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A simple model for geyser flat, whakarewarewa

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Abstract

The work presented in this paper is based on records of geyser activity and other data collected at Geyser Flat, Whakarewarewa, New Zealand. The data is used to construct a simple quasi-steady mass, heat, and chemical balance model to account for the interactions between the three geysers Pohutu, Prince of Wales Feathers, Waikorohihi, and the non-eruptive Te Horu cauldron. This model has provided order of magnitude estimates for mass and energy flows, and geyser cavern properties. The importance of the west-south-west wind component on the Te Horu waterlevel is established from the data. Te Horu waterlevels are also shown to correlate significantly with geyser performance. High waterlevels are connected with regular geyser behaviour, while low waterlevels are associated with rapid irregular eruptions. Cavern temperatures of 118Â°C, 107Â°C and 109Â°C are inferred from the observed full column plume heights of 20, 8 and 8 metres from Pohutu, Prince of Wales Feathers, and Waikorohihi respectively. The cavern of Pohutu is inferred to lie 9 metres below the local water table, while Feathers' and Waikorohihi's caverns are assigned depths of 3 and 4 metres

while Feathers and Waikorohihi's caverns are assigned depths of 3 and 4 metres respectively. A volume estimate for the Pohutu cavern is about 100 m^3. Those for Feathers and Waikorohihi are more difficult to assess but are probably of the order of 10 m^3 and 50 m^3 respectively. In the model recharge to the geysers consists of a mixture of shallow cold water (mostly from Te Horu), and upflowing deep hot water, in approximately equal proportions. The average mass flows of hot and cold water are about 16 kg/s each for Pohutu, about 1 kg/s each for Feathers and 4 kg/s each for Waikorohihi. Predicted transients in the concentration of chloride in ejected plume water from Pohutu, Feathers and Waikorohihi are approximately those observed. Approximately 10 minutes before an extended eruption of Pohutu a rise in the Te Horu water level occurs, which is associated with a subterranean overflow from Pohutu. Decreases in the Te Horu water levels are associated with geyser eruptions and the corresponding outflows are quantified.

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