



Reaction Induced Shear Localization: the Example From Torsion Experiments on Dolomite.

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We performed torsion experiments using a Paterson rig apparatus on cylindrical (diam. = 1cm; H = 1cm) samples of natural specimen of pure dolomite (<0.3 wt % of impurities on XRF analysis), drilled on a block of the Dolomia Principale from Mt. Frerone (Adamello, N-Italy).

Experiments were run at 800°, 300 MPa confining pressure under both vented and closed conditions, up to a bulk strain of about $\gamma = 1$, at different strain rates ($3 \cdot 10^{-5} \text{s}^{-1}$ up to $1 \cdot 10^{-4} \text{s}^{-1}$).

In the open system deformation was localized near both porous spacers placed at the extremities of the specimen, corresponding to the zone where dolomite broke down into a fine grained mixture of calcite and periclase according to the reaction:



At these conditions the nominal equilibrium PCO_2 should be around 70 MPa (Graf and Golsmith, 1955), but at the spacer interface the CO_2 was free to escape, triggering the reaction.

On the other hand, in the central part of the sample, the reaction occurred only along the grain boundaries of the dolomite grains. Due to the low permeability pore fluid could not escape building up CO_2 pressure which deactivated the reaction. Here deformation was accommodated by brittle shear bands in synthetic Riedel geometry, consistently oriented with the sense of shear; these bands do not extend up to the sample extremities.

Reaction products were identified using X-Ray diffraction technique, giving a molar

proportion very similar to the one expected from the theoretical decarbonisation reaction. T.E.M. analysis is currently being performed to visualize the eventual shape or lattice orientation of the fine grained products.

We conclude that the decarbonation reaction produced a weaker matrix in which deformation could localize. Moreover, the very fine grain size was probably produced during the decarbonation reaction, and was kept small by the deformation due to pinning between the different phases.

Graf, D. L. and J. R. Goldsmith (1955). "Dolomite-magnesian calcite relations at elevated temperatures and CO₂ pressure." *Geochimica et cosmochimica acta* 7: 109-128.