Anomaly of crustal noble gases associated with fault movement and aftershock the 3.11 Northeast Japan Mega Earthquake

KEIKO SATO*[1,4], HIDENORI KUMAGAI[1], TAKEHIRO HIROSE[2], NAOYOSHI IWATA[3], HIRONOBU HYODO[4], KATSUHIKO SUZUKI[1]

[1] R&D CSR, JAMSTEC (*correspondance: keisato@jamstec.go.jp); [2] KCC, JAMSTEC
[3] Faculty of Sci., Yamagata University
[4] RINS, Okayama University of Science

Noble gases have unique characteristics. They are rarely combined with other chemicals because of their very stable nature. Their main reservoir is atmosphere, whose isotopic composition is well defined and believed to be globally uniform, being insensitive to disturbance from anthropogenic and/or natural emission of geologically trapped noble gases in the earth interior. Based on our preliminary friction experiment, however, detectable amount of noble gases seem to be emitted accompanied with a fault motion (Sato *et al*., 2009). After the extremely large Northeast Japan Earthquake on March 11, 2011, extraordinary increase of seismic activity as numerous aftershocks, e.g. over 4000 felt earthquakes in four months, may generate non-atmospheric component preserved in the earth interior.

We collected atmosphere samples all over Japan from Hokkaido, to Kyusyu Is. The atmospheres have been sampled into vacuumed containers, Isotube®, at each sampling site to evaluate time-series changes. The elemental and isotopic compositions of the samples were analyzed mainly by quadrupole residual gas analyzers (RGA-200, SRS Co.) and are partly measured by sector-type mass spectrometers (GVI-5400He, GV instruments) for confirmation. In the duplicated analyses of the selected samples, the measured elemental and isotopic compositions were consistent within analytical uncertainties.

The relative elemental abundances were changed at least in the heavy noble gases. Argon was enriched in post-3.11 Earthquake atmospheres associating with a high $^{40}Ar/^{36}Ar$ ratio, which is consistent with our experiment. According to Kanamori *et al*. (1998), a frictional melting was occurred in a *>M5* earthquake. It is consited with Sato et al. (2009) reported significant degassinghus, thus the observed variation is possibly contributed by emission of crustal Ar at aftershock earthquakes, deformation and fault movements. These altered atmospheric Argon isotopic composition in Eastern Japan were observed until the typhoon season.