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Contrasting the morphology and internal structure of hummocky mounds in two landslide deposits, North Island, New Zealand.

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The existence of hummocky mounds has been reported in large landslide deposits around the world. They are particularly common in association with slope failures of volcanic edifices. A wide range of mechanisms has been proposed to explain their formation. Early hypotheses include: small, independent volcanic eruptions; the explosion of volatiles from lava flows; or deposits associated with glacial retreat. Recent proposed mechanisms regarding the genesis of these landforms concentrate on the transport/deposition dynamics of debris and rock avalanche and the post-depositional landscape responses. Researchers have used laboratory analogues to study vibratory movement concurrent with landslide events which can create hummocky mounds by segregation of clasts within the deposit. Others have suggested that deposition of large boulder can act as an anchor leading to the accumulation of mound-forming debris around it or that they represent large scale dewatering structures similar to sand-volcanoes.

Two sites with hummocky landslide terrain are examined as part of this project. The first examines deposits associated with volcanic edifice collapses on the west coast of New Zealand's North Island. The deposit of two major landslides have previously been recognised; the Pungarehu Formation ($\sim$20000 year old), on the western side of Mount Taranaki, and the Opua Formation ($\sim$6000 year old), on the south-western side of Mount Taranaki. Each landslide produced thousands of mounds across an approximately 15km^2 area. The average mound height is 5m with maximum of 50m. There is a general but irregular decrease in mound size with increasing distance from the source. Field investigation showed that most mounds lack definable internal structure, evidence of dewatering, and large anchoring boulders. Mounds largely consist of loose, poorly sorted volcanic debris with occasional evidence of shattered clasts.

The second site examines mounds at a large pre-historic landslide in weak sedimentary rocks near Hunterville, in the south-central portion of New Zealand's North Island. The geology in the headscarp area consists of interbeds of weak to very weak beige siltstone and moderately strong beige sandy coquina units. The landslide deposit consists of over one hundred individual mounds, covering an area of approximately 300000m^2. As in the mounds in Taranaki, there is no evidence of dewatering structures or large anchoring boulders. This site differs from Taranaki in that there were no shattered clasts; there is a general concentric alignment of the mounds, and mounds often consist of large (up to 7m high) single clasts with its primary sedimentary structures preserved. Mounds consisting of a dominantly siltstone lithology showed a more rounded morphology and were usually entirely vegetated while mounds of the coquina-dominated lithology retained a more angular appearance and are not completely vegetated.

Based on the observations from the two case studies, the mechanism for the formation of hummocky terrain was different at each site. The landslide near Hunterville shows hummocky mounds composed of single weathered large boulder. It thus suggests that the transport, deposition, and subsequent weathering of large intact blocks from the initiation zone have controlled the distribution of hummocky mounds. The origin of the mounds associated with the edifice collapses of Mount Taranaki is more difficult to conclusively assign to a particular mechanism. At this point it can only be suggested that the features observed in the field are consistent with a very dynamic mixing environment during transport that might have been caused by acoustic vibration.