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The importance of microearthquakes in crustal extension of an active rift: a case study from New Zealand

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The amount of extension accommodated in active rifts by earthquakes that do not rupture the ground surface (e.g., <Mw 5.5) is often poorly constrained. The Matata Earthquake Sequence (MES), a high quality dataset of 2563 relocated microearthquakes (1<Mw<4.7) that ruptured the Taupo Rift in New Zealand over a period of 49 months, has been used to quantify the proportion of extension produced by small to moderate sized earthquakes. Analysis shows that the extension rate across the rift due to the MES is 2.4$\pm$0.7 mm/yr (at 1σ standard deviation), an average extension rate for small to moderate magnitude earthquakes which also prevailed during the preceding 28 years (1977-2004) and represents up to $\sim$30% of the total contemporary deformation recorded across the north Taupo Rift by GPS (15$\pm$5 mm/yr). The bulk of the MES (94%) occurred at depths of 1.5 to 6.5 km and may not be observed in geological datasets (e.g., as displacements of the ground- or near-surface horizons). Small-scale faulting associated with microseismicity may record strains not measured by geological datasets, and constitute an important component of the $\sim$3-10 mm/yr disparity between geological and GPS rates of extension across the Taupo Rift.