Water-level fluctuations observed in the Shinyu volcanic crater lake, Tateyama Caldera

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Shinyu, located in the Tateyama Caldera, is a volcanic crater lake filled with hot water that was formed by the volcanic activity of the Midagahara volcano. The 40-m wide and 5-m deep crater lake has a surface water temperature of approximately 70˚C. The primary source of the hot water in the lake is from a few vents at the bottom of the lake because of the absence of surface rivers inputs. Shinyu has been continuously fed with hot water over the years; however, since the time the lake emptied in 2014, the water levels have cycled between empty and full phases. This lake is considered to be a type of geyser. We conducted observations on Shinyu lake by deploying a broadband and water level sensor close to the lake and measured the temperature and pH of the hot water from June to October 2017.
Four phases of visible surface activity were observed: empty, filling, overflowing, and draining. The fieldwork elucidated the empty, filling, and overflowing phases. Hot water was ejected along with gas, and overflowing water discharged from the gap in the crater wall and flowed into the Yukawa River. The temperature of the water remained nearly constant, at approximately 70˚C in both phases, but the pH value of the water significantly changed from approximately 6 (the filling phase) to 3 (the overflowing phase).
About seven cycles of the water level fluctuations were recorded on the water level gauge. The emptying phase of the lake lasted about half a day (all the water drains through vents at the bottom of the lake). The lake remained empty for about three days, and then the filling phase lasted for about four days. Although the duration of these phases was nearly constant, the overflowing phase varied between 0 and 20 days. The data also indicated that filling and draining cycles occur regularly during the early stage of the filling phase.
The broadband seismograph fragmentally recorded data for two cycles of water level fluctuations. Regular cyclic increases in the amplitude were observed in the high-frequency wave train during the filling and overflowing phases, whereas pulse-like waveforms were observed in the low-frequency wave train. However, the relation between the water level fluctuations and the pulse-like waveforms was unclear. These events suggest that the sources of water are shallow because the horizontal components are much larger than the vertical ones.
The results of the analyses provide important information regarding the cause of the water level fluctuations. However, the period of recorded data is too short to analyze and therefore cannot further elucidate the processes. This entails the need to continue conducting further observations in the coming year.

Keywords: Shinyu, Midagahara, Tateyama, water level fluctuation, geyser

