Type of presentation: Invited

MS-13-IN-2076 Imaging and reading micro-to nano-structures of hydrated rocks and mollusc shells: geomineralization versus biomineralization

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We plan to characterize and interpret the microstructures to nanostructures of abiotic and biogenic minerals with the different imaging, microanalytical and diffraction techniques offered by present-day available nanoscopes. Among them, transmission electron microscopy (TEM) will play a central role.

Serpentine minerals are the product of hydration of the upper mantle rocks by percolating sea water. Their wealth of flat and curved microstructures contrasts with a poor chemical variability. When combined to experimental data these mainly metastable microstructures and their texture may serve to trace back semi-quantitatively temperature paths followed during hydration. In an ophiolite serpentinized at medium-to-low-T, the replacement of anhydrous silicates (olivine and pyroxenes) by lizardite is fully pseudomorphic as the result of an interstitial dissolution/crystallization process in which chemical exchanges in the interfacial fluid are allowed via nanoporosity in the daughter minerals. Interfacial crystallisation from gel as close-packed chrysotile nanotubes also occurs in coeval “crack-seal” veins. Early mineral alteration occurs in independent nanosystems in which local reactions may be written from co-existing solid, relictual and neoformed, nanophases present.

Most shells of molluscs are multiscale composites combining calcite or aragonite crystals and organic matter, from mm scale down to the nm scale as shown here by TEM. Among bivalves and gastropods it will be shown how the carbonate polymorph, the species-specific shell shape and microstructures are mostly, but not fully, controlled by organics. Submicronic granules are ubiquitous bio-units of mineralisation. Organic nodules, fibers and envelopes as extracellular matrix secretions from mantle cells, insure nucleation, crystal propagation and shaping, respectively.

Though belonging to the distinct geo- and bio-worlds, the above two cases share in fact common features: interstitial growth from a gel and tailored shape of the resulting crystals or texture. However biomimetic materials with outstanding functional properties will be within reach only when biogenic crystallisation process(es) will be better understood.

Acknowledgement: Acknowledgements

We warmly thank Françoise Boudier (Géosciences Montpellier), Olivier Grauby (CINaM) and Julius Nouet (IDES, Orsay) for their decisive contributions to this work.