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Patterns of Gold Distribution, Pure Gold Mine, Red Lake Greenstone Belt, Ontario

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Historical data for ~13,500 drill holes for the Pure Gold Mine in Red Lake, Ontario, were well catalogued in a robust database but lacked focused interpretation, making comparison to other Archean orogenic gold deposits and determination of controls on gold deposition challenging. Past work focused on mining-scale interpretation used to follow known lodes down-plunge during nearly 40 years of underground production. Published research was preliminary and based on brief site visits during the early 2000s when underground access was limited and drill hole data not yet compiled.

Upon acquiring the project in 2014, Pure Gold Mining began systematic exploration of the large mineral system with property-wide geophysical, geochemical, and extensive geological surveys along with focused lithogemchemical and petrological studies, building a framework for interrogation of detailed deposit-scale information recorded by previous workers. A coherent structural model was required tie these large data sets together.

Anchored by the results of new drilling (~1,000 holes) by Pure Gold and relogging of all available archival core (~600 holes) the mine geology was reinterpreted in three dimensions on the recreated mine grid (~180 sections spaced at 100 feet) and on 30 level plans to ~1.5 km below surface. The historical lithology database was leveled and recoded to focus on identifying the main rock types and their distribution and relationship to gold orebodies.

We found consistent, repeating patterns meaningful at different scales. At the property scale, gold is distributed within planar zones that are continuous at the scale of kilometres despite being only ~2-50 metres wide. High-grade gold zones occur where these planes transect mafic/ultramafic lithological contacts, and the intersection defines the predominant oreshoot geometry. A quartz-phyric felsic unit conspicuously occupies the gold-bearing planes, including many areas with spectacular gold enrichment. We interpret these planes as structures that controlled emplacement of the felsic porphyries and also acted as the hydrothermal fluid conduits responsible for extensive alteration and later silicification and gold deposition. At a smaller scale (10s of metres), the gold lodes are modified into lensoidal shapes that locally define minor fold hinges and internal steeper ore-shoot plunges.

Careful interpretation of key lithological contracts through the dense network of drilling and extrapolation into lesser drilled areas results in a coherent geometrical pattern with gold demonstrably related to lithological contacts. The planar structures provided the primary control on hydrothermal fluid flow; however, they are typically not conspicuous within drill core. Instead, a broad zone within the mine trend is characterized by highly foliated and altered rock. In our model, this fabric is an overprint on the earlier gold system. Relict alteration phases (carbonate) promoted phyllosilicate growth during later postmineral compressive deformation such that the main structural elements preserved do not relate to the gold deposition event but rather modified the orebody shapes and locally remobilized gold. This understanding was critical to developing a new resource base for the mine currently under construction and expected to be in commercial production by early 2021.