Geophysical Research Abstracts
Vol. 21, EGU2019-18783-1, 2019
EGU General Assembly 2019

Sedimentology and geochemistry of Earth's oldest carbonate platform (2.94 Ga Red Lake Greenstone Belt, Ontario, Canada)

Stefan Lalonde (1), Pierre Sansjofre (1), Martin Homann (1), Philip Fralick (2), and the EARTHBLOOM team

(1) European Institute for Marine Studies, CNRS-UMR6538 Laboratoire Géosciences Océan, Technopôle Brest-Iroise, 29280 Plouzané, France, (2) Department of Geology, Lakehead University, Thunder Bay, Ontario, Canada

One of the major consequences of photosynthesis is locally increased carbonate alkalinity, which stimulates the precipitation of carbonate minerals in aqueous environments. On the modern Earth, reef–type ecosystems occupy the most productive end of the oxygen– and carbonate–producing spectrum. However, prior to about 700 million years ago, photosynthetic bacteria fulfilled this role, building reef–like microbialite (e.g., stromatolite) structures, and eventually whole carbonate platforms, out of the carbonate minerals they help precipitate as a consequence of their alkalinizing effect. The most ancient examples of these systems, dating back to ca. 3.0 Ga, remain little explored. The EARTHBLOOM project examines in detail the stratigraphy, major element and trace element geochemistry of the 2,940 +/- 2 Ma to 2,925+/- 3 Ma Ball assemblage, Red Lake Greenstone belt, N. Ontario, Canada (dates from Corfu and Wallace, 1986, Can. J. Earth. Sci. 23, 27–42). This deposit contains over 400m of metasedimentary rocks that include over 200m of stromatolitic calcite and dolomite, making it the earliest known significant accumulation of carbonate on the planet. Field studies and examination of multiple industry drill cores reveal that in the east, deep-water facies (BIF, chert) are overlain by carbonates with pervasive microbial fabrics, while in the west, carbonates showing few microbial textures were deposited on and interbedded with abundant siliciclastics. Trace element data indicate general anoxia during precipitation of carbonate lithofacies. Relatively abundant pyrite and potential pseudomorphs after gypsum suggest evaporative concentration of sulfate, and sulfur isotope studies are currently underway. Carbonate C and O isotope compositions are consistent with precipitation from Archean seawater. Carbonate C isotopes, however, do show some variation between facies, with lighter values in deeper water facies. Organic carbon isotopes show a significant range, with values spanning from -30 to as heavy as -10 permil. The statistical distribution of organic carbon isotope data appears to suggest different organic carbon sources in near-shore carbonate-dominated environments versus off-shore cherty or shaley environments. A diagenetic origin of this signal appears unlikely based on C- and O- isotope systematics. The ensemble of data available to date indicates that the Red Lake carbonate platform represents an evaporitic setting, perhaps with locally concentrated sulfate, and remarkably, with little evidence for the presence of cyanobacteria during carbonate precipitation.