Supplement to 'Focal mechanisms in the southeastern South Island of Aotearoa New Zealand indicate scale-dependent partitioning of transpressional strain'

December 8, 2025

1 Supplementary Figures

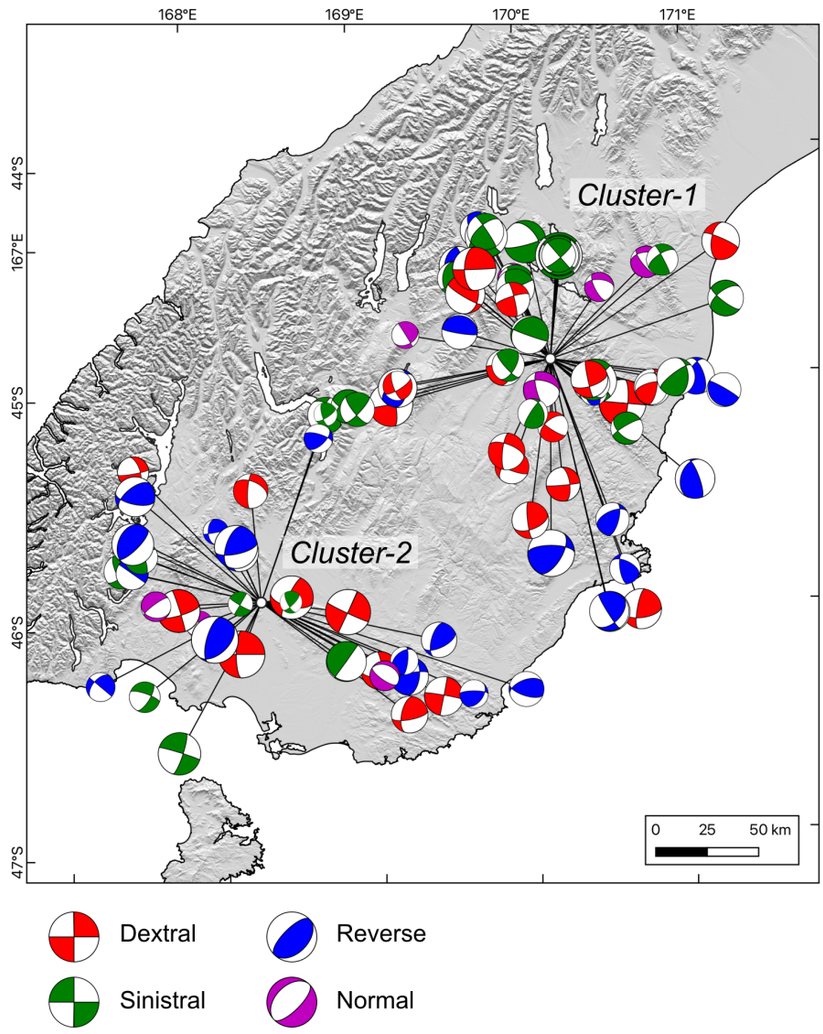

Figure S1: Grouping of southeastern South Island focal mechanisms into two spatial clusters using a k-means algorithm (see Section 3.3 in the main text). The average silhouette coefficient for these two clusters = 0.55, and so it was preferred over an alternative case where the focal mechanisms were subdivided into three clusters (average silhouette coefficient = 0.51).

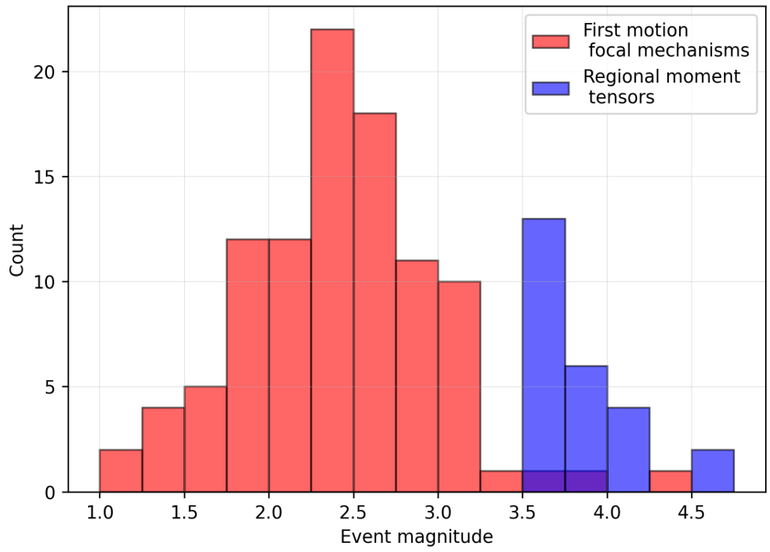

Figure S2: Distribution of event magnitudes for: (1) first motion focal mechanisms resolved from the OtagoNet, SOSA, and COSA data (n=102) and (2) events from the New Zealand regional moment tensor catalog (n=25; Ristau, 2013). Event magnitudes are M_{Lv} and M_W for the first motion focal mechanism and regional moment tensors respectively.

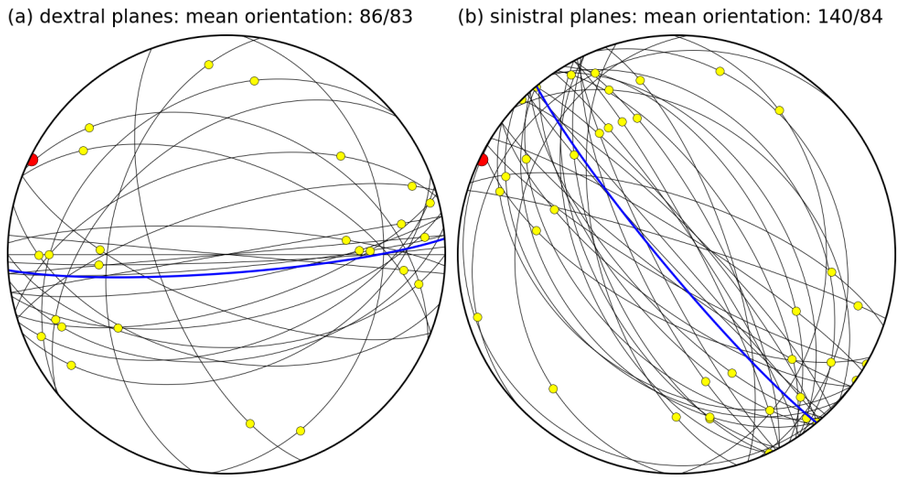

Figure S3: Lower hemisphere equal area stereonets indicating the orientation of (a) dextral and (b) sinistral fault planes from the southeast South Island first motion focal mechanisms, as selected by STRESSINVERSE (see Section 3.3 in the main text). Thick blue plane indicates the mean orientation of each fault set; yellow circles, the rake of each plane; red circle, orientation of σ_1 (01/296) derived from the stress inversion that considers all focal mechanisms.

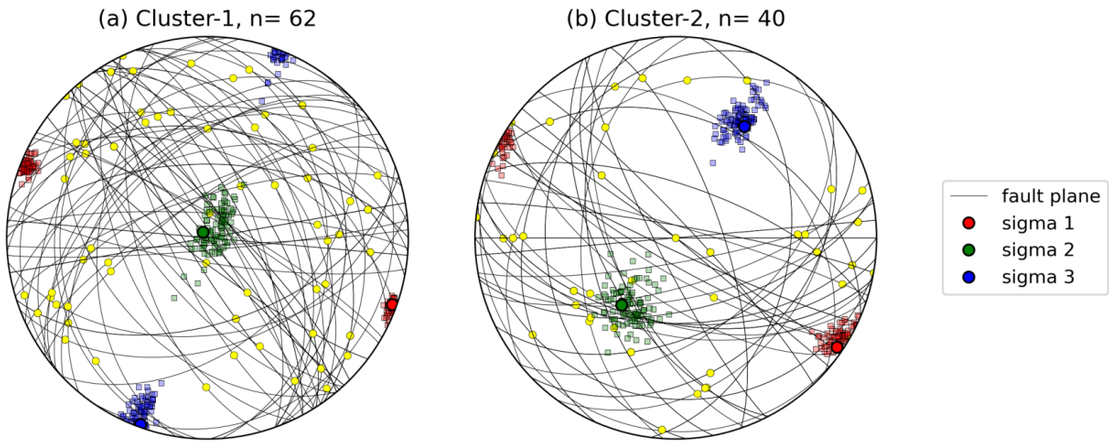

Figure S4: Lower hemisphere equal area stereonets depicting the orientation of the principal stress axes from stress inversions that consider focal mechanisms grouped into two clusters using the k-means algorithm (Fig. S1). Plot follows Fig. 4 in the main text, with the large circles showing the principal stress axes indicated by the 'preferred' focal mechanisms. The smaller circles indicate the stress axes using randomly sampled 'accepted' focal mechanisms (for OtagoNet and SOSA events) or randomly perturbed focal mechanisms (for COSA events). Black planes and yellow circles indicate the orientation and rake of nodal planes selected by STRESSINVERSE.

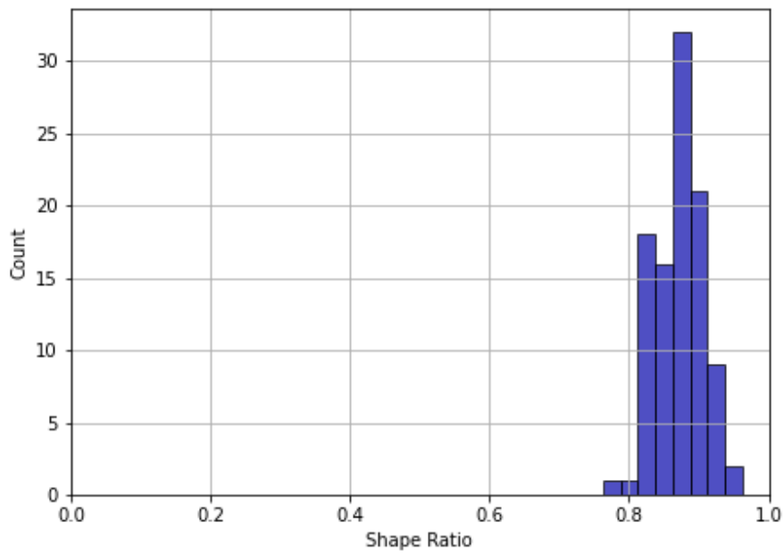

Figure S5: Histogram for the shape ratios, R, resolved from 100 stress inversions of the southeastern South Island first motion focal mechanism data. In each inversion, we randomly select mechanisms from: (1) the list of 'accepted mechanisms' returned by HASH for OtagoNet and SOSA events, or (2) by randomly perturbing COSA focal mechanisms.

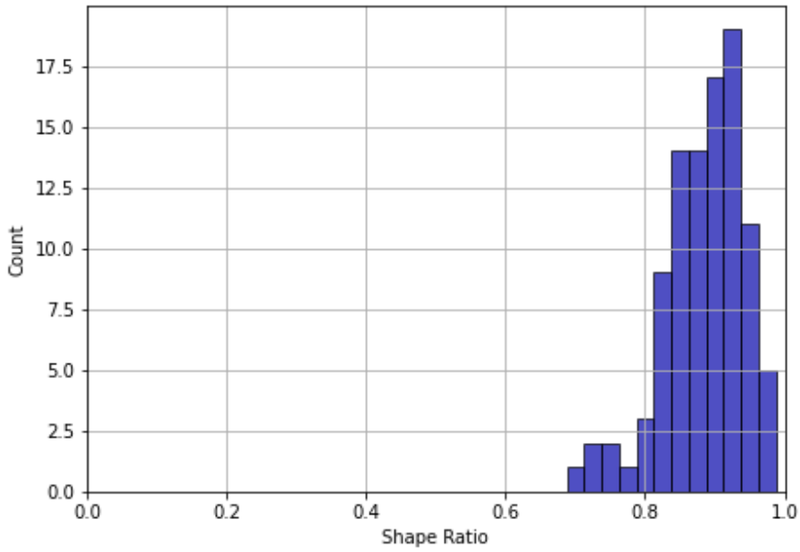

Figure S6: Equivalent to Fig. S5, but showing the distribution of stress shape ratios, R, from 100 stress inversions of events within the New Zealand regional moment tensor (RMT) catalog in the southeastern South Island (Fig. 1a, main text; Ristau, 2013). Here, fault plane orientations are sampled from a uniform distribution centered on each RMT event's fault plane, and are bounded by $\pm 5°$, $\pm 10°$, and $\pm 15°$ for strike, dip, and rake.

References

Ristau, J. (2013). Update of regional moment tensor analysis for earthquakes in New Zealand and adjacent offshore regions. *Bulletin of the Seismological Society of America*, 103(4):2520–2533.