Mount Ruapehu is an active andesitic stratovolcano in the centre of the North Island, New Zealand, and last produced a major magmatic eruption in 1995/1996. Previous studies have reported that seismic anisotropy in the vicinity of Ruapehu, determined via shear wave splitting (SWS) analysis, changes throughout the eruptive cycle. The anisotropy is thought to derive from either structural effects or stress in the crust aligning microcracks and creating an anisotropic medium. The polarisation of the fast quasi-shear wave, phi, is parallel to the maximum horizontal stress or strike of structure, and the delay time between the two quasi-shear waves, dt, is proportional to the strength of the anisotropy and the length of the raypath in the anisotropic medium. We identify the mechanism of anisotropy in regions around Ruapehu by comparison of phi to stress and structure and examine past changes in anisotropy by analysing clusters of earthquakes with reference to our benchmark model of local anisotropy.

In some regions the anisotropy is laterally uniform, while other regions display spatially varying anisotropy with close stations (<5 km) displaying differences in phi of up to 70 degrees. We also observe variations in SWS parameters with back azimuth and with depth, which emphasises the need to eliminate the possibility of spatial variations in the identification of temporally changes. Using clusters of earthquakes and permanent seismic stations, we remove the uncertainty of spatial variation masquerading as temporal changes and have identified strong changes of SWS parameters with reference to our benchmark.