Preliminary high-resolution Ge/Si data in early Archaean BIFs

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Banded iron formations are laminated sediments consisting of alternate banding of Fe-oxides layers and quartz layers which predominate in the Precambrian. Many aspects of their genesis are still controversial, but some observations such as the disappearance of BIFs at the time of atmospheric oxygenation (~2.3Ga), in spite of some recurrences between 0.8-0.6 Ga, indicate that the oceanic and atmospheric conditions have played an important role for their deposition. The Ge/Si ratios have been long used in studies concerning paleochemistry of oceans as a proxy for understanding the geochemical cycle of Si and Si sources in surface environments. It has been shown that Ge/Si ratio is higher in hydrothermal environments than that from continental weathering, and that the solubility of Ge in aqueous fluids varies with temperature [1]. This can suggest that Ge/Si ratios could be a potential tracer of Archaean environmental conditions and sources for BIFs deposition.

BIF samples from Isua-Greenland ($\approx$ 3.7-3.8 Ga) and Nuvvuagittuq-Canada (likely as old as 4.28 Ga [2]) have been studied in order to decipher the chronological evolution of their trace elements, Ge/Si and O, Si isotopic compositions. The main focus is the identification of compositional variations within bands and between bands of quartz and Fe-oxides. High-resolution *in situ* measurements of trace element concentrations have been performed using laser ablation ICP-MS. First results for Isua BIFs indicate that Ge concentrations range from $\approx$ 7 to $\approx$ 12 ppm in quartz, with variations of few ppm between large quartz and small quartz bands. The calculated Ge/Si ratios range from $\approx$ 0.6 to $1 * 10^{-5}$mole/mole, which is significantly smaller than previously determined data (Ge/Si $\geq 2 * 10^{-5}$mole/mole [2]) on bulk individual mesobands. This discrepancy can be explained by the presence of scarse amphiboles with measured Ge contents of $\approx$ 100ppm, which bias the Ge budget of individual bands. *In situ* Ge/Si, together with O and Si isotopes will provide insights on BIFs depositional environments.

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Alkaline particle size and delivery for settling and dissolution: Optimising ocean-based enhanced weathering geoengineering

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Among the many geoengineering techniques proposed for climate remediation by removing carbon dioxide from the atmosphere, a major benefit of ocean-based enhanced weathering is that it also holds the promise of being able to directly counteract ocean acidification. Operating such a geoengineering scheme successfully involves optimising many fine details. Arguably the most crucial detail is the size and delivery of the alkaline particles into the ocean: if the particle dissolution depth is too high, the particles will leave the mixed layer, underutilising the mineral, while if the particle dissolution depth is too low, there will be high localised concentrations of the alkaline mineral, risking undesirable side-reactions.

In this presentation, we present an analytical model for calculating the settling and dissolution rates for a suspension of multiple particles into ocean water in order to determine the optimum rates for dispersing alkalinity into the ocean. We develop a theoretical framework that can be used to determine the most efficient method for adding multiple alkaline particles, taking into account particle size and concentration as they are being dispersed.

Through our model, extending simple single-particle Stokesian analysis by taking into account average particle spacing as well as flows between and around the particles, the model enables the prediction of local conditions throughout the system to be determined in a straightforward manner. By predicting local conditions, the deleterious effects of side reactions, particularly those on the surface of the particles, can be minimised. By predicting the details of dissolution, such as concentration vs depth and time, our model predicts the efficacy of a given delivery system for adding alkalinity to the ocean.

In this presentation, a discussion will also be provided highlighting some of the applications of the model to geoengineering for removing atmospheric carbon dioxide and for moderating ocean acidification.