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A multifractal examination of whether along strike variations in the Alpine Fault geothermal gradient can affect deformation mechanisms and fault strength at the brittle-creep transition.

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A surprisingly high geothermal gradient measured in the Alpine Fault Drilling Project's DFDP-2B borehole has been attributed to advection of heat in meteoric-derived fluids circulating between high ridges and deep Quaternary sediment-filled valleys that strike perpendicular to the fault (Sutherland et al., 2017), yielding along-strike variation in the thermal gradient and the fluid pressure at the 5-20km length scale. If these perturbations persist to sufficient depths they may affect the deformation mechanisms at the base of the Alpine Fault seismogenic zone. Reasonable geothermal gradients are 120°C km^{-1} beneath major valleys and 40°C km^{-1} beneath ridges (Sutherland et al., 2017; Toy et al., 2010). These would yield brittle-creep transitions at 4km versus 8km, and shear stresses of 50MPa versus 140MPa.

We are examining the relationships between along strike topographic variation and measures of deformation mechanism and fault zone strength such as seismicity distributions, quartz grain size distributions in exhumed mylonites, and geodetic locking depths using multi-fractal methods. Our preliminary recurrence plots demonstrate systematic relationships between mean quartz grain size and seismicity do exist. We will report further analyses at the time of the meeting.

References:

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