DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1645-C

Base from U.S. Geological Survey
Blying Sound, Seward, 1953; Middleton Island, 1955;
Bering Glacier, Cordova, 1959; McCarthy, Valdez, 1960;
Icy Bay, 1961; Anchorage, 1962

SCALE 1:250 000

5 0 5 10 15 20 25 MILES

5 0 5 10 15 20 25 KILOMETERS

CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology by J. E. Case, J. A. Dumoulin, M. L. Miller, S. W. Nelson, M. L. Silberman, A. B. Till, G. R. Winkler, 1980; J. A. Dumoulin, R. A. Koski, M. L. Miller, S. W. Nelson, M. L. Silberman, 1981; J. A. Dumoulin, S. M. Karl, R. A. Koski, M. L. Miller, S. W. Nelson, G. R. Winkler, 1982. Geology in western part of Seward quadrangle from Tysdal and Case (1979), and in Don Miller Hills and Kayak Island from Winkler and Plafker (1981)

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine the mineral values, if any, that may be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a geochemical survey of the Chugach National Forest, Alaska, which includes (1) the Nellie Juan-College Fiord Wilderness Study Area (Public Law 96-487, December 2, 1980); (2) those areas designated Roadless Area and classified for further planning during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979; (3) Roadless Areas classified as nonwilderness; (4) national forest lands additions (under ANILCA, 1980); and (5) proposed State lands within the Chugach National Forest.

INTRODUCTION

A geochemical reconnaissance survey of the Chugach National Forest, south-central Alaska, was conducted between 1980 and 1982. The study area lies within the Kenai-Chugach Mountains and the Gulf of Alaska coastal section of the Pacific Border Ranges physiographic province. It is the second largest national forest in the United States, roughly 9,000 sq mi in area. This area encompasses Prince William Sound, the largest Alaskan coastal embayment between Cook Inlet to the west and Cape Spencer to the southeast. Much of the region is covered by active valley and tidewater glaciers. Mount Marcus Baker, at 13,176 ft, is the highest point in the national forest. Most of the area is only accessible by helicopter or on foot, though the extensive coastline can be reached by boat.

This is one of a series of maps that show the distribution of mineral occurrences within the Chugach National Forest, Alaska. These include a map of barite, galena, and sphalerite data (this report); gold data (Tripp and others, 1985); and chalcopyrite data (Goldfarb and Tripp, 1985). The barite, galena, and sphalerite data may be used as a mineralogic aid in identifying broad areas most favorable for the occurrence of base-metal veins and sediment-hosted disseminated sulfides. In the companion reports, the gold data and the chalcopyrite data may aid in identifying broad areas most favorable for occurrences of lode and placer gold and Fe-Cu-Zn massive sulfides, respectively. Pyrite and arsenopyrite, commonly associated with numerous ore deposit types, were observed in more than 50 percent of the heavy-mineral-concentrate samples. But because these minerals occur throughout much of the area, we did not prepare a map showing their distribution.

GEOLOGIC SETTING

The geology of the Chugach National Forest is dominated by two major lithologic units: the Valdez Group (Late Cretaceous) and the Orca Group (Paleocene and Eocene?) (Nelson, Dumoulin, and Miller, 1984). The Valdez Group largely consists of rhythmically interbedded graywacke, siltstone, mudstone, and rare pebble conglomerate. Sedimentary structures indicative of turbidites are present but are often discontinuous due to later metamorphism and deformation. The presence of bedded tuff, pillow basalts, sheeted basalt dikes, gabbro, and serpentinized dunite within the turbidite sequence provides evidence of sea-floor volcanism simultaneous with sedimentation. The Valdez Group was accreted to the southern Alaskan continental margin by the end of Cretaceous (Plafker and others, 1977) or by early Tertiary (Tysdal and Case, 1979) time. It generally is characterized by prehnite-pumpellyite to medium-grade greenschist metamorphic facies.

The Valdez Group is bordered to the south by the younger Orca Group. The Orca Group is also dominated by interbedded graywacke and siltstone turbidite facies and contains subordinate tholeiitic basalt. The Orca Group is believed to have been accreted onto the Valdez Group sometime during the Paleogene (Winkler and Plafker, 1975; Plafker and others, 1977). A landward-dipping thrust, referred to as the Contact fault system, separates the two subduction complexes. Sediments of the Orca Group have been generally metamorphosed to prehnite-pumpellyite to low-grade greenschist facies.

Sedimentary rocks, in part younger than the Orca Group, crop out in the southeastern part of the study area. They represent sediment deposition in a continental margin basin in which marine regression and transgression took place during the middle Eocene and into the late Miocene (Plafker, 1971; Winkler and Plafker, 1981).

Two periods of anatectic plutonism closely followed accretion and deformation of the Valdez and Orca Groups. Plutonic bodies developed during both events have intruded both the Valdez Group and the Orca Group. The earliest event has been dated by K-Ar methods as 50-53 m.y. in age (Plafker and Lanphere, 1974; Nelson, Dumoulin, and Miller, 1984). Biotite granite, hornblende-biotite granite, granodiorite, and tonalite produced during this episode make up a portion of the Sanak-Baranof plutonic belt, which rims the Gulf of Alaska (Hudson and others, 1979). Felsic through mafic plutons, ranging in age from 34 to 37 m.y., form the younger intrusive suite (Lanphere, 1966).

METHODS

Heavy-mineral-concentrate samples were collected at 2,013 sites using a 14-in.-diameter gold pan. Samples were taken from first- or second-order drainages at an approximate density of one site per 4 sq mi. In areas of extensive glacier cover, concentrates were collected from active medial or lateral moraines. Glaciofluvial outwash was also sampled from below the toe of many of the smaller valley glaciers. At least five grab samples were collected at each site along a 30-ft stretch of the active stream channel or moraine, using a polyethylene or aluminum scoop. Commonly 3-4 kg of composited sediment were collected to yield the desired 30-60 g of concentrate.

At the laboratory, the sample was air dried, and the highly magnetic material (magnetite, ilmenite) was removed with an electromagnet. Lightweight material was separated by flotation in bromoform (specific gravity 2.86), and the resulting heavy-mineral fraction was then separated into nonmagnetic and magnetic fractions using a Frantz Isodynamic Separator[1] at settings of 0.6 ampere, 15° forward, and 15° side. The nonmagnetic fraction was examined under the microscope to identify any ore and ore-related minerals.

[1]The use of trade names in this report is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

RESULTS

Barite was observed in 16 percent, galena in 9 percent, and sphalerite in 6 percent of the heavy-mineral-concentrate samples. We will discuss the mineral occurrences in terms of the following four rock units from which the samples were derived: (1) Upper Cretaceous Valdez Group, (2) flysch units of the Paleocene and Eocene(?) Orca Group and minor amounts of interbedded volcanic rocks, (3) Eocene to Miocene Poul Creek and the Miocene (in map area) Yakataga Formations, and (4) Eocene and Oligocene Tokun and the Eocene Kulthieth Formations.

Samples containing barite, galena, and (or) sphalerite derived from the Upper Cretaceous Valdez Group are restricted to the following four distinct areas, which are widely separated within the Chugach National Forest: (1) Area I--from Turnagain Arm to Harriman Fiord, (2) Area II--College Fiord, (3) Area III--east and southeast of Port Valdez, and (4) Area IV--central Kenai Peninsula. Barite, galena, and sphalerite were commonly found together in samples from Areas I and II. Galena, without any associated sphalerite, and rare barite was found in Area III. Samples containing barite and occasional sphalerite were collected from Area IV.

In addition to barite, galena, and sphalerite, samples from Areas I and II also contained abundant pyrite, arsenopyrite, and chalcopyrite, as well as occasional scheelite (R. J. Goldfarb, unpub. data). Gold was rarely observed in any of these samples. Martin and others (1915) reported base-metal enrichments from gold-barren quartz veins near the head of Eagle River to the northwest of Area I. Polymetallic veins are also known to be widespread in the area near Kadin Lake on Columbia Glacier (Area VI). The polymetallic anomalies in our concentrate samples are spatially distinct from the regionally more widespread gold-quartz fissure veins, largely hosted by the Valdez Group (Mitchell and others, 1981; Pickthorn, 1982; Tripp and others, 1985). Gold-poor polymetallic deposits within the same metallogenic province as gold-quartz lodes, but spatially separated from them, are common to metamorphosed volcano-sedimentary pile environments (Fyfe and Kerrich, 1984) such as the Valdez Group. Therefore, we think that the metals in samples from Areas I and II probably were derived from numerous, as yet undiscovered, small base metal-quartz lodes hosted by metasedimentary rocks of the Valdez Group.

Samples from Area III were enriched in galena, as well as in pyrite, arsenopyrite, chalcopyrite, and scheelite. Although only a few samples contained gold, extensive areas containing considerable placer gold were found to the immediate east and west of Area III (Tripp and others, 1985). Differences in metamorphic pressure-temperature conditions and (or) source rock chemistry may have favored the mobilization and (or) deposition in quartz fissures of abundant galena rather than gold. North of the Gravina fault, observations in the headwaters of the Rude River drainage system showed that the galena was derived from fissure quartz veins that are hosted by the Valdez Group. South of the Gravina fault, the galena-rich area is underlain by flysch units of the younger Orca Group; however, this galena may have been derived from the Valdez Group units that crop out at higher elevations.

In Area IV, many samples contained barite, and sphalerite was found in two regions of limited areal extent. The sphalerite-bearing samples also contained chalcopyrite, pyrite, and arsenopyrite, whereas the barite-bearing samples usually contained pyrite as the only sulfide mineral. The source for these minerals is presently unknown.

Occurrences of barite, galena, and (or) sphalerite derived from the Paleocene and Eocene(?) Orca Group are restricted to the following two areas: (1) Area V--from the southern tip of Montague Island northeast about 100 mi to the lower elevations of the Rude River watershed, and (2) Area VI--south of Miners River. Barite and some sphalerite were found in Area V. Barite, galena, and sphalerite occur together in Area VI.

In addition to barite, samples from Area V commonly contained chalcopyrite and pyrite. Sphalerite was found in a few samples from the southeast corner of Montague Island. Chalcopyrite-bearing quartz veins hosted by the Orca Group have been observed in the Jeanie Cove area of Montague Island (Marti Miller, oral commun., 1983). Perhaps the metals in the samples from Area V were derived from a belt of chalcopyrite- and barite-bearing quartz veins. Alternatively, Area V may define a unique flysch packet containing abundant syngentic sulfides and barite. Mafic volcanic rocks mapped in Area V are noticeably depleted in barium (Goldfarb, Nelson, and others, 1984) and are limited in areal extent, so they are not a likely source for the barite-pyrite-chalcopyrite assemblage.

As in Areas I and II, in addition to barite, galena, and sphalerite, samples from Area VI also contained abundant pyrite, arsenopyrite, and chalcopyrite. These metals were derived from brecciated base metal-quartz veins, pods of massive sulfide, and disseminated sulfides in the Orca Group throughout Area VI. Geochemical data for these base metal-quartz veins are as follows: lead, 20,000 ppm; zinc, over 25,000 ppm; copper, as much as 20,000 ppm; barium, as much as 5,000 ppm; arsenic, 4,500 ppm; silver, 150 ppm; antimony, 100 ppm (R. J. Goldfarb, unpub. data). Gold was rarely detected at the 0.05 ppm lower limit of determination in most of these samples.

The massive sulfide pods and the coarse quartz-sulfide brecciation are possibly indicative of syngenetic massive sulfide mineralization and later remobilization of sulfide minerals into shear zones cutting Orca Group slates and graywackes. Area VI does contain some small greenstone bodies, which supports the existence of localized submarine volcanism. However, the presence of abundant galena and barite in Area VI suggests a major difference between these occurrences and the Fe-Cu-Zn massive sulfide deposits (Nelson, Miller, and others, 1984) seen elsewhere in the Chugach National Forest. Some of Area VI is also underlain by the Eocene(?) Cedar Bay Granite (Tysdal and Case, 1979), which is cut by mineralized base-metal veins at the head of Cedar Bay. More detailed study of the polymetallic occurrences is required before the relationship of the intrusive activity to the sulfide mineralization is clearly understood.

Considerable amounts of barite and sphalerite derived from the Eocene to Miocene Poul Creek and the Miocene (in map area) Yakataga Formations were found in Area VII--Kayak Island and Don Miller Hills. Samples from Area VII were also enriched in pyrite and contained occasional chalcopyrite. The Poul Creek was deposited in a deep, sediment-restricted environment and contains some mafic flows and intrusive rocks, so some mineralization in the Poul Creek may be related to submarine volcanism. Results of a detailed soil survey of Kayak Island (Goldfarb, Pickthorn, and others, 1984) showed that zinc-rich soils overlie both the Poul Creek and the Yakataga, suggesting that the sphalerite may have a nonvolcanogenic origin.

Abundant amounts of barite derived from the Eocene and Oligocene Tokun and the Eocene Kulthieth Formations were found in Area VIII--northeast of Bering Lake. Samples from Area VIII were also enriched in pyrite. Sediment-hosted barite and pyrite were probably formed under varying redox conditions during diagenesis of the marine sediments of the Tokun and Kulthieth Formations.

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EXPLANATION

DISTRIBUTION OF MINERAL OCCURRENCES

Barite

Galena

Sphalerite

AREA REFERRED TO IN TEXT

GEOCHEMICAL MAP SHOWING DISTRIBUTION OF BARITE, GALENA, AND SPHALERITE WITHIN THE CHUGACH NATIONAL FOREST, ALASKA

By
Richard J. Goldfarb, Richard B. Tripp, and Suzanne M. Smaglik
1985

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