

Carbon and oxygen isotope chemostratigraphy of a Mesoarchean carbonate platform (Red Lake, Canada)

MUNIRA AFROZ¹, PHILIP W. FRALICK², LAURELINE
PATRY³, PIERRE SANS-JOFRE⁴ AND STEFAN V.
LALONDE⁵

¹CNRS-UMR6538 Laboratoire Géoscience Océan

²Lakehead University

³CNRS-UMR6538 Laboratoire Géosciences Océan

⁴IMPMC, CNRS, Sorbonne Université, MNHN

⁵CNRS-UMR6538 Laboratoire Géosciences Océan

Presenting Author: munira.afroz@univ-brest.fr

Carbon and oxygen stable isotope chemostratigraphy can provide critical insight into paleoenvironmental conditions, aqueous geochemistry, carbon cycling, and diagenesis in ancient sedimentary deposits. This study presents the first detailed carbon and oxygen isotopic chemostratigraphy through Earth's earliest known thick accumulation of carbonate sediments, preserved in the Ball Assemblage of the Red Lake Greenstone Belt, ON, Canada, deposited between 2.940 to 2.925 Ga ago [1]. The >200 m thick carbonate package is mostly composed of stromatolitic dolostone, with subordinate occurrences of limestone occurring at the easternmost (Hahn Lake, Golden Arm) and westernmost (Pancake Bay) exposures. A total of 280 samples of dolostone and limestone from five exploration drill cores were analyzed using a Kiel IV carbonate device coupled to a dual-inlet ThermoFisher MAT 253 mass spectrometer. The $\delta^{13}\text{C}$ values of dolostone and limestone range from -4.89‰ to +1.04‰ and -3.27‰ to +1.33‰, respectively, while $\delta^{18}\text{O}$ values range from -17.75‰ to -12.21‰ and -15.12‰ to -8.62‰, respectively (all values relative to VPDB). Over the >400m of stratigraphy covered, certain sections are remarkably homogenous in both $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$, while others show both coupled and un-coupled secular trends that, in at least two sections, permit tentative correlation between drill holes separated by ~5 km and multiple faults. The dataset further reveals a strong mineralogical control on stable isotope compositions between limestone and dolostone facies, as well as a platform-scale $\delta^{13}\text{C}$ vs. $\delta^{18}\text{O}$ trend that we interpret to reflect either mixing of water masses or alteration by meteoric water. This work significantly expands available stable isotope data for Mesoarchean carbonate platforms, provides critical chemostratigraphic context for this data, and places important constraints on depositional and post-depositional processes affecting this unique deposit.

[1] Corfu & Wallace (1986), *Can. J. Earth Sci.* 23, 27-42.