A new detailed glacio-eruptive history for Tongariro National Park, New Zealand: Results from mapping, geochronology, geochemistry and glaciology currently underway

Graham S Leonard[1], Dougal B Townsend[1], Chris Conway[2], Shaun Eaves[2], John Gamble[2], Colin JN Wilson[2], Andew Calvert[3], James Cowlyn[4]

[1]GNS Science, 1 Fairway Drive, Lower Hutt 5010, New Zealand, [2]Victoria University, PO Box 600, Wellington 6040, New Zealand, [3]US Geological Survey, Menlo Park, CA 94025, USA, [4]University of Canterbury, Private Bag 4800, Christchurch 8140, New Zealand

E-mail: g.leonard@gns.cri.nz

We present and discuss preliminary findings of a project to develop an integrated volcanic and glacial history for the composite volcanoes of Tongariro National Park. This collaboration with New Zealands Department of Conservation will publish the first detailed (1:50,000 scale) volcanic geological map and bulletin for the park. The park includes the iconic active vents of Ngauruhoe and Ruapehu, last eruptive in 1975 and 2007, respectively, and the reactivated Te Maari vent of Tongariro, which erupted twice in 2012. Ruapehu and Tongariro are at least 250,000 years old, having erupted multiple times from overlapping centres. Compositions are predominantly basaltic andesite to andesite and both centres have been host to ice caps during glacial periods, representing a significant proportion of their eruptive history.

A large amount of geological mapping and geochemical work has been conducted over past decades, focussed mainly on lava and pyroclastic units. Past moraine mapping has been limited and the extent of glacial landforms has been under-appreciated; the frequency, extent and precise timing of past glacier fluctuations remained unknown. Consideration of the influence of glacial processes with primary volcanism has largely been absent. The volcanoes are surrounded by a substantial laharic ring-plain, and we are integrating these sediments into the glacial and volcanic history of the peaks. Tongariro and Ruapehu volcanoes have now been geomorphically mapped from aerial photos and fieldwork, showing extensive complex moraine and lava sequences over much of the area. Distributions of lava flows and pyroclastic deposits have been heavily controlled by ice distributions during eruption. We now recognise widespread ice-contact textures including fine-scale lateral columnar jointed lava (sometimes grading into till); intercalated stacked moraines and perched lavas, often with lobes of lava dipping and thickening into the valleys toward now-missing ice; lava tubes and sheets apparently emplaced under ice; stalled lava flows inferred as bounded by valley-filling ice; Holocene valley bottom lavas mantling glacial features; and eruptive textures and landforms possibly due to sub-glacial lacustrine volcanism.

New high-precision groundmass Ar-Ar age dates are being produced on suitable lavas. We are achieving 1.2 kyr (1 s.d.) uncertainties on Holocene lavas and less than 1 kyr on c.40 kyr lavas. The tephra cover on moraines is being analysed in detail; stratigraphic constraints are being combined with cosmogenic 3He surface exposure dating of moraines to ascertain the relative and absolute timing of volcanic events and their relationships to past ice configurations and thus the till units. The dating is shedding new light on the timing of growth of late Pleistocene cones, and about the Holocene lavas and their relationships to the regional fall and flow deposits (see Cowlyn et al., this volume) previously documented from the east side of Ruapehu.