# Continental subduction, “*Intraslab UHP Metasomatism*”, and the formation of metamorphic diamond

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Deep continental subduction is the process carrying supracrustal materials into deep mantle, and UHP metamorphic rocks are the direct evidence for this process as the materials having the information of P-T and the chemical environments during subduction, escaped from the homogenization with mantle rocks. Usually, UHPM silicate rocks have been strongly retrograded during exhumation, and the preservation of UHPM information is limited excepting inclusions in refractory minerals; decoding the chemical processes in subducted materials is difficult. In carbonate and calc-silicate rocks, UHPM information has been well preserved and can be decoded even in the matrix because the chemical reactions in these rocks make distinct changes from the protolith chemistries, not erased during exhumation.

Carbonate-bearing assemblages have large P-T stabilities at HP/UHP and low $H_2O$ activity, and this indicates high possibility of survival of carbonates and transportation of carbon into deep mantle. $H_2O$-fluid supply is necessary for metamorphic reactions in these rocks because $H_2O$-fluid lowers temperatures of decarbonations. As a model showing the processes in deeply subducting continental materials, *Intraslab UHP Metasomatism* (metasomatism within subducting continental materials at UHP mantle depths) will be introduced on the basis of our last 20 years research on the Kokchetav UHPM rocks. In this model, key materials are $H_2O$ and $CO_2$ in the subducting continental slab, and a key process is $H_2O$-fluid infiltration within the slab. The outline of this model is as follows. 1) In the subducting slab, silicate rocks (gneisses and eclogite) were a $H_2O$ reservoir, and carbonate and calc-silicate rocks were a $CO_2$ reservoir. 2) During subduction, $H_2O$-fluid with several components (e.g. C, K, Ti) occurred by dehydrations of silicate rocks. 3) Dehydrations in silicate rocks preceded decarbonation reactions in carbonate and calc-silicate rocks. 4) Infiltration of $H_2O$-fluid into carbonate and calc-silicate rocks was a trigger for decarbonations. 5) $H_2O$-fluid infiltration was controlled by the timing of dehydrations in silicate rocks and vaired in mm to cm scales to form or to characterize the mineral assemblages in carbonate and calc-silicate rocks. 6) $H_2O$-fluid (with C-bearing species) contributed to the formation of diamond in some carbonate calc-silicate rocks. 7) Modal compositions of carbonates in the protoliths controlled the survival of carbonate depending on the intensity of fluid infiltration.

The following subjects from the Kokchetav UHPM rocks support this model. A) Dolomite marble contains abundant diamond formed at two stages; 2$^{nd}$ stage diamond ($\delta^{13}C$: -17 to -27 ‰) from $H_2O$-fluid. Dol + Di is not the highest-T assemblage and was controlled by fluid composition, $XCO_2$ as 0.1, which was suitable for diamond formation. B) Dolomitic marble has the highest-T assemblages, Arg-Fo, Arg-Ti-Chum, but diamond was unstable because of low $XCO_2$ as 0.01. C) Calcite (after Arg) marble with Coe exsolution in Ttn contains diamond only in Di layer, and other parts do not; this indicates short-term stability of diamond in this rock depending on changing $XCO_2$. The later fluid was low $XCO_2$ as 0.02; too low for diamond formation. D) Two types of Grt-Cpx rocks occur; diamond-bearing and diamond-free. Their protoliths are a mixture of silicates and carbonates. Minor diamond occurs as two modes in diamond-bearing Grt-Cpx rock; one is fine-grained (several $\mu$m) and the other is cubic (max. 200 $\mu$m). A cubic diamond has fine core and crystallized slowly from $H_2O$-fluid on a fine grain as a seed crystal. E) In gneisses, diamond occurrence is diverse; several morphologies with different colors were observed. Two-stage growth was not confirmed. Dissolution of carbon from diamond in gneisses could be possible, and carbon was carried into dolomite marble by $H_2O$-fluid to crystallize 2nd stage diamond.

Many of the subjects being still unclear will be mentioned as the targets of future research.

Keywords: intraslab UHP metasomatism, UHP metamorphism, diamond, carbonate, fluid, Kokchetav Massif

 