CASSIAR GOLD DEPOSITS
McDAME MAP–AREA
(104P/4, 5)

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INTRODUCTION

A mapping program at scale 1:10 000 encompassing approximately 120 square kilometres was initiated in 1980 in the area containing all the significant lode gold deposits east and southeast of Cassiar townsite. **Mapping**, centred on McDame Lake near Highway 37, covers the area from Quartzrock (Quartz) Creek adjacent to the Cassiar road on the north to Table (Tabletop) Mountain and the headwaters of Pooley Creek on the south. The area is between longitude 120 degrees 35 minutes and 129 degrees 46 minutes and latitude 59 degrees 7 minutes and 59 degrees 17 minutes (Fig. 18).

The main purpose of this mapping is to document stratigraphy, structure, and the distribution of quartz veins in the region. Geological mapping will be extended somewhat and selected areas studied in more detail during the 1981 field season.

HISTORY

Activity related to gold in Cassiar area has been ongoing since the discovery of placer gold in McDame Creek in 1874. In total some 70,000 ounces of placer gold was recovered, mainly between 1874 and 1895, although small-scale placer mining continues to date. Free gold in quartz veins was discovered on Troutline (Trout) Creek by F. F. Callison in 1934 which led to the discovery of many more veins during the next three years. During 1937 The Consolidated Mining and Smelting Company of Canada, Limited did extensive work including diamond drilling in the area. With rare exceptions, all the veins that are of interest today had been located and tested by 1939.

High-grade portions of some of the veins have been exploited by small-scale mining. In 1934, 1 ton of ore containing 4 ounces of gold from the discovery vein was shipped by air by Callison. In 1939, A. W. Boulton recovered 114 ounces of gold and 20 ounces silver from 130 tons of ore from the Erickson Creek (Jennie) vein. During each following decade a few tens of tons to a maximum of 100 tons of ore was mined from one or more of the five or six main deposits. In total, there are five abandoned millsites in the map-area, none larger than 12 tons per day capacity, and the remains of a 200-ton-per-day crusher site are at Snow (Snowy) Creek.

Boulton's venture remained the single biggest mining effort in the area until late in 1978 when Erickson Gold Mining Corp. (Nu-Energy Development Corporation and The Agnes & Jennie Mining Co. Ltd.) began milling ore. Full production began on January 18, 1979, and to the end of that year the company milled 28 296 tonnes with average recovery of almost 20.9 grams per tonne of gold and 20.5 grams per tonne of silver per tonne of ore (590 900 grams gold and 581 522 grams silver). Mining and milling continued in 1980 and the mill capacity is expected to be increased to 150 tonnes per day in 1981. Also in 1980, on the 18th of September, Cusac Industries Limited began milling a small stockpile of high-grade ore in their 30-tonne-per-day mill. The source vein is one of the rare new discoveries in the area. In addition, Plaza

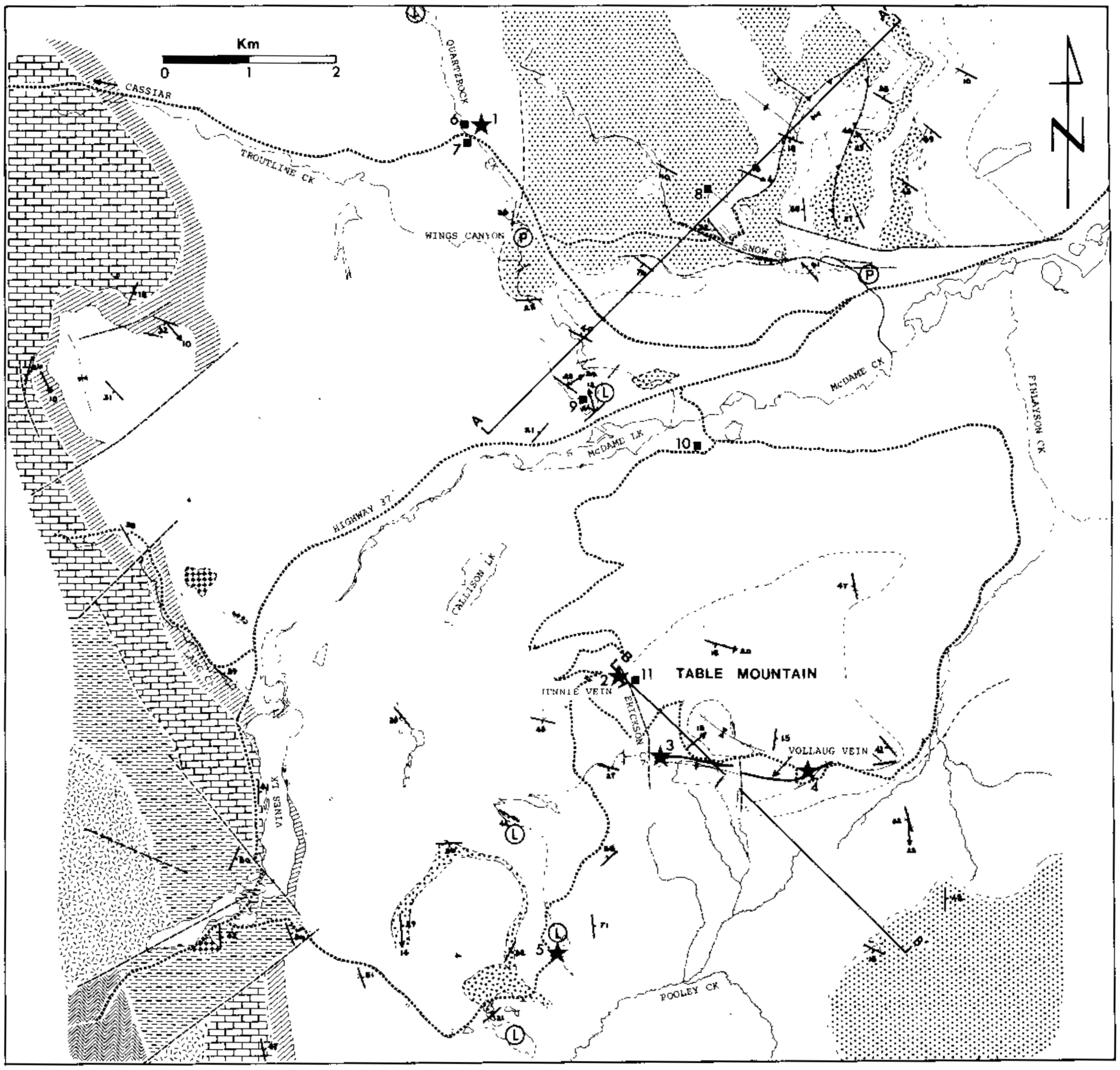

Figure 18. Geology of the McDame map-area.

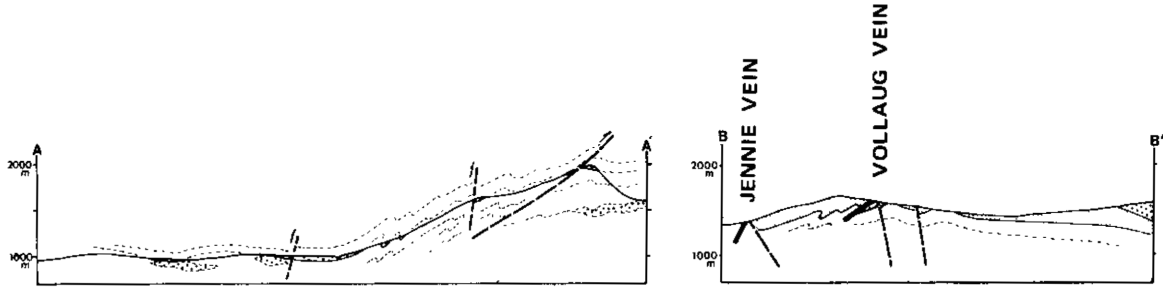

Figure 19. McDame map-area, cross-sections; for location *see* Figure 18.

LEGEND

SYLVESTER GROUP (MISSISSIPPIAN TO ? PERMIAN)

4	BASALT: WIDESPREAD PILLOWS, SOME BRECCIA, TUFF, AND MINOR ARGILLITE; IN SOUTHEAST, ABUNDANT BRECCIA, TUFF, AND SMALL LIME-STONE PODS
3	SILTSTONE, ARGILLITE, GREYWACKE, PEBBLE CONGLOMERATE, QUARTZ ARENITE, CALCAR-EOUS SILTSTONE, LIMESTONE
2	GREENSTONE-CHERT ASSEMBLAGE: MASSIVE PALE TO DARK GREEN ANDESITE FLOWS, TUFF, IN PART FINE-GRAINED DYKES AND SILLS, SOME CHERT, INCLUDES PORPHYRITIC FELD-SPATHIC ANDESITE FLOWS (AND ? SILLS)
2A	CHERT, TUFFACEOUS CHERT, INCLUDES SOME ARGILLITE; IN NORTHEAST WELL-LAYERED CHERT-PHYLLITE, TUFFACEOUS CHERT, RIB-BONNED CHERT, AND ARGILLITE
1	ARGILLITE, SILTSTONE, CHERT, QUARTZITE, LIMESTONE, PEBBLE CONGLOMERATE, TUFF; INCLUDES NUMEROUS DIABASE AND ANDESITE SILLS
1A	DIORITE: SMALL PLUGS AND SILLS IN UNIT 1 AND OLDER ROCKS

INTRUSIVE ROCKS

TROUTLINE CREEK QUARTZ MONZONITE (CASSIAR STOCK), UPPER CRETACEOUS

QUARTZ MONZONITE PORPHYRY

BEDDED ROCKS

SANDPILE AND McDAME GROUPS (ORDOVICIAN AND DEVONIAN)

LIMESTONE, DOLOMITE

KECHIKA GROUP (CAMBRIAN AND ORDOVICIAN)

SHALE, ARGILLITE

ATAN GROUP (LOWER CAMBRIAN)

CALC-SILICATE HORNFELS, HORNFELS

SYMBOLS

- ACTIVE PROPERTIES .... ★
- ABANDONED MILL SITES .... ■
- MAJOR PLACER WORKINGS .... (P)
- BEDDING 15
- FOLIATION 42
- MAJOR FOLD AXIS ....
- MINOR FOLD AXIS 23
- FAULT – NORMAL, THRUST ......
- QUARTZ-CARBONATE ALTERATION (LISTWANITE) . (L)
- ROAD ....

★ OPERATING PROPERTIES

1	UNITED HEARNE RESOURCES LTD.	104 P / 012
2	ERICKSON GOLD MINING CORP.	104 P / 029
3	TABLE MOUNTAIN MINES LIMITED	104 P / 019
4	PLAZA RESOURCES CORP.	
5	CUSAC INDUSTRIES LTD.	

■ FORMER MILL SITES

6	CORNUCOPIA (HANNA, BENROY)	104 P/012
7	GLEN HOPE (QUARTZROCK CREEK)	104 P/010
8	SNOW CREEK	104 P/014
9	TROUTLINE CREEK GOLD MINES	VARIOUS
10	NORA (DAVIS)	104 P/018
11	ERICKSON CREEK (BOULTON)	104 P/029

Resources Corporation began stripping and stockpiling ore in anticipation of future milling; engineering studies leading to production were proceeding for United Hearne Resources Limited; and advanced exploration work was being done by Table Mountain Mines Limited, Esso Resources Canada Limited, Newcoast Silver Mines Limited, and others (*see* Fig. 18 for locations).

GEOLOGIC SETTING

Host rocks for the gold-bearing quartz veins are Sylvester Group volcanic and sedimentary rocks of Mississippian to Permian age (Monger, 1980, personal communication) that form the core of the McDame synclinorium (Gabrielse, 1963). These rocks are mainly a greenstone-chert-argillite assemblage that is believed to be an allochthonous oceanic terrane thrust onto the carbonate and clastic rocks of the Cassiar platform (Monger, 1977).

LITHOLOGIES

The map-area is divisible into two major units: a lower sedimentary-volcanic assemblage consisting of fine-grained clastic rocks, andesitic fine-grained volcanic rocks, and diabasic or porphyritic intrusions, and an upper part composed primarily of massive and pillowed basalt.

In more detail, the basal unit (map unit 1) overlies McDame Group and consists of approximately 150 metres of mainly argillite, siltstone, and their calcareous equivalents, as well as some chert, quartzite, limestone, pebble conglomerate, and tuff. North of Lang Creek, diabase to medium-grained porphyritic andesite sills 5 to 15 metres in thickness are well exposed and intrude siliceous (cherty) tuffs near the top of this succession. We suspect that similar and considerably thicker sills are present throughout much of the map-area. This unit is also intruded by small bodies of medium-grained diorite (map unit 1A).

The overlying unit (map unit 2) is made up of fine-grained volcanic rocks of andesitic and possibly slightly *more acidic composition. They are interbedded with varying amounts of chert and medium-grained diabasic* to porphyritic feldspathic volcanic rocks that are probably sills. The fine-grained volcanic rocks form massive outcrops along Highway 37 and the walls of McDame Valley. These rocks are dark grey-green to brown and orange weathering but are pale grey-green when freshly broken. In the western and central parts of the map-area, little can be deciphered from the highly fractured and jointed but otherwise homogeneous outcrops. It appears that there are thick, massive units of both flows and tuffs that are of similar composition and texture. In detail, there is rare chert, and tuffaceous chert interbeds or lenses can be found as well as rare zones of flow breccia. Generally, flow breccia occurs as local, small zones with sparse, small clasts. One exception occurs on Table Mountain at the top of this map unit where excellent flow breccia developed with large, closely packed clasts.

Thin, reticulate chlorite veinlets that impart a webbed appearance to the rock are a common feature in the fine-grained volcanic rocks. Where the chlorite veinlets are abundant and well developed, the rock can have a brecciated appearance with angular 'fragments' surrounded by linear or interconnected, braided zones of chlorite veining.

To the south and west, in the vicinity of Cusac Industries' millsite, the fine-grained volcanic unit contains abundant interbedded chert and tuffaceous chert. These form chalky weathering pale, green to grey and brown massive outcrops that can be traced throughout the immediate area. They constitute continuous, mappable units, even though their contacts are somewhat arbitrary (map unit 2A).

In the northeastern part of the map-area north and east of Snow (Snowy) Creek and along Highway 37, volcanic rocks in the fine-grained volcanic map unit are similar to those seen elsewhere but contain considerably more, thinly bedded chert, tuffaceous chert, tuff, argillite, and impure quartzite. The rocks are very well bedded with interlayered thin-bedded to ribbon chert and phyllitic sedimentary rocks in tuff-argillite and tuff flow units that are in the order of 50 to 150 metres in thickness.

Note that although all the siliceous rocks in this volcanic unit and throughout the map-area are fine grained to microcrystalline, they range from thin to thick-bedded to massive layers. Consistently they appear to be chert or tuffaceous chert not rhyolite or any other acidic pyroclastic or flow rocks.

Bedded fine to coarse-grained clastic rocks (map unit 3) lie stratigraphically above the fine-grained volcanic-sedimentary unit and cap Table Mountain. These consist mainly of siltstone, argillite, greywacke, quartz pebble conglomerate, and quartz arenite. The coarser clastic rocks have abundant fluvial structures, including cyclical graded beds, crosslaminations, ripple marks, and flute casts. Much of the upper part of the succession is calcareous and it contains brown-weathering limestone beds to 1.5 metres in thickness. This map unit (3) appears to have been deposited as turbidites in a shallow, localized basin or trough. The succession appears to fine upwards and to the south and east.

Two kilometres east and southeast of Table Mountain the clastic rocks are overlain by a thick sequence of coarse tuffs and breccias (part of map unit 4). These are the only abundant coarse pyroclastic rocks known in the map-area. This unit also includes sparse pods of crystalline limestone to 5 metres in thickness.

A thick sequence of massive and pillowed basalt (map unit 4) underlies the entire north-central part of the map-area as well as a zone extending southward along Quartzrock and Troutline Creeks. Locally, the sequence contains basaltic tuff and argillite units. The tuffs may be iron rich with abundant magnetite and ferruginous chert and mudstone. Map unit 4 forms the upper part of the Sylvester Group in the map-area.

FOLDING

Two major folding events can be recognized and a third, older event is suspected. Phase 1 ? (F_1) folds, seen only in the northeast, have flat to gently plunging, northwesterly trending axes (Fig. 19). The folds are asymmetrical recumbent structures that probably formed during northeasterly directed thrust faulting. Phase 2 (F_2) is characterized by mesoscopic minor folds and moderately appressed recumbent folds with inclined axes that trend at 55 degrees azimuth. A weak foliation parallels the shallow northwest dip of the axial plane in some folded siltstone beds. Southeasterly plunging phase 3 (F_3) minor folds with well-developed axial plane cleavage are widespread. Axes of these upright folds trend at 150 degrees azimuth parallel to the trend of the McDame synclinorium. Crenulation lineations parallel to the F_3 fold axis occur locally.

A northeast-southwest-trending joint set is well defined in the area. The joints appear to be related to the youngest period of folding (F_3). Northeasterly compression resulted in a shear couple with strongly developed shear joints trending at 070 to 085 degrees as well as 015 degrees. In addition, a northwesterly trending cleavage developed along with northeasterly trending tension gashes. The tension gashes occur in zones trending at 050 degrees but individual gash veins within these zones trend at 040 degrees. The joint density is highest in the greenstone units and lower in the thinly bedded sedimentary rocks. A more detailed study of the jointing in restricted parts of the area was reported by Gabrielse (1963).

FAULTING

Thrust faults as well as steep normal transverse faults with considerable lateral offset are seen in the map-area. Thrust faulting is evident on the ridge north of Snow Creek where there is stacking of phyllite-basalt units. On Table Mountain a series of northerly trending, steeply dipping faults offsets the volcanic-sedimentary contact as well as sections of the Vollaug vein.

The major Erickson Creek fault has considerable oblique slip movement. It truncates the Vollaug vein in the west as well as cutting off the massive andesite flow unit southwest of the Silver Standard camp. Steeply dipping, polished, slickensided fault planes were found at the west end of the Vollaug vein and in Erickson Creek adjacent to the minesite. The displacement on this fault is not known, but it might be considerable. If the Jennie vein is a faulted extension of the Vollaug vein, the throw is about 575 metres.

East of the Erickson Creek fault, sections of the Vollaug vein are offset by small high-angle faults. Other faults are suggested by the displacement of the volcanic-sedimentary contact, localized overturned bedding, and skewed bedding attitudes.

South of Vines Lake, the McDame Formation, which normally underlies Sylvester rocks, is absent. Instead, there is a thick section of Kechika argillite. In addition, south of the fault the contact of the major granite body is displaced to the west about 1 kilometre. This implies that major northeasterly trending faults underlie the northwest flank of Table Mountain and McDame Valley.

LODE GOLD DEPOSITS

As a generalization, apart from its age, the Cassiar lode gold district is very similar in its geological setting to the Archean greenstone gold camps of Eastern Canada (Boyle, 1979; Roberts, 1980).

An excellent historical record and description of the placer and lode gold deposits was documented by Mandy (1931, 1935, and 1937). He recognized the three northeast to east-northeasterly trending greenstone-hosted vein systems that contain many of the well-mineralized veins. The three vein systems are subparallel fracture zones hundreds of metres in width and about 3 kilometres apart. The most southerly is along the south shore of McDame Lake. The middle system is the most extensive with a strike length of about 8 kilometres. It trends from the headwaters of Snow Creek through the junction of Troutline and Quartzrock Creeks and continues to the southwest. The northernmost system starts east of the Cassiar road by Quartzrock Creek bridge and passes southwest toward Troutline Creek. In addition to the three northeasterly trending belts, some of the largest and most continuous veins in the region are ribboned relatively flat-lying structures at or near the greenstone-argillite contact or are steeper massive veins in greenstone and cherty tuff. The most important of these are the Vollaug, Jennie, and Cusac Industries' veins in the vicinity of Table Mountain and on its south slopes toward Pooley Creek.

In the mineralized belts the majority of quartz veins in greenstone dip steeply; dominant trends are 075 and 010 degrees. These veins are a few centimetres to over 5 metres in width and are related to well-developed shear joints and faults. The better veins are commonly 10 to 30 metres apart, about 0.5 metre in width, up to a hundred metres in length, and several tens of metres in a vertical range. Northeasterly trending veins tend to be smaller and fill *en echelon* tension gashes. Many other veins with random orientations are found in faults, fracture zones, bedding planes, and along greenstone-argillite contacts. In the Wings Canyon area of Quartzrock Creek, for example, closely spaced veins resemble saddle reef structures or follow folded bedding contacts. In this highly faulted and altered locality up to 50 per cent of the canyon wall consists of quartz veins.

Veins at the contacts of greenstone with argillite are of secondary importance to those in greenstone. However, this is the setting of some of the largest and most continuous veins in the area, such as the Vollaug and other veins on Table Mountain. The contact in many areas appears to be a plane of décollément (possibly a major thrust fault). Argillite beds along the contact are crumpled and locally contain large boudins of dyke material. Quartz veins along this contact are highly fractured, ribboned, sinewy structures consisting of bone white quartz, minor carbonate, and laminae of graphite. Other more massive white quartz veins occupy crests of folds along the greenstone-sediment contact. Although many quartz veins follow the contact closely, a number clearly crosscut it.

In more detail, veins that are in greenstone are fairly regular in attitude and width although some pinch and swell, split, interconnect, and curve. Vein quartz is typically massive, coarsely crystalline, milky white to cream in colour and contains cream-coloured carbonate grains and veinlets. Local zones display multiple fracturing and healing by several generations of progressively finer grained quartz. These rehealed sections appear to contain some of the better gold-bearing oreshoots. At the extremities of the quartz vein belts, as well as at higher elevations, the veins contain vugs lined with white milky quartz, chlorite, epidote, and coarsely crystalline calcite. Veins of this type are barren.

The veins generally contain few metallic minerals but where these are present they are usually associated with free gold. On average, gold-bearing shoots contain 2 to 3 per cent metallic minerals consisting of pyrite, tetrahedrite, chalcopyrite, and local arsenopyrite, sphalerite, and galena. Near surface, the veins contain limonite, malachite, and azurite; occasionally they carry spectacular free gold in cellular boxworks resulting from leaching of sulphide minerals. Locally black tourmaline and white mica are present in the veins.

Alteration envelopes are pronounced around quartz veins in greenstone but are less obvious in argillite and chert. In greenstone even hairline fractures can have altered margins up to a few centimetres in width. The strong veins have bleached, buff to cream alteration zones up to 10 metres in width. The alteration zones consist of distinctive pale carbonate, quartz, mica, and coarse euhedral pyrite crystals; locally, coarsely crystalline arsenopyrite is developed. Margins of the altered zones are remarkably sharp.

One intriguing highly altered rock type found in the map-area (shown on Fig. 18) and reported from other greenstone gold camps (Karvinen, 1980), is quartz-carbonate rock containing green mica (mariposite). While it is not immediately associated with gold-bearing quartz veins in McDame map-area, it might be important as a regional indicator of favourable terrane. In at least two localities quartz veins are developed in narrow shear zones containing serpentinized volcanic rocks.

The mariposite-bearing rock was referred to as Listwanite by S. F. Leaming (1978) after a term coined by A. Holmes in 1928. The term has found widespread local usage and refers to 'a schistose rock of yellowish green colour composed of various combinations of quartz, dolomite, magnesite, talc, and limonite -- commonly called quartz-carbonate rock with distinctive features due to addition of mariposite.' In McDame map-area it forms large pods as well as smaller bodies that appear to have been emplaced along fault zones and at fault intersections. Karvinen (1980) argued convincingly that these rocks are metasomatized ultrabasic rocks. In Cassiar area, a specimen from Pooley Creek contained 70 ppm cobalt, 1100 ppm nickel, and 2300 ppm chromium, consistent with an ultrabasic origin. However, a similar rock in the same area contains crinoid columnals and a drill hole cored in similar rock nearby was also said to contain fossils

(W. D. Groves, 1980, personal communication). Therefore the origin of the Listwanite and its significance to exploration for gold veins is uncertain.

CONCLUSIONS

- In McDame map-area most quartz veins occur in volcanic flow rocks (greenstone) though some major veins occur at contacts between greenstone and argillite.
- Groups of quartz veins form well-defined east-northeasterly trending belts. These crosscut the major lithologic units.
- Quartz veins appear to be related to structures formed during large and small-scale folding. Lithologic control of veins is secondary.
- 'Exhalites' (chemical precipitates produced by seafloor hotsprings and volcanic vents) are present in the map-area in the form of widespread chert, minor ferruginous tuff, jasper, pyritic dolomite lenses, and rare rhodonite pods. None of these have any obvious association with quartz veining or mineralization.
- No rhyolite or other acidic volcanic rocks were recognized.
- Quartz carbonate alteration accompanies mineralized quartz veins.

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