Phosphate deposits in Cambrian rocks of Avalonia in the Saint John area, New Brunswick

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Unusual black sandstone beds of Cambrian age (~530 to 511 Ma) occur in the upper part of the Glen Falls Formation and the lower part of the overlying Hanford Brook Formation of the Saint John Group in the Saint John area of southern New Brunswick. The dark color of these beds has been attributed to phosphatic minerals and iron chlorite. The ubiquitous presence of phosphorous, an essential nutrient for life, is important as these rocks formed during the time of the "Cambrian Explosion" in the early evolution of life. This project focuses on mineralogy, origin, and depositional environment of the black sandstones, as well as their disputed stratigraphic relationships with overlying and underlying rocks, and the phosphorous cycling that took place during deposition. The study will investigate also the correlation between the evolution of life as recorded 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. 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 process 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 likely linked to sea-level rise at the Precambrian-Cambrian boundary and iron-redox cycling. These events allowed more phosphorous to be available for life forms.

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 have been compared for lateral and stratigraphic variations. Interpretations of seven lithofacies described in these outcrops suggest deposition was in a tidal barrier island environment to mid-to-distal shelf environment. Thin sections of samples have been cut and examined using both petrographic and scanning electron microscopy to aid in determining paragenesis. Results confirm that francolite occurs as firmgrounds, intraclasts, and coated grains. SEM-EDS was used to determine the chemical composition of the phosphorites. Five samples were sent to the Queen's Facility for Isotopic Research where stable isotope compositions for carbon ($\delta^{13}C$) are being determined by ICP-MS; these data will aid in the interpretation of depositional conditions.

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