Geophysical Research Abstracts
Vol. 16, EGU2014-5071, 2014
EGU General Assembly 2014

Pseudotachylyte formation vs. mylonitization – repeated cycles of seismic fracture and aseismic creep in the middle crust (Woodroffe Thrust, Central Australia)

Sebastian Wex (1), Neil Mancktelow (1), Friedrich Hawemann (1), Alfredo Camacho (2), and Giorgio Pennacchioni (3)

(1) ETH Zurich, Geological Institute, Zurich, Switzerland, (2) University of Manitoba, Department of Geological Sciences, Winnipeg, Canada , (3) University of Padova, Dipartimento di Geoscienze, Padua, Italy

The Musgrave Ranges in Central Australia provide excellent exposure of the shallowly south-dipping Woodroffe Thrust, which placed ∼1200 Ma granulites onto amphibolite facies gneisses. This ∼400 km long E-W structure developed under mid-crustal conditions during the intracratonic Petermann Orogeny around 550 Ma. From field observations and measurements, the shortening direction is constrained to be N-S and the movement sense top-to-north. Ductile deformation during this process almost entirely localized in the footwall rocks, developing a zone of mylonites, ultramylonites and sheared pseudotachylytes, several hundred metres wide, with pseudotachylyte abundance rapidly decreasing further into the footwall. In contrast, the hanging wall behaved in a predominantly brittle manner, producing significant volumes of pseudotachylyte breccia and isolated veins, but was otherwise mostly unaffected and only weakly foliated. The difference in rheological behaviour is reflected in the pseudotachylyte fabric, which is dominantly sheared in the footwall and largely unsheared in the hanging wall. Low-strain domains in the footwall show that localized shearing initiated along pseudotachylyte veins and that shear zones and mylonitic foliations were in turn exploited by subsequent pseudotachylyte veins. Neither phyllonitization nor synkinematic growth of new muscovite is observed. In contrast to models with a simple brittle-to-viscous transition, these observations show that a continuous cycle of brittle fracturing and shearing is active in dry mid-crustal environments. The products of multiple earthquakes and ductile overprint, repeatedly exploiting the same structural discontinuity, are composite layers of sheared pseudotachylyte. In the Woodroffe Thrust, these layers are numerous and frequently observed parallel to the foliation in the footwall mylonites. The thickest of these sheared pseudotachylyte horizons (∼15 m thick) mark the immediate contact to the hanging wall and almost entirely consist of pseudotachylyte matrix. Particularly in the footwall, but locally also in the hanging wall, shear strain can additionally be concentrated along the margins of dolerite dykes, whose mineral assemblages will be studied to determine the metamorphic conditions that were active during development of the Woodroffe Thrust.