A Simple Method to Filter Arsenic From Water using CuO Nanoparticles

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A continuous flow-through reactor with CuO nanoparticles (NPs) was developed to filter arsenic (As) from groundwater samples. Natural groundwater samples as well as spiked with 100 µg/L of As were passed through (1L per hr) the flow-through reactor to filter As. Samples from the flow-through reactor were collected at a regular interval and analyzed for As and other chemical components (e.g., pH, major and trace elements). The CuO NPs adsorbed with As were regenerated with a sodium hydroxide (NaOH) solution and tested again in the flow-through reactor. The continuous flow-through reactor was effective in filtering As from spiked or natural groundwater samples. The regenerated CuO NPs were also effective in filtering As from groundwater. The CuO nanoparticle treatment did not show any discernible effects on the chemical quality of groundwater samples. Results of this study suggest that CuO NPs show potential for developing a simple process for field applications to remove As from water (Table 1) [1].

Time (min)	Volume (L)	CuO NP (As, µg/L)	RegenCuO NP (As, µg/L)
0	Control	109	110
5	0.1	1.5	<1.0
30	0.5	2.5	<1.0
180	3.0	3.0	<1.0
600	10.0	12.5	5.0
900	15.0	19.0	10.0
1200	20.0	23.0	14.0
Composite		12.5	6.0

Table 1. Effect of CuO NPs in removal of As from groundwater samples with continuous flow-through system.

[1] Reddy, K.J (ed.) (2013) A novel arsenic removal process for water using cupric oxide nanoparticles. Journal of Colloid Interface Science, 397:96-102.

Geochemical proxy nanostructure of foraminifera by X-ray imaging: STXM and tomography

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Empirical palaeoceongraphic proxies typically exploit geochemical signiatures in biominerals, such as the shells ('tests') of foraminfera. Correlations between quantities such as Mg-content of the whole shell and the physico-chemical environment in which the shell was laid down by the planktonic organism are used to chart, for example, ocean temperature. Data off tests obtained from ocean floor sediment cores allow the proxy measurement of paleotemperatures back through geologic time.

Implicit here is the assumption that Mg substitutes into the calcite lattice of the shell. Links between XRD results for high-Mg-calcites of foram tests and inorganic high-Mg-calcites lend support to his assumption, but are, of necessity, made from crushed and averaged powder samples of whole shells. The Mg-contents of most formainifera (0-10 mmol/mol Mg/Ca) are lower than the detection limits of XRD, however. Furthermore, previous LA-ICP-MS and nanoSIMS mapping of elemental concentrations in forma tests indicate banding and chemical heterogeneity.

We have exploited the nanometre scale resolution of STXM methods at the ALS, Berkeley, to determine elemental concentrations and chemical environments (coordination states) of key targets, such as Mg, B and S in foraminifera test. STXM and related methods, such as PEEM, (potentially) ptychography provide unique insights into the chemical state of important geochemical proxies within mineral lattices. We find that Mg is indeed incoporated into the crystalline lattice of CaCO3, but with some potential indication of clustering. Results show that compositional banding in one element can be compared directly with other key elements.

The role of diagentic alteration in old foram tests has been explored through synchrotron tomography at Diamond Light Source. Additional capabilities such as coherent diffraction imaging technieus offer future prospects for further exploring the relationship between proxy element distributions and mineral nanostructure.

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