H2 and CO2 soil survey along active faults in central and western Japan

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Geochemical studies related to seismology have revealed that H2 concentrations in soil gases were higher along the fracture zones of active faults (Wakita et al., 1980; Sugisaki et al, 1983). These findings were explained in terms of a hypothesis that mechano-chemical reaction between fractured rock surfaces and groundwater triggered by fault movement produces H2. In addition, various volatile species as well as H2 were assumed to be released through active faults. However, after these investigations, no continuous monitoring of volatile species along active faults has been carried out. The purpose of this study is to confirm that a significant amount of volatile species is still observed in these faults before installing a continuous monitoring system for determining their concentration and efflux.

We performed soil gas analysis in fracture zones of Yamazaki, Atera, Neodani faults where a high H2 concentration had previously been reported. The soil gas survey was also performed along Nojima fault, which moved significantly at the time of the 1995 Hyogo-ken Nanbu earthquake. Soil gas samples were collected at 30 cm depth using a commercial metallic probe followed by determinations of H2, CO2, CH4, N2, O2, He, using a gas chromatography. The carbon isotopic composition of soil CO2 was also determined. CO2 effluxes were measured along Atera fault to compare soil gas data.

H2 concentration in soil gas ranged from 3-5 ppm in Yamazaki, 8-32 ppm in Atera, 0.5-8ppm in Neodani, to 2-63 ppm in Nojima fault zones. CO2 concentrations were observed to vary up to a few percent in these fault zones. delta13C of CO2 was less than -20 per mil in all samples, implying an organic origin for the CO2. A relatively higher CO2 efflux was observed in its fracture zones than that in its surroundings along Atera fault.

Our H2 concentrations are significantly lower than the published values for the same faults. Previous work has shown that soil H2 was widely variable both spatially and temporally at several points even along the active fault with high H2. We could not collect soil gas samples at exactly the same point in the same season as the published ones sampled more than 20 years ago. In addition, different sampling techniques between the one used here and the previous ones may have caused a lower soil H2 contents. We therefore have to check the various problems mentioned above before commencing continuous monitoring of H2 and CO2 concentrations and the flux of soil gases along active faults in order to elucidate the behavior of volatile species related to fault activity and perhaps earthquakes.