

Upwelling of volatiles from the mantle and the subsiding slab through faults and tectonic lines at Kinki district, Japan.

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Island-arc magmatic water have inherent stable isotope ratios (D/H=-30 to -10‰, $^{18}\text{O}/^{16}\text{O}$ =+5 to +10‰) which might be due to that those waters originated from the water dehydrated from the subducted slab (Giggenbach 1993). Arima-type thermal water discharges mainly through active faults and found in the area over 3000km² in Kinki district, Japan. The characteristics of the chemical and isotopic compositions are quite similar to that of the magmatic water, that is, D/H=-35‰, $^{18}\text{O}/^{16}\text{O}$ =+6‰, Cl conc.=40000ppm, $^3\text{He}/^4\text{He}$ = 10^{-5} , $^{13}\text{C}/^{12}\text{C}$ =-5‰. Temperature of the water is boiling point at the surface. Since Arima-type thermal water concentrates Cl which is twice greater than that of seawater, and has less contribution of meteoric water. The driving force of self-spouting can not be due to potential water height from the recharge area at high elevations but due to geostatic pressure at a very deep place.

The volcanic activity around the area that discharged Arima-type lacked for long geological period, in harmonious with that this area placed at forearc position 100km far from the volcanic front. Arima-type water might not be originated from arc magmas, however, relation to the water in subducted slab is strongly inferred. The Philippine Sea plate is subducting at Kinki district which has the character of; 1) slow rate subduction (3cm/y), 2) slab is relatively young, hot and thin, 3) slab depth is 40-80km at the area of Arima-type discharge, 4) the related arc volcanism is less active than that of other volcanic front in Japan, and 5) high heat flow rate in the wide forearc region of Kinki-Chugoku-Shikoku district (50000km²).

The hypothesis that Arima-type thermal water directly comes from dehydrated water at the deep slab, is supported by the work of Ito et al. (1983), who evaluated the water circulation budget in the solid earth, indicating amounts of missing water must have been existed. Those missing water is likely to be explained by water dehydrated from the hydroxyl-bearing minerals in the subducting slab at forearc position.

We performed a hydrological study to evaluate the Arima-type thermal water flux to the surface using isotopic and chemical monitoring of rivers where those thermal waters flow into. The results indicate that sum of Arima-type flux from big three springs (Arima, Ishibotoke, Gosha and Kobe) is 4 liters/sec. This flow rate agrees very well with that of missing water at Kinki district calculated as 4-35 liters/sec using Ito's global-earth estimate.