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Li isotope map of geofluid in SW Japan: Is deep-crustal fluid in fore-arc region derived from slab?

Yoshiro Nishio[1*], Kohei Kazahaya[2], Yoichi Oyama[2]

[1]Kochi Institute, JAMSTEC, [2]Geological Survey of Japan, AIST

It has been proposed that the island arc deep-crustal fluid has played important role in volcanic and seismic activities, although many things, including the relationships between the island arc deep-crustal fluid and slab-derived fluid, have been still unresolved. It has been difficult to identify the nature of deep-crustal fluid based on the geochemical researches using underground water recovered from spring and well, because the deep-crustal fluid is very diluted by surface water during ascending. Lithium (Li), the lightest alkali metal, is a fluid-mobile element having two stable isotopes, $^{7}Li/^{6}Li$, with abundances of 92.5% and 7.5%, respectively. Amount of Li leached from rock to fluid drastically increases with the temperature, and once leached Li is kept in fluid while decreasing temperature (cooling). These features indicate that non-traditional Li isotopic tracer has a great potential to provide new insight on the origin of nature of island arc deep-crustal fluid.

It has been expected that Li isotopic compositions of underground water samples whose Li/Cl ratios are significantly high were not affected by surface water (Nishio et al., 2010). Therefore, to reveal Li isotopic distribution of deep-crustal fluids, we have analyzed Li isotopic compositions of underground water samples whose Li/Cl ratios are significantly high. In this study, the analyzed samples have been recovered from SW Japan (excluding Kyushu area).

The results show that $^{7}Li/^{6}Li$ of near-trench samples are significantly higher than those of other samples. This result means that Li in deep-crustal fluids beneath forearc region in SW Japan are derived from subducted Philippine Sea slab. The results, furthermore, reveal that relatively $^{7}Li/^{6}Li$ ratios are observed in underground water samples from the western Kii Peninsula where is located in forearc region. Thus, Li isotopic results have presented us new knowledge for island-arc deep-crustal fluid.

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Reference:
Nishio et al., 2010, EPSL 297, 567-576.

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