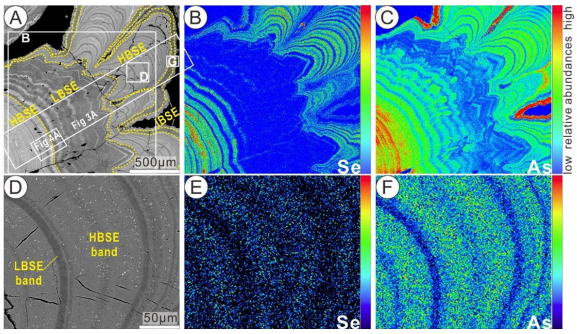
Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.36720



Towards a new model for the formation of some orogenic gold deposits

DANIEL D. GREGORY[1], CHAOYI DONG[2], NEIL R BENNETT[1], JENNIFER S CANN[3], JOY CARTER[1], DILEM HERDEM YUCEL[4], ANTHONY CHAPPAZ[5] AND EVAN HASTIE[6]

[1]University of Toronto
[2]China University of Geosciences
[3]Hemlo Mining Corp
[4]General Directorate of Mineral Research and Exploration
[5]STARLAB, Department of Earth & Atmospheric Sciences, Central Michigan University
[6]Ontario Geological Survey

Orogenic gold deposits are a major source of gold today and may be the source of several different critical metals (Te, Bi, Sb) going into the future. Currently, these deposits are largely thought to form from metamorphic fluids that are derived from sedimentary and/or mafic volcanic rocks. However, existing models do not account for (i) the formation of coarse native gold in many systems, or (ii) mineralization that predates peak metamorphism. Here, we integrate multiple case studies to evaluate an alternative mechanism for generating free gold in orogenic systems. Nano and micro focused synchrotron XANES analyses and XRF mapping at the Jinchang deposit link vein-hosted Au enrichment to cyclic seismicity, expressed as systematic As–Se redox shifts coincident with gold deposition. At Fenelon (Abitibi greenstone belt; AGB), mineralization initiates well before peak metamorphism. Here molybdenite in the gold bearing veins formed at the same time as the host intrusion and sediments, clearly too early to be due to regional metamorphism. Next, we will investigate a series of different deposits from across the Ontario side of the AGB and show that several of the gold related pyrite samples have early, gold rich, distinctive compositional zoning similar to that observed at the Jinchang deposit, indicating a similar initial gold enrichment mechanism. This pyrite was then dissolved and reprecipitated as gold poor pyrite, with remobilized gold potentially forming native gold. In addition, the AGB has many examples of magmatic-hydrothermal gold forming events (e.g., Cote and Au-rich VMS) well prior to metamorphism, which has become even more constrained recently. Lastly, we will discuss the results of preliminary experiments designed to assess how trace elements are remobilized in pyrite through metamorphism. These provide an understanding of how metamorphic reactions can remobilize trace elements held in pyrite. Using these case studies we will show that early gold mineralization in pyrite that formed during seismicity can subsequently be remobilized, leading to native gold formation and the high gold grades observed in many orogenic gold deposits.