

The effect of P_{CO_2} on the high temperature behavior of dolomite: insights from deformation experiments

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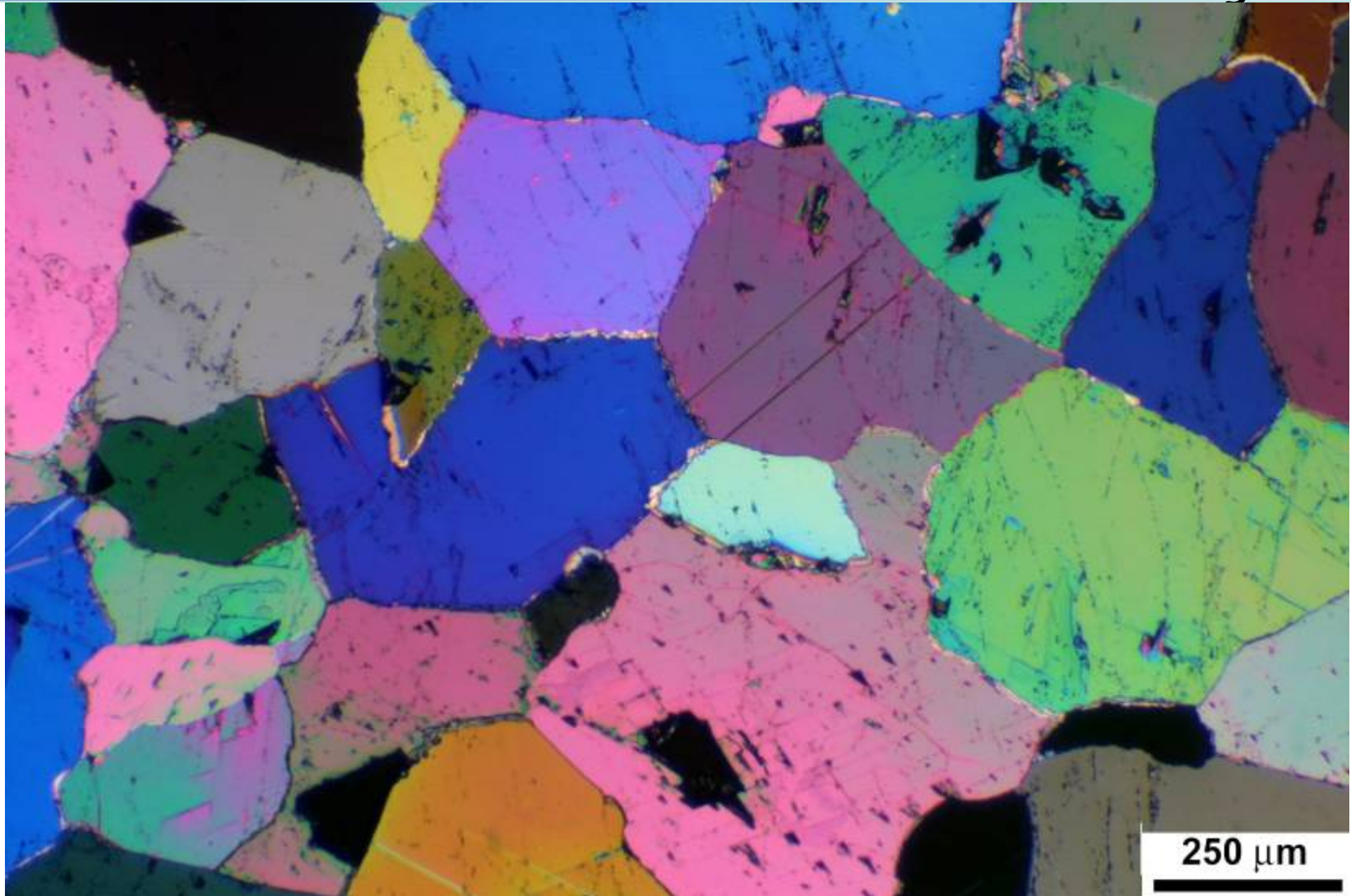
Goals

Infer the influence of decarbonation reaction on:

- mechanical response of deforming rocks
- fluid transport properties
- micro-seismicity

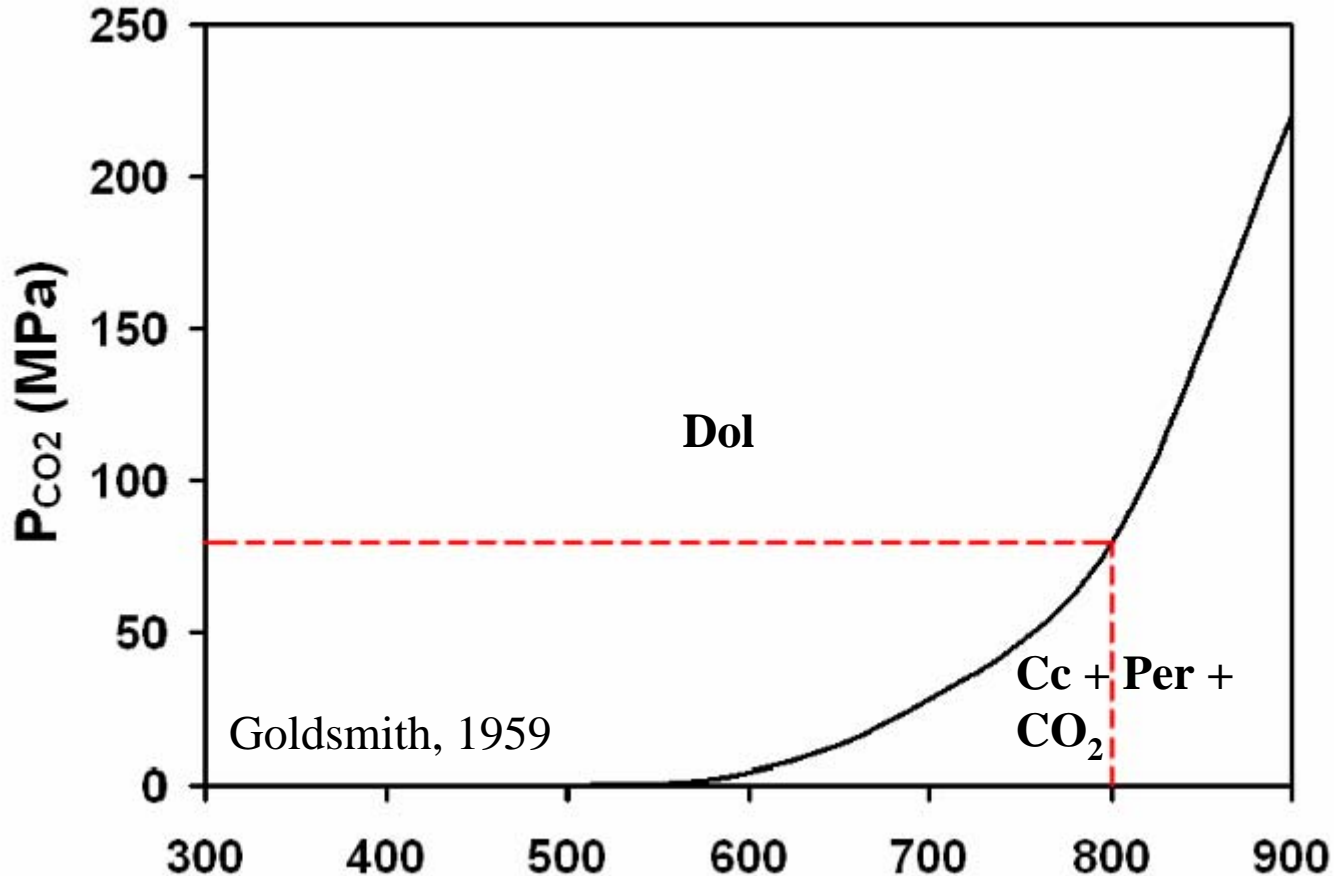
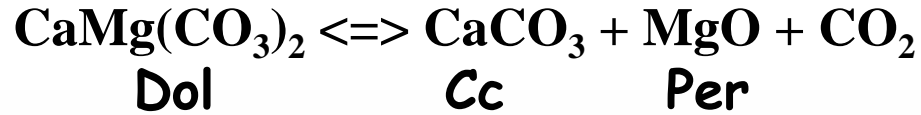
Methods

- Large strain experiments on a reacting system
- Microstructural characterization of the deformed samples
- Acoustic emission measurement during static HT/HP experiments

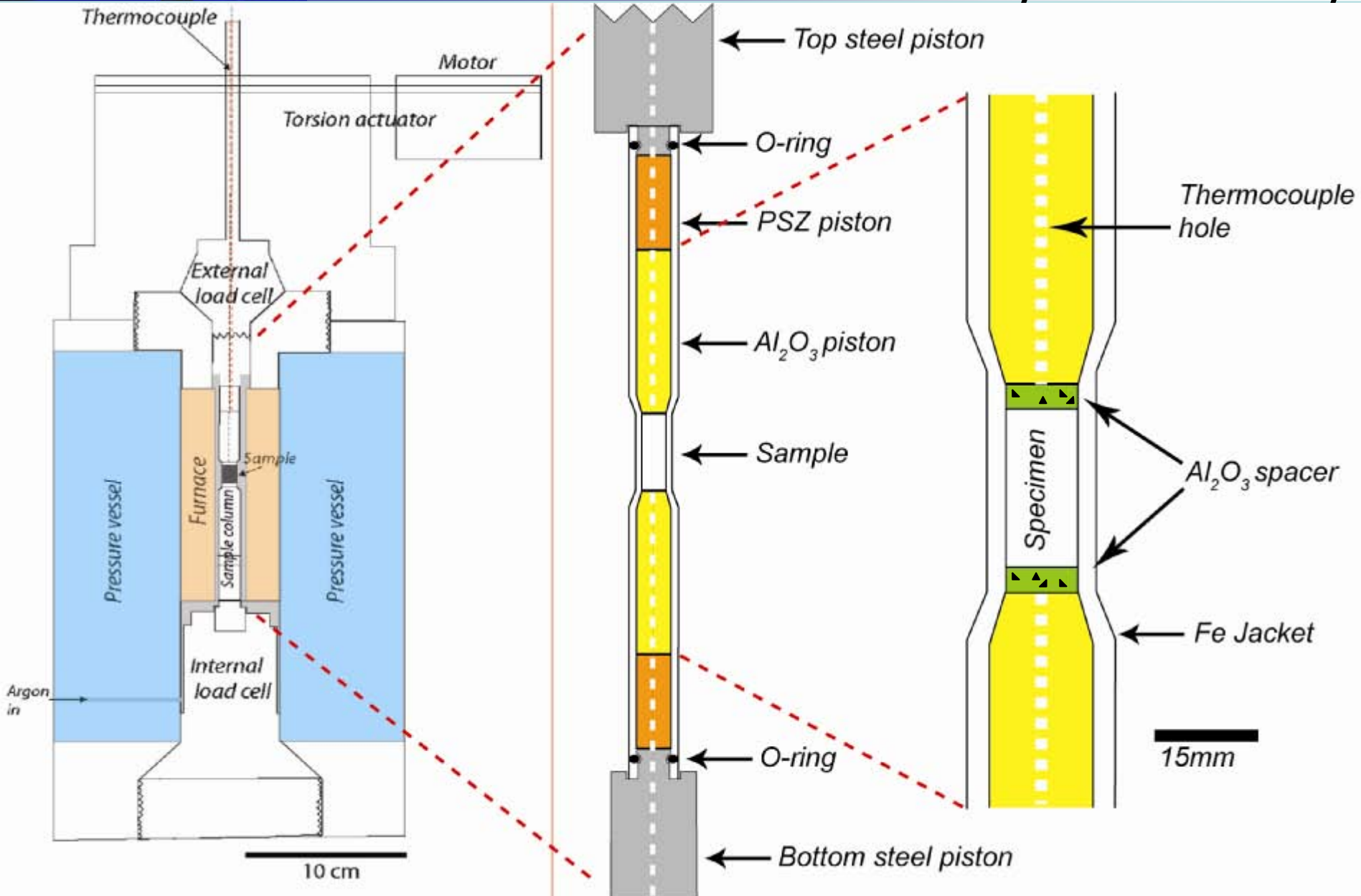


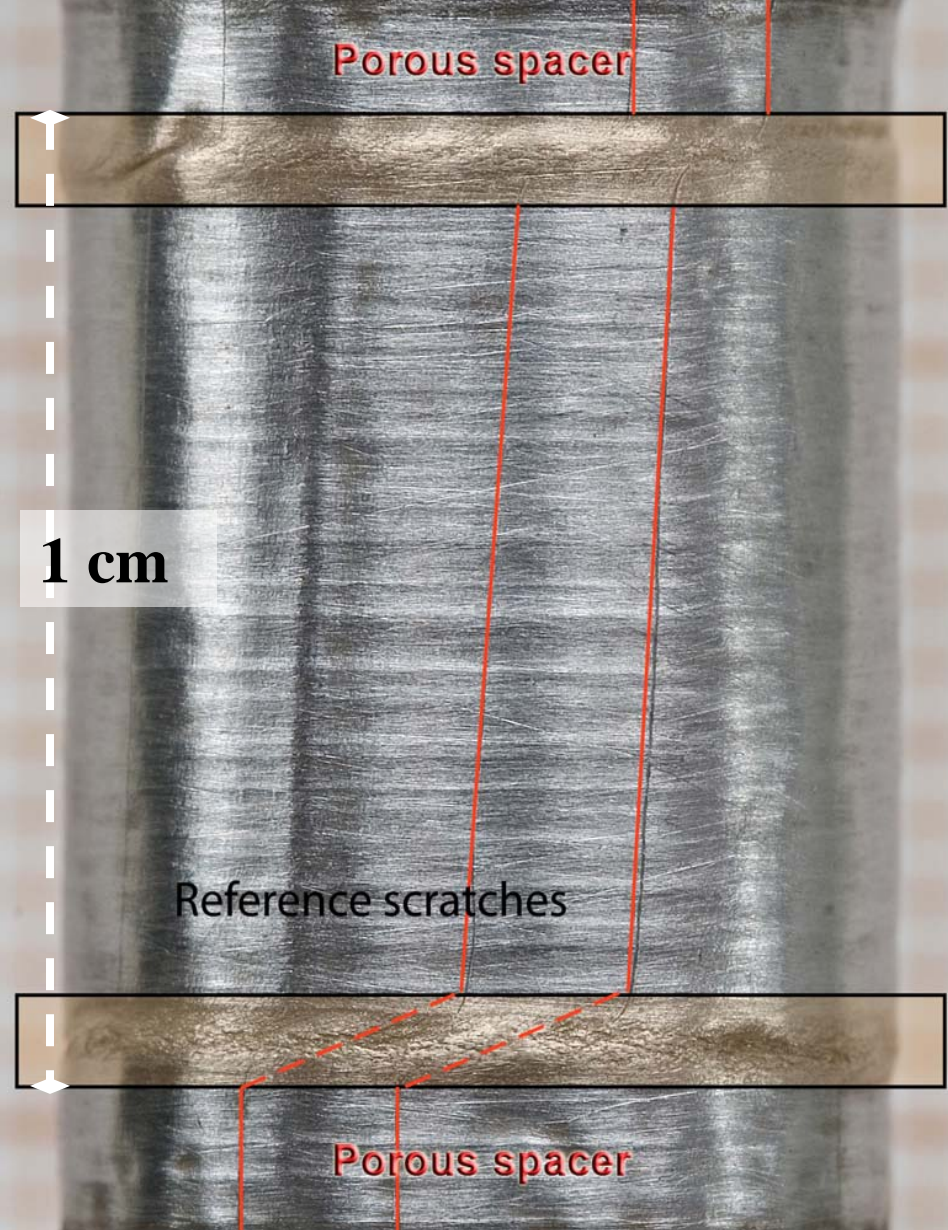
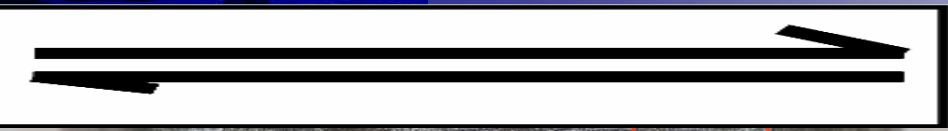
X-Ray Fluorescence and single-point microprobe analyses show that the dolomitic marble is very pure with almost stoichiometric composition

Dolomite decomposes according to the reaction:



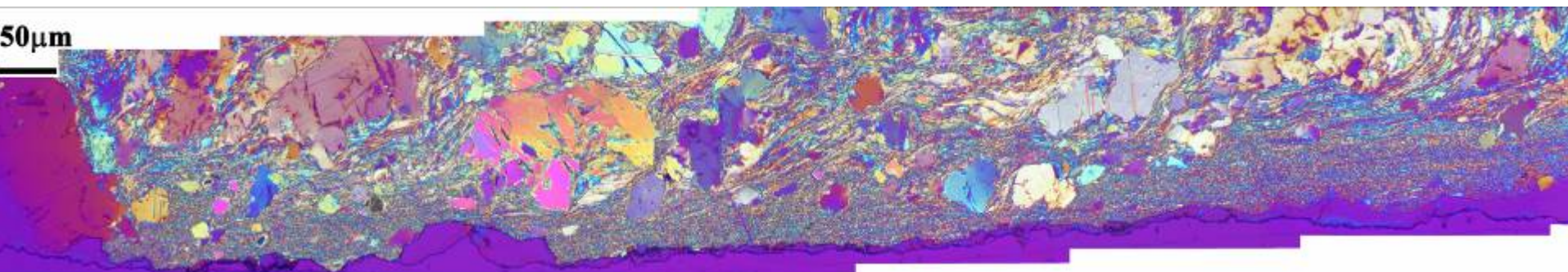
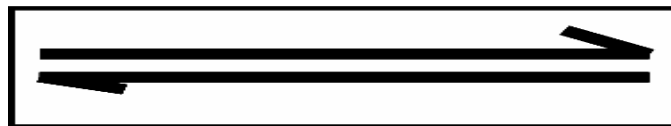
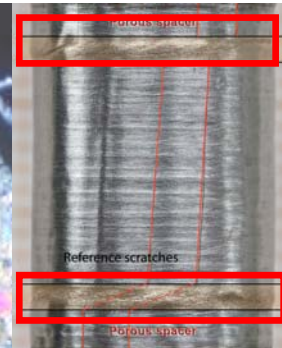
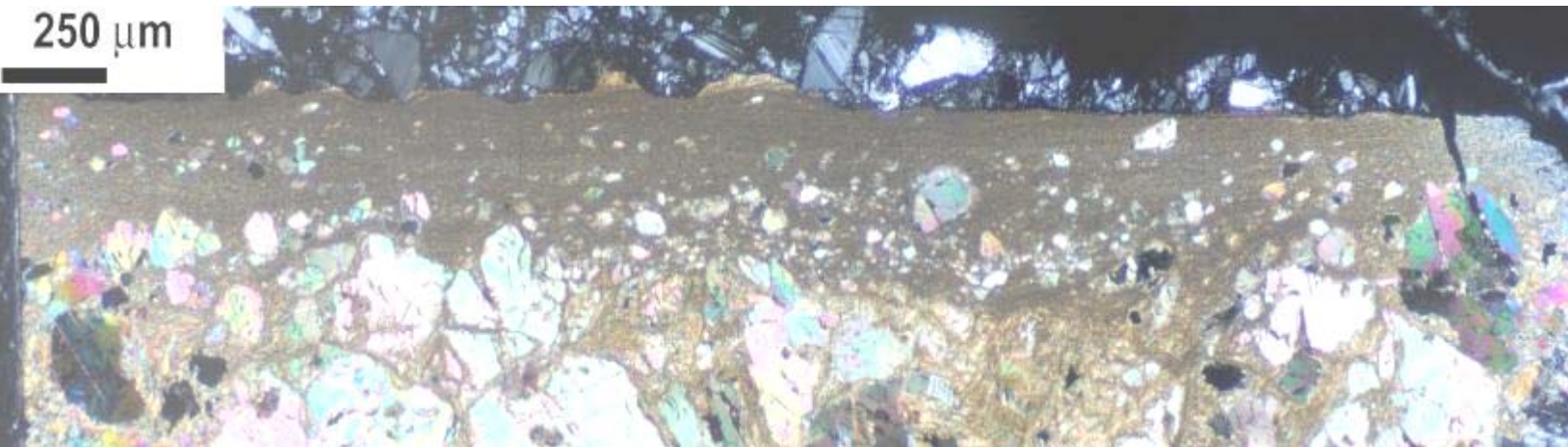
The kinetic of the reaction is controlled by the partial pressure of CO₂





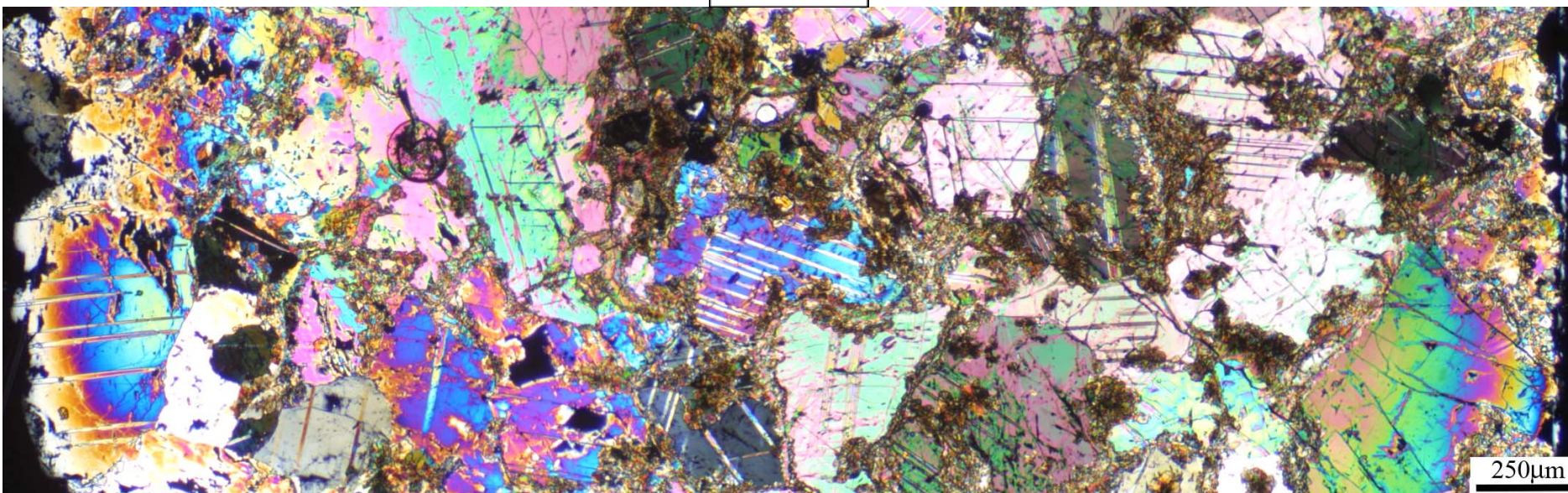
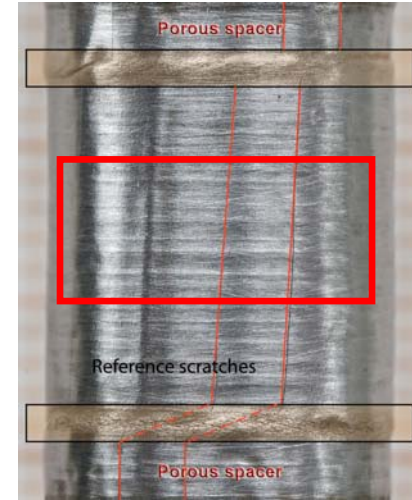
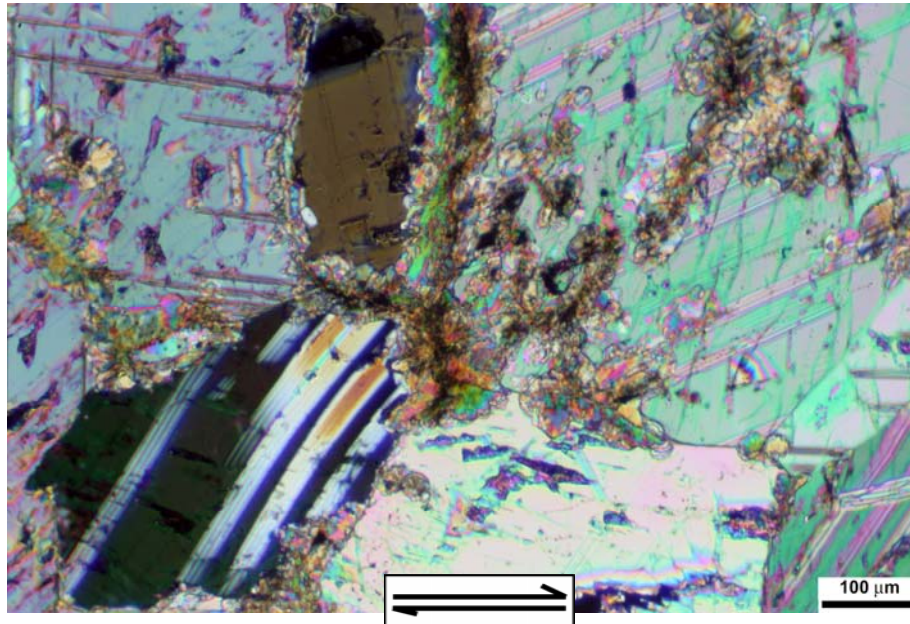
After the experiments deformation is highly non-hogeneous along the sample

Zones of localized deformation

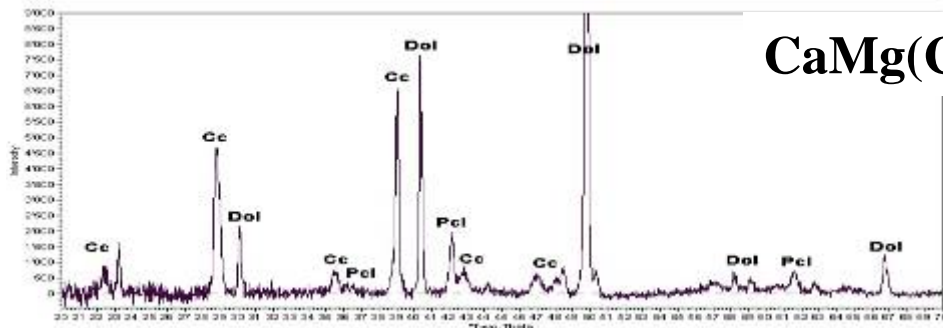
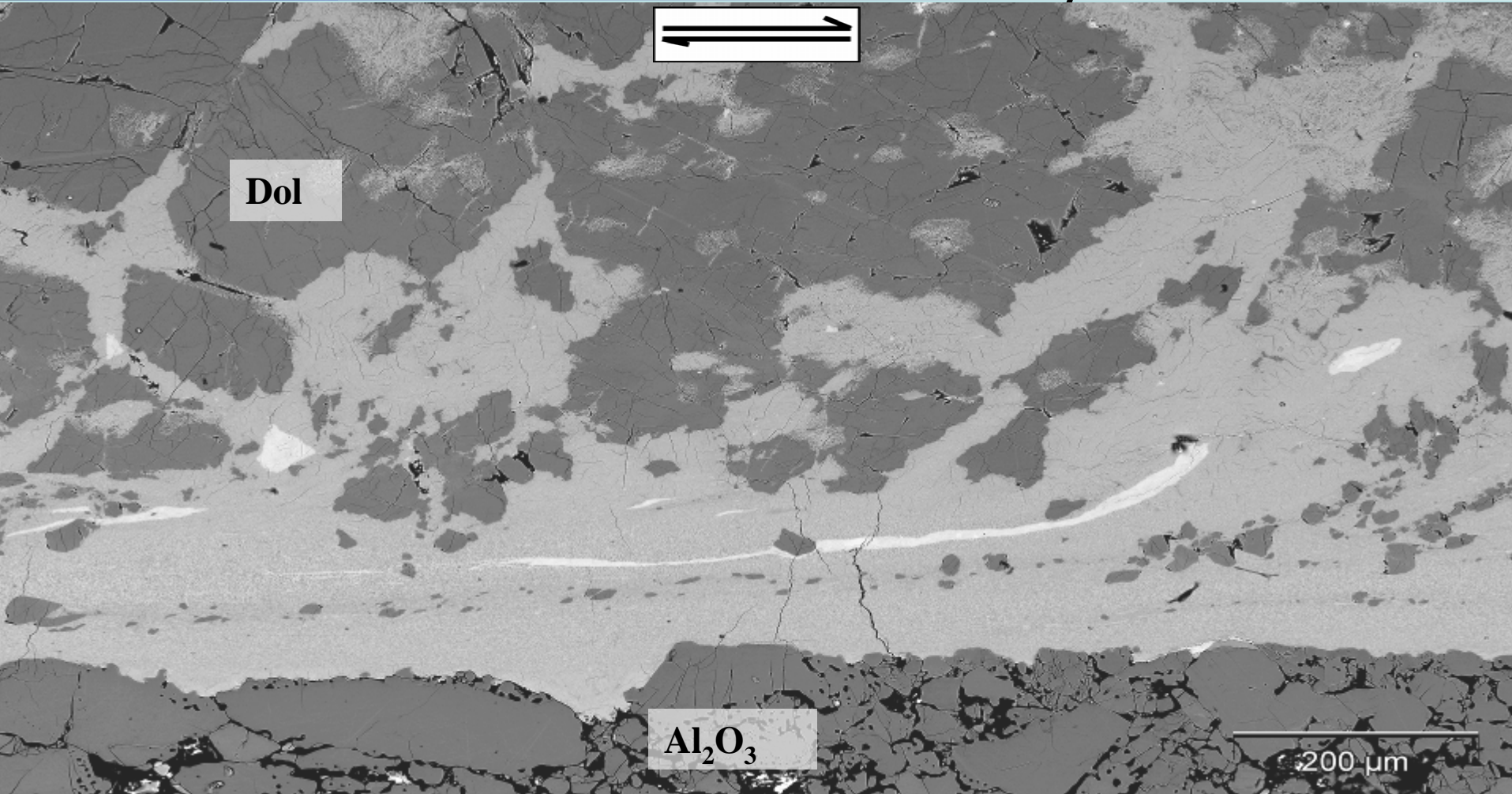


Localised shear bands occur in zones of grain size refinement

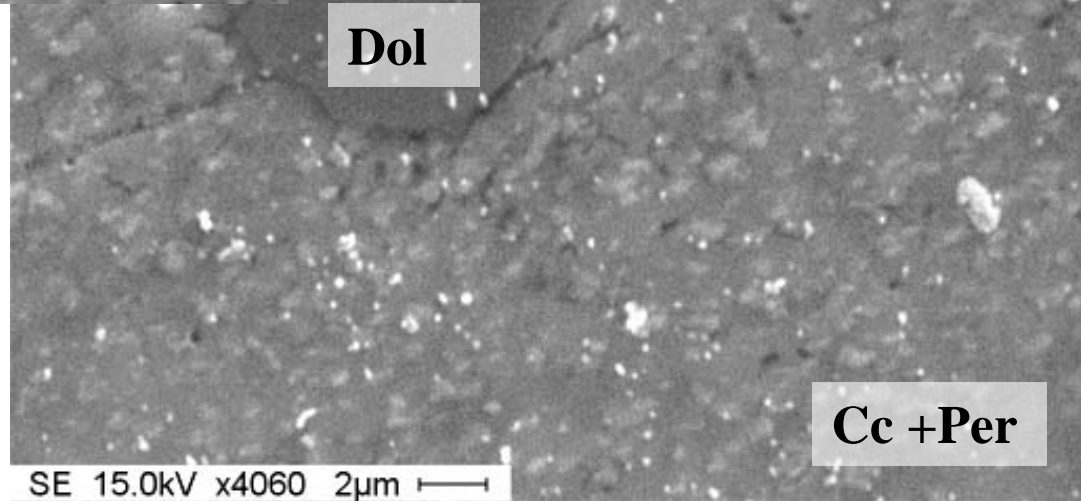
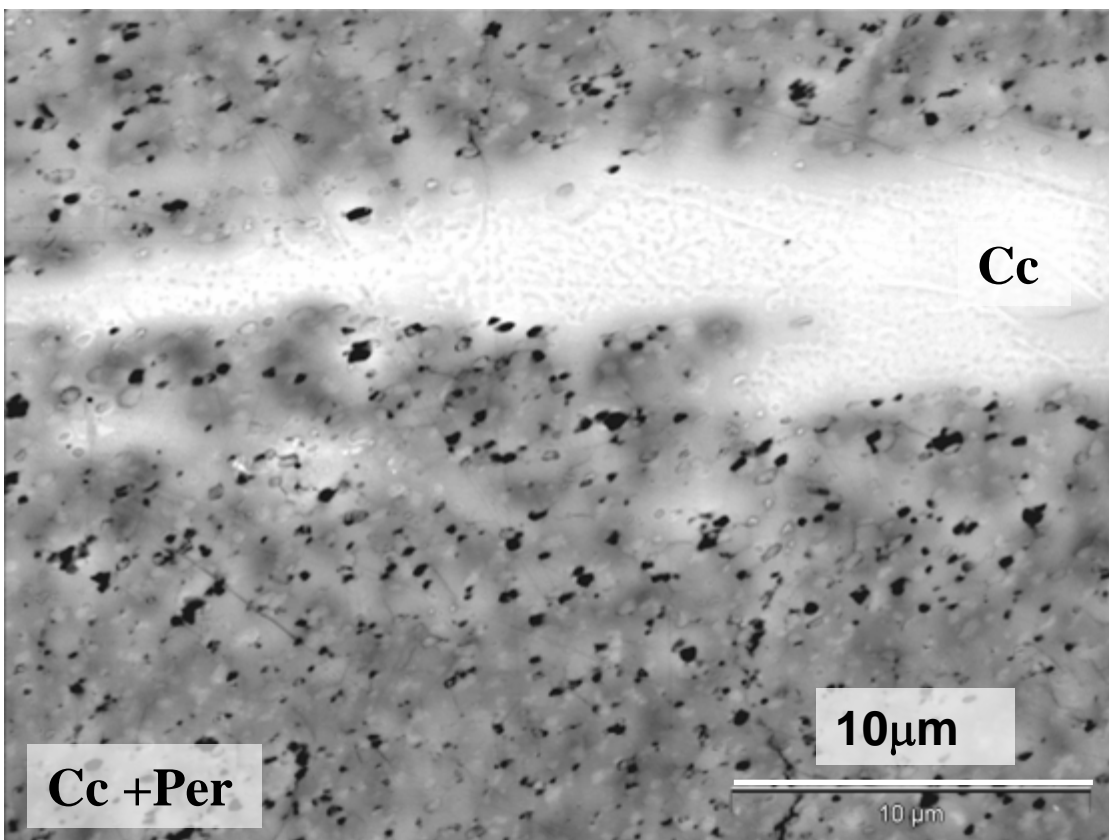
Dolomite: deformation microstructure



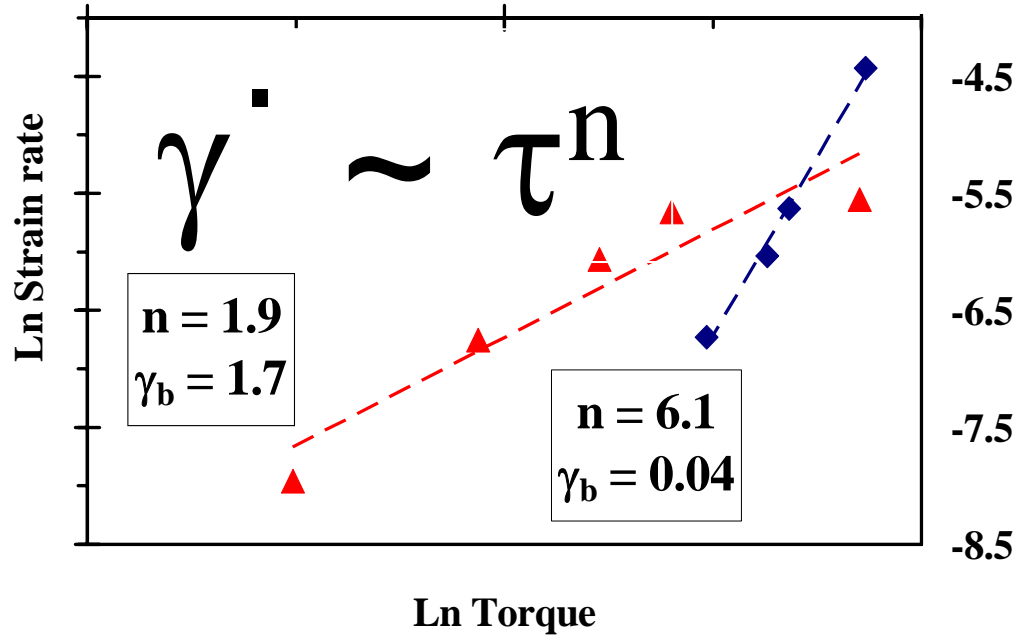
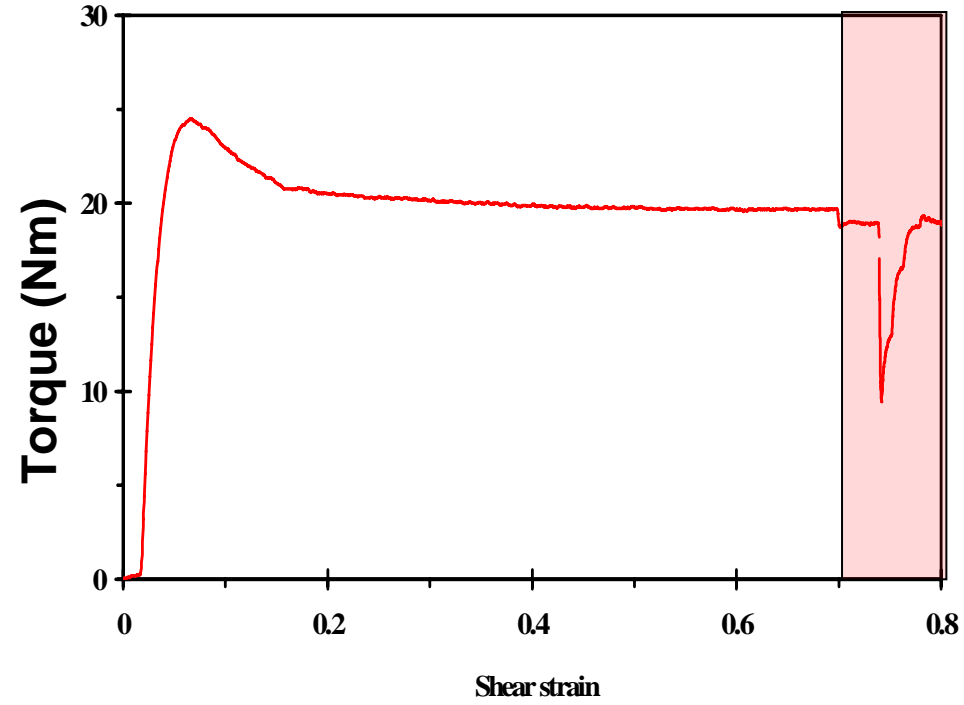
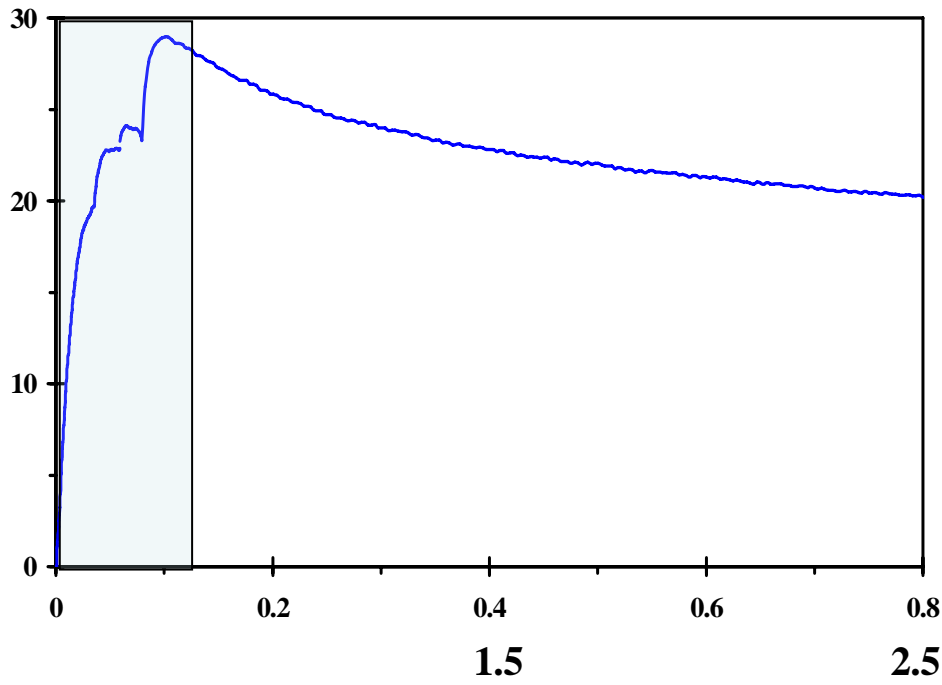
The core almost non-deformed part of the sample presents evidence of intracrystalline deformation and microcracks

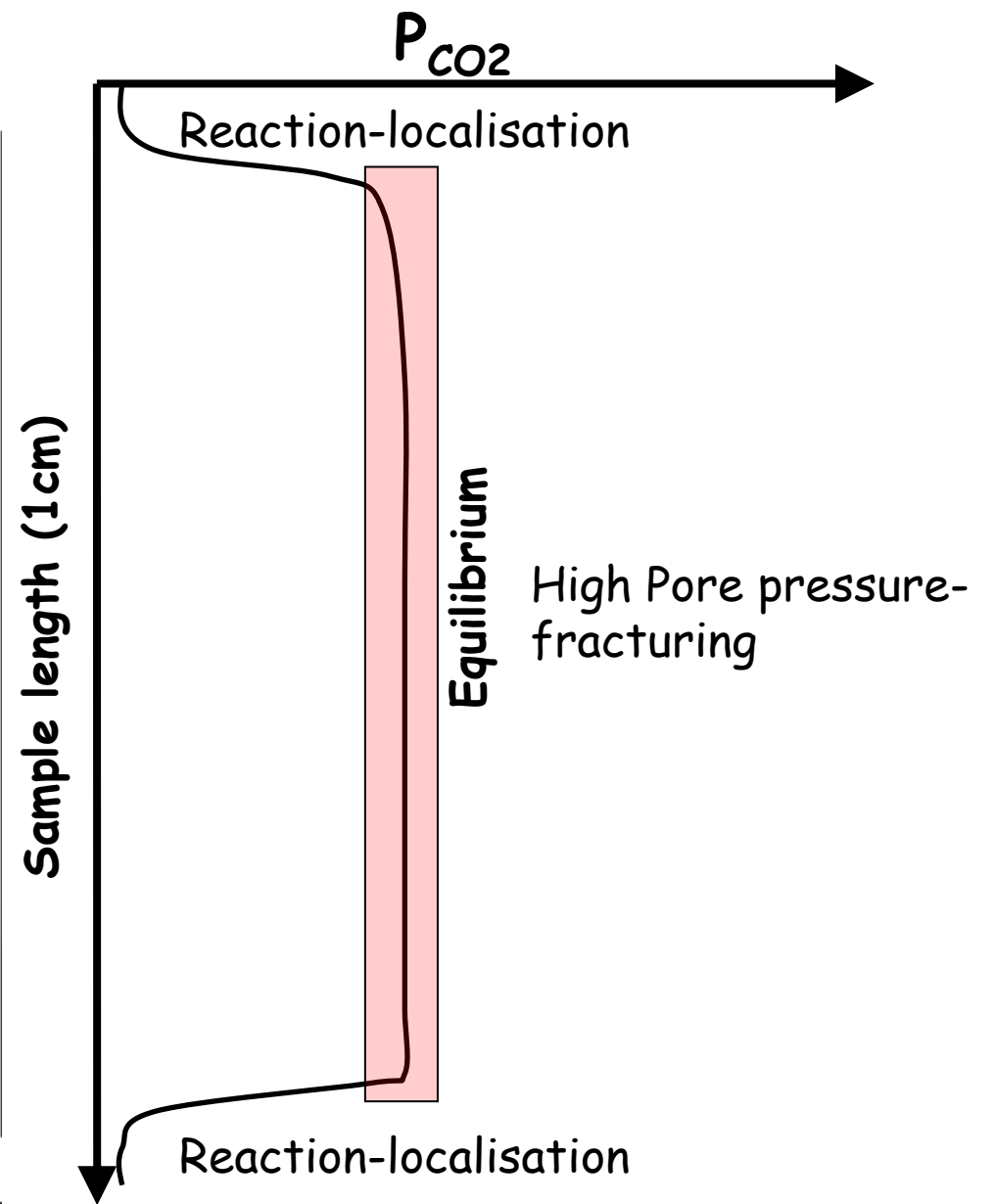
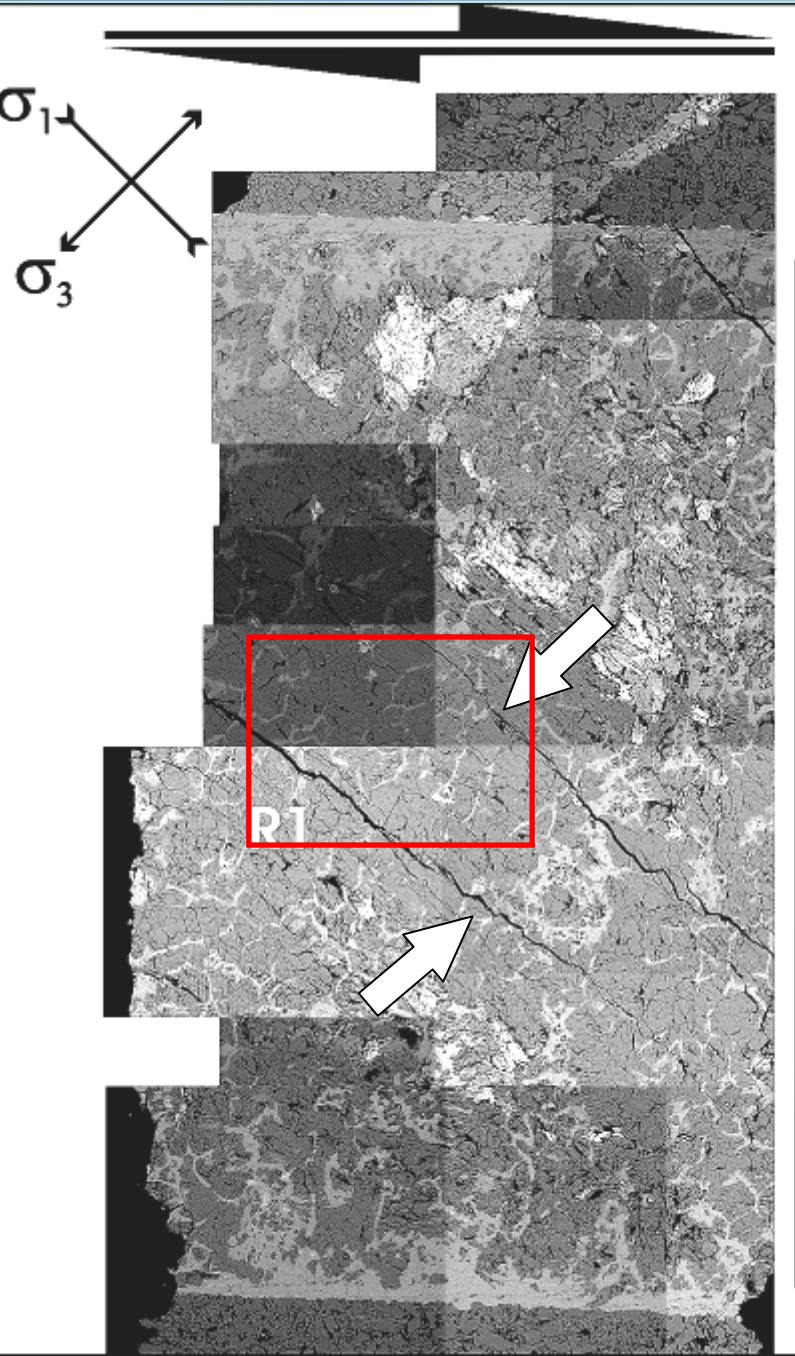


XRD pattern indicating presence of calcite, periclase and dolomite

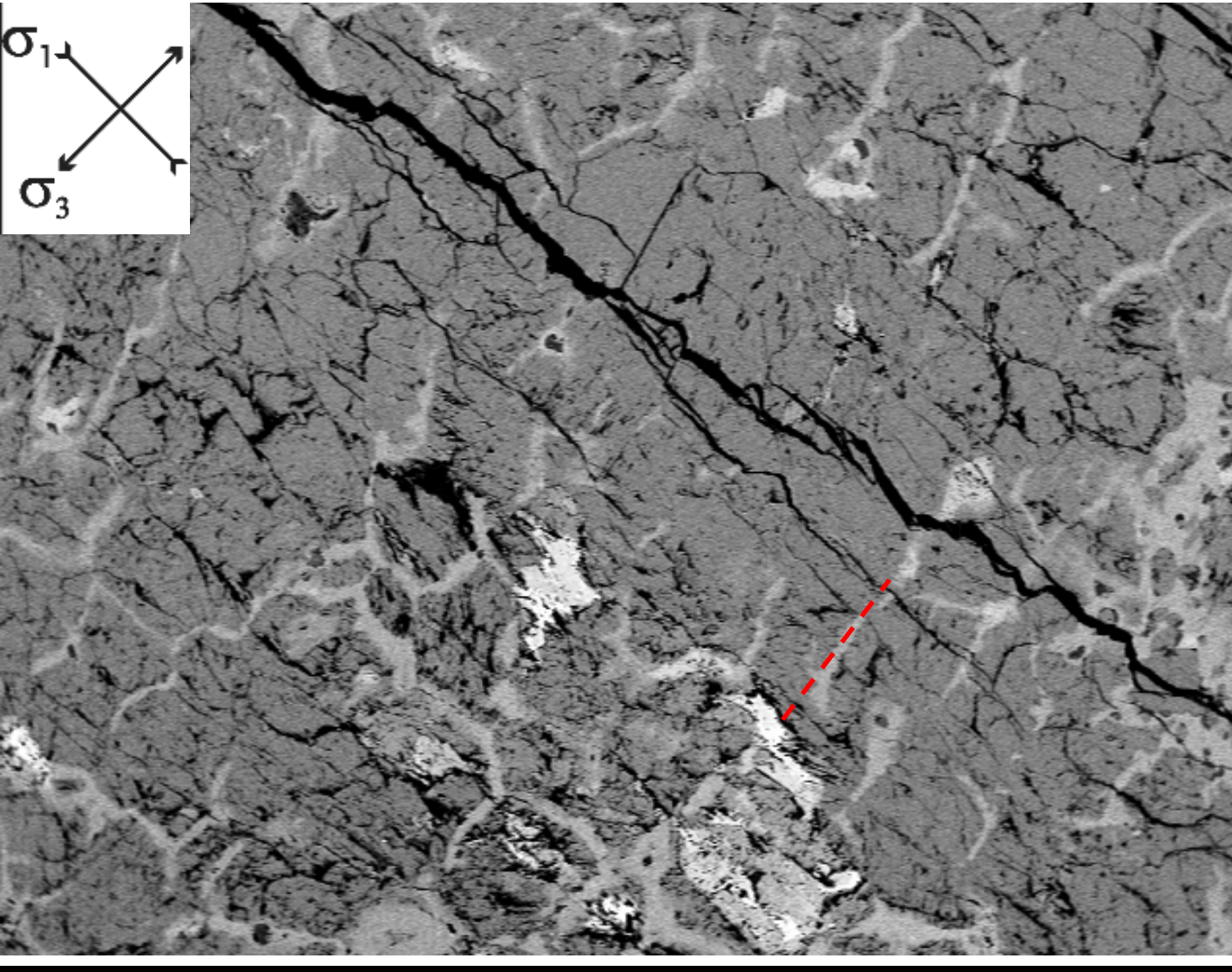


Ultra fine-grained new phases



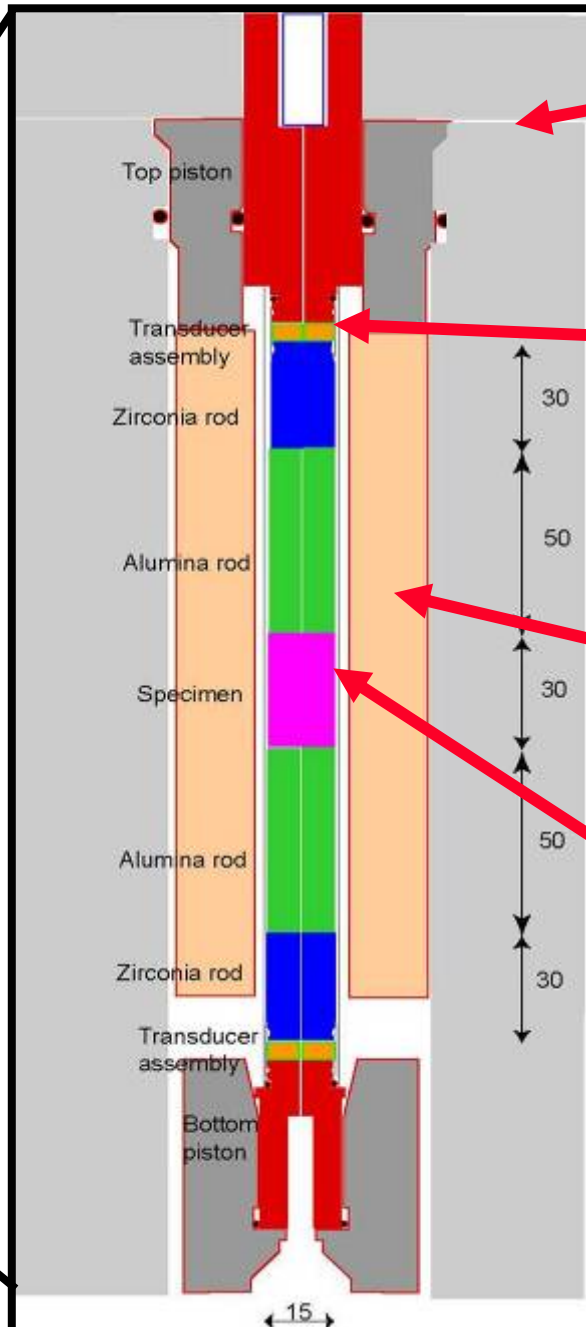


Solid volume decreases by ca. 25% due to the decarbonation reaction



250 μ m

Sample assembly



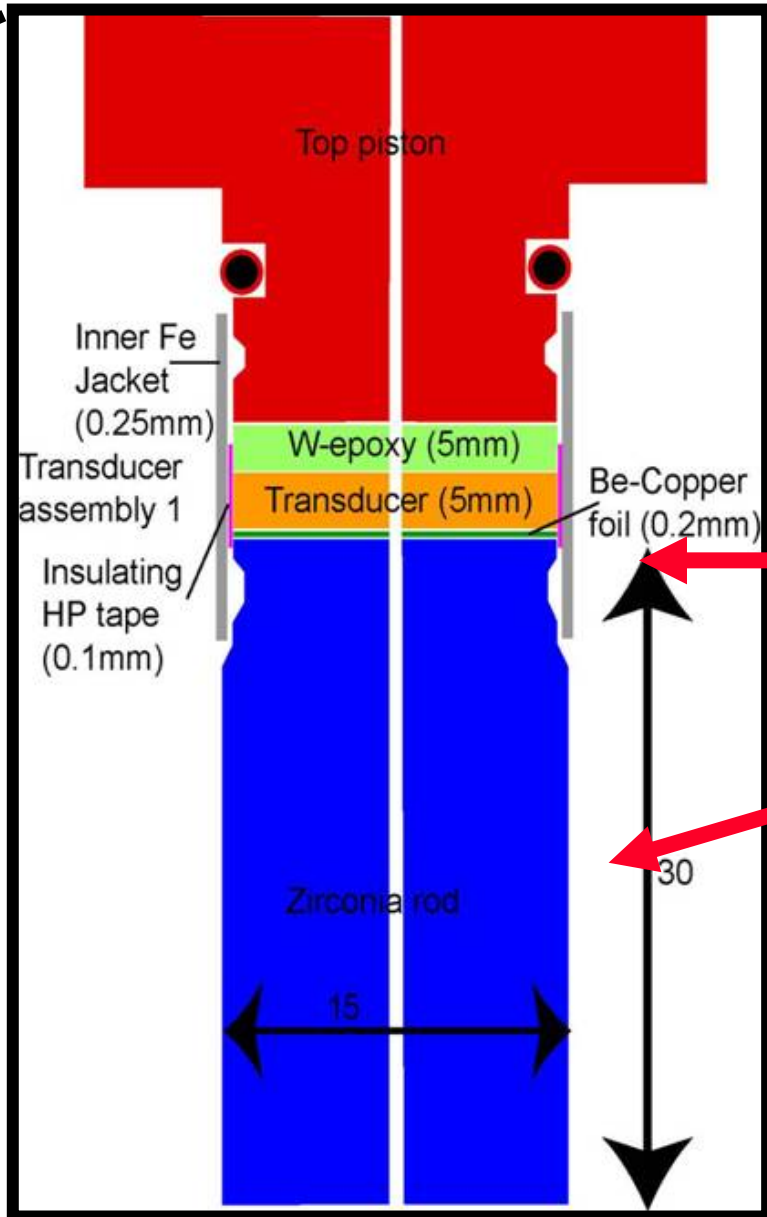
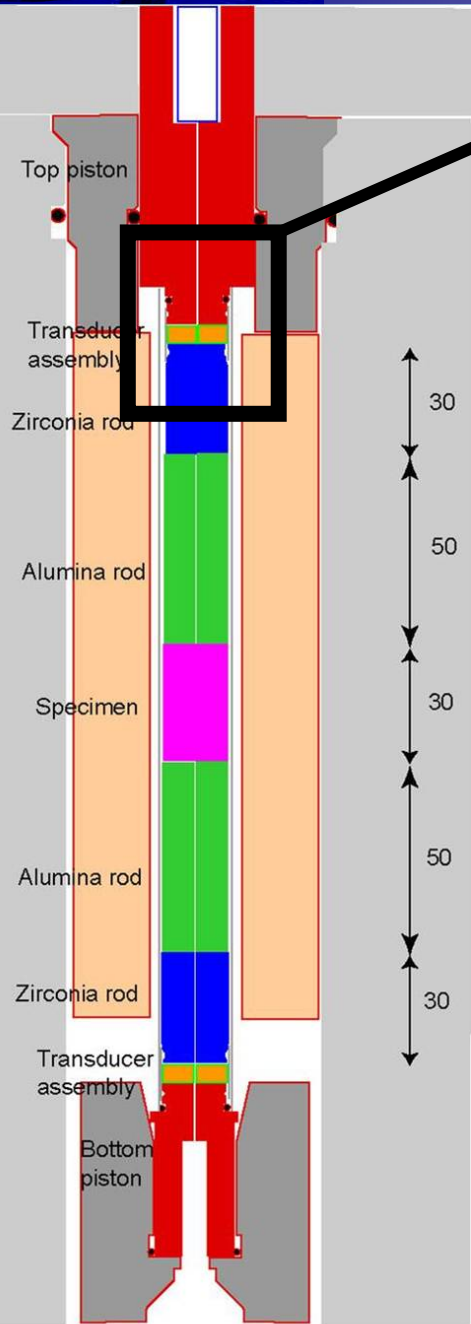
Pressure vessel

AE trasducer

Furnace

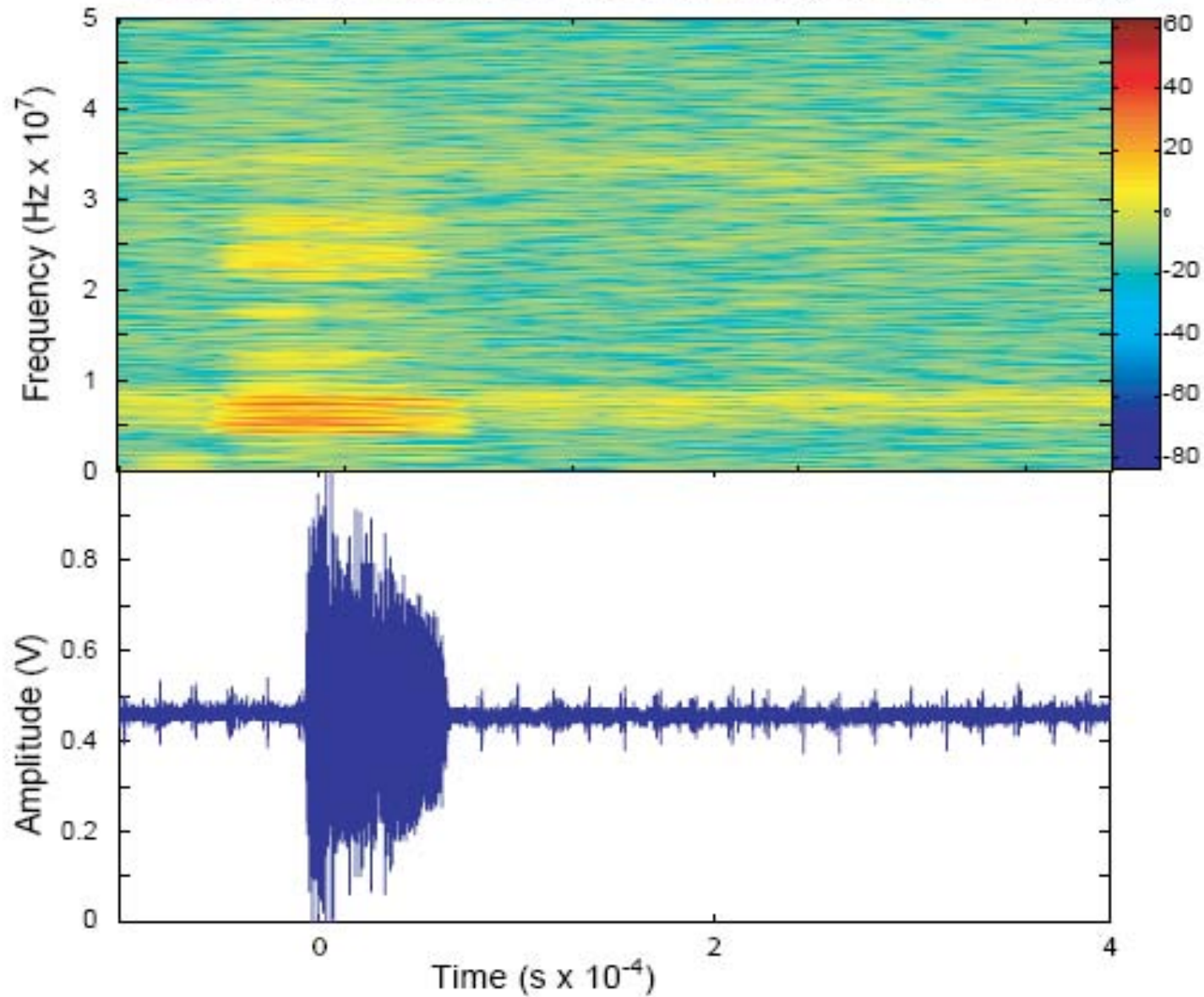
Specimen

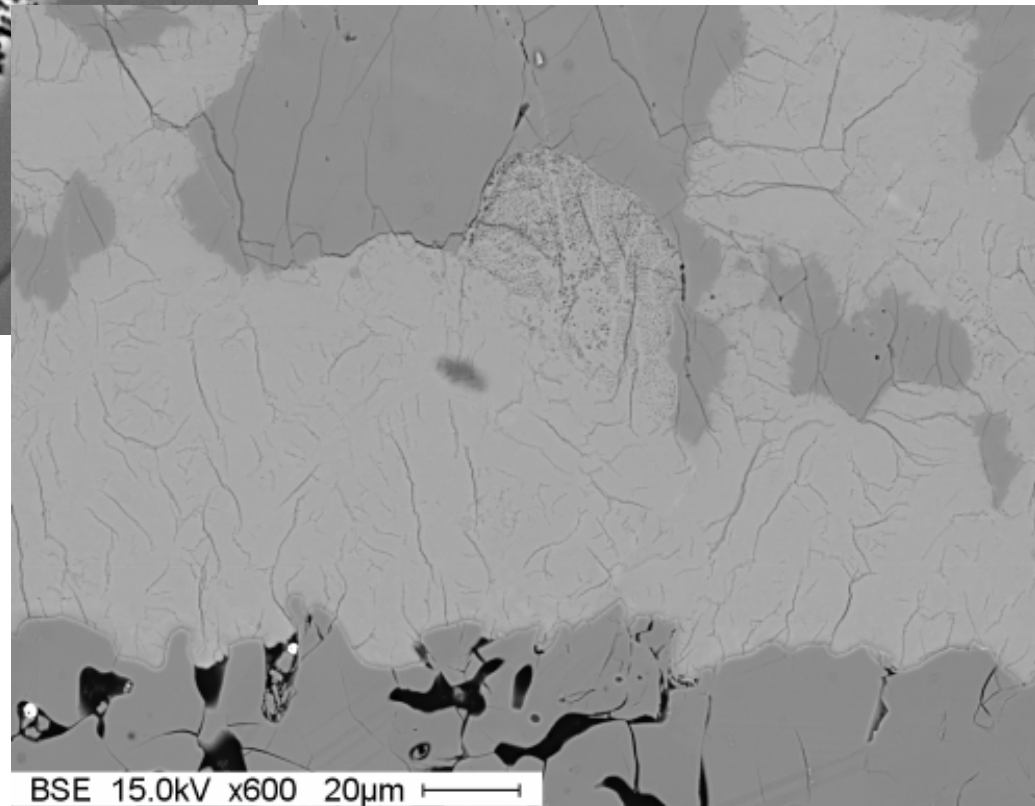
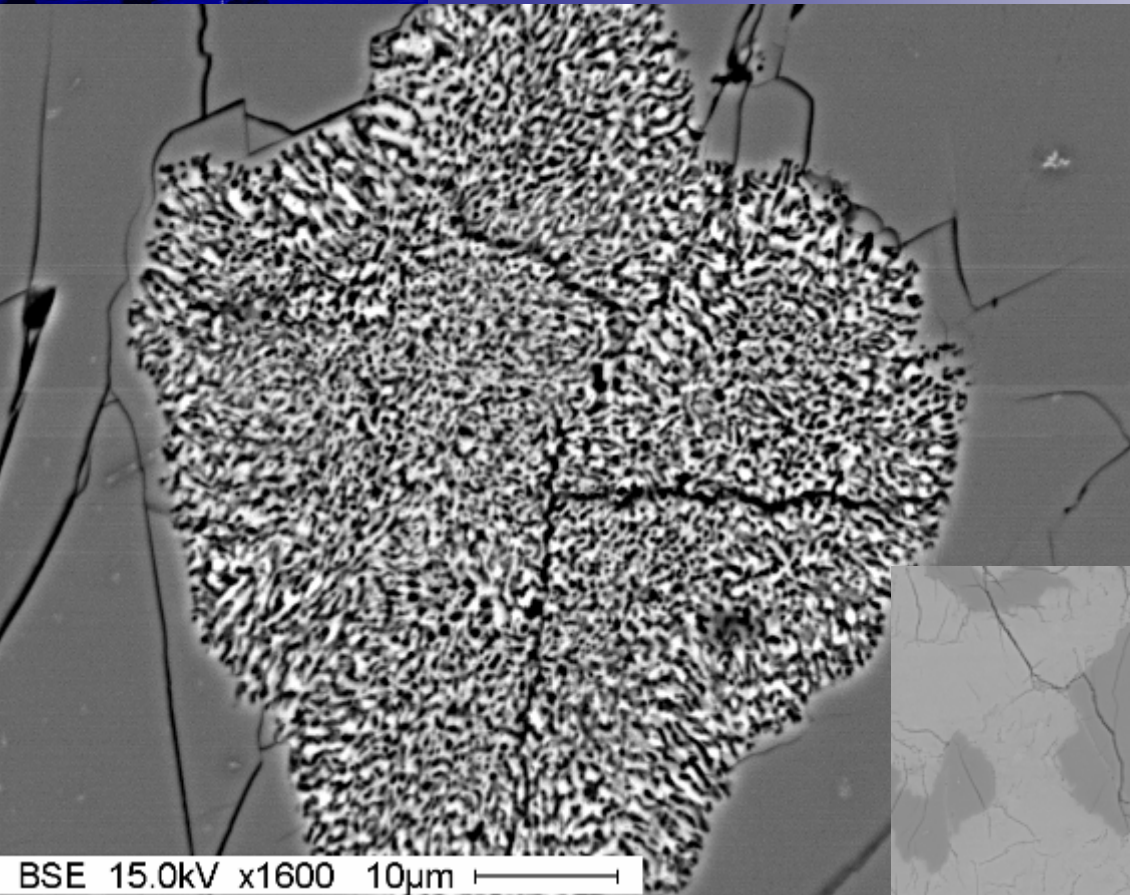
AE transducer (works up to 200 °C)



Zirconia rods
(therm. insulation)

CO₂ Degassing (Decarbonation, open system)





- Natural dolomitic marble was deformed **drained** conditions during decarbonation reaction. The reaction progress is controlled by the CO₂ pressure gradient along the sample
- **Sub-micron size products** are found at the interfaces between the sample and the porous Al₂O₃ spacer
- **Strong strain partitioning** occurs between the reacted and non-reacted portions of the deformed samples.
- Stress exponent evolves with strain towards values close to 1, suggesting an increasing contribution of **grain size sensitive** mechanisms in accommodating deformation as reaction progresses.
- Localisation is driven by **weakening** due to grain size refinement associated to the decarbonation reaction
- Solid volume reduction is responsible for **compaction bands** formation
- AE associated with **pore collapse** and **fluid migration** under hydrostatic conditions