much higher than the wet solidus close to the critical end point. Hence the fluid phase in these rocks has properties of a hydrous silicate melt. In contrast, eclogite facies metamorphism often found in subducted slices of oceanic crust reaches conditions of 20 kbar and 600 - 650 °C. The peak temperature in such rocks is lower than the wet solidus and consequently a silica-rich, aqueous fluid is stable. A special case is encountered in the Dora Maira Massif, where peak metamorphic conditions of ~730 °C and ~40 kbar are situated directly above the second critical endpoint. It is expected that the fluid phase at peak conditions was transitional between a hydrous melt and an aqueous fluid. The examples show that first order estimates on the composition of the fluid phase can be made if the wet solidus and the second critical endpoint are known. Further-more, this permits to estimate the activities of H<sub>2</sub>O in such systems, which is essential for all thermodynamic modeling. As the position of the wet solidus, the critical point and the solubility isopleths are all bulk rock dependent, the activity of H<sub>2</sub>O in HP rocks will be a function of P, T and bulk.

While we can obtain a general picture about total solubility of major elements in fluids from phase relations, this is not possible for trace elements. We present a case study from eclogite facies rocks of New Caledonia (P ~19 kbar, T ~600 °C) showing that only minor amounts of trace elements were mobile during peak metamorphic conditions. On the other hand, the rocks lost most of their water indicating that there is a decoupling of dehydration and loss of trace elements during prograde subduction zone metamorphism. To further test this hypothesis we performed piston cylinder experiments in which we were able to trap such fluids in synthetic fluid inclusions or in a diamond trap layer. Both methods confirm that during eclogite facies dehydration the liberated fluids are surprisingly dilute. A low concentration (< 5 ppm) of trace elements in eclogite facies aqueous fluids in equilibrium with metapelites is also in agreement with published mineral / fluid partitioning. The combined study of phase relations, natural samples and experiments puts new constraints on the nature and composition of fluids in HP and UHP rocks which provide an important window on subduction zone processes.