Phosphate deposits in Cambrian rocks of Avalonia in the Saint John, New Brunswick Area: insight into Paleozoic life?

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Unusual black sandstone beds of Cambrian age (~530 to 511 Ma) occur in the Saint John area of southern New Brunswick. These beds are located in the Saint John Group and occur in the upper part of the Glen Falls Formation and the lower part of the overlying Hanford Brook Formation. The dark color of these beds has been attributed to the presence of phosphate minerals and iron chlorite. The presence of phosphorous, an essential nutrient for life, is important in these rocks as they span the time of the early evolution of life. The research of this project focuses on mineralogy, origin, and depositional environment of the black sandstones, as well as their disputed stratigraphic relationships with the overlying and underlying rocks, and the phosphorous cycling that took place during deposition that may have influenced the early evolution of life. No study prior to this has conducted the correlation between the evolution of life in the Saint John group and the appearance of phosphorite.

Phosphorite is defined as a marine sedimentary rock with equal to or greater than 18% P_2O_5. The sedimentary phosphate mineral is francolite, $(Ca_5(PO_4,CO_3)_3F)$. The origin of phosphorite involves phosphorous in particulate organic matter being transferred to sediment, followed by diagenetic degradation and dissolved inorganic phosphorous being released from the organic matter to sedimentary pore waters, causing the precipitation of francolite. This produces phosphorite hardgrounds, as well as individual grains or concretions that become reworked, forming concentrated phosphorite beds. The phosphorite that occurs in the Glen Falls and Hanford Brook formations was probably linked to the sea-level rise at the Cambrian-Precambrian boundary and iron-redox. These events would have allowed for more phosphorous to be available for life forms.

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Fifty-two samples were collected from outcrops in and around the Saint John area and stratigraphic sections were logged for each location. The stratigraphic sections are being compared for lateral and stratigraphic variations. Thin sections of samples have been cut and examined for petrographic features using both petrographic and scanning electron microscopy to aid in determining paragenesis. SEM-EDS was used to determine the composition of the phosphorite. Five samples were sent to the Queen's Facility for Isotopic Research where stable isotope compositions for carbon (^{13}C) and oxygen (^{18}O) can be determined through ICP-MS, giving redox potential and temperature of precipitation, respectively. Future work includes further examination of polished thin sections under the scanning electron microscope as well as cathode luminescence to determine paragenesis.