

Variety of discharge styles of geothermal water generated by plumbing systems: An experiment

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Styles of geothermal water discharges vary even they locate in a small area. When steam discharges continuously, it is called as a fumarole. Continuous liquid water and steam supply makes a boiling spring. Intermittent supply becomes a geyser. When these geothermal features are closely located, they sometimes interact [1]. The origin of various styles of water discharge and those interactions may be attributed to the different plumbing systems.

We thus performed a series of laboratory experiments with various plumbing systems. The hot water bath (flask) heated from the bottom is connect to the vent (funnel) through the conduit (plastic tube). In some cases, the conduit has a branch connected to the cold water tank. We varied the conduit diameter (2, 6mm), its length (0.5-2m), and branching depth.

By the boiling of the water in the flask, we observed various discharge styles even in the experiments without branches. For the short (<1 m) and thin (2mm) conduit, the steam supplied from the boiling flask discharges like a fumarole. For a thick (6mm) conduit with a same length, the steam condenses in the funnel. Further supply of steam splashes the condensed water like a boiling spring. For a long (2m) and thick conduit (6mm), the condensed water intermittently drains into the conduit, like a geyser. Interestingly, during the steam condensation in the funnel, the inside conduit is filled by steam. Here, the measured pressure becomes lower than that measured when liquid water fills the conduit. We thus consider that the pressure inside the conduit and hot water bath is governed by the static pressure.

When the conduit connects to the cold water tank, the depth difference between the water tank and the branching point determines the discharge styles. For a large depth difference, which generates large hydrostatic pressure, the cold water easily flows into the conduit to stop boiling.

Our experiments show that subtle difference of plumbing system can explain various discharge styles.

[1] Munoz-Saez, C., et al. (2015), J. Geophys. Res. Solid Earth, 120, doi:10.1002/2015JB012364.