

Litho-Tectonic Framework of the Busia-Bugiri Goldfield, Uganda: Structural Controls and Comparative Metallogeny with North American Cordilleran Systems

Vanessa Kisakye Nakaddu¹, Ivan Mukiibi¹

¹Department of Geology and Petroleum Geoscience, Makerere University, Kampala , Uganda

The Busia-Bugiri Goldfield of Eastern Uganda represents a high-potential frontier within the Neoproterozoic Lake Victoria Greenstone Belt, where gold mineralization occurs predominantly within a complex crustal framework of quartz veins and Banded Iron Formations (BIF) hosted in mafic volcanic and metasedimentary sequences. Despite its strategic location, regional exploration has been hindered by deep regolith and a lack of integrated structural models.

This study employs a multi-scalar methodology, integrating regional airborne magnetic and gravity datasets with 1:5,000 scale structural mapping and petrographic analysis. Geophysical interpretations, processed using First Vertical Derivative (1VD) and Analytical Signal filters, reveal a framework of E-W trending crustal-scale shear zones overprinted by NW-SE brittle-ductile faults.

Kinematic analysis confirms that gold is localized within D2 dilatational jogs, where hydrothermal alteration halos extend up to 50 meters from the core structures. Geochemical evidence indicates that gold is present as native gold and electrum inclusions within sulphide minerals, particularly pyrite. Petrographic studies identify two distinct mineralization stages: an early disseminated pyrite-gold phase within BIF (averaging 1.5–3.0 g/t Au), and a later high-grade orogenic stage in quartz-pyrrhotite-chalcopyrite veins where grades locally exceed 15 g/t Au.

The mineralization is interpreted to be epigenetic, associated with hydrothermal fluid activity during tectonic events. Reactivation of pre-existing structures likely enhanced fluid circulation and resulted in multi-stage mineralization.

The structural evolution of the Busia district specifically the interaction between competent BIF units and regional shearing mirrors the tectonic framework of North American Cordilleran systems like the Mother Lode district. Both systems exhibit similar spatial relationships between deep-seated crustal sutures and second-order splay faults. By applying these comparative models, this research identifies new regional targeting vectors.

In conclusion, this integrated approach defines the “plumbing system” of the Busia-Bugiri district, providing a validated framework for uncovering Tier-1 targets in the under-explored Archean terranes of East Africa.