

U004-04

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Earthquakes, volcanoes, crustal deformations and geofluid

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Recent investigations have revealed that slab-origin aqueous fluids play an extremely important role in generation of earthquakes and magmas and deformation of the arc crust in subduction zones.

Generation mechanism of intraslab earthquakes, especially those in the slab crust, is considered to be the dehydration embrittlement: i.e., rise in temperature and pressure accompanying subduction causes dehydration decomposition of hydrated minerals and generates H₂O, which increases pore fluid pressure, so reduces the effective normal stress and enables brittle fracture within the slab. H₂O thus released goes up and reach the plate boundary, some of which ascends along it. Pore fluid pressure by H₂O prescribes the behavior of asperities and surrounding stable sliding areas. Thus, H₂O plays an important role in the generation of interplate earthquakes too. H₂O expelled from the slab also goes up to the arc crust and the mantle wedge. At shallow depths cold enough to generate interplate earthquakes, it contributes to the serpentinization of mantle wedge which suppresss the occurrence of interplate earthquakes. At deeper depths, the slab-origin water forms a serpentinized mantle layer just above the slab, which is dragged downward associated with the slab subduction. H₂O finally encounters the upwelling flow of the mechanically induced convection in the mantle wedge, and addition of H₂O generates arc magams. This upwelling flow reaches the Moho of the arc crust, forming the volcanic front. Thus H₂O released from the slab is transported to the arc crust, but it is limited to some places such as the volcanic front. H₂O of slab origin weakens the surrounding crustal materials, and is inferred to be responsible for large anelastic local deformation of the lower crust. Local deformation in the lower crust concentrates stress in the upper crust right above, and causes shallow inland earthquakes there. Recent observations show that pore fluid pressure by this water plays an important role also in generation of shallow inland earthquakes.

Keywords: Earthquake, Crustal fluids, magma, crustal deformation