Residual gas composition of fault rocks along the ancient subduction zone megaspray fault: An example from the Nobeoka thrust fault in the Kyushu Shimanto Belt

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Gases and fluids in the deep crust are thought to circulate through faults as their main flow channel in addition to diffusion in rock matrix (e.g., McCaig, 1997). It is also known that some types of gas are formed by the fault rupture and slip itself (e.g., Wakita et al., 1980). Therefore, clarification of the gas composition in the vicinity of the fault will be important not only for understanding the characteristics of fluid and gas movement on the fault, but also for understanding the rupture and sliding processes of the fault. In this study, we investigated the gas composition of the Nobeoka fault in the Kyushu Shimanto Belt, which is considered to be a mega-branching fault in the ancient plate subduction zone.
Core samples obtained by a drilling survey through the Nobeoka fault in 2012 (NOBELL; Hamahashi et al., 2013) were used for the experiment. The drilling core samples include the main slip zone of the thrust, ~40 m of the fracture zone on the hanging wall side (the Eocene Kitagawa Group), and ~200 m of the fracture zone on the footwall side (the Eocene to early Oligocene Hyuga Group). Residual gases from the rock chips were recovered by crushing and extraction using a ball mill (Saito et al., 2012; Suzuki et al., 2017), and the gas composition was measured using a gas chromatograph (7890A: Agilent) equipped with a pulsed discharge helium ionization detector.
Analysis showed that H_2, CO_2, and alkanes such as CH_4, C_2H_6, and C_3H_8 were detected at all depths. Among these, CO_2 variations showed a good correspondence with the internal structure of the fault zone. The compositions of H_2 and CH_4 are somewhat different between the hanging wall and footwall at the main slip zone of the fault, and this trend may reflect the difference in metamorphic to diagenetic grades, considering the results of previous studies on similar rock samples (Suzuki et al., 2017). On the other hand, H_2 concentration normalized by the total organic carbon content is generally higher than the value obtained from the analysis by Suzuki et al. (2017), suggesting the possibility of traces of hydrogen production on the fault. In this presentation, we will discuss these gas compositions and their origins, with particular attention to their relationship to faulting.

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