Correlating oxidized phase minerals to late gold mineralization at the 144 Gap Deposit, Western Timmins Camp: Evidence for gold enrichment associated with late-stage, oxidized fluids

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The 144 Gap Deposit is the most recent development at the Timmins West Complex. Along with the Timmins and Thunder Creek Deposits, these orebodies define the mineralized “144 Trend”. They are hosted within the Bristol Township Alkaline Complex (BTAC), which consists of hanging wall pyroxenite and footwall syenite. The BTAC is emplaced along the unconformable contact between 2.71 Ga Tisdale-age metavolcanics and 2.68 Ga Porcupine-age metasedimentary rocks that are disrupted by strongly deformed shear zones. Mineralization at the 144 Gap Deposit is steeply dipping to the northwest and hosted within a syenite-monzonite porphyry dyke swarm in the footwall to a high strain zone. The dominant alteration assemblage of quartz-K-feldspar-albite±carbonate±sulfate is relatively widespread with varying intensities. It occurs along boundaries of feldspar phenocrysts, and as fine-grained matrix flooding. Carbonate-magnetite alteration is more extensive, but lacks a spatial and textural correlation with mineralized zones. Gold mineralization is associated with medium-grained disseminated pyrite and medium to coarse-grained vein-hosted pyrite. WDS trace element maps are used to establish the timing of gold mineralization relative to the complex, multi-stage growth of pyrite, which includes primary growth, brittle deformation, dissolution and resorption creating coarse secondary porosity. Three main styles of mineralization are identified: early gold as fine-grained inclusions within primary pyrite, late gold occurring as fine to coarse grains along fractures within pyrite, and a second style of late gold as inclusions deposited within the porous pyrite. Based on secondary electron microscope image analysis of 38 polished sections, these styles of late stage gold contributed more than 70% of the overall gold endowment. Electron probe microanalysis shows that late gold has a distinctly lower Au:Ag ratios than early gold. The presence of the sulfate minerals celestine-barite and anhydrite, as well as hematite, indicate oxidizing conditions at the time of late mineralization as they all occur in contact with gold, or along the same fractures within pyrite. Celestine-barite is particularly abundant, commonly occurring along fractures, and as inclusions within pyrite as well as within quartz veins and micro-veinlets. The strong correlation between late gold and sulfates, and a lack of textural evidence for remobilization, suggests that late gold was added by oxidized fluids rather than locally remobilized. This late gold enrichment may be important at other Archean deposits and the widespread spatial distribution suggests that celestine-barite has potential as an exploration tool.