

## Towards a quantitative record of Archaean ocean water chemistry: An element partitioning approach

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The composition of the Archaean ocean is of interest for two reasons in particular: 1. Ocean water is the reaction product of processes operating on the surface of the early Earth and in its interior, and its composition thus allows for insights into, and constraints on these processes, including the nature of Archaean plate tectonics; and 2. Ocean water is the likely medium in which life originated and developed, and knowledge of its composition, and changes therein over time provides insights into the inorganic forcing on life's evolution.

Qualitative information on the composition of the early Earth ocean has been obtained from the mineralogy and compositions of marine sediments preserved in the geological rock record. Banded Iron Formations, in particular, appear a viable source of information on changes in (trace) element abundance [1]. At present, it is not possible to translate this qualitative record into actual concentrations, and information is furthermore restricted to a small suite of elements, which severely limits the information that can be gained.

In this contribution, we present an approach that uses the lattice-strain theory systematics in element partitioning to reconstruct *quantitative* information on water chemistry from the composition of minerals. Although this approach can be applied to marine sediments, we use it here on samples of altered ridge basalts (greenstones), which are an indirect source of information on ocean water chemistry, because the interaction between ocean water and fresh oceanic crust at the ridges has a dominant control on the composition of the ocean. Combining experimentally determined mineral - fluid partition coefficients for chlorite and plagioclase at appropriate conditions, with the compositions of these minerals in well-preserved Archaean greenstones, we are able to track the evolving composition of the early Earth ocean.

[1] Konhauser, Pecoits, Lalonde, Papineau, Nisbet, Barley, Arndt, Zahnle & Kamber (2009) *Nature* **458**, 750-754.

## Innovative low kV X-ray microanalysis of submicron particles using PARC algorithms

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One of the challenges in microanalysis is to get accurate qualitative and quantitative analysis on the smallest phases present in a sample. Using PARC (**Ph**ase **R**ecognition and **C**haracterization) algorithms as developed at CRC, we can arrive at the theoretical resolution using a FEG-SEM equipped with X-ray microanalysis equipment as will be shown in this paper.

The analytical spatial resolution for microanalysis is dictated by the SEM acceleration voltage, and the average atomic number of the phases present in the specimen. The challenge is finding the proper spot in a sample where the best analysis (without contaminated signal from the surrounding), can be obtained of the smallest phase for a given analytical condition.

The PARC approach simply circumvents manual selection of spots by including ALL pixels of an image field in the spectral image (SI) dataset. PARC software sorts all pixels of the SI dataset according to the phases they represent. The pixel populations can then be automatically cleaned from contaminant signals, leaving pure spectra for ZAF corrected quantification. The quality of analysis subsequently can be assessed from the resulting phase stoichiometry. In addition, phase area proportions and phase chemistry can be combined to reproduce the bulk composition of the sample material. We will show that using PARC in combination with FEG-SEM-EDS good stoichiometric analysis can be obtained on samples with crystals of less than 500 nm, even for trace phases.

Several PARC applications will be presented during this conference.