OCGC Seminar

Bioelemental Sediments, Earth Oxygenation, and Critical Elements

Dr. Peir Pufahl

Professor, Department of Geological Sciences and Geological Engineering
Queen's University

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Carleton University
Herzberg Laboratories
Room 3120

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Carleton University
Herzberg Laboratories
Chambre 3120 HP

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https://carleton-ca.zoom.us/j/94932733637?pwd=SnVqMkowK251M3R1a0pWeTdPTEROQT09

Abstract: Bioelemental sediments include phosphorite, iron formation, ironstone, and chert, which are precipitates of the nutrient elements P, Fe, and Si. The largest deposits accumulated beneath sites of active coastal upwelling and are economically important sources of P for fertilizer production and Fe for steel manufacture. Their deposition records myriad life processes that led to the precipitation of stable minerals commonly enriched in critical elements (Mn, Cd, Cu, As, Zn, Co, Ni, Se, Cr, Ba, Ge, Pd, Te, REEs). As the precipitation of P, Fe, and Si is so closely linked to biology, bioelemental sediments are not simply recorders of geological processes, but intimately involved in Earth system evolution.

Thus, chemical proxies such as redox sensitive trace elements (Cu, Cr, V, Cd, Mo, U, Y, Zn, REEs) and the ratio of stable isotopes (δ56Fe, δ53Cr, δ97/95Mo, δ98/95Mo, δ34S, δ33S) in bioelemental sedimentary facies are routinely used to understand paleoceanography and the history of ocean-atmosphere oxygenation. The first major stepwise increase in oxygen occurred in the early Paleoproterozoic. A second protracted increase is interpreted to have begun in the Neoproterozoic and ended in the Devonian when the deep ocean became fully ventilated. Periods of bottom water anoxia punctuated the Mesozoic. Sequence stratigraphic and paragenetic context is critical for understanding whether geochemical trends through these intervals represent local or global changes in seawater redox stratification or the consequence of post-depositional alteration.

Such an approach permits the systematic evaluation of basin type, oceanography, and diagenetic hydrostratigraphy on the geochemistry of bioelemental sedimentary successions. It also provides a framework for interpreting authigenic and alteration-related processes that concentrated critical elements. This holistic methodology is therefore vital in the industry project pipeline for assessing the critical element potential of sedimentary terranes because it aids in identifying areas of interest and generating targets for exploration.

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Speaker Bio: Dr. Peir Pufahl (P.Geo.) is a Professor of Sedimentary Geology at Queen's University, Canada, and Co-director of the Queen's Facility for Isotope Research. He is an internationally recognized expert on the geology and paleoceanography of bioelemental sediments (phosphorite, iron formation, ironstone, chert). Dr. Pufahl's fieldwork has taken him across the globe through North America, the Middle East, coastal Africa, Australia, Brazil, Spain, and the United Kingdom. Bioelemental sediments are precipitates of the nutrient elements P, Fe, and Si, and therefore not simply recorders of geological processes, but intimately involved in Earth system evolution. Dr. Pufahl's research focuses on understanding how the biogeochemical cycling of these elements through time relate to episodes of Earth oxygenation and biological evolution. By bridging the interface between academia and industry, Dr. Pufahl and his research group have also developed state-of-the-art exploration models for iron, phosphorus, copper, and other critical elements. Dr. Pufahl is the past Chief Editor of Sedimentology and a Fellow of both the Society of Economic Geologists and Geological Society of America.

For further information, or to arrange to meet the speaker, please contact Lyle Nelson (Lyle.Nelson@carleton.ca)

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