Geophysical Research Abstracts,
Vol. 11, EGU2009-5208, 2009
EGU General Assembly 2009

Initiation of and distributed deformation at and around stylolite interfaces: Insights from detailed microstructural analysis

M. Ebner (1), S. Piazolo (2), and D. Koehn (1)

(1) Tectonophysics, Institute of Geosciences, University of Mainz, Mainz, Germany (ebnerm@uni-mainz.de), (2) Department of Geology and Geochemistry, Stockholm University, Stockholm, Sweden (sandra.piazolo@geo.su.se)

In the present contribution we investigate the microstructure of bedding parallel and bedding normal stylolites in carbonate rocks. We focused our study on micro-stylolites which represent an initial stage of this localised pressure solution process as stylolite roughness amplitude is a function of strain. We use electron backscatter diffraction analysis (EBSD) and orientation contrast imaging to address the following issues: (i) What causes the initiation of stylolite interfaces at a submicroscopic scale, (ii) is there distributed deformation around the stylolite interface and (iii) what is the role of the interface (residuum)?

Our findings demonstrate that the characteristic stylolite teeth are initiated at a pre-existing heterogeneity in the host-rock. This quenched noise in carbonate rocks is typically composed of clay particles in the submicron scale. In addition, qtz-grains are present along especially pronounced stylolite peaks. The stylolite interface evolves with increasing strain from individual clay particles separated by grain-grain contacts of calcite along the interface to a continuous layer of clay and oxides. Thickness variation of the residuum along the interface is inferred to be strongly influenced by the pre-existing distribution of pinning particles that are more resistant to dissolution. Another important observation is that a shaped preferred orientation (SPO) exists in a halo around the stylolite. This SPO increases with proximity to the stylolite interface. Within this halo, crystal plastic deformation is expressed by subgrain formation with subgrain boundaries usually aligned parallel to shortening direction. Bedding normal (tectonic) stylolites which overprint already compacted beds i.e. with a pre-existing sedimentary SPO parallel to the bedding plane exhibit a SPO at a high angle to the sedimentary SPO.

We conclude that stylolite roughness is primarily caused by pre-existing heterogeneities in the host-rock which are more resistant to dissolution e.g. clay particles and/or qtz grains. Secondly, we demonstrate that stylolite formation is not a process that is restricted to the stylolite interface itself but a process that is active in a broader zone around the actual interface.