Water, heat and chloride budgets of the crater lake at Naka-dake, Aso volcano, Japan

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A volcanic lake is not a simple pool of meteoric water but an unstable hydrothermal reservoir, which is controlled by the balance of volcanic and nonvolcanic heat, water and chemical fluxes into and out of the lake. By studying volcanic lakes, therefore, we can estimate the hydrothermal activity under the lake and detect some signals preceding an eruption. Naka-dake, one of the central cones in Aso caldera, Japan, is an active volcano whose crater is now occupied with light-green-colored hot water. The lake water shows high temperature above 50 degrees C, high acidity below PH 1 and high concentration of chloride anion, suggesting high flux of volcanic input. However, little is known about the crater lake system at Naka-dake. In order to evaluate volcanic input into the crater, box models about water, heat and chloride were constructed and calculations were made by using the data collected between 2000 and 2003. During this period, the water level was gently decreased by more than 10 meters. The results showed that the lake water is mainly supplied by volcanic input (3500-5800 m^3/day) and is dissipated by evaporation from the lake surface (3900-5900 m^3/day) and seepage from the lake bottom (800-2100 m^3/day). Meteoric water flux (460-2900 m^3/day) is not so important. Positive correlation between the chloride concentration of volcanic input and volcanic water flux was suggested. Thermal energy of volcanic input was estimated to be about 110-200 MW, which is the dominant influx. Most heat loss occurred at the lake surface through evaporation (100-150 MW). The enthalpy of volcanic input was estimated to be about 2600-4600 kJ/kg, which corresponds to the enthalpy of steam at several hundred degrees C.