Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08346, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08346
EGU General Assembly 2008

Recognising the seismic cycle along ancient faults: CO_2-induced fluidization of brittle cataclasites in the footwall of a sealing low-angle normal fault

S.A.F. Smith (1), **R.E. Holdsworth** (1), C. Collettini (2) & J. Imber (1)

(1) Reactivation Research Group, Department of Earth Sciences, University of Durham, Durham, DH1 3LE, UK, (2) Geologia Strutturale e Geofisica, Dipartimento Di Scienze della Terra, Università degli Studi di Perugia, Perugia, 06123, Italy (steven.smith@durham.ac.uk)

The Zuccale low-angle normal fault exposed on the island of Elba, Italy, is a crustal-scale structure with a displacement of 6-8km. It contains a pervasively foliated and low-permeability fault core composed of phyllosilicate-rich fault rocks which have been exhumed from 3-6km depth. The fault core contains numerous foliation-parallel extensional detachments which are associated with narrow ($<$5mm) zones of ultra-cataclasis and polished slip surfaces. In the immediate footwall of the Zuccale Fault, cataclasites which were initially deformed by frictional mechanisms have experienced fluidization over areas of at least 10^{-2}-10^{-3} km^2.

Three internal variants of fluidized cataclasite are recognized, with each related to a separate fluidization episode. All three variants of fluidized cataclasite preserve intrusive relationships with foliated fault rocks within the core of the Zuccale Fault. The boundary between the fluidized cataclasites and the fault core has a highly irregular 'cuspate-lobate' nature and is typically warped into a series of meter-scale folds. Fragments of fault core material are found floating within the underlying fluidized cataclasites. On a grain-scale, fluidized cataclasites are characterized by a matrix-supported framework and there is no evidence for the operation of typical frictional deformation mechanisms. Clasts are sub-rounded to sub-angular and are frequently overgrown by carbonate cements. Immediately overlying the fluidized cataclasites, the core of the Zuccale Fault is highly altered and dominated by fresh carbonate growth, indicating

that circulating fluids were rich in CO_2. Additionally, the fluidized cataclasites contain a clast-preferred orientation which indicates that the fluids were moving vertically within the footwall and spreading laterally as they encountered the low-permeability fault core.

Our observations suggest that the fluidized cataclasites are a type of fault rock representative of the interseismic period along the Zuccale Fault. We propose a model whereby fluidized cataclasites develop in the immediate footwall of the Zuccale Fault across small fault patches during build-ups in fluid overpressure. The development of a critical fluid overpressure triggers hydrofracturing and the formation of discrete extensional detachments within the overlying fault core, which may account for the presence and the dimensions (10^{-1}-10^{-3} km^2)of slip patches which are known to produce microseismicity along currently active low-angle normal faults at depth in central Italy.