

ORE HORIZONS

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A JURASSIC EPITHERMAL GOLD AREA

By Tom Schroeter, Nick Carter and Arne Birkeland

Located some 300 km north of Smithers, B.C., the Toodoggone precious metals area awaits its inevitable development.

Over the next couple of years, several development projects may be undertaken in the Toodoggone area, and their success may establish a new gold mining camp in British Columbia. The gold-silver deposits, as currently known, are modest in size but hold the potential for economic success. The camp is in an early stage of exploration and development compared to other classic epithermal camps such as El Indio in Chile, the Comstock Lode and the Goldfields areas of Nevada, and the Creede district of Colorado. Exploration and pre-production test work will continue through 1987. Less than 20% of favorable mineralized structures are being explored and ongoing work programs should result in new discoveries. This year is shaping up to be exciting and interesting in the Toodoggone.

In 1925 Charles McClair attracted some attention to the area when he mined placer deposits, but that was fleeting as he and his partner went missing in 1927. Production was short-lived, and it wasn't until the 1960s that prospectors returned searching for gossanous zones indicative of porphyry-type deposits. In 1968 the late Gordon Davis, exploring on behalf of Kennco, recognized greyish-colored quartz float on the Chappelle property. The greyish color turned out to be a fine-grained mixture of electrum (a gold-silver alloy) and argentite (a silver sulphide). This was subsequently developed as the Baker gold mine, which yielded 37,558 oz of gold and 742,198 oz of silver from 79,580 tonnes of ore between 1980 and 1983.

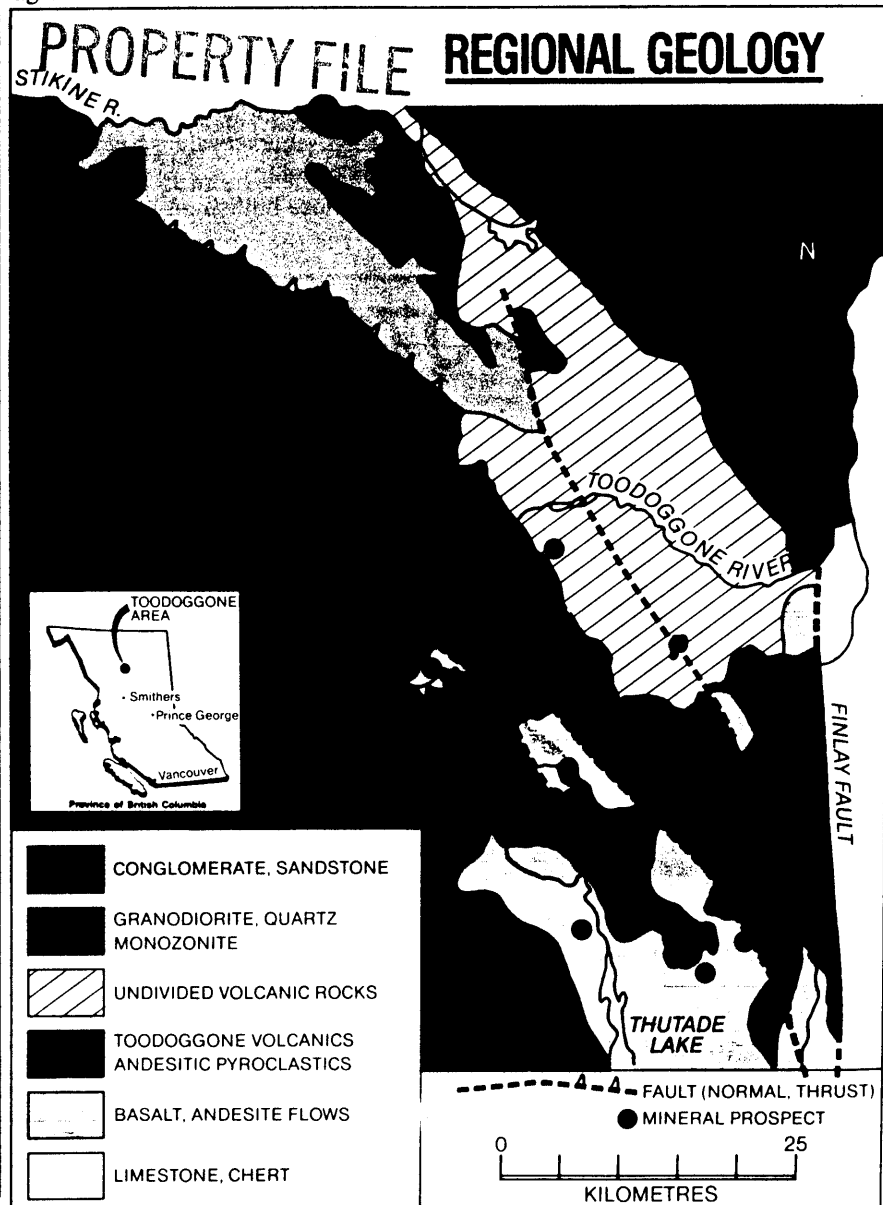
Following the production decision in 1979, Du Pont of Canada Exploration (the operator) and the B.C. government built a 1,620-m gravel airstrip capable of handling Hercules aircraft. A 90-tonne-per-day mine-

and-milling complex was constructed utilizing full air support from Smithers and access roads were built to the mine (13 km) and later extended to the Lawyers property (a further 8 km).

Extension of the Omineca Resource Road from its current terminus at Moosevale Flats, 70 km southeast from Sturdee airstrip, represents a critical step in supplying materials for further development in the Toodoggone. Helicopter transport and air expediting has accounted for more than 20% of exploration costs. An agreement between Serem Inc. and

the B.C. government to cost-share the extension depends on the company making a positive production decision.

Although remote, ground acquisition has generally proved easier than in less isolated, better established areas in the province. More than 50 companies hold ground in the Toodoggone with the more explored prospects held by Serem Inc., Energex Minerals, Multinational Resources, St Joe Canada, Golden Rule Resources, International Shasta, and Newmont Exploration of Canada. Mining at the Baker mine over three winters dem-



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onstrated no major constraints.

Since the early 1970s, when the Toadoggone was recognized as a gold-silver "camp," more than 55 new mineral prospects have been identified and more than \$40 million has been spent on exploration and development. To date, the total mineral inventory identified in at least seven deposits is estimated at 400,000 oz of gold and 7.6 million oz of silver for a gross metal value of nearly \$300 million. Over the past years annual expenditures have ranged between \$3.5 and \$6.5 million.

The favorable Toadoggone belt consists predominantly of andesitic pyroclastic rocks and is 100 km long by 20 km wide. To date, only small parts have received detailed exploration. Northwesterly trending faulting has played a major role in localizing mineralization both regionally and on a local property scale. Smaller high-angle graben-related structures such as those identified at the Lawyers property as well as and flatter thrust-type structures such as those at the JD and Golden Lion properties are also important. Characteristic ore minerals include electrum, native gold, native silver and minor base metals. There is a distinct absence of deleterious elements such as arsenic, antimony or mercury. Gangue minerals include amethystine to chalcedonic quartz, barite, calcite and minor pyrite. The Toadoggone ore and alteration assemblages exhibit zonation typical of worldwide epithermal deposits ranging vertically from base metal rich zones at depth (the Baker zone for example) to an intermediate "bonanza" precious-metals-rich zones (the Lawyers) and finally to near surface, hot spring zones (the A1).

Several age dates of host volcanic and intrusive rocks and alteration associated with mineralization suggest a coeval period of formation around 180 Ma (early Jurassic). This age represents one of the oldest documented areas of epithermal mineralization in the world.

The size of deposits discovered to date ranges from about 50,000 tonnes grading 12 g gold per tonne to more than one million tonnes grading 7.2 g gold per tonne and 244 g silver per tonne. High grade ore shoots within individual deposits locally host "bonanza-type" mineralization; however, the possibility of finding larger tonnage, lower grade deposits in the area cannot be overlooked. ▶

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Traditional prospecting integrated with geological mapping and careful, large-volume sampling has proven most effective. Methods of sampling include extensive back-hoe trenching, blasting and large diameter diamond drilling. The best geochemical signatures are, not surprisingly, expressed by gold and silver. Locally, increased amounts of barium may be significant. Soil and silt sampling has been very useful; however, these methods have limited application in areas of heavy overburden. Electromagnetic and induced polarization surveys have aided in identifying contrasting zones of high-resistivity silica and low-resistivity clay alteration which tends to flank or halo the former. Future discoveries may result from the application of depth-zoning geological models.

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Lawyers Deposits

The Amethyst Gold Breccia (AGB) zone on the Lawyers property, 8 km north of the Baker mine, was found in 1973 by Kennco during routine follow-up of silver silt geochemical anomalies. During 1974 Kennco carried

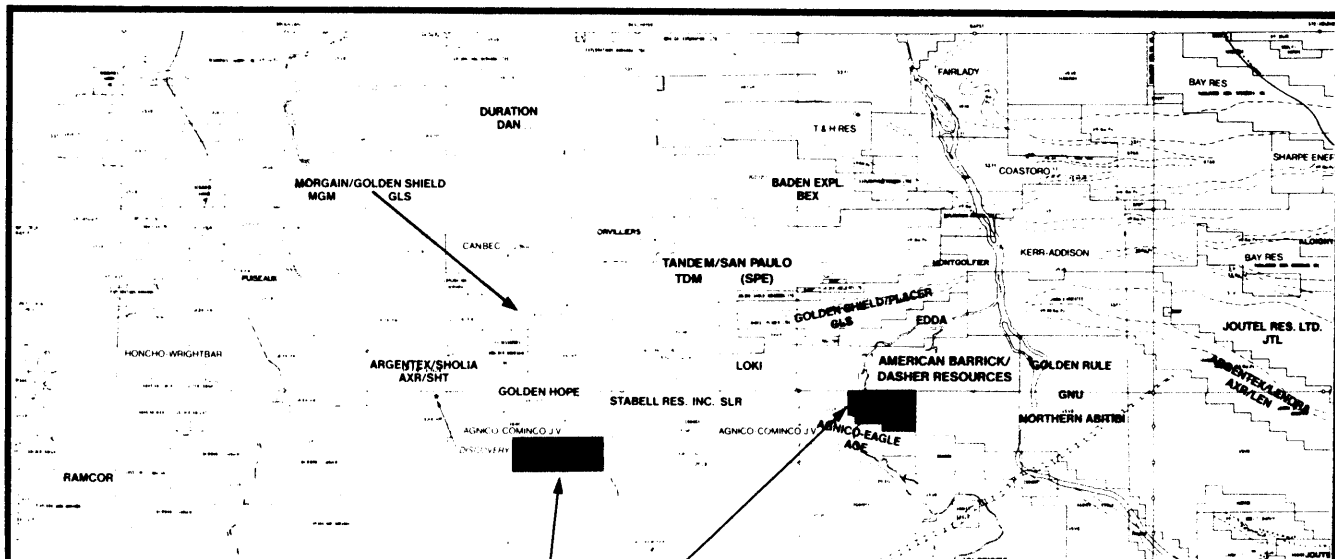
out a small trenching and diamond drilling program. Serem Inc. obtained an option on the property in 1979. Since then, work completed on three zones (AGB, Cliff Creek and Duke's Ridge) includes extensive surface and underground diamond drilling and drifting on two adit levels. Reserves (cut and diluted) are reported to be 941,300 tonnes grading 259.6 g silver per tonne and 7.182 g gold per tonne. Of this about 50% is contained in the AGB zone and the remainder in the Cliff Creek zone (45%) and the Duke's Ridge zone (5%). Recoveries are estimated at 95% for gold and 82% for silver.

The AGB zone has been traced over a strike length in excess of 600 m (including 430 m drill tested), a width of alteration varying between 60 m and 75 m, and a minimum depth of 150 m. Within the AGB zone, higher grade, mineralized shoots pinch and swell and average 3 m in thickness. Mineralization consists predominantly of native gold, native silver, electrum and argentite (acanthite) with minor chalcopryrite, sphalerite and galena in a gangue of chalcedony, quartz-amethyst and calcite. This

forms fracture fillings occurring as stockwork veins as well as the matrix within breccia zones; both occurrences are controlled by a north and north-northeast trending fracture system which dips steeply to the west. Multiple episodes of veining and brecciation have been recognized. The mineralized zone appears to occur along one flank of a paleo-half-graben structure.

The Cliff Creek Breccia zone has only been explored over a strike length of 300 m to a depth of 250 m. The associated geochemical anomaly extends more than 1.5 km. The Duke's Ridge zone contains breccia zones similar to those in the AGB zone and requires further work.

Serem Inc. is studying the feasibility of production at a milling rate of up to 500 tonnes per day, utilizing a workforce of about 140 persons. A positive production decision is expected shortly. A minimum mine life of five years is expected and the potential for discovery of additional ore is considered excellent. Exploration targets remain on the property. ▶



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A1 Deposits ^{94E091}

Energex Minerals holds more than 14,570 ha in the Toodoggone area. In 1979 the company acquired the A1, Moose and JD properties. More than \$7.5 million has been spent since that time.

The property covers a complex sequence of porphyritic, subaerial Toodoggone andesitic to dacitic volcanic rocks which dip gently south to southwest. Three north- to northeast-trending, radical fault systems cross the A1 property. Surface exploration, IP resistivity and more than 12,000 m of drilling have delineated three gold deposits with drill-indicated reserves (the Bonanza, Thesis III and BV deposits) related to these faults as well as numerous, less explored gold showings. The epithermal gold mineralization, with a strong barite association, occurs within intensely silicified zones flanked by strongly argillized andesitic wall rocks. The silicified cores of these alteration zones are tabular to elliptical in plan and range up to 150 m in length and 45 m to 90 m in width. Mineralization consists of free gold, barite, minor copper sulphides and pyrite.

Energex's 1985 exploration program developed a shallow mineral inventory for two deposits (the BV and Thesis III) of about 235,820 tonnes grading 8.57 g gold per tonne in all categories. Closely spaced diamond drilling in 1986 brought this inventory into the drill-proven/probable categories and added significantly to probable and possible drill reserves. Trenching and diamond drilling established the continuity of mineralization along strike and to depth. Encouraging drill intersections from two additional prospects (the Thesis II and Bonanza South) have strengthened the interpretation that these zones are extensions of the other drilled deposits. Less than 20% of the length of the mineralized fault structures on the A1 property has been tested by drilling.

The Bonanza deposit is associated with the north-south Bonanza Fault, which appears to extend for over 5 km southwards to the Manson Creek-Golden Rule METS deposit on Metsantan Mountain. The nearby Ridge deposit, a tabular quartz-hematite-imonite breccia body, can be traced for over 600 m along a northeastern play of the Bonanza Fault. The Bonanza deposit has been tested by

43 holes; the Ridge zone has received only preliminary trenching and two drill holes.

The southeast-trending Thesis Fault crosses the A1 property west of the Bonanza Fault. It has been traced for over 3.2 km. The Thesis III deposit, positioned midway along this fault system, has been explored by drilling, trenching and stripping across a width of 80 m and a length of 250 m. The deposit comprises three intensely silicified zones, flanked and enveloped by moderately to strongly argillized andesitic host rocks.

In the Thesis III deposit, brecciation, with silica clasts in a barite and crushed silica matrix, is important in localizing the higher gold values, up to 13.75 g gold per tonne. Non-brecciated silica typically grades 0.5-2 g gold per tonne. Pyrite and minor chalcopyrite have been leached to depths of 10-15 m and deposited in a prominent gassan downslope from the deposit. The Thesis II deposit is interpreted to lie within the Thesis Fault system about 400 m southeast of the Thesis III deposit.

The BV deposit is within the southeast-trending BV Fault. It has been

tested by 37 drill holes and displays good continuity. The 1986 intersections included 8.8 m of 25.7 g gold per tonne and 7.5 m of 22.6 g gold per tonne. Another mineralized zone with similar characteristics lies some 900 m to the southeast along the BV Fault system. Follow up trenching is planned on this and other geophysical/geochemical anomalies.

Sufficient reserves now appear attainable on the A1 property to commence production from three open pits, beginning in 1988. Underground mining operations will depend on the results of deeper drilling scheduled in 1987. Energex is also evaluating a seasonal heap leaching program on lower grade open pit wall rock. Road access will be a major economic factor in dictating the feasibility as well as the size, duration and cut-off grade of any operation.

^{94E026} Chappelle Property

The known gold/silver-bearing quartz veins occur in a window of late Triassic Takla Group volcanic rocks marginal to a Lower to Middle Jurassic granitic stock. Takla Group andesites and dacites are in fault contact with,



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or are unconformably overlain by, slightly younger Toodoggone volcanic rocks. Late Permian limestones and lesser cherts underlie Takla Group rocks south of the known vein structures.

Gold/silver-bearing quartz veins strike northeast and east-southeast and several have a spatial relationship with quartz-feldspar porphyry intrusions which may represent feeders for Toodoggone volcanic rocks.

The A Vein, mined by Du Pont from 1980 to 1983, is part of a northeast-striking, steeply northwest-dipping quartz vein system known to extend over a strike length of 400 m. Better gold-silver grades (pre-production, drill-indicated reserve estimate: 90,000 tonnes grading 33.9 g gold and 680.2 g silver per tonne were contained in a flat-lying shoot with a 200-m strike length, a width of 2-3 m and a thickness of 40 m). Principal ore minerals in the A Vein were fine-grained electrum and acanthite (argentite) which occur with disseminated pyrite, chalcopyrite and sphalerite in a quartz and minor carbonate gangue.

Extensive cross-faulting resulted in greater-than-anticipated dilution, such

that recovered grades were about half those originally estimated.

Multinational Resources acquired the mineral rights to the Chappelle property from Du Pont Canada in mid-1985 and embarked on an exploratory drilling program to test several of the other known vein systems. Two holes were drilled on the B Zone, 400 m northeast of A Vein, and one of these yielded significant gold-silver assays. The B Zone had been discovered during the earliest stages of exploration on the property when limited trenching revealed narrow, quartz-pyrite veins and closely spaced quartz stringers with low precious metals values. Drilling by Multinational on the B Zone in 1986 disclosed the presence of a quartz (carbonate) vein with a northeasterly strike length of at least 150 m and true widths in the 2-7-m range. This structure apparently terminates below surface and is oblique to the trend of the veins and stringers exposed in the surface cuts. These are hosted by volcanic rocks displaying moderate to intense sericite and clay mineral alteration and are interpreted to represent a hanging wall alteration zone.

The B Zone is apparently the northeast extension of the structure which hosts the A Vein. Mineralogy of the two zones is similar and better mineralized sections in both are concentrated near the hanging wall. Work to date indicates that the B Zone is not as structurally complex as the A vein.

The last 1986 drill hole on the B Zone intersected 58.4 g gold and 728 g silver per tonne over a core length of 5 m. Work to date indicates some 50,000 tonnes grading 17 to 20 g gold and 140 g silver per tonne within the B Zone, which is open along strike and to depth.

A substantial work program is scheduled for the B Zone in 1987. The fact that this zone has only limited surface expression necessitates re-evaluation of other vein structures on the property. □

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