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Subducted materials through the Earth's history

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The Earth's subduction zone has changed its role for the material cycle through the Earth history. Input material is dependant on igneous process near surface and hydrothermal activity in the ocean floor. Temperature of the subduction zone controls devolatilization in the subducted material and wedge mantle magmatism; higher-T subduction releases volatile components in shallower depth, while lower-T subduction carries the volatile components to deeper mantle. Here, we present a summary of the history of subducted materials and metamorphism they suffered. In the Archean era, subducted slabs were Fe-rich basalt which was 20km thick and hydrothermal carbonates in it. Carbonate was decomposed in the upper-mantle depth and wedge mantle would be carbonated. In this area, it is suggested that size of the plate was much smaller than the present and that many TTG arcs are formed. These arcs probably collided each other and considerable amount of them should have subducted into the mantle. In the Proterozoic, thickness of the oceanic crust became thinner and harzburgitic oceanic lithosphare begun to be subducted. The hydrothermal product in the oceanic crust changed to carbonate poor composition. Extensive decarbonation in the upper mantle and CO_2 release to the surface are suggested in this era. In particular, significant CO_2 release from the tectosphere had been recorded in ultrahigh-T metamorphic terrane. Moreover, the subduction zone was going to become a conduit for water drainage into the mantle in the Neoproterozoic (1-0.5 Ga). Such water must have played the role of trigger to release the Precambrian CO_2 in the upper-mantle, also. In the Phanerozoic, size of continent became comparable to the present; therefore amount of subducted continental material should have been small. Stability of the hydrous minerals extended to the mantle transition zone. In the present earth, stagnation of the slab is observed in most subduction zones, and most water is considered to be released in the mantle transition zone, therefore activity of the upper-mantle has been kept to be high. In the future, when the mantle transition zone become cool enough, upper mantle dynamics would be significantly reduced. However, the dehydration in the lower-most mantle will activate lower-mantle dynamics so that plumes or superplumes will continue in the future Earth.