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Upper Triassic Volcanogenic Zn-Pb-Ag(-Cu-Au)-Barite Mineral Deposits Near Petersburg, Alaska

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Introduction

This report describes a newly-defined belt of Upper Triassic Zn-Pb-Ag(-Cu-Au) massive sulfide and related barite deposits that extends at least from Zarembo Island to the Duncan Canal area of Kupreanof Island, near Petersburg in southeastern Alaska (fig. 1). The belt includes many of the scattered), long-known but poorly defined mineral deposits in the area (Buddington, 1923), and several key deposits discovered by the U.S. Geological Survey in 1979 that provide significant new data about their genesis and age. Our investigations are part of a continuing U.S.G.S. geological mapping and mineral resource appraisal project in the Petersburg and eastern Port Alexander quadrangles.

Our field studies to date have been mainly brief reconnaissances of the deposits: our data thus are limited and our interpretations are based on information composited from several similar deposits, rather than on a lengthy investigation of an individual deposit or district. Despite the reconnaissance nature of our work, poor exposures, and thick vegetation, the fact that we discovered at least two previously unknown mineral deposits strongly suggests to us that additional deposits occur in the area. The rocks in the Kupreanof-Zarembo area are complexly folded and faulted, and the deposits are probably dismembered fragments of what once were more extensive Upper Triassic stratabound volcanogenic massive sulfide and related barite deposits[1/].

The geology of the Kupreanof Island area near Duncan Canal is poorly known, complicated, and largely obscured by water and thick vegetation. The area is underlain by diverse, more or less regionally metamorphosed Paleozoic and Mesozoic marine sedimentary and volcanic rocks that are unconformably overlain by Cenozoic nonmarine sedimentary and volcanic rocks (Buddington and Chapin, 1929). The stratified rocks are complexly folded and faulted and are intruded and locally contact metamorphosed by several generations of stocks, dikes, and sills that range in composition from granite to peridotite.

Zarembo Island also comprises a structurally complex assemblage of Paleozoic(?) and Mesozoic marine metasedimentary and metavolcanic rocks unconformably overlain by Tertiary nonmarine clastic and volcanic rocks. The older bedded rocks are intruded by stocks and smaller bodies of upper(?) Mesozoic quartz diorite, granodiorite, and peridotite; these rocks in turn are intruded by a stock of Cenozoic granite porphyry, and by swarms of Cenozoic basalt, andesite, and rhyolite dikes (Buddington and Chapin, 1929; H. C. Berg, unpublished field data).

[1/] We interpret massive or disseminated sulfide deposits that mainly coincide with the stratification of marine volcanic or volcaniclastic hostrocks to be syngenetic stratabound mineral deposits of submarine volcanic origin. All of these deposits have subsequently undergone more or less regional or contact metamorphism that has resulted in variable amounts of remobilization or reconcentration of sulfide and gangue minerals.

Prior to our reconnaissance, faunally dated Upper Triassic strata were not known in the Duncan Canal-Zarembo Island area, although such rocks have long been known nearby on northwestern Kupreanof Island (Muffler, 1967) and on the Screen Islands off western Etolin Island (Buddington and Chapin, 1929). In 1979, however, we discovered remains of marine fossils at two mineral localities (numbers 1 and 5 on figure 1 and table 1) in the Duncan Canal area, and one of these fossil collections (locality 1) proved to be Late Triassic in age[2/]. Although the fossils at the other locality were too poorly preserved to date, the enclosing rocks are lithically nearly identical to those at the Upper Triassic locality. Unfossiliferous, but lithically nearly identical rocks also host the mineral deposits described in this report on Woewodski (4 and 6 on figure 1 and table 1) and Zarembo (2 and 3 on figure 1 and table 1) Islands. Poor outcrops of these rocks prevented measuring and describing complete stratigraphic sections; however, the exposures suggest a cumulative thickness of at least 100 meters of intertonguing and locally gradational, compositionally very diverse marine sedimentary and volcanic rocks. Representative rock types, not all of which crop out at every locality, include: carbonaceous (graphitic) dark gray to black pyritic limestone, siltstone, and mudstone; gray, slightly fetid silty or arenaceous limestone; greenish and brownish gray siltstone, sandstone, mudstone, and minor conglomerate; rusty-weathering light-greenish-gray very siliceous muscovite phyllite and semischist probably derived from felsic or intermediate tuff; thinly layered gray or green rhyolite or dacite (tuff) that locally closely resembles chert; and andesitic to basaltic pillow flows, breccia and tuff. Known, inferred, or suspected outcrop areas of Upper Triassic rocks in the Duncan Canal-Zarembo Island area are shown by a line pattern on figure 1. All of the rocks are more or less foliated and regionally metamorphosed to prehenite-pumpellyite or low greenschist facies; near the contacts of some intrusive rocks they also have undergone subsequent thermal metamorphism. Locally, layers, lenses, and disseminated grains of pyrite, pyrrhotite, arsenopyrite(?), sphalerite, galena, and chalcopyrite occur in the rusty-weathering phyllitic metatuff and in the chertlike siliceous metatuff; but disseminations, layers, and lenses of pyrite and possibly other sulfides also occur in the carbonaceous units.

Characteristics of the deposits

The following characteristics generally typify the volcanogenic deposits. Pyrite, pyrrhotite, sphalerite, galena, chalcopyrite, and possibly arsenopyrite are rarely all present in any single deposit, but various combinations are nearly ubiquitous. These minerals occur in conformable lenses or layers up to 2 meters thick and 10 meters long that consist largely of pyrite, often with major amounts of sphalerite, minor chalcopyrite, and sparse-to-rare galena. Barite is generally inconspicuous or minor, but at one deposit that is being mined intermittently (5 on figure 1), it forms a massive lens with

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[2/] These fossils have been studied by N. J. Silberling of the U.S. Geological Survey, who reports (written communication, 1/10/80):

> "...by present standards, these specimens have to be identified as *Halobia rugosa*, which is evidently a reliable index to the lower Karnian [stage of Late Triassic time], a rather unusual level for fossiliferous marine rocks in most places in North America."

only minor sulfides (Burchard, 1914; Buddington and Chapin, 1929, p. 72-73). Analyses of numerous "grab" samples of the deposits (table 1) show a pronounced geochemical association of Au, Ag, Ba, Cu, Pb, and Zn. The deposits commonly occur in muscovite-bearing felsic metatuff (phyllite) or in thinly layered to laminated metarhyolite that commonly are intercalated with distinctive black carbonaceous mudstone, siltstone, and limestone of known or inferred Late Triassic age. The rocks hosting the deposits have undergone regional metamorphism and generally are penetratively deformed to phyllite showing one or more well-defined lineations. Mafic igneous rocks often occur near the deposits: some probably are Tertiary volcanic and intrusive rocks that postdate the mineral deposits, but at least some probably are Upper Triassic marine pillow flows and breccia.

Several auriferous quartz veins occur with or near the stratabound volcanogenic deposits; the veins may be related to these deposits, but there is no evidence for this other than their spatial association. We feel that the veins most likely have formed by selective remobilization and reconcentration from the older syngenetic mineral deposits during subsequent deformation and regional metamorphism.

Descriptions of the deposits

A short description of each of the Upper Triassic volcanogenic deposits that we examined in the belt follows. Their locations are shown on figure 1; sample analyses, lithologies, and outcrop data are summarized in table 1. These descriptions do not include all of the data contained in many of the earlier descriptions of the deposits; instead, they briefly summarize our new data and interpretations based on our work, with appropriate references to the earlier studies.

<u>Kupreanof Island west of Castle Islands</u>.--A potentially significant deposit of massive sulfides, discovered during our reconnaissance in 1979, occurs in the bed of a small creek at about the high tide level at the northwest corner of a large bay off Duncan Canal on Kupreanof Island west-northwest of the Castle Islands (loc. 1, figure 1 and table 1). The massive sulfides occur as lenses and layers up to 10 cm thick and a meter or so long in complexly folded and faulted rusty-weathering, light greenish gray muscovite-rich siliceous phyllite and chertlike felsic metatuff. These phyllitic and chertlike rocks adjoin pyritic black carbonaceous mudstone, siltstone, and limestone that are prominently exposed in a small landslide on the west bank of the creek. The exposed width of the carbonaceous unit is about 35 meters; locally, the limestone contains sparse fossil clams of Late Triassic age (see footnote 2). The rusty-weathering siliceous phyllite, along with the chertlike felsic metatuff, crop out for an undetermined distance upstream, and are common elsewhere on the northwest shore of the bay. The massive sulfide lenses consist almost entirely of pyrite, sphalerite, and galena, in decreasing order of abundance. Analyses of samples (table 1) also show up to 100 ppm Ag and 1,000 ppm As, but only minor Cu and Ba.

Nearby, on the northwest shore of the same bay about 400 meters south of locality 1, Buddington (1923, p. 70) described a 2-meter thick bed of pyrite that we also examined (loc. 7, figure 1 and table 1). The rocks in the vicinity mostly are rusty-weathering muscovite-rich siliceous phyllite and chertlike felsic metatuff discontinuously exposed in the intertidal zone. Locally, the rocks contain disseminated pyrite and in one outcrop, probably the Buddington locality, a layer about 2 meters thick consists predominantly of pyrite. We identified no sulfide minerals other than pyrite, but analyses of random samples (table 1) show up to 1500 ppm As, 2000 ppm Ba, 700 ppm Pb, and 350 ppm Zn.

Zarembo Island quarries.--A small, but well-exposed outcrop of massive sulfides occurs in the north wall of a quarry along a logging road on northwestern Zarembo Island (loc. 2, figure 1 and table 1). The sulfides occur as lenses and discontinuous layers up to a half-meter thick and about 5 meters long in a 15-meter thick wedge of subhorizontally layered chertlike felsic metatuff ("metarhyolite"). The wedge is cut by several faults and is intruded and bounded by steeply-dipping dikes of Tertiary andesite, basalt, and rhyodacite(?). The felsic metatuff contains one prominent layer of massive sulfides--chiefly pyrite with sphalerite and pyrrhotite, minor chalcopyrite, and rare galena--in a very fine-grained to aphanitic siliceous matrix. Several thinner layers of massive sulfides occur higher in the section but are obscured by weathering and surficial debris. Although the lithology of the hostrocks of the massive sulfide deposit resembles some of the widespread Tertiary felsic intrusive and subaerial volcanic rocks on western Zarembo Island, we believe that the mineral deposit and its hostrocks probably are of Late Triassic age based on analogy with the other deposits in the belt.

We briefly examined several other quarries in the area. The rocks in them consisted mainly of Tertiary andesite, but float blocks of massive sulfides similar to those at locality 2 are abundant along a logging road at two sites about 100 meters east and west, respectively, of the discovery quarry. It is unclear whether the float material was transported during road construction or represents additional as yet uncovered mineralization.

The analyses of the massive sulfides from locality 2 (table 1) not only show high Zn, Pb, and Cu, as expected from their mineralogy, but also up to 0.55 ppm Au, 30 ppm Ag, and more than 5,000 ppm Ba.

St. John Harbor, Zarembo Island.--A deposit about a mile south of St. John Harbor on northwestern Zarembo Island (loc. 3, figure 1 and table 1) was originally described by Buddington (1923, p. 69-70) in terms that in retrospect strongly suggest a massive sulfide deposit. The deposit is well exposed and persistent. A 2-meter thick, flat-lying layer of massive sulfides consisting mainly of pyrite along with sphalerite, chalcopyrite, and rare galena, crops out in the west wall of a creek for at least 75 meters, is faulted off, and then reappears for another 50 meters downstream. The massive sulfide layer is associated with light-gray, quartz-muscovite-chlorite phyllite (metatuff); banded to laminated light and dark gray chertlike metarhyolite; and a distinctive carbonaceous dark gray to black silty limestone and calcareous siltstone unit. We tentatively assign a Late Triassic age to this unit because of its similarity to the faunally-dated carbonaceous rocks at locality 1.

Selected samples of this deposit (table 1) contain the anomalous amounts of Zn, Pb, and Cu that would be expected by the mineralogy; they also contain up to 5.5 ppm Au and 20 ppm Ag, and commonly contain more than 5,000 ppm Ba.

A short adit was driven on the deposit by early prospectors, and it has recently been restaked, probably for its obvious massive sulfide potential. Except for the prominent exposures along the walls of the creek, the extent of the deposit is unknown and the area adjacent to it is almost entirely a tundra- or tree-covered flat.

Woewodski Island.--Gold has been mined from at least three gold-quartz vein systems on Woewodski Island (Wright and Wright, 1908, p. 182-184; Buddington, 1923, p. 67-68). We examined these in 1979 and found that although quartz veins are prominent, they commonly occur in country rocks similar to those that host the massive sulfide deposits elsewhere in the belt, and massive sulfides are associated with one of the vein systems.

The Helen S. group of claims (loc. 4, figure 1 and table 1) was developed before World War I; an ambitious mine plant was built but little production resulted (Wright and Wright, 1908, p. 184). Most of the work was on the auriferous quartz veins that cut carbonaceous black slate and schistose felsic(?) metavolcanic rocks that formerly were considered to be of Devonian age, based on tentative correlations with lithically similar Devonian rocks elsewhere in southeastern Alaska (Buddington and Chapin, 1929). Our own interpretation, also based on lithology, is that these rocks are Late Triassic in age. Our examination identified numerous pits and shafts on auriferous quartz veins. However, rocks containing massive sulfides are abundant in a small dump near a water-filled shaft perhaps 30 meters deep, that occurs about 150 meters inland from the high tide line along a small creek that flows near the old mill foundation. The massive sulfide minerals consist mainly of pyrite accompanied by major sphalerite and minor galena and chalcopyrite. Analyses of the massive sulfide samples (table 1) also show that they contain up to 30 ppm Ag, but little Ba or Cu. The older descriptions of the deposits are ambiguous because they do not distinguish the gold-quartz veins from the massive sulfides, but the latter may be the 40 ft. by 1,000 ft. lode described by Buddington (1923, p. 67).

The Maid of Mexico mine (loc. 6, figure 1 and table 1) is on a gold-quartz vein that has been known since 1908; it is still active but has had little recorded production since before World War II (Buddington, 1923, p. 67-68). Our brief examination confirmed early descriptions of a persistent auriferous quartz vein about 1.3 meter thick. However, the country rocks consist primarily of black carbonaceous limestone and calcareous phyllite and light-gray felsic metatuff--rocks that commonly host the known and inferred Upper Triassic massive sulfide deposits elsewhere in the belt. An unpublished airborne EM survey by private mining interests suggests that the carbonaceous rocks underly a large elliptical area on northern Woewodski Island (figure 1).

Castle Island.--One of the Castle Islands is the site of an intermittently active barite mine (loc. 5, figure 1 and table 1); the barite occurs as a large pod or lens that once formed most of a small island. The barite originally was interpreted as a penecontemporaneous replacement of Devonian limestone (Burchard, 1914; Buddington, 1923, p. 72). However, the island has been totally mined, and operations now are being conducted underwater; thus we could not observe the geologic relations of the deposit.

The Castle Islands include rocks that vary from fossiliferous Devonian limestone on the southernmost island to Tertiary columnar basalt on the northern-most, with a variety of intervening rocks of indeterminate to controversial age. Remnants of the islet that contained the barite deposit, and the island immediately to the west of the deposit, where the rocks strike toward the former islet, consist mainly of basaltic pillow flows and breccia, chertlike metarhyolite, and rusty-weathering light greenish gray siliceous phyllite (metatuff?) containing disseminated pyrite and other sulfides. Fossil clams occur in phyllitic calcareous (volcani)clastic beds in the intertidal zone about 100 meters southwest of the barite deposit, but are too poorly preserved to date. Nevertheless, the marked similarities between these rocks and the faunally-dated Upper Triassic rocks at locality 1, strongly suggests to us that the barite lode is an Upper Triassic volcanogenic stratiform deposit rather than a Devonian replacement.

Burchard (1914) emphasized that the massive barite typically contains a wide variety of ore minerals as tiny disseminated grains. He cites analyses that show that the barite contains 0.01-0.03 oz. Au and 0.79-1.05 oz. Ag per ton, 1.14-1.27% Zn, 0.05-0.07% Cu, and as much as 0.29% Pb and 0.37% SrO. An examination (D. Grybeck, unpublished data, 1979) of polished sections of typical barite shows roughly equant disseminated grains 5-300 microns in diameter of pyrite, sphalerite, galena, marcasite, chalcopyrite, bornite, and tetrahedrite.

Regional implications

The Petersburg area Upper Triassic volcanogenic mineral deposits and host-rocks described in this report are part of a 300-km long belt of similar deposits and hostrocks stretching the length of southeastern Alaska from Juneau to Ketchikan (Berg, 1980). Our investigations, for example, suggest that volcanogenic massive Pb-Zn-Ag sulfide deposits and hostrocks similar to those described in this report occur as far north as Greens Creek on northern Admiralty Island (Dunbier and others, 1979), and as far south as the Annette-Gravina Islands area (Berg, Elliott, and Koch, 1978; Elliott and others, 1978). We assign the Greens Creek deposit a Late Triassic age because the hostrocks are felsic and intermediate metatuffs intercalated with black carbonaceous phyllite and argillite; the deposits on Annette and Gravina Islands occur in similar hostrocks that locally contain well-preserved Upper Triassic fossils (Berg, 1972; 1973; and unpublished data, 1980).

The northern part of the belt is in the Admiralty subterrane of the Alexander tectonostratigraphic terrane[3/] (figure 1; Berg, Jones, and Coney, 1978; Berg, 1979), and the southern part is in the Annette subterrane of the Alexander terrane. We interpret this belt as a regional metallogenic province containing stratabound volcanogenic Zn-Pb-Ag(-Cu-Au)-bearing massive sulfide and related barite deposits in deformed and metamorphosed Upper Triassic strata. This newly-recognized province appears to be restricted to the Admiralty and Annette subterranes, with potentially important implications for regional mineral exploration and resource appraisal in southeastern Alaska.

[3/] Tectonostratigraphic terranes (also called accreted, allochthonous, or suspect terranes) are originally disjunct assemblages of biostratigraphically coherent rocks that originated far from their present location and subsequently were accreted by various processes to the North American continent.

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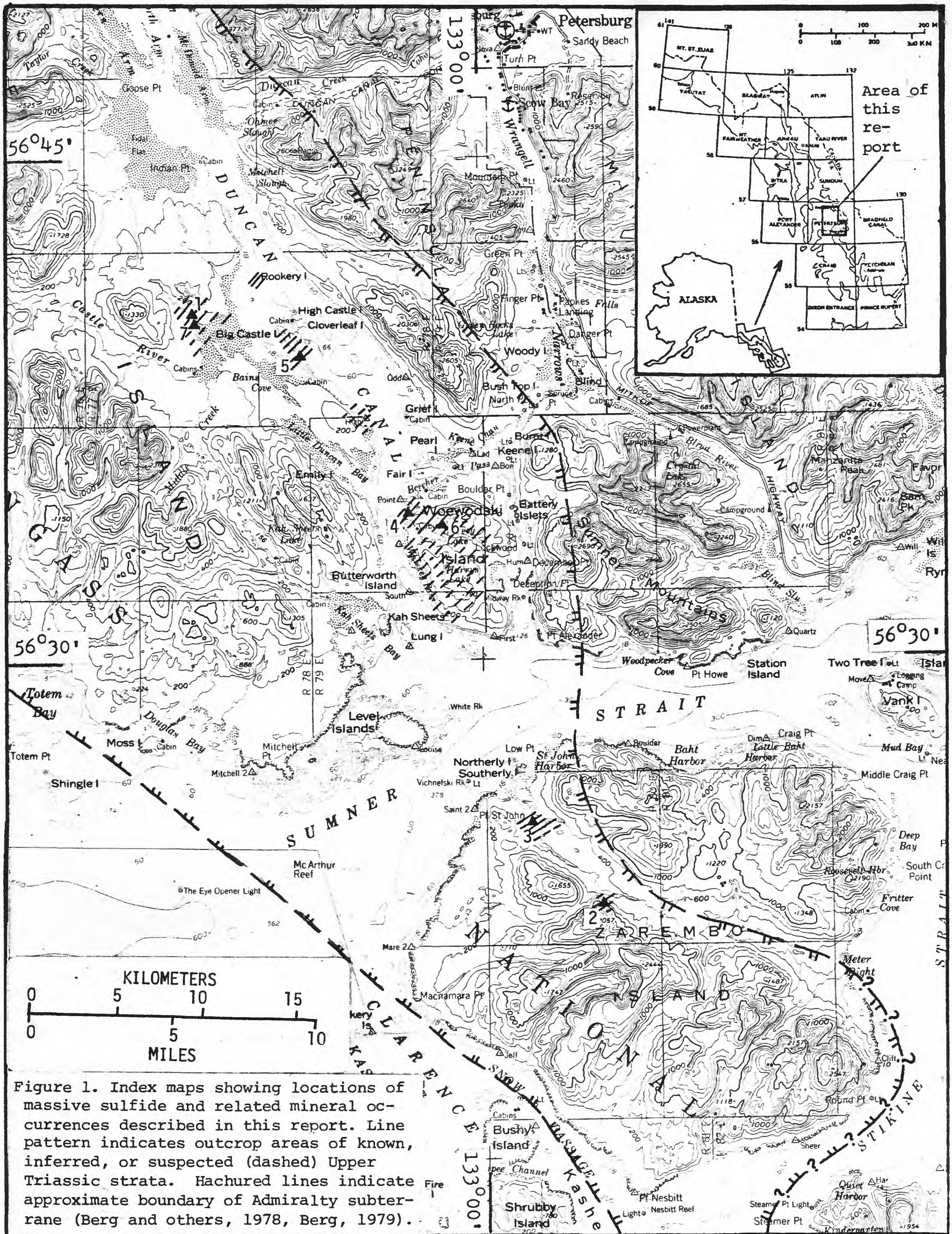

Figure 1. Index maps showing locations of massive sulfide and related mineral occurrences described in this report. Line pattern indicates outcrop areas of known, inferred, or suspected (dashed) Upper Triassic strata. Hachured lines indicate approximate boundary of Admiralty subterrane (Berg and others, 1978, Berg, 1979).

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TABLE 1. Analyses and descriptions of rock and mineral samples collected at localities shown on figure 1.

ANALYTICAL DATA (PPM). Analyses by B. F. Arbogast, G. W. Day, M. Heard, J. D. Hoffman, J. C. Lucas. Symbols: N(), not detected at limit of detection or at value shown in parentheses; L(), detected, but below limit of determinability, or below value shown in parentheses; H, interference. Looked for but not detected: Bi (except 20 ppm Bi in sample 79DG102D), Sb, Sn, Th, W (except 2 ppm in samples 7808185B and E).

Locality Number on Fig. 1	U.S.G.S. Sample Number	Atomic absorption analyses: Au	Cu	Pb	Zn	Semiquantitative spectrographic analyses: Ag	As	B	Ba	Be	Cd	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sr	V	Y	Zn	Zr	DESCRIPTION: Sample	Locality
1	79BG069C	N(.05)	35	25	L(5)	3	N	30	500	N	N	5	N	50	N	N	N	15	15	5	N	70	10	N	70	Felsic metatuff (phyllitic grit)	Lenses up to 1 m long of massive pyrite, sphalerite, and galena in phyllitic felsic metatuff intercalated with pyritic carbonaceous phyllite, phyllitic siltstone and limestone. Limestone locally contains sparse Upper Triassic fossils. Exposed width of massive-sulfide-bearing zone (in creek bed) is 30-40 m. Lat: 56°40'18"N; Long: 133°15'27"W
	79DG135A	│	100	13000	120000	100	1000	10	150	│	500	N	N	100	│	│	│	10	5000	N	│	30	N	>10000	N	Massive pyrite, sphalerite, galena, arsenopyrite(?)	
	135B	│	40	4200	20000	15	1000	10	150	│	150	N	10	50	│	│	│	10	1000	N	│	30	N	>10000	N	Massive pyrite, sphalerite, galena, arsenopyrite(?)	
2	7808185A	N(.05)	35	15	40	N	N	L	500	2	N	5	20	20	20	N	L	N	20	5	150	50	50	N	100	Banded porphyritic felsic metatuff(?)	North wall of rock quarry along logging road exposes approx. 10-m thick zone of banded greenish-gray felsic metatuff containing layers up to 1.5 m thick of massive pyrite, pyrrhotite(?), sphalerite, chalcopyrite, and galena. Occurrence forms approx. 10 x 30 m wedge-shaped, locally fault-bounded outcrop enclosed by steeply-dipping Tertiary basalt, diabase, and rhyolite dikes. Lat: 56°22'56"N; Long 132°53'53"W
	185B	│	30	25	120	│	│	L	200	N	│	50	100	100	N	│	N	30	20	30	200	200	30	│	100	Diabase dike with pyrite	
	185C	│	20	15	90	│	│	L	300	N	│	30	100	70	N	│	N	20	N	30	300	200	30	│	100	Diorite? dike with pyrrhotite	
	185D	│	15	15	170	│	│	N	100	2	│	N	N	10	100	│	20	5	20	N	N	10	70	│	200	Porphyritic rhyodacite dike(?)	
	185E	│	20	25	130	│	│	10	300	N	│	50	100	70	N	│	N	20	20	30	300	200	30	│	100	Basalt dike	
	185F	│	20	35	770	│	│	L	2000	2	│	N	L	20	20	│	N	5	70	N	200	20	100	1000	200	Felsic metatuff(?)	
	185G	│	850	620	720	15	│	20	1000	1	70	50	N	700	N	50	N	20	200	│	N	30	N	>10000	N	Felsic metatuff? with pyrrhotite	
	185H	│	25	25	380	N	│	L	150	7	N	N	│	20	N	7	50	10	20	│	│	10	100	500	300	Felsic metatuff? with pyrite	
	79BG072A	│	10	35	190	N	│	L	70	1	N	L	│	7	70	5	50	L	20	│	│	10	100	N	500	Felsic metatuff with disseminated pyrite	
	072B	│	30	35	300	N	│	│	100	5	N	L	│	15	70	20	70	L	15	│	│	10	100	N	500	Felsic metatuff with disseminated pyrite	
	072C	L(.05)	3000	2500	44000	30	│	│	>5000	2	200	20	│	3000	N	70	N	15	3000	│	1000	30	30	>10000	20	Felsic metatuff with massive sulfides	
	072D	.55	3900	1700	38000	30	│	│	>5000	1	100	15	│	3000	│	50	│	20	3000	│	1000	30	30	>10000	70	Felsic metatuff with massive sulfides	
	072E	N(.05)	1400	1400	38000	5	│	│	5000	1	500	30	│	1500	│	15	│	10	1500	│	N	30	20	>10000	N	Float sample of banded felsic metatuff with massive sphalerite	
	072F	.05	1000	910	16000	5	│	10	>5000	1	70	15	│	1500	│	15	│	10	1500	│	700	20	N	10000	N	Float sample of banded felsic metatuff with massive sphalerite	
3	79BG028A	N(.05)	15	H30	95	.5	N	L	300	N	N	N	70	15	N	N	N	20	10	L	1000	100	10	N	20	Carbonaceous limestone with pyrite	Adit at old prospect (Buddington, 1923, p. 69): layers and lenses as much as 2 m thick of massive pyrite, pyrrhotite(?), sphalerite, chalcopyrite, and galena in felsic metavolcanic rocks interbedded with recrystallized carbonaceous limestone and calcareous sedimentary rocks. Intruded by Tertiary(?) andesite dikes. Lat: 56°25'08"N; Long 132°57'07"W
	028C	│	15	5	25	.5	200	L	5000	1	│	5	N	30	│	│	│	10	20	N	N	20	50	N	200	Felsic metatuff with disseminated pyrite	
	028D	│	5	15	820	N	200	L	2000	N	│	5	N	5	│	│	│	5	30	N	N	20	50	300	100	Banded "rhyolite" with disseminated sulfide	
	028E	│	25	10	80	N	L	20	5000	1	│	50	100	70	│	│	│	20	20	20	1000	300	30	L	300	"Andesite" dike with disseminated pyrite	
	79DG102A	.20	10000	180	4300	20	N	L	>5000	1	│	15	N	10000	20	50	│	10	500	N	1000	20	30	5000	N	Pyrite-rich massive sulfide	
	102B	.45	890	7600	64000	7	N	│	>5000	N	200	N	│	700	N	15	│	5	3000	│	2000	10	N	>1000	│	Sulfide-rich banded felsic metatuff	
	102C	.40	1700	4100	55000	10	L	│	>5000	│	200	N	│	2000	20	30	│	5	3000	│	5000	20	20	>10000	│	Pyrite-rich layer in felsic metatuff	
	102D	5.5	20000	190	15000	10	1000	│	>5000	│	50	5	│	15000	N	30	│	5	200	│	300	10	30	10000	│	Banded felsic metatuff with layers of pyrite, sphalerite, galena	
	102E	.65	1900	10000	46000	7	N	│	>5000	│	150	N	│	1500	N	15	│	5	3000	│	2000	10	L	>10000	│	Banded massive pyrite and chalcopyrite	
4	79DG129A	.05	230	10	60	N	N	N	500	N	N	15	70	100	N	N	N	20	N	10	N	150	10	N	50	Schistose rhyodacite	"Helen S." group of old lode gold prospects (Buddington, 1923, p. 67). Occurrence of massive sulfides consists of crudely banded (10 cm thick) massive pyrite, pyrrhotite(?), arsenopyrite(?), sphalerite, and galena that has been dug from a small water-filled pit about 30 m inland at elevation about 15 m. Country rocks near pit include hematite-bearing phyllitic felsic metatuff, carbonaceous phyllite and limestone, and mafic intrusive(?) rocks. Current owners report boulders of massive sulfides in creeks near pit, and possibly at the Maid of Mexico mine (Buddington, 1923, p. 67) near Harvey Lake about 2 km east-southeast of locality 4. Lat: 56°34'11"N; Long: 133°04'03"W
	130A	N(.05)	25	H750	2100	3	N	│	200	│	│	N	N	15	│	│	│	5	300	N	100	10	10	500	N	1.5 meter thick quartz-calcite vein in greenstone	
	131A	3.0	70	190	130	.5	700	│	70	│	│	│	│	50	│	│	│	5	30	│	N	20	N	N	│	1.0 meter thick quartz vein at old mine shaft	
	132A	N(.05)	45	10000	38000	30	N	│	70	│	200	│	│	50	│	│	│	5	2000	│	N	L	N	>10000	│	Massive pyrite, sphalerite, galena from dump at pit	
5	79BG065A	N(.05)	30	H25	35	N	N	10	1000	N	N	20	100	20	N	N	N	20	L	20	500	150	30	N	70	Calcareous phyllitic metatuff(?)	Locality is site of intermittently active barite mine (Buddington, 1923, p. 72). Country rocks include phyllitic felsic metatuff with pyrite and minor sphalerite and galena, andesitic pillow flows and breccia, chert(?), and phyllitic calcareous (volcani?) clastic rocks locally containing poorly preserved fossil clams possibly of Late Triassic age. Lat: 56°38'56"N; Long: 133°09'45"W
	79SH134A	│	85	H1300	25000	│	│	L	>5000	│	200	30	30	150	│	│	│	30	1500	5	700	100	15	10000	10	Silicic metatuff(?)	
	134B	│	200	20	170	│	│	10	1000	│	N	50	200	200	│	│	│	100	20	20	200	500	30	N	70	Recrystallized andesite pillow breccia	
6	79BG078A	N(.05)	10	H30	15	N	N	L	100	N	N	N	20	7	N	N	N	15	L	7	500	50	20	N	50	Pyritic black carbonaceous phyllite	Maid of Mexico mine (Buddington, 1923, p. 67-68). Main adit is on NW bank of creek at about 350 ft. elevation; adit is caved a few feet from portal. Current (1979) operators are exploring for an auriferous quartz vein that locally also contains pods and streaks of pyrite and other sulfides. According to operators, vein cuts black carbonaceous slate near contact of dike- or sill-like body of felsic igneous rock. Country rocks at mine are black carbonaceous phyllitic mudstone, siltstone, and limestone intercalated(?) with rusty-weathering calcareous felsic metatuff ("impure siliceous dolomite" of Buddington) containing disseminated pyrite and possibly other sulfide minerals. The bedded rocks apparently are intruded by dikes or sills of rusty-weathering felsic aphanite that also carries disseminated sulfide minerals. Lat: 56°33'54"N; Long: 133°01'57"W
	078B	│	180	H10	45	│	│	10	200	│	│	30	100	150	│	│	│	70	L	20	150	300	20	│	100	Rusty-weathering calcareous felsic metatuff	
	078C	│	160	H10	85	│	│	10	100	│	│	20	N	150	│	│	│	10	N	10	100	200	20	│	50	Rusty-weathering felsic aphanite with disseminated pyrite	
	79DG141A	5.5	680	1300	1400	1	│	N	70	│	70	5	N	300	│	│	│	10	200	N	N	20	N	>1500	N	Sulfide-bearing quartz vein	
	141B	N(.05)	65	15	70	N	│	N	150	│	N	5	10	100	│	30	│	50	L	5	│	70	│	300	│	Quartz-slate "ribbon rock" with abundant pyrite (from mine dump)	
	141C	5.5	1800	43000	48000	200	│	10	50	│	>500	30	N	1500	│	N	│	50	20000	N	│	10	│	>10000	│	Quartz with abundant galena and sphalerite (from mine dump); semiquantitative spectrographic analysis also shows 200 ppm Sb	
7	79DG133A	N(.05)	40	700	170	10	1500	20	1000	N	N	N	N	50	N	N	N	5	300	N	N	30	N	200	N	Float sample of massive pyrite with minor quartz	Locally rusty-weathering light gray muscovite-rich siliceous phyllite (rhyodacite metatuff?) intercalated(?) with layers up to 2 or 3 meters thick of massive to phyllitic light greenish gray felsic aphanite (rhyolitic or dacitic metatuff?) that locally contains abundant (5-15%) disseminated pyrite, and at this locality a two-meter thick zone of massive (about 50%) pyrite. Lat: 56°40'02"N; Long: 133°15'25"W
	133B	│	35	240	350	5	N	10	2000	│	│	N	N	30	│	5	│	7	70	L	190	30	L	200	30	Typical sample of pyritic felsic metatuff from massive sulfide zone	
	134A	│	30	H10	45	N	N	10	700	│	│	15	100	70	│	N	│	30	N	N	300	100	L	N	70	Phyllitic felsic metatuff containing disseminated pyrite	