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THERMOBAROGEOCHEMICAL DEFINITION OF AN EPITHERMAL AU-AG SYSTEM, TOODOGGONE DISTRICT, BRITISH COLUMBIA

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The Toodoggone district of north-central British Columbia hosts the Baker mine, the Lawyers deposit, and numerous other precious metal showings. The focus of the present study is the Alberts Hump area, where a particularly complete section of mineralization and alteration is exposed in dominantly subaerial Jurassic volcanic and volcanoclastic rocks. The volcanics locally exhibit calc-alkaline (shoshonitic) to near-alkaline affinity (6-10% Na2O+K2O, 60-70% SiO2), and are classed as dacites, quartz latites, latites, and andesites. All are hornblende/biotite phyric, many have K-feldspar megacrysts, and only a few contain significant quartz.

The overall model envisaged for the Alberts Hump area is based on enhanced circulation of geothermal fluids at intersections of small local NE-SW faults with a regional NW-SE (transcurrent?) structure. These weaknesses allowed hypabyssal felsic intrusions of a mature orogenic type to rise close enough to the surface to provide anomalous heat flow and possibly a fluid component to the system. Hydrothermal alteration is widespread, and is superimposed on diagenetic hematitization. Peripheral alteration includes zeolitic, propylitic, weak to moderate sericitic, and weak argillic assemblages. Mineralogy in zones of strong alteration tends to have few phases, and in idealized vertically descending order includes alunite-quartz, clay-quartz-barite, clay-quartz, quartz-hematite, and quartz-pyrite. Texturally the silicification usually passes from massive to banded to brecciated sequences, and vein-type material occurs sporadically at all but the highest levels.

Au-Ag mineralization is found primarily in association with replacements of quartz-hematite, quartz-sulfide, and in drusy vein quartz. These alteration zones are characterized by a gain in Si, Au, Ag, Hg, Ba, Cu, Pb, Zn, and S, and net losses of Fe, Mg, K, Na, Ca, and Al. Occasionally, enrichments of As, Sb, Bi, Sn, Mo, V, and Mn accompany the precious metals. Preliminary fluid inclusion homogenization temperatures range from 110-250C for quartz-hematite zones to 260-350C for quartz-sulfide assemblages. Salinities appear to be relatively low. Vapour-rich inclusions from non-sulfide-bearing and drusy mineralization types suggest boiling. Crude reconstructions indicate this level to occur at 300-400m below the paleosurface in at least one conduit.

Work is in progress to fully define the environment of formation of Au-Ag mineralization, and place it within the framework of the larger alteration picture. The development of an algorithm of favourable depositional conditions is expected to greatly facilitate exploration and evaluation of the potential of the systems.