"Exploring the relationship between evolving Proterozoic tectonics and oxygenation"

By: Dr. Camille Partin

Associate Professor, University of Saskatchewan

Abstract:

Nearly all models of Earth's oxygenation converge on the premise that the first notable rise of atmospheric oxygen occurred shortly after the Archean-Proterozoic boundary, with the second notable rise occurring shortly before the Proterozoic-Phanerozoic boundary. Plate-tectonic driven secular changes at the Archean-Proterozoic boundary are thought to have been partly responsible for the initial rise in atmospheric oxygen. The trajectory of atmospheric oxygen and oceanic redox conditions in the intervening Proterozoic Eon, representing almost two billion years of geological history, is far less certain. The emerging picture shows a dynamic oxygenation history with global trends that indicate overall high-low-high oxygen levels throughout the Proterozoic Eon, with low oxygen conditions established by ~1.85 Ga, or possibly as early as ~2.05 Ga. This contravenes the tenet that major orogenic events (e.g., the Himalaya-scale Trans-Hudson orogen) should yield higher oxygen levels, not lower. Plate tectonics represent both positive and negative feedbacks for oxygen levels. Mountain building, for example, promotes high erosion rates, nutrient delivery, and efficient biogeochemical cycling of carbon, resulting in the net burial of organic carbon—thought to be the primary regulator of atmospheric oxygen levels. The contrast of a low-oxygen mid-Proterozoic with a high-oxygen Paleoproterozoic is particularly striking, and mechanisms that might have caused this secular change remains unclear. This talk explores the feedbacks of oxygen with tectonic processes and events operating in the late Paleoproterozoic, especially exploring the question of whether tectonic evolution impacted the trajectory of atmospheric oxygen in the latest Paleoproterozoic to Mesoproterozoic.

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Dr. Camille Partin
P.Geo. Associate Professor
University of Saskatchewan
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