

Fundamental characteristics of experimental geyser

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Geysers are the periodical eruption of the hot water. Using an analogue experiment (basically same one documented by Nishimura (Tohoku University) and Sugiyama (Tohoku University) on Japan Geoscience Union Meeting 2006 abstract), we measured the mass of erupted water for each eruption and the period between eruptions, and considered the mechanism of the geyser eruption. For analysis, we make definition for some phenomena; 'jet eruption' is the event that water vigorously spouts from the vent, 'outflow' is the event that water flows from the vent, and 'period' is the time interval between onsets of sequential eruptions. We measured the mass of erupted water for each eruption and the period for variable condition of the initial water level (60, 65, 70 cm) and the insertion (the length of supplying tube inserted into the flask; 0, 1, 2, 3, 4 cm), the initial water level (60, 65, 70 cm) and heating temperature (temperature of the hot plate; 553.15, 613.15, 668.15 K). From experimental results, it is found that (a) there is the condition whether jet eruption can occur or not depending on the initial water level and insertion, (b) there is the positive correlation between the mass of erupted water and the period after the eruption, (c) the mass of erupted water is depends on the initial water temperature, initial water level, and the heating temperature, (d) there is the negative correlation between the period and the heating. In order to understand the cause of result (b), we considered a simple model on the basis of some assumptions. Predicted values calculated by the model is successfully consistent with measured ones at the first order. As a result, it is found that the experimental geyser by our setup is the time predictable type like many natural geysers which we can predict a period by measuring the mass of erupted water by the eruption. The condition whether the jet eruption occurs or not is controlled by the height from water level in the conduit to the vent and degree of degassing. The difference between theoretical period and measured one comes from uncertainties for unknown effects of the duration of superheating state, eruptive duration, dissipation of energy and the latent heat by phase transition, which the model does not include.