Decoding downcore patterns of authigenic mineralization from elements distributions in annually-laminated sediments of Shira Lake (Central Asia)

M. PHEDORIN

Institute of Petroleum Geology and Geophysics of the Siberian Branch of Russian Academy of Science, Koptyuga str., 3, Novosibirsk, 630090, Russia (mikeph@mail.ru)

Reported are the results of studying vertical geochemistry profiles in five cores collected across the Shira Lake (Central Asia, E90°12', N54°30') at different depths of water column. Cores were dated employing Pb-210 and Cs-137 measurements; sedimentation rates amounted to 1.0-1.5 mm/year; 0.x mm laminations were identified as annual layers; sediments from cores cover ages 0-80 years.

Shira Lake is small (32km^2), saline (ca.20g/l SO^{4-}, Cl^-, Na^+, Mg^+, K^+) reservoir, being filled with precipitation of ca. 300mm/year (river Son is the only major tributary) and has no surface outflow. Bottom anaerobic conditions are now observed at depths below 12 m, leading to formation of organic-reach muds. Current research is focused on elements supplied into sediments from dissolved compounds or/and able to chemical transformations within the sediments.

The concentrations of elements in the sediments were determined from recorded x-ray fluorescence (XRF) when continuously scanning the halves of the cores under sharp synchrotron radiation beam in Siberian Synchrotron Center. The resolution of the scanning was 0.1 mm. Processing of the measured XRF spectra provided downcore records of 20 elements. Special attention was payed to Ca (its abundance fall within 5÷25% per dry mass), Sr (0.1÷0.9%), Ba (200-700 ppm) – as markers of sulphate and carbonate authigenic mineralization, Fe (0.5÷3.0%) – hydrotroilite accumulation, I (10÷150 ppm) and Br (10÷180 ppm) – halogenide mineralization and biogenic deposition. All the noted elements show distinctly different downcore behoviour. Even alcaline-earth elements, representing single group, diverge, that probably marks sulphate-sulphide-carbonate competition in bottom mineralization. The study allowed to detect ca. 11-year cycle of Ca-precipitation (most probably, as sulphate) and cycles in past aerobic-anaerobic switching due to lake-level changes (recorded in Fe, Br).

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Two pools of mass-independent sulfur isotope anomalies of hydrothermal sulfides at North Pole (~3.5 Ga Dresser Formation, Pilbara)

P. PHILIPPOT[1] AND M. VAN ZUILEN[2]

[1]Geobiosphère Actuelle et Primitive, Insitut de Physique du Globe de Paris, IMPMC, Paris 75252, France (philippot@ipgp.jussieu.fr)

[2]Centre of Geobiology, department of Earth Sciences, University of Bergen, N-5007 Bergen, Norway

Mutiple sulfur isotope ratios ($^{32}S/^{34}S$, $^{33}S/^{34}S$) were measured *in situ* by SIMS analysis of sulfides in the hydrothermally-altered volcanic sequence located beneath the ~3.5 Ga chert-barite deposit of the Dresser Formation, Western Australia. The rocks investigated concern altered komatiites and associated network of silica-feeder veins, the later representing conduits for hydrothermal fluid circulation. Samples analyzed are from the Pilbara Drilling Project drill cores as well as several komatiite-silica vein pairs collected at different distances from the base of the drill holes towards the underlying North Pole granitoid intrusion.

Sulfides in altered komatiites and silica veins show the same range of $\Delta^{33}S$ (~ $\delta^{33}S$ - 0.515 $\delta^{34}S$) values between about –1 and +4 ‰. In both cases, however, sulfides form two isotopically distinct populations; a positive $\Delta^{33}S$ pool, with values of about +2 to +4‰ and a negative $\Delta^{33}S$ pool with values of about -1 to 0‰. The two sulfide populations were likely derived from seawater sulfate (negative values) and elemental sulfur (positive values) reservoirs in the Early Archean ocean. High spatial resolution measurements indicate that the two reservoirs did not mix during hydrothermal fluid circulation responsible for the formation of the chert-barite deposit, thus providing significant new insights into the early Archean sulfur cycle.