Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35550

Halite and brachiopods: Novel geochemical archives for reconstructing end-Ordovician climate

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Fluid inclusions in marine halite have been recognized as exceptional archives for storing original information on the evolution of the atmosphere, hydrosphere, and biosphere. They can preserve primary seawater-derived fluids and therefore offer a powerful basis for reconstructing the chemical, isotopic and thermal evolution of Earth's surface spheres. Coupled with paleotemperature data of ancient articulate brachiopods, the two archives have the potential to constrain high-resolution thermal histories resolved at seasonal to daily temporal scales.

Microthermometry of halite fluid inclusions is a well-suited paleotemperature method due to the mineral's thermodynamic properties. It uses the density of the aqueous phase to assess temperature of mineral formation through liquid-vapor homogenization temperatures (T_hºC) [1] [2]. As well, it does not require any assumptions about equilibrium conditions or external calibrations [3].

Using pristine halite intervals from the Mallowa Salt (Western Australia) and Red Head Rapids Formation (Canada) a thermal gradient was reconstructed that covers multiple cooling pulses during the Hirnantian. Microthermometry of halite samples produced an average, tropical paleotemperature of 27.4 ºC ± 0.5 ºC. During the Hirnantian glacial maximum (HGM), the produced low-temperature extremes revealed an excursion averaging 13.9 ºC ± 0.5 ºC. Presumed glacio-eustatic cycles led well into the Silurian, with the Mallowa Salt capturing five additional cooling pulses following the HGM (Figure 1).

Additional data was supplemented by Hirnantian-aged brachiopods from Anticosti Island (Canada) using the brachiopod-based oxygen-isotope paleothermometer of Brand et al. (2019) [4]. Relative to previously defined greenhouse and icehouse seawater compositions (-1.0 ‰ and +0.5 ‰, respectively), the brachiopods produced an average, tropical paleotemperature of 27.5 ºC ± 1.0 ºC and low-temperature extremes between 10.2–18.7 ºC ± 1.0 ºC.

[1] Roedder, E., Bodnar, R.J., 1980. Geologic pressure determination from fluid inclusion studies. *Rev. Earth Planet. Sci.*, *8*, 263–301.

[2] Roberts, S.M., Spencer, R.J., 1995. Paleotemperatures preserved in fluid inclusions in halite. *Cosmochim. Acta, 59*, 3929–3942.

[3] Arnuk, W.D., et al., 2024. Nucleation-assisted microthermometry: A novel application to fluid inclusions in halite. *Chem. Geol.*, *667*, 122318.

[4] Brand, U., et al., 2019. Brachiopod-based oxygen-isotope thermometer: Update and review. *Ital. Paleontol. Stratigr.*, *125*(3), 775–787.

