Self potential monitoring at Onikone Geyser

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A geyser, as a proxy for a volcano, will be useful in studying the vapor eruption environment. We carried out multi-electrode monitoring of a geyser at Onikobe caldera, NE Japan. This geyser has a 140-second continuous flushing with the interval of 18 minutes. The height of the flushing water reaches 16m.

We deployed 12 Pb-PbCl2 electrodes within 10m around the hole. The signals were directly recorded by 24bit data logger with the sampling rate of 100Hz. This lead to the successful measurements of as small a signal as 0.1mV and less. At the same time, in order to make a marker for the flushing time, we used digital camera with a high-precision radio clock.

We successfully measured the temporal changes of self potentials which were due to the flushings. The repeatability of the data was good. The major features of the self potential changes were3 as follows. (1)At 10-20 seconds before the flushing, the SP starts increasing. This fact was one of the most important ones, as this shows that we can predict the vapor eruption beforehand by the SP. This can be explained by the shallowing the vapor/liquid surface toward the hole. (2)Then the geyser flushes and the height of the fluid fluctuates with a time constant of several seconds. This fluctuation is also reflected in the SP data. After the flushing finishes, the SP goes back to the previous level before flushing. (3)After the flushing is over, SP increases quickly to the maximum values. This implies that the fluids are rushing into the vacant reservoir, until the reservoir gets full. (4)As the reservoir is getting filled with fluids, the amount of charge is getting less and SP decreases.

We also inverted a point source of SP (which corresponds to a divergence of the fluid velocity). The point souse stays in the reservoir until it gets full and moves toward the hole during flushing. The reservoir was located at 2m off the hole at 4m depth from the surface.

The zeta potential was measured in the laboratory of Earthquake Research Institute, University of Tokyo, using the fluids from the geyser and the rock sample around the hole. The zeta potential showed -38mV. Since this is negative, our interpretation of positive SP anomaly as a fluid convergence was supported.

Lastly, the fluid permeablity was estimated from the zeta potential, fluid flow volume, and the resistivity of the ground (10ohmm). The estimated permeability was as high as the order of 10ˆ(-10) to 10ˆ(-13) darcy.

Our observation proved the usefullness of SP in the vapor eruption environment.