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Modeling crater rim stability at Mt. Ruapehu, New Zealand

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The active Mt. Ruapehu volcano (New Zealand) hosts a 106 m3 lake in the summit crater, making it prone to lahar events. In 1953, a lahar caused 151 deaths when the Tangiwai railway bridge was destroyed, resulting in one of New Zealand's largest natural disasters. The most recent large lahar occurred in March 2007, when the lake refilled to a critical point after being emptied during 1995-96 eruptions. Both of these events were primarily the result of failure of preceding eruption deposits that had accumulated over the normal lake outlet, damming the lake. The 2007 event was well predicted and did not result in any casualties, with similar future scenarios expected to have similar outcomes. However, the current lake outlet occupies the lowest portion of the crater rim, the failure of which could be more unpredictable and produce larger lahars such as have occurred in previous centuries. An understanding of the current and future stability of the rim is required for appropriate emergency planning. Field and archived data were used to track the geomorphology and topography of the rim over several decades, which are influenced by glaciation and eruptive activity. This information was integrated with regional tectonics and the physical-mechanical material properties of the rim rock and rock mass found through field observations and laboratory tests to create an engineering geology model. The interbedded sequence of lava that currently forms the lip of the outlet and dams the lake is significantly stronger than the tephra dam and other volcanic material that failed in the 1953 and 2007 events. Initial results of stability modeling using finite element numerical methods indicate that a worst case scenario could result in 4m of catastrophic drainage should the rim fail. This engineering geology model will be updated and analyzed as the outlet continues to evolve.