Scientific Report on the Monte Verità Conference

„Iron Biogeochemistry - From Molecular Processes to Global Cycles“

Monte Verità, Ascona Switzerland, March 3-8, 2013

Most biogeochemical processes and element cycles on Earth are directly or indirectly linked with the biogeochemistry of iron. An improved understanding of iron biogeochemistry will therefore also enhance our knowledge about other biogeochemical cycles, with important implications for processes that are critical to human civilization such as the supply of clean water, remediation of contaminated sites, or the regulation of the global carbon cycle. This conference focused on five key areas of iron biogeochemistry, in which much progress has been made during the past decade. Keynote lectures, contributed talks, and poster presentations covered important topics within these five areas:

1) Iron minerals, surface structure, and biogeochemical reactivity (Mo/Tu)
2) Iron and biogeochemical redox processes (Tu)
3) Formation of iron minerals by organisms and the influence of natural organic matter (We)
4) Coupling between iron biogeochemistry and cycles of other elements (Th)
5) Iron as an essential micronutrient (Fr)

In total, 16 excellent keynote lectures were presented on various topics. On the first day, Lee Penn (USA) presented fascinating new cryo-TEM results on the formation of goethite from ferrihydrite nanoparticles by an “oriented aggregation” phenomenon, which is still poorly understood but meanwhile well documented by her group. Jeffrey Catalano (USA) followed with a presentation on Fe(II)-induced atom exchange and incorporation of trace metals in to the structure of iron oxide minerals. Juraj Majzlan (Germany) discussed the thermodynamic, structural, and kinetic constraints on trace element incorporation into Fe minerals, using arsenate incorporation into hematite as example. Thomas Hofstetter (Switzerland) presented the newest results on the electrochemical characterization of redox properties of clays, which is highly relevant for many redox reactions in soils and aquifers, as well as nuclear waste repositories. Andreas Kappler (Germany) concluded the first day with an overview lecture on iron oxidizing and reducing bacteria in modern and ancient environments. This topic was further discussed by Eric Roden (USA) on the second day, talking specifically on extracellular electron transfer and the close coexistence of Fe oxidizing and reducing bacteria in the environment. David Waite (Australia) discussed the current state of knowledge of light-induced redox reactions in the environment, in particular involving Fe. In the afternoon of the second day, Coleen Hansel (USA) presented new results on the influence of Fe mineralogy on microbial populations under Fe reducing conditions. The third day started with the keynote of Karim Benzerara (France) on biomineralization by Fe oxidizing bacteria, and then shifted towards Fe sources in marine systems in Brandy Toner’s (USA) lecture on the role of mid-ocean ridge hydrothermal vents as potential source for Fe. The fourth day started with new studies on the biogeochemistry of Fe and formation of schwertmannite in acid-sulfate soils presented by Ed Burton (Australia). The second keynote on Thursday was held by Robert Raiswell (UK), presenting a review on quantifying Fe fluxes to the ocean. A special focus was on the role of icebergs, which transport much more Fe into the oceans than atmospheric dust. The last day of the conference featured keynotes by Owen Duckworth (USA) on the interactions of siderophores with Fe and other trace metals, Simon Poulton (UK) on the role of Fe mineralization on nutrient cycling in the ancient oceans, Satish Myneni (USA) on the chemical speciation of Fe in the southern ocean using synchrotron-based X-ray micro-spectroscopy techniques, and Yeala Shaked (Israel) on quantifying Fe uptake rates and bioavailability of Fe to marine phytoplankton.

In addition to these keynote lectures which were 40 minutes plus 10 minutes discussion, the program included 26 contributed oral presentations of 15 minutes plus 5 minutes discussion. A total of 42 posters were presented in two 2-h poster sessions, during which the authors were present and discussed with conference participants.

One of the goals of this conference was to give young researchers an opportunity to interact with experienced scientists including world-leaders in the field. This goal was fully achieved, with 27 PhD students and 13 postdocs participating. There was ample time for in-depth discussion between all participants after oral presentations, at the posters during the entire week, and during breaks, meals, and evenings.

In total, the conference had 97 active participants from 21 different countries. It was very interdisciplinary, with scientists from various fields including geology, mineralogy, soil sciences, geomicrobiology, marine ecology, plant nutrition, and others. The environmental systems studied by the participants ranged from the modern and ancient oceans, glacial and sub-glacial environments, mining-affected environments, acid-sulfate

soils, to Mediterranean soils. Nevertheless, every single presentation was of great interest to all participants which had one common interest: Understanding the biogeochemistry of Fe from molecular processes to global cycling.

The numerous feedback comments we received from the participants were outstanding. The following are some examples:

"*I really appreciate the opportunity to participate. The conference was an invaluable part of my doctorate - I enjoyed meeting other people that work in the field and left with lots of new ideas!*"

"*I really enjoyed the conference at Monte Verità. The opportunity to converse with some of the most prominent scientists in the field of iron biogeochemistry really was invaluable. ….. I found the talks, and also the conversations over coffee, to be really useful. I have also come away with some more ideas about the direction of my research! It was definitely inspiring.*"

"*It was truly a great Monte Verità conference and I enjoyed every minute of it!*"

"*I just wanted to thank you for the opportunity to participate in the Monte Verità conference. I enjoyed the conference immensely, and have found that it has provided a significant boost in my excitement about Fe biogeochemistry.*"

"*The meetingwas great. I learned a ton, and my brain is FULL of new ideas. Which is simply lovely.*"

Figure 1. Conference photo, impression from the Auditorium, and the two CSF Award winners Alexander Rücker (University Tübingen, best poster award) and Hagar Lis (Hebrew University of Jerusalem; best oral presentation award), both PhD students.

The initial spark for this conference came from the steering committee of the ESF Research Networking Programme FIMIN (The Functionality of Iron Minerals in Environmental Processes). We wish to thank all FIMIN steering committee members and Prof. Thomas Borch (USA) for their valuable input as Scientific Advisory Board during the organization and for serving on the CSF Award jury.

We also thank Mrs. Liliana Cantoreggi (Fondazione Monte Verità) and Dr. Chiara Cometta (Centro Stefano Franscini), including their team members, for the great organizational support before and during the conference.

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Zürich, 22.3.2013

Prof. Dr. Ruben Kretzschmar (Organizer)