New implications for the cause and mechanism of a high-temperature mud volcano, Goshogake, via mineralogy and geology

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Most terrestrial mud volcanoes (MVs) have low-temperature fluid from the ambient to 50 ˚C and are considered to erupt mud from a few to 10 km depth due to the compression related to tectonic activity, rapid sedimentation, and/or dehydration of clay minerals. On the other hand, the mechanism of high-temperature MVs which have the fluid temperature above 80 ˚C has been still unknown. We defined the former with low-temperature fluid and the latter with high-temperature fluid as low-temperature MVs and high-temperature MVs, respectively. Then, to better understand the cause and mechanism of high-temperature MVs, we explored the Goshogake MV field which is also a high-temperature MV system in Sengan geothermal area between Akita Yakeyama volcano and Hachimantai volcano and sampled the extruded mud. The mud in the Goshogake MV field is fed with a high-temperature fluid in the temperature range from the ambient to 100 ˚C. In this presentation, we will focus on the source layer(s) and driving force of the Goshogake MV from the point of view of mineralogy and geology via XRD and Vitrinite reflectance.
We found that the erupted mud includes much silica (45-75 wt.%) such as opal-A, opal-CT and quartz and clay minerals (15-40 wt.%) based on XRD quantitative analysis and that the mud erupts from ~700 m depth by using Vitrinite reflectance. Based on the mineral composition, estimated source depth, and geological information, we found i) that the erupted mud comes from the shallow sedimentary layer deposited at a caldera lake, ii) that both rapid sedimentation and the dehydration of both opal and clay minerals make this MV active, and iii) that higher geothermal gradient due to the magmatic and hydrothermal activity in this hydrothermal region increases the temperature in the source layer. Especially, as the dehydration of opal in MVs has been not reported clearly, the new possible candidate of the driving force of MVs is proposed in this study. In conclusion, we clarified the cause and mechanism such as the source layer and driving force of the Goshogake high-T MV field.

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