Cogenetic distributions of deep fluids and earthquakes in Japan arc: Implications for slab fluid processes

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Very saline, CO2-bearing and 18O-shifted springs are found in Japan. Those springs naturally occur at various places along active faults, tectonic lines and close to volcanoes. Here, we show the spatial distribu-tion of these deep fluids and discuss crustal fluid pro-cesses by showing the areal relationships between chemistry and hypocenters of earthquakes (deep low frequency (DLF) and shallow micro-earthquakes).

The waters of Cl concentration higher than 200 mg/l are selected to classify into three origin groups: seawater, fossil seawater, and deep fluid (including magmatic fluid) using Li/Cl ratios, water chemistry and hydrogen and oxygen isotope ratio. Deep fluid is defined here as originated neither from meteoric water nor from fossil seawater in isotopic composition and with the feature showing high Li/Cl ratio (>0.001 in wt. ratio), which is an indicator of a deep hydrothermal origin.

The DLF earthquakes are well determined for hy-pocenter having feature of very deep (20-40km depth) and thought to be related with hydrothermal fluids. Characteristic feature of spatial distribution of the DLF earthquakes are as follows; type-1) found along 1000 km of the SW Japan arc on the upper part of subducted Philippine Sea Plate, type-2) occurs close to Quater-nary volcanoes, and type-3) occurs as non-volcanic clusters.

The deep fluids found along the Median tectonic line (MTL) through Shikoku-Kinki-Tokai district (close to type-1) have a mixing end-member with iso-topic composition of water similar to magmatic water, highly saline and free CO2 gas. These fluids are likely originated from dehydrated water from the Philippine Sea slab since there are no mantle above the slab be-neath the MTL. The deep fluids close to type-2 DLF events are neutral to a little acidic in pH, and never have low pH like the volcanic fluids degassed from shallow magmas. Amounts of the free CO2 with salts would never come from shallow degassing magmas but likely from fluids released when basalts are solidi-fied at the lower crust. The type-3 DLF earthquake clusters are found at non-volcanic areas especially in Chugoku-Kinki at forearc area and Tohoku-Hokkaido regions at rear-arc area. The deep fluids related to type-3) in forearc area may be directly come from slab, and those in rear-arc area are possibly related to solid-ifying basaltic magmas at the lower crust like the type-2.

Spatial distribution of the deep fluids is found to relate to that of the shallow micro earthquakes. This evidence suggests that either earthquake makes a fault as fluid path for the deep fluids ascent or the deep fluid itself makes a fault to occur earthquakes. Recent studies on sceismic tomography reveal that fluids are inhomogeneously existed in the crust and our distribu-tion of the deep fluid is consistent with those geophys-ical observations. Therefore, the crustal deep fluids are NaCl-CO2-type water originated directly from the slab or released from a solidified magma at lower crust.

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