Carbonation of steel slag II

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One of the options that the steel undustry has to mitigate some of its CO2 emissions is mineral carbonation of steel slag, a by-product of the steel refining process. Our study investigates reactions taking place during dissolution and carbonation of steel slag, with the aim of determining optimal conditions for conversion. A H_2O-CO_2 fluid is pumped through slag grains (2 – 3 mm) in a flow-through reactor at elevated pressure, and temperatures of 125 to 200°C, as described in a companion abstract [1]

The starting steel slag contains ~50 wt% CaO in larnite (Ca_2SiO_4), srebrodolskite ($Ca_2Fe_2O_5$) and free lime. In addition, there is an inert phase, Mg-wuestite ((Fe, Mg)O)). After an experiment, entire cross sections of slag grains were analysed by SEM-EDS spectral imaging. Based on the information in the images, the volume proportions and distribution of reactant and product minerals were quantified using in-house developed PARC (PhAse Recognition & Characterization) software. This method reliably reproduces bulk compositions of solids as confirmed with XRF analysis [2]. The PARC results were used to calculate the mass balance between starting material, reacted slag and fluid and, in conjunction with the fluid chemistry, helped reconstruct the reaction path.

[1] Berryman *et al*. (2011) Goldschmidt Conference, this issue. [2] van Hoek & van der Laan (2011) Goldschmidt Conference, this issue

δD of alkenones as proxy for paleo sea surface salinity

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Culture studies of haptophyte algae showed that there is a strong correlation between the fractionation factor $\alpha_{alkenones-growth}$ water and salinity [1]. with less fractionation at higher salinities. Based on these results, paleosalinities of the Black Sea and the Eastern Mediterranean have been reconstructed using the δD of alkenones [2, 3].

However, there has been some debate about whether analyzing the C_{37} alkenones together is appropriate for reconstructing paleosalinity since there is a relatively large difference in the δD of the $C_{37:2}$ and $C_{37:3}$ alkenones, respectively [4-6]. To examine this potential problem we analyzed the $C_{37:2}$ and $C_{37:3}$ alkenones of the original Schouten *et al*. [1] *E. huxleyi* samples separately and found an increasing difference in δD between the $C_{37:2}$ and $C_{37:3}$ alkenone with decreasing temperature and, therefore, decreasing relative abundance of the $C_{37:2}$ alkenone. These results suggested that for the purpose of reconstructing paleo SSS it might be better to analyze the C_{37} alkenones together rather than the separate isomers.

To test this δD paleo sea surface salinity proxy in open marine settings it was applied to assess Agulhas current variability during the transition from Marine Isotope Stage (MIS) 6 to 5 and MIS 2 to 1. The reconstructed paleo SSS show a substantial shift to lower salinities during both deglaciations in agreement with reconstructions based on oxygen isotopes and Mg/Ca of planktonic foraminfera. These results indicate the potential of this proxy in open marine settings where salinity shift are relatively small.

[1] Schouten *et al*. (2006) *Biogeosciences* **3**, 113–119. [2] van der Meer *et al*. (2007) *EPSL* **262**, 594–600. [3] van der Meer *et al*. (2008) *EPSL* **267**, 426–434. [4] D'Andrea *et al*. (2007) *Anal. Chem*. **79**, 3430–3435. Schwab & Sachs (2009) *Org. Geochem*. **40**, 111–118. [6] Wolhowe *et al*. (2009) *Biogeosciences* **6**, 1681–1694.