

TOODOGGONE RIVER (94E)

By T. G. Schroeter

INTRODUCTION

The Toodoggone River area is situated approximately 300 kilometres north of Smithers. Geographically, it is one of the most isolated areas in the province, being several hundred kilometres from the nearest settlement and without road access. The 'Omineca mining road' from Germansen Landing terminates at Moosevale Flats, approximately 65 kilometres south of the Toodoggone area. Access at the present time is by fixed-wing aircraft, floatplane, or helicopter and nearly all the traffic has come from Smithers. The Sturdee airstrip, completed to a useable length of over 1 620 metres, was the centre of activity during the past year. A Hercules aircraft supplying the Baker mine and several other charter aircraft used the gravel strip, which will soon be equipped with landing lights. The area discussed in this report is a northwesterly trending belt 80 kilometres in length, 35 kilometres in width, and approximately centred on the Baker mine (Fig. 40).

Early mining exploration dates back to the early 1930's when placer claims near the junction of Belle Creek and the Toodoggone River were worked. Lead-zinc showings near the head of Thutade Lake were covered by several small blocks of claims. Exploration was minimal until the late 1960's when numerous companies explored the area for large tonnage, low-grade copper and molybdenum porphyries. Of the numerous claims staked, the most significant to date are the Chappelle claims which cover the Baker mine which is currently being readied for production by Du Pont of Canada Exploration Limited. With the notable exceptions of the Baker (formerly Chappelle) gold-silver prospect and the Lawyers gold-silver prospect, the 1970's saw little exploration. Minor work was carried out on the McClair Creek, the Shas, the Kemess, and the Fin (formerly Pine) prospects, to name a few. 1980 heralded the beginning of a new era for this rich gold-silver 'province.' At present, approximately 2 600 active claim units exist within the Toodoggone area, about 2 000 of which were staked during the past year (Fig. 40).

REGIONAL GEOLOGY

The Toodoggone area lies within the eastern margin of the Intermontane Belt. The oldest rock exposed are wedges of crystalline limestone more than 150 metres thick that have been correlated with the Asitka Group of Permian age. The next oldest rocks consist of andesitic flows and pyroclastic rocks including augite-tremolite andesite porphyries and crystal and lapilli tuffs that belong to the Takla Group of Late Triassic age. The Omineca intrusions of Jurassic and Cretaceous age (potassium-argon age of 186 to 200 Ma obtained by the Geological Survey of Canada) range in composition from granodiorite to quartz monzonite. Some syenomonzonite bodies and quartz feldspar porphyry dykes may be feeders to the Toodoggone rocks which unconformably overlie the Takla Group. The 'Toodoggone' volcanic rocks (named informally by Carter, 1971) are complexly intercalated volcanic and volcanic-sedimentary rocks of Early and Middle Jurassic age, 500 metres or more in thickness, along the west flank of a northwesterly trending belt of 'basement' rocks at least 90 kilometres in length by 15 kilometres in width (*Geological Survey of Canada*, Open File 306, replaced by Open Files 483 and 606). A potassium-argon age of 186 ± 6 Ma was obtained by

Carter (1971) for a hornblende separate from a sample collected from a volcanic sequence 14 kilometres southeast of Drybrough Peak. Four principal subdivisions of 'Toodoggone' rocks have been recognized:

- (1) *Lower volcanic division* – dominantly pyroclastic assemblage including purple agglomerate and grey to grey to purple dacitic tuffs.
- (2) *Middle volcanic division* – an acidic assemblage including rhyolites, dacites, 'orange' crystal to lithic tuffs, and quartz feldspar porphyries; includes welded tuff. The 'orange' colour of the tuffs resulted from oxidation of the fine-grained matrix while the rock was still hot. A coeval period of explosive volcanism included the formation of 'laharic' units and intrusion of syenomonzonite bodies and dykes. This event was accompanied by explosive brecciation along zones of weakness, predominantly large-scale faults and attendant splays, followed by silicification and deposition of precious and base metals to varying degrees in the breccias. Rounded fragments of Omineca intrusive rocks are rare components in Toodoggone tuffs.
- (3) *Upper volcanic-intrusive division* – grey to green to maroon crystal tuffs and quartz-eye feldspar porphyries.
- (4) *Upper volcanic-sedimentary division* – lacustrine sedimentary rocks (sometimes varved), stream bed deposits, and possible local fanglomerate deposits and interbedded tuff beds.

Many Toodoggone rocks have a matrix clouded with fine hematite dust implying a subaerial origin, however, some varieties may have accumulated in shallow water. The host rock for mineralization (division 2) is an orange to chocolate brown-coloured crystal tuff with varying minor amounts of lithic and vitric ash. Broken crystals of plagioclase and quartz are set in a fine-grained 'hematized' matrix of quartz and feldspar. The exact chemical composition(s) and rock name(s) await chemical analyses. Carter (1971) determined the composition of a suite of rocks collected from the Toodoggone area to range from latites to dacite (less than 30 weight per cent quartz); fused beads gave refractive indices between 1.505 and 1.535. Apatite may be a common accessory mineral.

To the west, Upper Cretaceous to Tertiary pebble conglomerates and sandstones of the Lower Tango Creek Formation of the Sustut Group (Eisbacher, 1971) unconformably overlie both Takla Group volcanic rocks and Toodoggone volcanic rocks.

STRUCTURE

The structural setting was probably the most significant factor in allowing mineralizing solutions and vapours to migrate through the thick volcanic pile in the Toodoggone area. The entire area has been subjected to repeated and extensive normal block faulting from Jurassic to Tertiary time. It is postulated that a northwesterly trending line of volcanic centres along a gold-silver-rich 'province' marks major structural breaks, some extending for 60 kilometres or more (for example, McClair Creek system, Lawyers system). Prominent gossans are often associated with structural zones but many contain only pyrite; sulphides occur as disseminations and fracture fillings in Toodoggone and Takla Group rocks. Thrusting of Asitka Group limestones over Takla Group rocks probably occurred during Middle Jurassic time.

Today Toodoggone rocks display broad open folds with dips less than 25 degrees. The Sustut Group sedimentary rocks have relatively flat dips and do not appear to have any major structural disruptions.

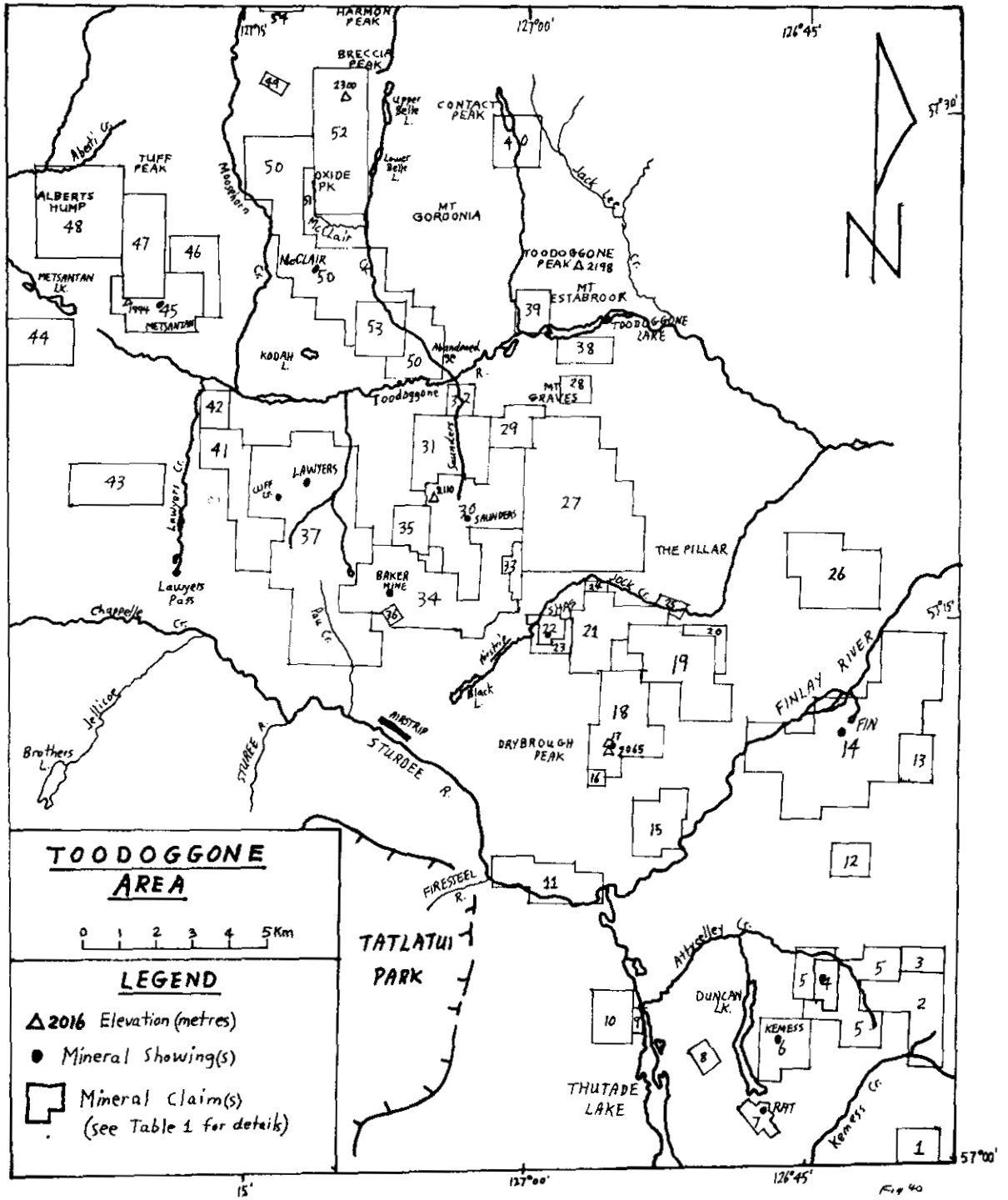


Figure 40. General map of the Toodoggone River area.

TABLE 1. TOODOGGONE RIVER AREA, MINERAL PROPERTIES

No.	Claim Name	MDI 94E	Operator	No.	Claim Name	MDI 94E	Operator
1	Aura	-----	SEREM Ltd.	31	Saunders	17, 40	Taiga Cons.
2	Mess 1-3	-----	SEREM Ltd.	32	Canyon No. 1	-----	Lacana Mining
3	Audrey 1-2	-----	Inca Res.	33	Fagan No. 1	-----	Lacana Mining
4	Audrey East, Audrey West	22	Inca Res.	34	Chappelle	26, 27	Du Pont Expl.
5	Kem 1-9	-----	Inca Res.	35	Pel	-----	Du Pont Expl.
6	New Kerness 1-2	21	Kennco	36	Crown granted claims	-----	O. MacDonald
7	Rat	25	Cominco Ltd.	37	New Lawyers 1-4, Law 1-3, Breeze, Road 1-III, Perry 1-2, Mason 1-2, GTW 1-3 Plus Fractions	-----	SEREM Ltd.
8	Crown granted claims	-----	Cominco Ltd.	38	Duke 1-2	-----	SEREM Ltd.
9	Atty	-----	Taiga Cons.	39	To No. 1	-----	Du Pont Expl.
10	Firesteel	2	SEREM Ltd.	40	Mul 1-2	-----	Du Pont Expl.
11	Fire 1-3	-----	Du Pont Expl.	41	Silver Pond, Silver Creek, Silver Butte, Silver Peak, Silver Grizzly	-----	C. Kowall
12	Rich	-----	Taiga Cons.	42	Kodah	-----	SEREM Ltd.
13	Mex	57	Cominco Ltd.	43	Lass 1-4	-----	Du Pont Expl.
14	Fin 1-9, Zip, Gem, Kid	16	Rio Tinto	44	Edo 1-4	-----	Du Pont Expl.
15	Grace 1-4	47, 48, 49	D. MacQuarrie	45	Metsantan 1-5	-----	Lacana Mining
16	Amigo	58	Cominco Ltd.	46	Ant 1-3	-----	Du Pont Expl.
17	RN	3, 4, 5	Winderra Mines	47	Mets 1-2	-----	Taiga Cons.
18	Aca, Pul, Acapulco, Gotch 1-2	3, 4, 5	SEREM Ltd.	48	Al 1-6	-----	Texasgulf
19	Jock 1-5	8	Taiga Cons.	49	Har	53	SEREM Ltd.
20	Gossan 1-2	-----	Lacana Mining	50	Scree 1-3, Moose 1-3, JM, JD, JB, JS, JR, McClair Creek 1-5, plus Fractions	31, 32, 1	Texasgulf
21	Jock 1-5	8, 39	SEREM Ltd.	52	Poo, On, Lou, Oxide	-----	SEREM Ltd.
22	Shas	50, 45	International Shasta	53	Belle 1-2	-----	Taiga Cons.
23	Silver Reef	45, 50	C. Kowall	54	Moose 1-4	-----	S. Young
24	Pill	-----	J. Weishaupt				
25	Brenda	-----	J. Weishaupt				
26	Nub Mountain	63	SEREM Ltd.				
27	Orange, Argus 1-4, Arg 1-2, OJ 1-4	28, 29	SEREM Ltd.				
28	To No 2	-----	Du Pont Expl.				
29	GWP	7	Great Western Pet.				
30	Golden Neighbour 1-4, Camp, Camp Fr., Jolly Roger, Artful Dodger	37	Lacana Mining				

MINERALIZATION

The Toodoggone area is host to many polymetallic mineral prospects and four main types are recognized:

- (1) *'Porphyry'* copper±molybdenum±silver±gold – mainly associated with Omineca Intrusions. Chalcopyrite and pyrite, with or without molybdenite, occur in fractures, as disseminations, or in quartz veins within both intrusive and the host volcanic rocks (mainly Takla Group andesitic rocks). Secondary chalcocite and covellite may form layers up to 30 metres thick. In these 'porphyries,' silver may exceed 3.1 grams per tonne (0.1 ounce per ton) and gold 0.47 gram per ton (0.015 ounce per ton) and therefore be economically significant [for example, Riga (MI 94E-3, 4, 5), Fin (MI 94E-16), Pillar (MI 94E-8), Rat (MI 94E-25), Mex (MI 94E-57), Kemess (94E-21)].
- (2) *Skarn* – contact of limestone and host rock resulting in formation of small bodies of magnetite, galena, and sphalerite [for example, Castle Mountain (MI 94E-27) and several other minor showings west of Duncan Lake].
- (3) *Precious and base metal epithermal* – gold-silver±copper±lead±zinc
 - (a) Fissure-vein type – the most important economic type. It is associated with predominantly silicified zones (quartz veins and/or older volcanic 'centres') related to repeated, extensive block faulting and possible tensional fractures formed during late doming. Large and small-scale faulting were integral processes in the sequential development of calderas formed by progressive emplacement and subsequent collapse of different phases of composite magmas (batholiths). So far, no distinct superimposed complex zones have been identified as isolated calderas in the Toodoggone area. Many calderas have a moat structure around their periphery, which is infilled by lacustrine sedimentary and pyroclastic rocks, mainly volcanic ash, deposited penecontemporaneously in the moat. Local fanglomerate deposits form adjacent to the steeper walls away from tributary streams. In the Toodoggone area, recurrent faulting during crater building would guide intrusions and the soft lacustrine sedimentary rocks may have acted as an impermeable barrier to mineralizing solutions.

Principal ore minerals include fine-grained argentite, electrum, native gold, and native silver with minor amounts of chalcopyrite, galena, and sphalerite. Rare constituents include bornite, polybasite, stromeyerite, and secondary chalcocite and covellite. Gangue minerals include, in order of decreasing abundance: amethystine to white quartz, chalcodony, calcite, hematite, manganese oxide, and rare barite and fluorite. Deposits occur in the form of vein fillings, stockworks, irregular branching fissures, and large, recurrently brecciated fault zones. Common textures include comb structures, symmetrical banding, crustifications, and drusy cavities – all typical features of epithermal deposits formed at shallow depths and at low temperatures. Alteration is commonly restricted to vein systems [Chappelle (MI 94E-26), Lawyers (MI 94E-17), Metsantan Lake (MI 94E-35), McClair, Cliff Creek, Shas (MI 94E-50), Saunders (MI 94E-37)].

- (b) Hydrothermally altered and mineralized type – associated with major fault zones and possibly after subsidence of volcanic centres followed by a doming of caldera cores. Pyrite is the most common sulphide present with minor amounts of galena and sphalerite

and rare molybdenite and scheelite. This type is probably somewhat older or contemporaneous with fissure-type mineralization. Cauldron zones are strongly leached and sulfidically altered to varying degrees to clay minerals and silica; some areas contain alunite (for example, Alberts Hump). Epidote is a common alteration mineral in both hydrothermal and fracture zones [for example, Kodah, Alberts Hump, Saunders (MI 94E-17), Chappelle (MI 94E-26), Oxide].

- (c) Alteration generally associated with the precious and base metal epithermal is as follows:
- (i) Epidotization and silicification in the vicinity of quartz veins,
 - (ii) Laumontite in fractures,
 - (iii) Extensive pyritization,
 - (iv) Anhydrite as veinlets and fractures up to 70 metres or more long,
 - (v) Hematization near surface, and
 - (vi) Carbonatization at depth.
- (4) *Stratabound* (?) — galena±sphalerite±chalcopyrite occur in or adjacent to limestone with interbedded chert in Takla Group (?) volcanic agglomerates and tuffs. This type of deposit, which may have been deposited on the flank of a volcano adjacent to a limestone reef, usually has associated low-grade silver values [for example, Firesteel (MI 94E-2), Attycelley (MI 94E-22)].

MINERAL PROSPECTS

BAKER MINE (DU PONT OF CANADA EXPLORATION LIMITED)

Construction of the Baker, formerly Chappelle (MI 94E-26), gold-silver mine continued during the summer and fall and production at a rate of 90 tonnes per day is scheduled for early 1981. Capital costs were estimated at \$12 million and, as mentioned earlier, access is provided via a 13-kilometre road to the minesite. Mineable reserves are listed at 90 718 tonnes containing 25.5 grams gold per tonne and 594 grams silver per tonne. Mining will be carried out by both surface cuts and underground methods.

Seven quartz vein systems have been identified in the area of the mine. The main or A vein, that consists of two more subparallel veins with a width of 10 to 70 metres, has been traced over a length of 435 metres and a vertical depth of at least 150 metres. Fine-grained argentite, pyrite, electrum, chalcopyrite, bornite, native gold, sphalerite, galena, polybasite, and stromeyerite occur within a highly fractured and brecciated quartz system cutting Takla Group andesites (see Barr, 1980 for detailed description). One sample of high-grade ore assayed 0.23 per cent molybdenum. Tellurium values for selected high-grade specimens ranged between 16 ppm and 38 ppm.

LAWYERS (S.E.R.E.M. LTD.)

The Lawyers gold-silver prospect is located approximately 12 kilometres north of the Baker mine. During 1980 S.E.R.E.M. completed 2 895 metres of diamond drilling in 18 holes on the 'Amethyst Gold breccia zone.' The drilling was done on two tiers on 30.5-metre spacings to test the steeply dipping fissure structure. The mineralized zone varies from 60 to 75 metres in width and has been partially drilled tested over a north-south length of 610 metres and a vertical depth of between 30 and 60 metres.

Fine-grained argentite, electrum, native gold, and native silver, with minor pyrite, chalcopyrite, sphalerite, and chalcocite occur in a gangue of predominant amethystine to white quartz with minor calcite cutting the middle volcanic division of 'Toodoggone' crystal tuffs. Hematite and manganese oxide are common alteration products. Mineralization appears to be more closely associated with the quartz-eye deficient (<5 per cent) 'orange' crystal tuff than the underlying quartz-eye-rich (>5 per cent) 'green to grey' crystal tuff.

The highest grade intersection from drilling was obtained from diamond-drill hole 80-13: 1 554 grams silver per tonne and 119 grams gold per tonne over a 6-metre interval.

The Cliff Creek breccia zone, located approximately 1 600 metres to the west of the Amethyst Gold breccia zone, lies in the same structural setting and has similar characteristics.

SAUNDERS (LACANA MINING CORPORATION)

During 1980 Lacana investigated by trenching and mapping a large anomalous zone containing at least four quartz vein systems intrusive into 'Toodoggone' volcanic rocks. Chalcopyrite, pyrite, sphalerite, molybdenite, and scheelite occur in amethystine to white quartz fissures along a north-northwesterly trending geochemical anomaly 1 220 metres in length and 300 metres in width that is also anomalous in gold and silver. Significant ferricrete occurs adjacent to the quartz veins. The area appears to have been strongly hydrothermally altered, possibly suggestive of a near-vent environment.

METSANTAN (LACANA MINING CORPORATION)

A quartz stockwork with galena, pyrite, chalcopyrite, and gold-silver values exists within 'orange' 'Toodoggone' crystal tuffs of the middle volcanic division. Hydrothermal alteration has produced abundant epidote and quartz veining.

McCLAIR CREEK (TEXASGULF INC.)

Fissure zones of rebrecciated mineralized material occur within the middle volcanic division of 'Toodoggone' crystal tuffs. Rounded to subangular fragments of quartz, chert, jasper, and sulphides, including galena, sphalerite, chalcopyrite, and pyrite as well as gold and silver values, occur in a fine matrix of brecciated crystal tuff cemented by silica. Manganese staining and hematite veining are prominent.

FIN (RIO TINTO CANADIAN EXPLORATION LIMITED)

During 1980, Rio Tinto diamond drilled 10 holes totalling approximately 1 020 metres. The environment is similar to that of the Kemess (M1 94E-21) property (Cann and Godwin, 1980) where a highly altered intrusive complex that is part of the Omineca intrusions has intruded Takla Group volcanic rocks producing 'porphyry' type mineralization with anomalous copper-silver-gold-molybdenum values. At the Fin property, the intrusive rock is highly altered to quartz, sericite, epidote, and chlorite and contains numerous fractures coated by laumontite. It is quite possible that the intrusive rocks at Fin and Kemess represent subvolcanic feeders for the 'Toodoggone' volcanic rocks.

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