Trace element and isotope geochemistry of Naica gypsum mega-crystals

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Giant selenite crystals within Naica Mine, northwest of Mexico, are among largest crystals in the world, with specimens reaching up to 10m in length. “La Cueva de los Cristales” has been recognized as an unique site worldwide due to the selenite megacristals present there. Despite many mineralogical and geochemical studies aiming to unravel the physicochemical conditions that lead to crystallization [1], the relationships between the present-day aqueous fluids with gypsum, and the provenience of such amounts of $CaSO_4$, are yet to be established.

We have analyzed a crosssection derived from a single crystal from Cueva de los Cristales, and found significantly different contentrations of Sr and Mg between the crystal edges and the core. Such diference could be the result of the variations of temperature, grown rate and hydrochemistry. However, based on the water/gypsum partition coefficients for Sr and Mg [2], and their relationship with temperature, the effect of the latter we rule out temperature as a source of such differences.

Stable isotope analiyisis ($\delta^{18}O$, $\delta^{2}H$) of groundwater, and selenite ($\delta^{18}O$), strongly suggest that the latter precipitated in isotopic equilbrium with the former at ~50°C.

[1] Garcia *et al*. (2007) *Geology* **35**, 327-330. [2] Kushnir (1982) *Geochim. Cosmochim. Acta* **46**, 433-446

Monitoring cell transport, biofilm evolution and movement of genetic material in porous media: potential of cm-scale fluorescence imaging

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Centimetre-scale imaging techniques enable the direct quantification of solute and particle transport [1] in non-uniform, unsaturated [2] or transient flow conditions in porous media. The requirement for fluorescent tracers has to date limited their suitability for use in biological systems [3].

We performed proof-of-concept experiments for use of the DNA stain 4′, 6-diamino-2-phenylindole dihydrochloride (DAPI) to enable centimetre-scale fluorescence imaging of transport and deposition behaviour of *Escherichia coli* MG1655 within saturated flow through coarse quartz sand.

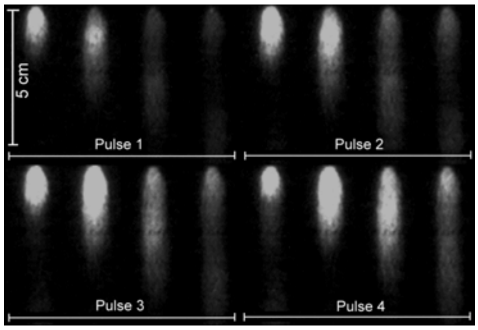

Figure 1: Time-lapse fluorescence image sequence showing transport and cumulative retention of DAPI-stained cells over four separate pulse inputs in Ottawa quartz sand.

DAPI staining enabled high-resolution fluorescence imaging of cells within the sand although several issues remain unresolved. Apparent deposition rates varied with growth phase and ionic strength, in good agreement with predictions based on surface characterizations [4]. Universal cell stains such as DAPI have strong potential for application to cm-scale imaging of cells, biofilms and biogeochemical processes in heterogeneous porous media.

[1] Bridge *et al.* (2006) *Env. Sci. Technol.* **40**, 5930-5936.
[2] Bridge *et al.* (2007) *Env. Sci. Technol.* **41**, 8288-8294.
[3] Yarwood *et al.* (2006) *Wat. Resour. Res.* **42**, W10405.
[4] Eboigbodin *et al.* (2006) *Appl. Microbiol. Biotechnol.* **73**, 669-675.