The Ice Box Calorimetry: Application to the Nishiyama steaming ground at Usu volcano

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Local differences in rate of heat transfer in vapor and by conduction through the ground in geothermal area are difficult to measure quantitatively. Using an ice in an aluminum box, we can easily measure the total heat transfer including conductive and convective heat flow from steaming ground.

[Method]

We freeze aluminum boxes with 100 g water by a household refrigerator, and put it on steaming ground. After a few minutes passed, hereafter the passing time is called as the contact time, we pick up the icebox and measure the molten water volume by a beaker. The heat in Joule necessary to melt ice is water weight in kg multiplied by the heat of fusion in J/kg. To obtain the heat flux Q', we divide the heat by the contact time.

The Q' include the heat flux Qc from the sun and atmosphere. To evaluate the Qc, we put the ice box on insulting matter at the same time. The insulting ice box presumably absorbed as much heat from the sun and atmosphere as the ice box on the nearby ground, consequently, we obtain Q by subtraction of Qc from Q'.

Hereafter we call this method as the Ice Box Calorimetry.

[Results]

The Ice Box Calorimetry was applied to the geothermal area at Nishiyama steaming ground of Usu volcano on September 2006. The observations were carried out on the ground where the 10 cm temperatures were from 30 to 98 degrees, and revealed exponential increase of Q against the 10 cm depth temperature. The heat fluxes Q are at the range from 0.40 to 2.89 kW/mˆ2. The large scattering of Q around 98 degrees at the 10 cm depth is probably due to the local difference of the rate of vapor transfer. The Ice Box Calorimetry is as superior method to detect a difference of local vapor flux in particularly prominent gas emitting place.

Combining the contour of heat flux inferred from 28 data and infrared images, total heat flux of Nishiyama steaming ground evaluate about 11 MW. This value is consistent with 8.7 MW obtained from the heat balance technique (Sekioka and Yuhara, 1974) applied to the same area.