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LATE QUATERNARY LAHARS FROM MOUNT RUAPEHU IN THE WHANGAEHU RIVER VALLEY, NORTH ISLAND, NEW ZEALAND

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ABSTRACT

The stratigraphic record of lahars in the Whangaehu River reveals that in the past 180,000 years this route has been one of the main conduits for lahars from Mount Ruapehu, the highest active andesitic stratovolcano in the Central North Island of New Zealand. Both debris flows and hyperconcentrated flows have engulfed surfaces up to 160 km distance from the Volcano. Eight episodes of laharic activity are recognized by the distinctive lithology and similar age of their deposits. The newly defined upper Pleistocene Whangaehu Formation provides evidence for the earliest lahar event in the Valley, *c.* 180,000-140,000 years ago. There is only meagre evidence for laharic activity following this event until the Ohakean and Holocene, although two new informally named deposits - the Mangatipona pumice sand (*c.* 37,000 years B.P.) and Apitian lahars (*c.* 32,000-25,500 years B.P) - are recognized, of minor extent. The formerly defined late Quaternary Te Heuheu (*c.* 25,500-14,700 years B.P.), Tangatu (*c.* 14,700-5,370 years B.P.), Manutahi (*c.* 5,370-3,400 years B.P.), Mangaio (*c.* 4,600 years B.P.) and Onetapu (< *c.* 1,850 years B.P.) Formations are here described and interpreted.

Triggering mechanisms for lahar deposits are distinguished based on lithological criteria.

(a) Bouldery deposits in the Whangaehu Formation are interpreted to have been emplaced by a single highly competent debris flow triggered by a southerly-directed flank collapse at Mount Ruapehu. This debris flow was competent enough to transport boulders up to 2 m in diameter over 140 km from the Volcano. Bouldery deposits are also recognized in the Onetapu Formation, but are restricted to higher gradient surfaces on the Mount Ruapehu ring plain. The Onetapu Formation deposits are interpreted to have been emplaced by lahars resulting from catastrophic drainage of Crater Lake, which occupies the active crater on Mount Ruapehu.

(b) Pebbly and sandy deposits are interpreted to have been emplaced by low competence debris flows and hyperconcentrated flows. These lahar deposits are recognized in all formations described. The lithology in these deposits is

commonly pumice and they are interpreted to have been triggered by eruptions and/or high rainfall events at the Volcano.

Formations, and individual members within Formations, were dated by radiocarbon dating of organic material found below, within or above lahar deposits, or by coverbed stratigraphy. Both rhyolitic and andesitic tephras provided recognizable time planes in the late Quaternary coverbeds overlying lahar deposits. In this study quantitative analysis of quartz abundance, which is shown to vary between loesses and palaeosols, is used as an indirect means of establishing a surrogate for past climate changes which have been correlated to the deep sea oxygen isotope curve. A minimum age for the newly defined Whangaehu Formation is established by this method.

The accumulation rate for lahars in the Whangaehu River has accelerated from 1 km^3 every *c.* 23,000 years in the past *c.* 160,000 years to 1 km^3 in 589 years in the past *c.* 2,000 years. This acceleration probably results from the increased frequency of lahars in the River following the development of Crater Lake *c.* 2,000 years B.P. According to this pattern an estimated 0.17 km^3 volume of lahars could be anticipated over the next 100 years. If the 2,000 year accumulation rate were to be met over the next 100 years there would be 170 lahars of 10^6 m^3 in this time interval, or 17 lahars of 10^7 m^3 (or 1.7 lahars of 10^8 m^3). The largest reported volume for an historic lahar is 10^6 m^3 and these have occurred on average once every 30 years. The accumulation rate for historic lahars is 0.0054 km^3 in 100 years. Therefore, although the accumulation rate appears to have slowed down, further large lahars with magnitudes 10 or 100 times greater than those witnessed could be expected.

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