MIS04-06 :105 :5 20 14:10-14:25

5GPa C-O-H

Melting phase relation of pelitic sediment to 5 GPa and deep subduction cycling of C-O-H volatiles

[1]*, Rajdeep Dasgupta[1], Lisa Danielson[2], Kevin Righter[2]
TSUNO, Kyusei[1]*, Rajdeep Dasgupta[1], Lisa Danielson[2], Kevin Righter[2]

[1] , [2]NASA-JSC
[1]Department of Earth Science, Rice University, [2]NASA-JSC

Recycling of C-O-H volatiles in subduction zones is important for understanding the chemical evolution of the Earth's mantle, crust, and long-term surface environments. Downgoing sediments carry an important fraction of water and carbon [1]. Although most water is released in the shallow mantle wedge, some water bound in phengite and most of the carbon bound in crystalline carbonate likely subduct past sub-arc depth (an example of this can be found in the work of Kerrick and Connolly [2]). While experimental data on the melting relations of alumina-rich pelite up to 23.5 GPa have recently been completed [3, 4], those of alumina-poor pelite investigations have been limited to 3 GPa [5, 6]. In order to further understand deep volatile recycling via sediment subduction, melting experiments on an alumina-poor carbonated pelite under water-poor conditions up to 5 GPa have been performed.

Experiments were conducted using piston cylinder (3 GPa) and multi-anvil (4-5 GPa) apparatus with an Au capsule between 800 and 1150 ^{o}C. The starting materials HPLC3 (1 wt.% H_2O and 5 wt.% CO_2 in the bulk) and HPLC4 (0.5 wt.% H_2O and 5 wt.% CO_2 in the bulk) studied here are deficient in SiO_2 compared with those used in our previous studies [5, 6], which simulates the loss of siliceous hydrous fluid in the shallow part of subduction.

We bracketed the solidus temperatures of 800-850 ^{o}C at 3 GPa and 900-950 ^{o}C at 5 GPa for HPLC3, and of 850-900 ^{o}C at 3 GPa and 900-950 ^{o}C at 5 GPa for HPLC4. Subsolidus phases include cpx, garnet, quartz/coesite, rutile, phengite, and calcite$_{ss}$ for both HPLC3 and HPLC4 at 3-5 GPa. The subsolidus phases also include water vapor and K-feldspar for HPLC3 and HPLC4, respectively; this indicates the differences of the near-solidus melting reactions between the vapor-present (HPLC3) and vapor-absent (HPLC4) conditions. The near-solidus melts at 3-4 GPa for HPLC3 and 3 GPa for HPLC4 are hydrous rhyolitic, whereas those at 5 GPa are Ca- and K- rich carbonatitic for both materials. Excess water vapor decreases the temperature in comparison to the vapor-absent solidus at 3 GPa where the hydrous silicate is stable at near-solidus temperatures. On the other hand, excess water vapor does not affect the temperature in comparison to the vapor-absent solidus at 5 GPa where the carbonate melt is present at near-solidus temperatures.

Comparison of the melting boundaries up to 5 GPa with slab surface temperatures as a function of depth [7] predicts that the extrapolated solidus temperatures of hydrous carbonated pelite might intersect the P-T trajectory of Central America (Nicaragua) where carbonated sediments similar to the composition studied here may be subducting at 180-200 km depth. The seismic low-velocity zone in the mantle wedge, located from the subducting slab at 180-200 km depth to the arc volcanoes of Nicaragua [8], might be responsible for the transport of the sedimentary carbonated melt from the deep upper mantle.

[1] Plank T, Langmuir CH (1998) *Chem Geol* 145, 325-394 [2] Kerrick DM, Connolly JAD (2001) *Nature* 411, 293?296. [3] Thomsen TB, Schmidt MW (2008) *EPSL* 267,17-31 [4] Grassi D, Schmidt MW (2011) *J Petrol* 52, 765-789 [5] Tsuno K, Dasgupta R (2011) *Contrib Mineral Petrol* 161, 743-763. [6] Tsuno K, Dasgupta R (2012) *EPSL* 319-320, 185-196. [7] Syracuse EM et al. *PEPI* 183, 73-90. [8] Nilay Dinc et al. (2011) *GJI* 186, 99-112.
Keywords: subduction zone processes, sediment melting, deep water cycle, deep carbon cycle, C-O-H volatile recycling, arc magmatism