The effect of mica on pressure solution of single crystal calcite

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Clays and micas are known to accelerate the rate of pressure solution in various geomaterials. It is not clear however whether clays exert merely a mechanical effect (i.e., maintaining a thick conduit for fluids at the contact) or whether their surface chemistry plays a critical role. A case in point is the insoluble clay filling of stylolites, which are thought by some to be merely an inert byproduct of dissolution, while others consider it to be a necessary feature for the propagation of the seam.

To study the "clay effect" on pressure solution, we polished the corner of a cleaved calcite single crystal rhomb into a triangular face (edge length ~ 200μm) and pressed it against either muscovite or quartz discs to yield nominal contact stresses of 10-20MPa. Immersing the contact in pre-saturated (with respect to microcrystalline calcite) solutions of distilled water or 0.25M NH4Cl caused axial shortening of the crystal, which was measured with a capacitance sensor (<0.5nm/h resolution). Contact morphology was imaged *in situ* with a confocal microscope (~ 3μm spatial resolution).

In pre-saturated water solution the axial shortening of calcite loaded against muscovite is ~1nm/h, and no significant changes in contact morphology are detected. In pre-saturated NH4Cl solution however, both calcite-quartz and calcite-muscovite contacts evolve in two stages: the first stage is characterized by low axial strain rates (<5nm/h) during which the original contact area inside the triangle (as determined by interference fringes) shrinks and its perimeter roughens. The second stage is distinguished by high axial strain rates (~40nm/h) and changes in the size and spatial position of isolated contacts (diameter< 10 microns) in a dynamic channel-island morphology covering the entire triangular region. Post-experiment SEM analysis suggests dissolution in this region and precipitation on the free faces adjacent to it. At this point we see no significant difference between the calcite quartz and calcite muscovite experiments under similar load conditions.

Trace element and Nd-isotopic compositions of the Neoproterozoic clastic sedimentary rocks of the Ikorongo Group, NE Tanzania: Implications for provenance, palaeoweathering, mineral sorting and post-depositional processes

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The north-eastern part of the Archaean Tanzania craton is unconformably overlain by a Neoproterozoic clastic sedimentary cover, namely the Ikorongo Group. The Ikorongo Group is comprised of conglomerates, quartzites, shales, siltstones, red sandstones with rare flagstones and gritstones and is regionally subdivided into four litho-stratigraphic units: the Makobo, Kinenge, Sumuji and Masati Formations.

Geochemical data from the mudrock samples (i.e., shales and siltstones; $N = 54$) indicate derivation from cratonic sources that formed by intra-crustal differentiation. Initial ε_{Nd} values of – 27.4 to – 38.1 and T_{DM} ages (2.2 – 2.9Ga) for the mudrock samples ($N = 10$) confirm derivation from the Musoma-Mara Greenstone Belt (MMGB) of the Archaean Tanzania craton. The ranges in T_{DM} ages, however, provide insight into the participation of a relatively juvenile crust and/or progressive younger periods of magmatism in the source terrains.

The similarity in the Nd-isotopic compositions between the source rocks and the Ikorongo mudrocks indicate that Nd signatures of the sediment sources are unaffected by factors such as weathering, heavy mineral sorting and post-depositional processes.