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Detection of deep fluid using lithium isotope of waters along the Atotsugawa fault system, central Japan

OOHASHI, Kiyokazu[1*], NISHIO, Yoshiro[2], TANIKAWA, Wataru[3], YAMAGUCHI, Asuka[4]

[1]Graduate School of Science, Chiba University, [2]Agency for Marine-Earth Science and Technology, [3]Japan Agency for Marine-Earth Science and Technology, Kochi Instutute for Core Sample Research, [4]Department of Earth and Planetary Science, The University of Tokyo

The Atotsugawa fault system, central Japan is one of the active faults located in the Niigata-Kobe tectonic zone (strain-concentration zone) which detected dense GPS observation network (Sagiya et al., 2000). Along this fault system, active microearthquakes and possible fault creep has been detected from seismic observations and EDM/GPS survey, respectively (Tada, 1998; Ohzono et al., 2011). However, mechanism for strain concentration along this zone is still open question. Iio et al. (2002) speculated that the dehydrated fluid (water) from the Philippine Sea plate and the Pacific plate may weaken the lower crust beneath the Niigata-Kobe tectonic zone. Recent geophysical observations revealed existence of low resistivity and low velocity bodies beneath the zone (Yoshimura et al., 2009; Nakajima et al., 2010) which is consistent with Iio et al. (2002). Nevertheless, there is no direct evidence to represent existence of water (H_2O), and details about fluids such as origin are still unknown. On the other hand, geochemical signal of ground water can be a reliable evidence for detection of deep fluids if they come up to the shallow portion of the crust. Lithium (Li) is a fluid-mobile element having two stable isotopes, $^{7}Li/^{6}Li$. 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 Li has a great potential for tracer of deep fluid provide information on the origin and nature of fluid circulation. We thus collected water along the fault system (especially for the water leaking from fault zone), river water and spring water nearby the fault system, and analyzed their chemistry and isotope.

The results show that the several water samples collected from the fault zone have high concentration of Li and significantly lower value of $^{7}Li/^{6}Li$ whereas the river water and spring water shows low Li concentration and high $^{7}Li/^{6}Li$ value. These results suggest that the deep-crustal fluid which has peculiar chemical properties exists beneath the Atotsugawa fault system, and upwelling to the ground along the fault zones.

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