

A tool box for characterising chalk

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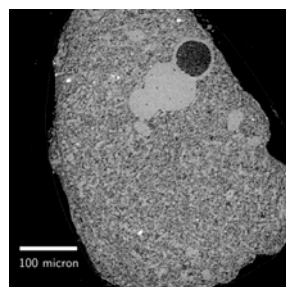
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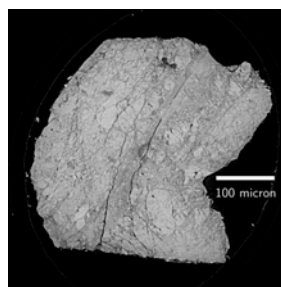
Porous rocks are our reservoirs for oil and aquifers for water and current efforts to store CO₂ rely on permeable strata for injection sites. Understanding the geochemical reactions that control porosity often requires characterising the morphology of the particles and the pore spaces between them. Our aim was to develop a method to link the nano-scale features of a rock's crystals and crystal aggregates, or particles, with the macroscopic characteristics of porous strata, which extend for kilometers.

We focus on chalk, a rock with porosity ranging from 10 to 60%, with surface area ranging from about 2 to 6 m²/g, that is often 95% or more biogenic calcite. Current studies of chalk morphology rely on image analysis, where a parameter for global characterisation is lacking, or on mechanical methods that give parameters that average properties at the macroscopic scale.

We have applied X-ray scattering and gas sorption techniques, to determine average crystal and particle sizes, and we have used 3D X-ray nanotomography and scanning electron microscopy to describe the structures of pores, aggregates and fractures. The results from this multi-technique approach are consistent, and they give us a very good overall picture of the porous formation.



(a)



(b)

X-ray nanotomography cross-sections of two different chalks. The inner structures are consistent with the average radius, for crystals (a) 264 nm, (b) 57 nm, and for particles (a) 222 nm and (b) 272 nm.

Mineralogical and geochemical controls on Arsenic mobility in geothermal areas of the Philippines

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The Philippines is the second largest producer of geothermal energy in the world. Accompanying most of the geothermal waste water is the trace element arsenic in its native reduced state - arsenite (As³⁺). After exploitation of its thermal energy, the waste waters are impounded in ponds for further cooling wherein most of its dissolved constituents precipitate. Smectites, amorphous silica and pyrite are the usual precipitates which are later disposed either through re-injection or in another form of impoundment.

Despite these instances where arsenic could be leached out into the environment, there was no arsenic contamination reported in the areas surrounding these geothermal areas. Here we look at the mineralogy of the solid precipitates formed in cooling ponds, and the natural precipitates that are found in geothermal areas as the primary control in dissolved arsenic immobilization. Possible alterations of these precipitates upon exposure to the environmental conditions (e.g. abundant rainfall) are also assessed for possible leaching into surface and ground waters.