Placer gold provenance in the Black Hills Creek watershed, west-central Yukon: exploration strategies from grain morphology and geochemical analysis

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Epithermal lode gold sources for rich placer gold deposits in West Central Yukon have been elusive since the 1898 Klondike gold rush. Poor bedrock exposure in an area that escaped Cenozoic glaciation has hindered the effectiveness of traditional exploration techniques. The recent discovery of potentially mineable resources in the White Gold District south of the Klondike has launched a new exploration rush. This study applies morphological and geochemical analysis of placer gold grains at six sites in the Black Hills Creek (BHC) watershed, a south-flowing

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tributary of the Stewart River, to help identify local gold sources. The flatness index = [(a + b)/2c] of gold particles was determined using a binocular microscope and PAXIT imaging software, measuring the long (a), intermediate (b), and short (c) axes. Bulk-gold fineness is defined by the ratio of [Au/(Ag + Au)*1000] and provides information about source-rock composition and weathering. Fineness values were measured using microprobe analysis. Flatness and fineness are both expected to increase with downstream transport, e.g., high measured flatness values (>5.0) would suggest reworking of grain shape during transport. Contributing areas for each placer site were determined by ArcGIS watershed analysis.

Sites 1–4 are located on northern tributaries that drain areas of 17.3 km^2, 16.4 km^2, 18.4 km^2, and 48.4 km^2 respectively. Over 350 grains have flatness indices from 3.4–7.4, and averages of 5.0, 4.8, 5.4, and 4.3. Mean gold fineness is 706, 713, 774, and 770. Site 5, located in the southern BHC, has a contributing area of 292 km2, consists of 92 grains with a flatness range of 6.3-9.8 (average of 8.4), and a fineness of 806. A total of 120 grains from Site 6, the southernmost BHC placer operation, represents a catchment of 378.2 km2 (including watersheds 1–5) with flatness indices ranging from 7.4–12.5 and an average of 8.9, with geochemical analyses pending.

Grains from the four northern placers (Sites 1–4) have similar low flatness indices, suggesting short to moderate transport distances (0–5 km). Additionally, grains from these four sites have low fineness values and narrow silver leached rims, suggesting a low degree of weathering and supporting short to moderate transport distances. Local bedrock sources are implied, within 5 km upstream from the placer operations. In contrast, grains from the southern two placer deposits show a broad range of flatness indices indicating variable transport distances (0–20 km). This variable transport range suggests multiple bedrock sources. High Hg content from microprobe analysis and indications from previous research also suggest that multiple gold occurrences contributed to the BHC placer deposits. Inferred transportation distances, when considered with detailed mapping and analysis of structural controls on mineralization, may be useful in identifying lode gold occurrences.