Ruapehu Crater Lake: Latest developments of a long temperature record

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Regular temperature records of Ruapehu Crater Lake date back nearly 50 years, but we are still finding new ways to use them to better understand what is happening in the volcano.

The major heat loss from the lake is by evaporation, so the formula used for evaporation is critical for estimating the volcanic heat input to the lake. Recent experiments with a weather buoy have shown that the lake keeps the air above it significantly warmer and wetter, which lowers the evaporative loss. By tracing the history of evaporation equations, it seems that some of the disagreements in this area are due to equations that were formulated from lakes with weather stations on the lake being applied to lakes where the weather information was gathered away from the lake.

The surface temperature of Ruapehu Crater Lake varies between about 20℃ to 60℃, with a tendency to cycle on a 6-12 month basis. It is not surprising that a hot crater lake has sometimes been an eruption precursor, although before telemetered dataloggers were installed the statistics were rather biased by how willing observers were to approach the lake. However, it has also been observed that there is an increased likelihood of an eruption when Ruapehu Crater Lake has a long cold spell. It was assumed that this was because the low heat input was often caused by a blockage in the volcanic vent, but it is only in the last few years that we have had a way of confirming this, by estimating vent temperatures from the ratios of certain gases in lake water samples.

Since a phreatomagmatic eruption in late 2007, water samples have been analysed approximately monthly for their solute gas contents, and it is noteworthy that H_2/Ar and CO/CO_2 ratios have coherently followed lake temperatures over much of this period, with CO/CO_2 equilibrium temperatures ranging between 350 and 700℃. Since mid-2012, however, the curious development of high CO/CO_2 equilibrium temperatures in the absence of any thermal cycling appears to point to the formation of such a blockage. We are waiting to see whether this situation resolves itself by an eruption or not.