

Activity of mud volcano and stable isotope ratio

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Groundwater is erupted from mud volcano (MV) caused by abnormal water pressure generated in deep underground. Stable isotope ratio of the groundwater was measured in Niigata Prefecture and southwest Taiwan to investigate the origin of abnormal water pressure formation and the rising process of groundwater from deep underground to the ground surface.

Erupted groundwater in Niigata MV is highly saline and older than about 50 years at least by Tritium analysis. Delta ^{18}O and delta D of the groundwater is corresponded to that of the pore water sampled from the Nanatani Formation that is distributed about 3500 m deep in the area (Kato and Kajiwara, 1986). The temperature of the depth is high enough for dehydration of clay mineral during illite-smectite transition. Vitrinite reflectance of the erupted coal samples supports the idea mentioned above (Shinya, 2005MS). Consequently, it is assumed that the abnormal water pressure is caused by the dehydration of clay mineral in Niigata. Delta ^{18}O and delta D of groundwater of the groundwater squeezed from boring cores 120 m long near the mud volcanoes was investigated. Delta ^{18}O and delta D obtained from cores shallower than 50 m in depth is corresponded to the meteoric water and those deeper than 50 m increase with depth (Ishihara, 2008MS). As a result, it is thought that the saline groundwater rises by abnormal water pressure to the depth of 600m and formed the mud chamber by degassing (Tokuyasu, 2006). Then, highly pressurized groundwater caused by degassing and abnormal water pressure rises to the depth of 50 m accompanying the hydrofracturing. Finally, mud volcano is erupted through the fracture formed at the wing of the pushed up block.

Delta ^{18}O and delta D of groundwater erupted in two areas in Taiwan where are characterized by the fault zone and the anticline respectively are investigated (Hamada, 2007MS). Relationship between delta ^{18}O and Cl^- shows that the groundwater from MV is plotted on the dilution line between sea water and gas hydrate. Dilution line obtained in two areas is characterized by the same slope and different Cl^- intercept, suggesting that groundwater is originated in deep underground by the mixing of sea water and hydrate and groundwater erupted in the fault zones is affected by water-rock interaction more than that in the anticline area (Yang, 2006).

Stable isotope ratio of groundwater erupted at the MV is thought to be a key factor to understand the origin and rising process of abnormal water pressure.

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