Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10829, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10829
EGU General Assembly 2008

Thin film coatings and weak fault behavior: New insights from the SAFOD drillhole, Parkfield, California

L.N. Warr (1), A.M. Schleicher (2,3), B.A. van der Pluijm (3)

(1) Ernst-Moritz-Arndt Universitaet Greifswald, Institut fuer Geographie und Geologie, Friedrich-Ludwig-Jahn-Str. 17, 17487 Greifswald, Germany, E-mail: warr@uni-greifswald.de
(2) Universitaet Erlangen, Geologisches Institut, Schlossgarten 5, 91054 Erlangen, Germany
(3) University of Michigan, Department of Geological Sciences, 1100 University Ave, C.C. Little Building, Ann Arbor, MI 48109, U.S.A

Coatings composed of clay minerals are often reported on displacement surfaces in exposed fault zones. Such surfaces are typically smoothed, polished and occasionally slickensided. The occurrence of thin-film clay coating at ca. 2.5 - 2.7 km true vertical depths (or ca. 3.0 - 3.4 km measured depth) in the creeping section of the San Andreas Fault at Parkfield is of particular interest as the precipitation of clays on fault surface substrates may be intimately linked to the unexpected weak fault behavior of this crustal scale structure. The small, platy particles of mixed-layered smectite minerals are of particular interest due to their large surfaces areas, hydrated interlayers and strong orientation produced by substrate growth on displacement surfaces. A hypothesis is presented which explores the possibility that the majority of slow creep occurs along heterogeneously distributed micron-scale thin films and was accommodated by a combination of three mechanisms 1) slip along particles surfaces, 2) displacement along hydrated interlayers and 3) intracrystalline deformation of the clay lattice possibly associated with repeated nucleation and growth. The role of cation exchange reaction, related changes in hydration state and associated fluid pressure changes are additionally considered. Based on nanoscale observations of microstructure by transmission electron microscopy of the clay films, an attempt is made to quantify these mechanisms to evaluate if these micro-shear plans can accommodate the up to 28 mm

yr-1 creep that characterizes this segment of the San Andreas Fault. Our results reveal the importance of thin clay film deformation in the active Parkfield section of the fault, and suggest that much of the weak fault and creep behavior of this crustal scale structure can indeed be attributed to highly localized precipitation of hydrous phyllosilicate clays along displacement surfaces.