

## **Iron Solubility Workshop**

**23 – 24 February 2009**

**University of East Anglia**

**Norwich, UK**

The meeting was attended by 26 people from 6 countries, with 14 of these being supported by COST Action 735. The aim of the meeting was to discuss various issues relating to the supply of soluble iron (as a proxy for biologically-available iron) to the oceans from the atmosphere, and specifically the dissolution of iron from aerosol particles. This topic is crucial to our understanding of the role that the oceans play in the global carbon cycle, because iron availability appears to limit phytoplankton growth in several ocean regions and is also important in regulating nitrogen fixation in other regions.

The composition of the group was chosen to include biogeochemists working in both the marine and atmospheric environments, as well as modellers interested in the global marine iron cycle. A number of early-career scientists also attended the meeting.

The meeting was designed to be a series of discussion sessions, each focussing on a specific aspect of iron dissolution. The key questions and parameters discussed were:

### *Deposition flux of iron to the ocean*

There was general agreement in the group that a key step in improving our understanding of the flux of soluble/bioavailable iron to the oceans must be a better understanding of the total flux of iron to the ocean. Our understanding of this is currently inadequate because of our poor knowledge of the global dust cycle and, in particular, our very uncertain estimates of the rates of dry and wet deposition of dust to the ocean. While these are significant problems, they lay outside the expertise of the group and were not discussed in depth.

### *High variability in ranges of aerosol iron solubility reported in the literature*

The range of values reported for the fractional solubility of aerosol iron covers at least 4 orders of magnitude, and this has been a source of considerable confusion. Much debate has focussed on what the “true” value for aerosol iron fractional solubility might be, and also on whether the range of values might be an artefact of the diverse methods employed to determine solubility by different researchers. Recent results, discussed by the group, suggest that much of the range in fractional solubility is actually a reflection of natural variability in aerosol, presumably influenced by factors such as aerosol source, chemical, physical and mineralogical properties and atmospheric history.

### *Different methods of determining aerosol iron solubility*

Many different methods are in use for the determination of iron dissolution from aerosol, ranging from simple batch methods employing model leaching solutions, to much more complex and difficult methods which examine dissolution into seawater directly. The group discussed the relative merits of the various methods and what information each might be expected to yield. Points noted included the apparent lack of realism of the simple leaching solution methods; the complicating factors introduced by the use of solutions such as seawater, which are strongly influenced by iron solubility constraints; and the problems associated with extrapolating from short-term laboratory

experiments to iron dissolution from aerosol particles during their residence time in the surface ocean.

#### *Parameterisation of iron dissolution in global models*

Discussion focussed on how models could be improved to reflect advances in experimental and observational work, for instance, through the inclusion of variable fractional iron solubility, and how experimental / observational work can be better targeted to provide maximum benefit to the modelling community (e.g through better understanding of the role of complexing ligands in determining dissolved iron concentrations in the ocean).

#### *Standardisation of methods and improvements in comparability*

The group recognised the current diversity of analytical methods employed and the lack of any “standard” materials for aerosol dissolution experiments to be a major obstacle to progress in the field, since they make comparison between results obtained by different research groups extremely difficult. The need for a small number of samples of desert dust, from key sources regions, to help establish intercomparability was discussed, as was the need for one or two standardised analytical methods. Such methods would need to be relatively simple because this would allow groups engaged in more complex work to easily provide a reference point for their results to the work of others. Simple standard methods would also have the advantage of allowing more groups to produce “comparable” results and so aid the acquisition of a large database of iron solubility measurements. Intercomparison exercises, such as the one currently being undertaken within the GEOTRACES programme, in which samples are shared between several laboratories and results compared will also help to address this problem.

#### **Products and outcomes**

The meeting proved to be highly successful, with the exchange of ideas and information between participants from different disciplines being particularly valuable. It was agreed that a manuscript would be prepared which would contain a synthesis of the key points discussed during the meeting. This manuscript would be submitted for publication in an appropriate journal so that the conclusions and recommendations of the group can be communicated to the wider community. Several ideas for new experimental work were also generated during the workshop and preliminary discussions regarding a joint field campaign to examine aerosol iron solubility changes over large spatial scales were also held.