Composition of a 3.5 Gyr shallow seawater from the North Pole Dome, Western Australia

J. FORIEL[1], P. PHILIPPOT[1], D. BANKS[2], P. REY[3],
J. CAUZID[1,4], AND A. SOMOGYI[4]

[1] Laboratoire de Géosciences Marines, CNRS, Institut de Physique du Globe de Paris, case 89, 4 place Jussieu, 75252 Paris cedex 05, France [philippo@ipgp.jussieu.fr]
[2] School of Earth Sciences, University of Leeds, Woodhouse Lane, Leeds LS2 9JT,UK
[3] School of Geosciences, The University of Sydney, Sydney, NSW 20006, Australia
[4] European Synchrotron Research Facility, ID 21, BP 220, 38043 Grenoble, France

Although valuable information about the composition of the Archaean ocean can be derived from indirect evidences such as sediments composition, preserved fluid inclusions offer a unique opportunity to analyze direct samples of Archaean seawater. In this work, we presents the first determination of the composition of 3.5 Gyr seawater from from the North Pole Dome, Western Australia. Fluid inclusions from intra-pillow quartz samples were analyzed by crush-leach and Synchrotron X-Ray Fluorescence (SXRF). These intra-pillows were formed by shallow sub-seafloor seawater circulation in lavas deposited in a shallow submarine basin, in the vicinity of emerged continental crust and submarine hydrothermal springs. A single population of 5-20µm, H_2O-NaCl-$CaCl_2$ fluid inclusions was found. Composition estimates from crush-leach and SXRF are in good agreement and give a Cl/Br composition of North Pole seawater ($Cl/Br_{crush\text{-}leach} = 289$, $Cl/Br_{SXRF} = 309$), similar to modern seawater value (=288). $K/Cl_{SXRF} = 0.021$ and $SO_4^{2-}/Cl_{crush\text{-}leach} = 24.6$ are also close to their present-day counterparts (respectively = 0.020; 21.5). Excess in other elements (Cr, Mn, Fe, Cu, Zn, Ba) however, probably represent a hydrothermal imprint. Therefore, these inclusions may represent a mixing of evaporative brine and contamination from a hydrothermal fluid. Although evaporites have been described at North Pole, we argue that the absence of fractionation of K or Br compared to Cl indicates that this brine was not influenced by halite precipitation but was formed by concentration of seawater. These results differ from earlier fluid inclusions based studies of Archaean seawater (Channer et al., 1997). However, they may not be contradictory if considering a stratified Archaean ocean where North Pole shallow water would be isolated from deep-sea water. Our results suggest that shallow seawater may have had a modern composition, in terms of halogens and sulfate, as soon as 3.5 Gyr ago. We also believe that North Pole seawater composition may result from a strong biological control.

References

Channer D. M. DeR, De Ronde C. E. J. and Spooner E. T. C., (1997), *EPSL*, **150**, 325-335.

A multiple collector for the SHRIMP II high resolution ion microprobe

J.J. FOSTER[1], S.W. CLEMENT[2] AND I.S. WILLIAMS[1,3]

[1] Research School of Earth Sciences, The Australian National University, Canberra, ACT, 0200, Australia (john.foster@anu.edu.au, ian.williams@anu.edu.au)
[2] Ion Optical Consulting, Tryon, Prince Edward Island, Canada (stevec@isn.net)
[3] Australian Scientific Instruments Pty. Ltd., P.O. Box 857, Fyshwick, ACT, 2609, Australia (info@asi.anutech.com.au)

A commercial version of the experimental multiple collector for SHRIMP II developed by the ANU Research School of Earth Sciences is now being manufactured by Australian Scientific Instruments Pty. Ltd. To maximise flexibility, the collector uses "hands off" technology: all mechanical adjustments (mass, slit width, detector and focus selection) are made under remote computer control without breaking vacuum.

The multiple collector has been designed for high-precision simultaneous measurement of the relative intensities of ion beams over a wide dynamic range. It incorporates five Sjuts single channel electron multipliers (CEMs) designed to operate in pulse counting mode. Close packing of the CEMs is achieved by off-axis mounting and detector life is enhanced by the use of conversion electrodes. Collectors immediately adjacent to the central detector are adjustable over a 1 mm range, allowing simultaneous measurements of heavy isotopes with one mass unit separation (e.g. Pb, Hf) at mass resolution >5000. Two other collector assemblies are each adjustable over a range of 10 cm with a repeatability of a few microns, designed for a maximum mass range of 1 in 7, suitable for simultaneous measurements of light isotopes (e.g. B, C, O, S) or heavy combinations (e.g. Pb and Th or U).

The central detector and two outer detectors can be mechanically interchanged with Faraday cups. Careful shielding of the detectors, low input capacitance of the Faraday cups and the use of sapphire insulators ensure optimised performance of the electrometers. For measurements requiring high abundance sensitivity (<200 ppb) or count rates above those acceptable by CEMs, the central CEM can be removed and the ions measured in single collector mode by a Faraday cup or ETP high-rate multiplier fronted by a retardation lens.

The whole collector assembly can be traversed parallel to the central ray trajectory to place the collector slits on the focal plane for maximum resolution at any chosen mass. Further, the two outer slit assemblies can be moved independently along the beam line to compensate for any minor curvature in the focal plane. Resolution at the ends of the usable focal plane is >3000. Collector slit widths are adjustable using in-vacuum piezo-electric motors.