# Influence of geopressured hydrothermal system to geological phenomena on the Earth surface

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Abnormal fluid pressure strata at the depth of more than 1000 meters have been recognized in the Niigata oil and gas fields according to published data of drill-hole logs for petroleum exploitation. The hydraulic pressure gradients in the strata are much higher than the hydrostatic pressure gradient (10.5 kPa/m) and approach the lithostatic pressure gradient (22.6 kPa/m) with increasing depth. Geothermal waters from the Niigata oil and gas fields, e.g. the Matsunoyama geothermal waters show geyser action associated with methane gas and are typically very high in salinity with considerable amount of chloride. These waters are geochemically similar to oil brines and originally altered fossil seawaters trapped in the organic-matter-bearing sedimentary rocks based on the characteristics of hydrogen and oxygen isotope composition and hydrochemistry. Above characteristics are also extremely similar to the geopressured hydrothermal system in the Gulf of Mexico, USA. The Murono mud volcano is located in the neighborhood of the Matsunoyama area and associated with saline water and methane gas. The Shibatoge geothermal water near the mud volcano was developed at the drilling depth of 1200 meters. The geochemical characteristics of the Shibatoge geothermal water is slightly different from the Matsunoyama geothermal waters. The saline groundwater from the mud volcano is also formed by mixing the deep Na-Cl type geothermal waters into the meteoric ground waters. The hydrogen and oxygen isotope values and boron/chloride ratio suggest that the groundwater is similar to the Shibatoge geothermal water rather than the Matsunoyama geothermal water. The Na-Cl type geothermal waters and spring water from the Murono mud volcano have been influenced by the geopressured hydrothermal system in the Niigata oil and gas fields. On the other hand, Na-Cl type ground waters have limitedly appeared in active landslides or large-scale landslides in the Niigata oil and gas fields and are formed by mixing the deep Na-Cl type geothermal waters into the meteoric shallow ground waters. It is most likely that the geothermal waters inject into shallow aquifers in landslide mass, and then generate partially high pore-water pressure and are closely related to occurrence of landslides. Here we take up an example of the large-scale Kamazuka-dangosashi landslide with a length of 2000 m, a width of 2000 m and a maximum depth of 140m. Most of groundwaters from the drainage tunnel in the landslide are saline waters which contain approximately 8000 - 16000mg/kg of chloride ion and range from approximately -1.77 to -0.55 permil of Oxygen isotope value. It is impossible that the relationship between chloride concentration and oxygen isotope value can be explained by the mixture of saline water and meteoric water. It is high probability that chloride concentration is reduced by the membrane filtration. Under the high fluid pressure condition, saline waters are filtered through low-permeable mudstone with keeping constant oxygen isotope value. We also visualized profiles of electrical resistivity up to 1000 m depth in the landslide by the CSMT (Controlled-Source Magneto-Telluric) survey. This survey revealed that the super low resistivity zone was emerged wide spreading between -300m and -50m depth from the ground level. It is interpreted that the zones contain high concentration of electrolyte solution such as the fossil seawaters. It suggests that the groundwater behavior is controlled by the continuous injection of the geopressured saline waters. The geopressured hydrothermal system, anomalous high-pressure fluid might play important role to solve the causes of large-scale landslides, mud diapirs and swarm earthquakes in the Niigata oil and gas fields.

 

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