

## Impacts—The key to understand Earth

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A significant factor, where are the major elements e.g. Mg, Fe, Si, Al, Ca, P, Ni that make up the asteroid or comet after the impact, has been ignored since the proposal of the impact events. In a striking contrast, there are many remaining unanswered or poorly answered questions regarding the formation and nature of banded iron formation (BIF), iron stone, phosphorite, bedded manganese ore, dolomite and carbonaceous black shales. The appearance of Lake Superior type banded iron formation associated with dolomite, quartzite, and black shale, the deposition of manganese ore and the occurrence of large phosphate repository during the Proterozoic; the onset of BIF with phosphate deposition and sedimentary manganese deposits and cap dolomite during the Neoproterozoic; the penecontemporary formation of oolitic iron stone taking place of the BIF, bedded manganese deposit, phosphorite, dolomite, and black shale during the Phanerozoic, which suggest a genetic link among them from the perspective of chemical elements. Actually, during hypervelocity impact cratering events, the main part of the asteroid or comet and target material are vaporizing, which forms a mushroom cloud of vapor in the atmosphere. The previous study shows that the calcite, magnetite, clay minerals and organic compounds condense from a solar gas at  $10^{-4}$  atm with temperature less than 400 K, which provides an analog for the generation of the chemical sedimentary ore deposits. Thus, the impact of the asteroid or comet provides not only the elements source of chemical sedimentary ore deposits and the mechanism for their formation. Algoma-type BIFs in the Archean greenstone belts are also the product of impact, which is supported by their enrichment in iridium and associated impact spherule units.

## Microbial As(V) and Fe(III) reduction: Mobilization or sequestration of As?

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Microbial reduction of As(V) and Fe(III) in anoxic environments typically results in elevated dissolved As concentrations [1], but may also promote As sequestration [2]. In this study, we investigated the kinetics of As(V) reduction and As mobilization by *Shewanella putrefaciens* CN-32 ( $1-5 \times 10^9$  cells  $\text{mL}^{-1}$ ) in 2-line ferrihydrite (2L-Fh) suspensions ( $0.01-10$  g  $\text{L}^{-1}$ ) containing  $20$   $\mu\text{M}$  As(V), corresponding to molar Fe/As ratios of  $\sim 5$  to  $\sim 5000$ . Incubation experiments over 5 days were performed at pH 7.0 (10 mM PIPES) in solutions initially containing 2.5 or 20 mM lactate. Additional incubation experiments with 2 g  $\text{L}^{-1}$  2L-Fh and 20-2000  $\mu\text{M}$  As(V) (Fe/As ratios of  $\sim 1000$  to  $\sim 10$ ) were spiked with 1, 10 and 100  $\mu\text{M}$  9, 10-antraquinone-2,6-disulfonic acid (AQDS) to accelerate microbial reduction rates.

In the absence of AQDS, the relative extent of Fe and As reduction decreased with increasing 2L-Fh concentration: Whereas 55% of the 2L-Fh and 40% of the spiked As(V) were reduced at  $0.01$  g  $\text{L}^{-1}$  2L-Fh, only 1% of the 2L-Fh was reduced at  $10$  g  $\text{L}^{-1}$  2L-Fh and reduction of As(V) was not detectable. In contrast to similar incubations with 25  $\mu\text{M}$  lactate [3], As(V) reduction and release of dissolved As (III) occurred with  $\sim 10$  h delay after adding bacterial cells, and As(V) was the dominant As-species in solution over the entire incubation time. These results suggested that microbial Fe(III) reduction was favored over microbial As(V) reduction. In the presence of AQDS, about 30% of the 2L-Fh were reduced, whereas As(V) reduction did not exceed 12% of the total As. Although Fe/As ratios in incubations with AQDS and without AQDS were similar, no As(V) and As(III) release into solution was observed at initial As(V) concentrations of 20 and 200  $\mu\text{M}$ , and dissolved As(V) even decreased at an initial concentration of 2000  $\mu\text{M}$ , indicating that As sequestration occurred during faster Fe(III) reduction in the presence of AQDS.

[1] Smedley & Kinniburgh (2002) *Appl. Geochem.* **17**, 517-568. [2] Hebel & Fendorf (2006) *Chem. Geo.* **228**, 16-32. [3] Huang *et al.* (2008) *Geochim. Cosmochim. Acta* **72**, A399.