STRESS FIELD CYCLING COUPLED TO FLUID FLOW RECORDED IN QUARTZ VEIN SYSTEMS HOSTED BY STRIKE-SLIP FAULTS, PROTEROZOIC MT ISA INLIER, AUSTRALIA

R.H. Sibson[1], **M.J. Begbie**[1], **& F.C. Ghisetti**[1]
[1]Dept. of Geology, University of Otago, PO Box 56, Dunedin
rick.sibson@stonebow.otag.ac.nz

The Proterozoic Mt Isa inlier (~50,000 km^2) in NW Queensland, Australia, underwent a complex tectonothermal history involving multiple episodes of intracontinental rifting, sedimentation, and magmatism that culminated in the Isan Orogeny (1590-1500 Ma) where strong E-W shortening led to compressional inversion of former rift basins. Brittle, late-orogenic (1500-1450 Ma?) strike-slip faults disrupt the metamorphic complex of subgreenschist to amphibolite facies assemblages. A dominant set of dextral strike-slip faults striking NE-SW to NNE-SSW with offsets <25 km, is apparently conjugate to a set of sinistral faults striking NW-SE to NNW-SSE, consistent with continued ~E-W shortening.
The faults commonly outcrop as blade-like ridges extending linearly across the semi-arid terrain for many kilometers (Fig. 1)

Transects across the dextral NE-SW Fountain Range and Overlander Faults (which crosscut granites and amphibolite facies metasediments and metavolcanics) have shown that the fault zones are about 100 m thick with a composite brittle fabric comprising: (1) subvertical silicified cataclastic shear zones (cataclasites plus microbreccias containing vein fragments); (2) innumerable subvertical quartz-veins (cm to m thickness) lying subparallel to the principal shear zones (some retain purely dilational textures; others are multiply recemented fault-breccias with wallrock fragments); (3) highly irregular non-systematic veins; and (4) a systematic set of predominantly extensional, steep planar quartz veins oriented 080-120° at moderate angles to the main faults. Mutual cross-cutting relationships occur between all structural components, indicating broad contemporaneity. Recorded dextral separations along shear fracture components are commonly of the order of 1-10 cm, consistent with small-moderate seismic slip increments.

A preliminary interpretation is that the different systematic vein-sets reflect changing orientations of the local stress field at different stages of the earthquake stress cycle. Minimum compressional stress oblique to the fault through the interseismic interval alternates with minimum compression oriented subperpendicular to the fault immediately postfailure, suggesting that each slip episode was accompanied by near-total relief of shear stress along the fault. Amethystine quartz, open-space filling textures, and calcite-quartz intergrowths in the veins are consistent with hydrothermal precipitation occurring within 1-2 km of the former ground surface. The source of the hydrothermal fluids responsible for these extensive vein systems is not yet clear, nor whether they developed under hydrostatic or overpressured fluid conditions.

Geological Society of New Zealand, Annual Conference, Dunedin Dec. 2003.