Confined thermal water in sedimentary basin as a probe for investigation of fore-arc crustal fluid

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In Japan, confined thermal waters stored in sedimentary basins, which are taken from the wells drilled up to one kilometer deep, are used for bathing, and sometimes coexisting methane gases (CH_4) are also taken as natural resources for fuel. From vertical temperature profiles in the wells, hydraulic head distributions, tritium concentrations of the well waters, this type of thermal water has been recognized as heated stratum pore water by normal terrestrial heat flow, and classified as non-volcanic thermal water. Especially, thermal waters of this type originating in fore-arc regions have seemed not to have their origin in volcanism.

About the middle of 1990's, I started a hydrogeochemical study of confined thermal waters taken from wells drilled from 200m to 800m deep in the Oita plain located in the fore-arc region of Kyushu district. From data analysis of chloride and boron concentrations (B/Cl ratio), it was not an obstacle for these thermal waters to be connate (Ohsawa, 1996), however it was clearly shown that the thermal waters classified into Na-Cl, HCO_3 type involve deep-originated CO_2 from carbon and helium isotope data (Ohsawa et al., 2000; Ohsawa, 2001). At the same time, it came to be recognized that dehydrated water from the subducting Philippine Sea plate has to do with formation of high temperature thermal waters in the fore-arc region of Kinki district (Nishimura, 2000). Chemical type of these thermal waters is almost the same as that of the Oita confined thermal waters involving deep-originated CO_2. This chemical agreement strongly implies that deep-seated crustal fluid originated from the dehydrated water from the subducting Philippine Sea plate affects the formation of the confined thermal waters in the Oita plain as well as the high temperature thermal waters in the fore-arc region of Kinki district.

Almost the same inferences as those as mentioned above were presented from viewpoints of dehydrations of subducting slab and/or subducted oceanic sediments (Kazahaya, 1997; Fujimoto, 1995). Based on chemical compositions of fluid inclusions in high pressure metamorphic rocks, it is thought that dehydrated water formed during metamorphism of the subducted oceanic sediments might mainly involve CO_2, CH_4 and NaCl (Fujimoto, 1995). This view is very interesting for hydrothermal geochemists because chemical type of the thermal waters in the fore-arc regions of Kinki and Kyushu districts (Na-Cl, HCO_3) is almost equal to that of such metamorphic fluid. Further examinations by metamorphic petrologists and/or hydrogeologists are needed to solve the formation mechanism of deep-seated fore-arc crustal fluid: e.g. detail of decomposition reaction of carbonate ($CaCO_3$) accompanied with dehydration in the subducted oceanic sediments, migration process of the dehydrated water from the subducting plate to the crust.

On the other hand, since confined thermal waters of Na-Cl, HCO_3 type in sedimentary basins are regarded as probes for investigation of deep-seated crustal fluid as mentioned above, we hydrothermal geochemists have a plan to detect several signals of upflow of the deep-seated crustal fluid from chemical and isotopic analyses of saline water samples collected from deep wells in fore-arc regions. From last year, we stated sampling of saline confined thermal waters in the Oita and Miyazaki plains, so I will present results of this research obtained by the time of this presentation.