# Controls on Mineralization at the FAT (Felsic Ash Tuff) Deposit, Courageous Lake Greenstone Belt, NWT, Canada: Epithermal Gold in Archean Rocks

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Seabridge Gold's FAT (felsic ash tuff) deposit, within the Courageous Lake greenstone belt (CLGB) represents a rare example of economic, well-preserved epithermal gold in Archean rocks. The FAT deposit has a proven and probable reserve of 91 Mt at 2.20 gpt gold. The CLGB is within the Yellowknife Supergroup of the Central Slave province, NWT, Canada, a fertile gold district that includes the former Giant and Con orogenic gold mines. The CLGB is one of several Archean greenstone belts in the Slave Province. It formed as a volcanic succession was deposited on to a 3218 Ma sodic granitoid gneissic complex. Periodic volcanism at 2660 Ma formed an extrusive cycle of mafic flows to ryholitic tuffs reaching a maximum (post-compression) thickness of 1800 m proximal to the FAT deposit. Volcanic textures of the rocks hosting the FAT deposit are well preserved; subaerial lapilli and lesser amounts of ash tuff are intercalated with aqueously reworked beds. These are overlain by shallow, low energy, graywacke turbidites. Three distinct metamorphic events have affected the CLGB: compression and vertical tilting of stratigraphy and associated regional dynamothermal metamorphism to mid-greenschist facies at 2592 Ma, concurrent discreet thermal metamorphism associated with local granitic intrusions, and late hydrothermal retrograde alteration. There are common, intermittent deformation and shear textures within FAT that do not correlate spatially with mineralisation.

Seabridge Gold's resource model defines eight parallel strata-bound domains. This study examines the volcanic and mineralization evolution through a single cross section that exhibits good grades and drill density in the center of the deposit. Gold is refractory within acicular and rhombic, clean and ragged arsenopyrite. SIMS and EMP analyses have defined several styles of distinct crystal habits and zoning of gold with associated trace elements. These are attributed to multiple geothermal events associated with episodic volcanic activity. The drill density and outcrop exposure is insufficient to define individual marker horizons, however broad lithologies identified by distinct volcanic textural styles (transitions from proximal to distal facies and subaerial versus subaqueous depositional environments) can be attributed to each mineralised domain. The eight strata-bound domains are interpreted to represent evidence of episodic mineralization related to repetitive volcanic events. A thick, unmineralized quartz vein that is observed in two drill holes is stratigraphically above volcanic ash with arsenopyrite and jarosite in textural equilibrium. This is thought to represent an Archean paleo-sinter and evidence of oxidized, ore-forming fluid prior to metamorphism.

The intensity of the white mica occurrence is intimately correlated to mineralization. Terraspec and SEM-EDS analysis indicate the mineralogy to be dominantly end-member muscovite, not phengite. This possibly represents recrystallized geothermal illite, rather than being a product of regional metamorphism.