Quantifying Ag uptake and storage in marine diatoms

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The biological pump has been identified as a potential mechanism for controlling atmospheric CO_2 between glacial-interglacial cycles, with diatoms playing a central role in this process. However, dissolution of the remains of siliceous organisms in the water column and sediments can make reconstructing their past productivity a difficult task. A new proxy is therefore required to overcome this limitation: silver shows promise as this new proxy, in part because similarities between Ag and silica in water column profiles have suggested a link with diatoms. Enrichment of Ag is therefore predicted to occur in sediments underlying regions of high diatom productivity. However, studies have yet to establish an unequivocal route for the delivery of Ag to sediments.

This study aims to answer the question of whether diatoms are the main source of Ag to marine sediments. We cultured the marine diatom *Thalassiosira pseudonana* and added $AgNO_3$ to the growth medium at varying concentrations. Diatoms were collected approximately 24 hours after reaching exponential growth phase and washed with diethylenetriaminepentaacetic acid (DTPA) to remove surface adsorbed Ag. Samples of the growth medium were also taken to determine actual Ag concentration during growth. The diatoms were digested first in HNO_3 to isolate the organic material, and then in NaOH to dissolve the silica frustules. Each fraction was subsequently analyzed by ICP-MS for Ag concentration. Our results will aid in quantifying the amount of Ag that diatoms take up from their surroundings, and determine whether Ag is stored in the body or in the diatom frustule.

Reactive oxygen species generation by elemental iron and silver nanoparticulates

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Zero-valent iron nanoparticles (nZVI) are recognized to produce hydrogen peroxide on reaction with oxygen with the subsequent production of strongly oxidizing hydroxyl radicals as a result of the reaction of the so-produced H_2O_2 with ferrous iron concomitantly produced on oxidation of Fe° [1]. While the extent of hydroxyl radical production via this Fenton process is limited because most of the reducing capacity of the elemental iron is utilized in the reduction of oxygen to water rather than hydrogen peroxide, catalysts such as polyoxometallates have been shown to increase the proportion of oxygen reduced to H_2O_2 thereby increasing the rate of hydroxyl radical production [2]. The hydroxyl radicals so produced are effective in degrading organic contaminants and in reducing bacterial viability [1, 3]

Other zero valent nanoparticulates, particularly those of silver and gold, are more effective in producing H_2O_2 than nZVI with the extent of production strongly dependent upon pH and solution composition as well as the nature of the nanoparticulates.

The processes leading to the production of H_2O_2 on reaction of nanoparticulate silver with oxygen are described here and the implications of this production of H_2O_2 to the bactericidal properties of nanosilver are discussed.

[1] Joo, Feitz & Waite (2004) *Environmental Science & Technology* **38**, 2242–2247. [2] Lee, Kim & Choi (2007) *Environmental Science & Technology* **41**, 3335–3340. [3] Auffan, Achouak, Rose, Chanéac, Waite, Masion, Woicik, Wiesner & Bottero (2008) *Environmental Science & Technology* **42**, 6730–6735.