

Characterizing an Archean Sanukitoid-Hosted Porphyry–Skarn Mineralization: The East Sullivan Stock, Val-d’Or District, Abitibi Greenstone Belt, Canada

Florent L. Bigot¹, Michel Jébrak¹, Stéphane De Souza¹

¹Université Du Québec À Montréal, Montréal, Canada

The Val-d’Or district in the Abitibi Greenstone Belt is globally renowned for its world-class orogenic gold deposits (e.g., Sigma, Lamaque, Triangle), which predominantly formed during late orogenic events. However, the district also preserves earlier, magmatic-hydrothermal events that are critical for understanding its protracted metallogenic evolution. Among these is the magmatic-hydrothermal system associated with the Archean East Sullivan Stock (ESS), a multiphase monzonitic–syenitic sanukitoid intrusion linked to Cu-Au mineralization. This study integrates geological, geochemical, isotopic, and Re-Os geochronological data to characterize the ESS and its associated magmatic-hydrothermal ore-forming processes.

Detailed characterization reveals that the ESS (ca. 2684 Ma) is a highly oxidized, water-rich intrusion of alkaline affinity. Mineralization occurs in two distinct styles. The first consists of intrusion-hosted porphyry Cu-Mo-Au mineralization, dated at ca. 2695 ± 12 Ma (Re–Os on molybdenite, this study), associated with potassic, phyllic, and propylitic alteration assemblages, alongside localized episyenitization and vuggy endoskarn formation. The second corresponds to an extensive Cu-Au-Ag exoskarn developed in adjacent pre-carbonatized volcanic rocks. Paragenetic relationships indicate that an initial high-temperature contact event was followed by skarn formation, which evolved from a prograde garnet-dominated stage to a calc-silicate-dominated retrograde stage associated with the bulk of the Cu-Au-Ag mineralization.

Our genetic model confirms the ESS as a remarkably preserved Archean porphyry-skarn system that predates the district's main orogenic gold events by tens of millions of years. These results indicate that the East Sullivan system represents an early, intrusion-related metallogenic stage linked to fertile sanukitoid magmatism. Recognizing such systems highlights the potential for Archean sanukitoid intrusions to generate significant porphyry–skarn mineralization in greenstone belt environments.