

Earth Sciences

Colloquium Series

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Green smokers and red BIF: Unraveling the geochemistry of Archean subseafloor hydrothermal systems



Date: Friday, October 17, 2025

Time: 1:30 PM

Location: BGS 0153

Precambrian iron formation provides valuable windows onto ancient marine environments, but exactly how they formed has remained a matter of debate. Although traditionally envisaged as the products of chemical oxidation of ferrous Fe, directly or indirectly by biology, the last decade has witnessed a major shift in our understanding of the primary mineralogy of iron formation. Application of high-resolution transmission electron microscopy and selected area electron diffraction has shown that magnetite and hematite largely derive from late diagenetic and/or metamorphic oxidation of the ferrous iron silicate mineral greenalite, and that greenalite, along with microcrystalline silica, appear to have served as the building blocks that constructed Precambrian iron formations. In this talk, I will review the observational support for these conclusions, and discuss the chemical and physical processes that could have led to widespread greenalite deposition across vast spatial scales, including its later oxidation. Thermodynamic constraints and experimental data indicate that mineral precipitation triggered upon venting of Fe-rich hydrothermal fluids into anoxic seawater may have served as a principal mechanism for generating a large proportion of the mineral mass now preserved as Archean iron formation. Experimental and theoretical studies probing the geochemical and isotopic fractionations associated with these processes therefore have the potential to provide new and valuable constraints on the nature of seafloor-hosted hydrothermal systems on the ancient Earth, and their chemical interactions with seawater.

Coffee and Timbits will be served