

Clarification for Boron Sorption Mechanism in Coprecipitation with Magnesium Hydroxide

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Although boron is absolutely essential in various industries, especially in glass industry, the high contaminant levels of boron in water are regulated in several countries because of its toxicity. While ion-exchange resin is commonly used to remove boron from wastewater, it is relatively expensive. In this study, boron removal by coprecipitation method using magnesium salt has been investigated. The objective of this study is to clarify how coprecipitation of boron with magnesium hydroxide occurs in order to achieve cost efficient way to treat wastewater.

We carried out three kinds of experimental studies; (i) sorption isotherm formation, (ii) XRD analysis, (iii) NMR analysis. In general, when pH is below 9.2, the predominating species is orthoboric acid, which is less adsorptive because of its low electrical activity [1]. Therefore, we carried out the coprecipitation experiments at pH 10.5 and 0.3 of ion strength. Indeed, we could achieve the best adsorption efficiency of boron to magnesium hydroxide at pH 10.5.

We found that the sorption isotherm was BET type, which suggested that the sorption mechanism of boron adsorption was changed as the initial B/Mg molar ratio increased. From XRD analysis, the crystal structure of the precipitation corresponded with magnesium hydroxide when the initial B/Mg molar ratio was less than 0.4, whereas uncertain amorphous precipitation and carbonate hydromagnesite were formed when the initial B/Mg molar ratio was larger than 0.4. Formation of the uncertain amorphous precipitation indicated that surface precipitation was formed and related to boron uptake to magnesium hydroxide when the initial B/Mg molar ratio was larger than 0.4. NMR analysis showed that boron was adsorbed onto the surface of magnesium hydroxide as three-coordinate boron. These results suggested that a part of boron was precipitated or intercalated with uncertain amorphous precipitation as three-coordinate boron during coprecipitation with magnesium hydroxide.

[1] M.M. de la Fuente García-Sotoa, E. Muñoz Camacho (2008), *Desalination*, 249, pp.626–634

Seeing through the haze: Testing the existence of a Neoproterozoic bistable organic-rich atmosphere

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The Great Oxidation Event (GOE; ~2.45–2.32 Ga) represents the onset of pervasive atmospheric oxygenation; however, ~2.7 Ga cyanobacterial microfossils and biomarkers [1] coupled with additional geochemical evidence [2], suggests a potentially earlier origin for photosynthetic O₂ accumulation. This temporal disparity implies either localised O₂ production or transient small rises ('whiffs') in atmospheric O₂ [2]. Despite the emerging data, large uncertainties surround the composition and the evolution of the Neoproterozoic atmosphere.

Analyses of sediments from the Campbellrand-Malmani platform (GKF01; ~2.65–2.5 Ga) suggest localised O₂ production, in a reducing atmosphere [3]. Importantly, within GKF01, large deviations in $\Delta^{36}\text{S}/\Delta^{33}\text{S}$ correlate with pronounced ¹³C-depletions in $\delta^{13}\text{C}_{\text{Org}}$, implying increased sedimentary incorporation of methanogenic carbon [3, 4]. Photochemical model simulations corroborate these data and predict the persistence of a bistable atmosphere poised between clear-skies and hazy conditions, implicating methane as an important component of the Neoproterozoic atmosphere.

Here, a new multiple S-isotope record from age-equivalent successions in W. Australia, combined with proxies for ocean redox and nutrient availability, will test the envisaged coupling between oceanic and atmospheric chemistry [3] whilst examining the drivers that link the two.

[1] Eigenbrode *et al.* (2009) *EPSL* **273** 323-331. [2] Anbar *et al.* (2007) *Science*. **317** 1903-1906. [3] Zerkle *et al.* (2012) *Nature Geosci.* **5** 359-363. [4] Eigenbrode *et al.* (2006) *PNAS* **103** 15759-15764.