

Phase equilibria in CASCH under fluid-excess to -absent conditions: reactions, mineral assemblages, and fluid compositions

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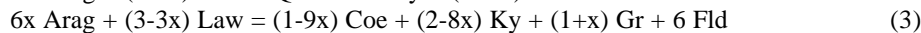
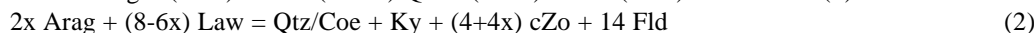
P-T diagrams in the range of P=0.05-5 GPa and T=350-1200 C were calculated in the system CaO-Al₂O₃-SiO₂-CO₂-H₂O (CASCH) with excess silica mineral to discuss the following subjects; 1) maximum stability fields of coexisting hydrous and carbonate minerals, 2) fluid composition at the boundary of these maximum stability fields, 3) the relations between the mineral assemblage and equilibrium fluid composition, 4) reactions in fluid-absent condition.

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The model system CASCH is applicable to the metamorphic marl and the sub-system of the meta-basites. The implications of the hydrous minerals in this system for material cycle in subduction zones have been emphasized; the hydrous minerals of this system act as H₂O carrier to the mantle (Pawley, 1994); clinozoisite and lawsonite also carry REE and Sr to the mantle (Nagasaki and Enami, 1998). In addition, this system is responsible for the behavior of CO₂ in subduction zones, because of the common coexistence of hydrous minerals and carbonates both in meta-pelite and in meta-basite at high to ultra-high pressure condition (Liou et al. 1995), as well as common occurrence of calcite in hydrothermally altered oceanic crust (Alt et al., 1986).

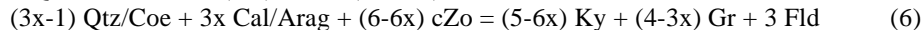
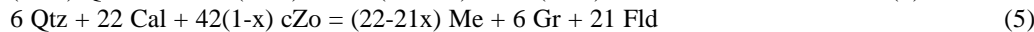
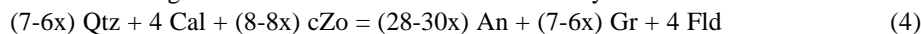
Results:

The maximum stability field of Law + SiO₂ + CaCO₃ assemblage is bounded by the following reactions (x=XCO₂ in Fld):

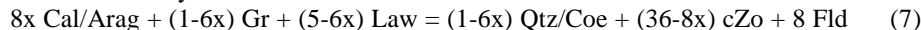


The XCO₂ value of the fluid in equilibrium with Law + SiO₂ + CaCO₃ increases in higher temperature. Those reaction curves are located at just low-T side of the boundary curves for Law+SiO₂, and yield maximum XCO₂ which is less than 0.04 in the present calculation range. Thus, the fluid must be water dominant when lawsonite occurs.

The following reactions bound the maximum stability field of the cZo + SiO₂ + CaCO₃ assemblage.



Low-T boundary with the fluid is the reaction:



The intersection of reaction (6) and (7) (invariant point; P=4.2 GPa, T=893 C, XCO₂=0.0357) yields the maximum P for clinozoisite stability with the fluid. The maximum XCO₂ of the fluid coexisting with cZo + SiO₂ + CaCO₃ is 0.813 at the invariant point (2.1 GPa, 978 C) of the intersection of (5) and (6). It is suggested that high-XCO₂ fluid can be in equilibrium with clinozoisite at high T, even in carbonate-absent assemblage.

Pressure limit for clinozoisite in fluid-absent condition is the reaction: cZo = Coe + Ky + Gr + Law (8). The significance of this reaction is that H₂O in clinozoisite is taken over, without releasing fluid, by lawsonite which is stable in higher-P condition.

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