CHAPTER 1

Introduction to the Present Study, Previous Studies, and a Descriptive Summary of the Vein Systems and their Production History

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Geological and Geophysical Setting of the Gold-Silver Vein Systems of Unga Island, Southwestern Alaska

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OBJECTIVES OF THE PRESENT STUDY

Between 1891 and 1904, the Apollo, King, and Sitka mines on Unga Island produced $2 to $3 million of gold and secondary silver, which is the most significant mineral production in Alaska southwest of Cook Inlet (Berg and Cobb, 1967). All mining ended during World War II. Gold exploration, however, has resumed in the 1980's on the Apollo-Sitka deposits and the adjacent Shumagin deposit (White and Queen, 1989), and exploration for copper and precious metals in similar host rocks has been carried out elsewhere on Unga Island and the Alaska Peninsula over the past few decades (see Wilson and others, 1988). Thus, the Apollo-Sitka deposits provide a useful model of a type of volcanic-hosted mineral deposit that has been economic and that can be expected to occur elsewhere in the region (see, e.g., Singer, Chapter 7, "Other Deposits in Region") and in other volcanic arcs.

This report presents results of (1) new geologic mapping at 1:63,360 scale of Unga Island and the adjacent part of Popof Island, (2) an airborne magnetic and resistivity survey of part of southeastern Unga Island carried out by private industry, and (3) a preliminary interpretation of the combined geologic and geophysical data sets. The geophysical data are owned by The Aleut Corporation (400 Old Seward Highway, Suite 300, Anchorage Alaska 99503) and are published here with permission. This report also includes previously published, potassium-argon ages of the volcanic host rocks and their alteration products and rock- and stream-sediment geochemical analyses. Lastly, the combined data are used to infer the probable deposit type at the Apollo and Sitka.

PREVIOUS MINERAL-RELATED STUDIES

The first reports on Unga Island emphasized gold-production data (Becker, 1898; Martin, 1905), although Atwood (1911) produced a geologic map of the island at a scale of 1:250,000. The U.S. Bureau of Mines (Webber and others, 1946) briefly cited the historic production of the King, Sitka, and Apollo mines in an unpublished report. The most extensive report on the Unga Island deposits after the early production reports was Brown's (1947) evaluation of the Apollo-Sitka properties for the Alaska-Apollo Consolidated Company. Brown's evaluation together with a critical analysis by an anonymous reviewer was published as an Alaska Territorial Department of Mines internal report, and

provides the only published information on the subsurface geology and extent of underground workings at the Apollo and Sitka mines

Burk (1965) included Unga Island in his reconnaissance study of the geology and stratigraphy of the Alaska Peninsula (scale 1:250,000).

Mineral exploration activity resurged throughout Alaska in the 1970's as a result of land selections by Native regional and village corporations formed under the terms of the Alaska Native Claims Settlement Act (ANCSA; 1971). The Aleut Corporation formed joint ventures with Quintana-Duval and Resource Associates of Alaska to carry out geologic and geochemical surveys, mainly of potential copper and gold deposits, on Unga and Popof Islands and elsewhere in the region. These initial studies concluded with drilling of the Zachary Bay porphyry prospect and gold prospects on Unga Island (Wilson and others, 1988, p. 12). Investigations on Unga Island in the 1980's focused on gold (UNC Teton Exploration Drilling; Alaska Apollo Gold Mines; Battle Mountain Gold) and included airborne geophysical surveys (Dighem Ltd.; Pritchard, 1990). Summary reports on file with The Aleut Corporation, Anchorage, include those by UNC Teton Exploration Drilling, Inc. (1982), Ellis and Apel (1991), and Ellis and Randolph (1991).

Not only were the new corporations interested in the mineral potential of their prospective selections, but the State and Federal governments also wanted evaluations of land tracts that were being transferred to satisfy ANCSA requirements as well as the terms of the 1958 Alaska Statehood Act. Consequently, in 1974, the U.S. Geological Survey (USGS) was mandated by Congress to assess the mineral potential of ANCSA land selections. The assessment process, called the Alaska Mineral Resource Assessment Program (AMRAP), was given new impetus in 1980 by passage of the Alaska National Interest Lands Conservation Act (ANILCA). By 1986, new geologic mapping of the Port Moller quadrangle had been largely completed as part of an AMRAP assessment. Reports that include Unga Island and that were published as part of the AMRAP mineral assessment include:

* a summary of mines, prospects, and mineral occurrences in the Port Moller and Stepovak Bay quadrangles (Wilson, White, and DuBois, 1988);
* analytical results for stream-sediment, heavy-mineral concentrate, and rock samples (Angeloni, Wilson, and Sutley, 1985; Arbogast, Bailey, and Frisken, 1987);
* a geologic map of the Port Moller, Stepovak Bay, and Simeonof Island quadrangles (scale 1:250,000; Wilson and others, 1995);
* potassium-argon ages and analytical data for rock samples (Wilson and others, 1994);
* a resource assessment of the Port Moller, Stepovak Bay, and Simoneof Island quadrangles, including an historical review of exploration and production at the Apollo and Sitka mines (Wilson and others, 1996).

Following the resource assessment, site-specific study of the gold veins on Unga Island was undertaken by the USGS in collaboration with industry geologists who were re-evaluating the Shumagin claims. Industry data from core drilling were combined for publication with analytical results from detailed surface sampling (White and Queen, 1989). Detailed geologic mapping begun in 1979 (Riehle and others, 1982) was renewed in 1988 in conjunction with the vein study, to better understand the relations among rock types, structures, and mineralization. The geologic map that is newly released in this report is the result of that mapping.

Lastly, the airborne geophysical data that were acquired by Dighem Inc. for the Aleut Corp. have been interpreted in conjunction with the new geologic mapping, toward the goal of trying to better understand the geologic framework of the Unga vein deposits. Such sharing of data between the USGS, the Aleut Corporation, and private industry has characterized research efforts in the area since the start of the AMRAP study (Wilson and others, 1996, p. 14).

DESCRIPTION OF THE VEIN SYSTEMS

White and Queen (1989, reprinted in Wilson and others, 1996) provide a detailed description of the Shumagin deposit, and descriptions of the Apollo and Sitka vein systems are summarized by Wilson and others (1996, p. 8). A brief synopsis of these recent publications and of earlier descriptions is presented here for reference in subsequent chapters.

The Shumagin vein system occupies a fault zone that strikes N60E and dips 80-85 SE. Surface evidence for faulting extends discontinuously for several kilometers across Unga Island and includes subtle topographic linears, silica-cemented fault breccia, and quartz veins (fig. 1). There is little doubt of fault offset at the northeastern end of the system because andesitic lava flows are juxtaposed across the vein system with an ash-flow tuff; the sense of offset, however, is uncertain (see Riehle, fig. 2, Chapter 4). Two fault-breccia units and six parallel veins or vein systems have been recognized based on surface examination and coring (White and Queen, 1989). Because of mutually cross-cutting relations among the fault and vein units, multiple and (or) protracted movements are indicated. Both fault units are older than all vein units. The highest gold values (10-210 ppm; White and Queen, 1989; see also Ellis and Apel, 1991) are in the oldest vein unit, which extends about 370 m along the strike of the fault zone. The veins are chiefly quartz in which open vugs are common. Other vein minerals include chlorite, galena, sphalerite, pyrite, arsenopyrite, and late calcite.

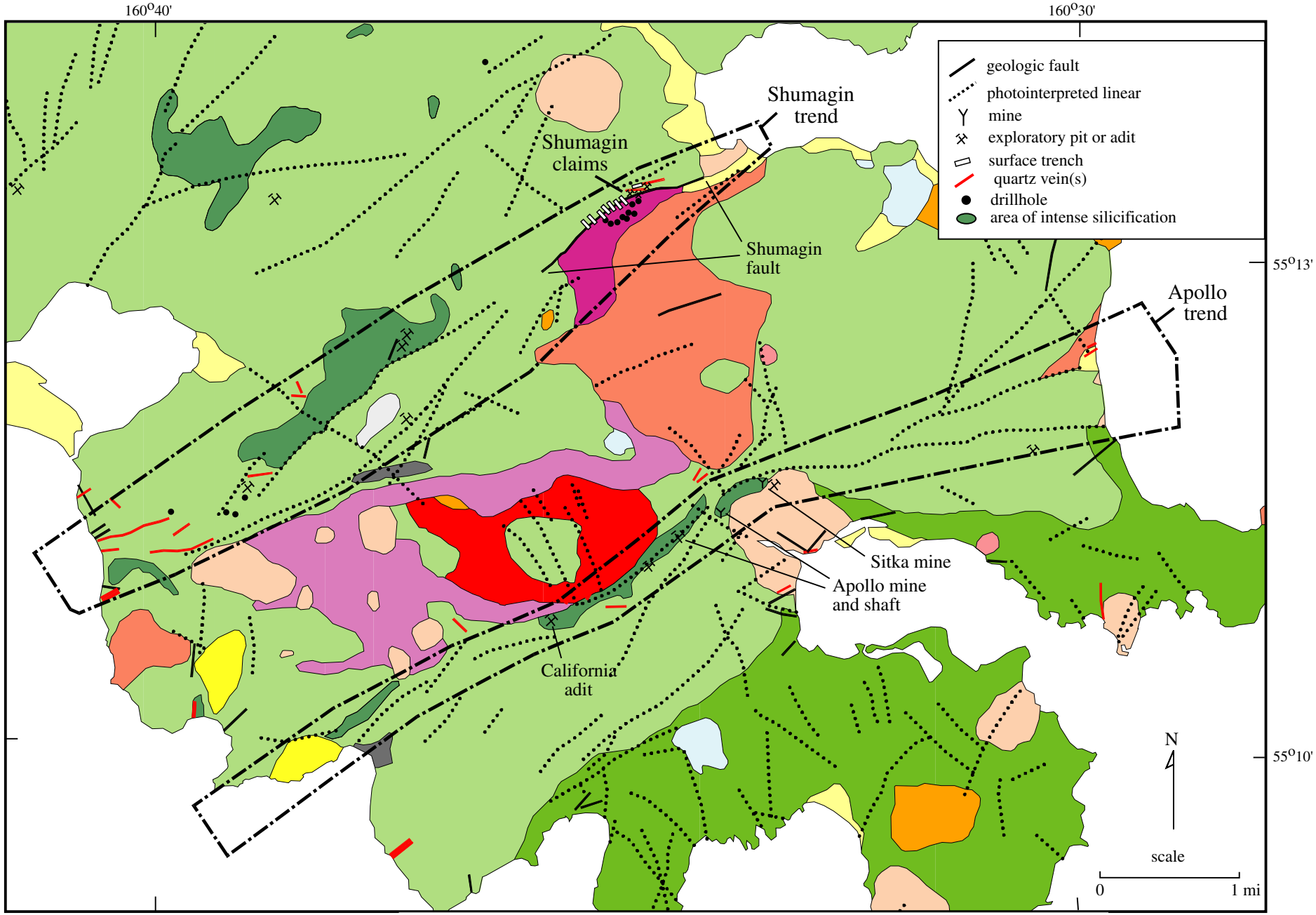

Fig. 1. Locations of mines, exploratory pits, trenches, and drillholes on the Shumagin and Apollo trends, southeastern Unga Island, and the inferred extensions of the trends based on physiographic lineaments, faults, veins, and silicification. See explanation of geologic map (Riehle and others, Chapter 2) for geologic unit descriptions.

The Apollo vein system is a steeply dipping, “reticulated vein” (Becker, 1898; in old mining jargon, "reticulated" typically meant network) that trends N43E and occurs in propylitically altered, andesitic lava flows. Vein minerals are chiefly quartz in which free--chiefly native--gold occurs, and galena, native copper, sphalerite, pyrite, calcite, chlorite, adularia, and sericite. The quartz is sugary, which to Becker implied multiple fault movements during deposition. Wallrock clasts in quartz-cemented fault breccia have sharp boundaries, indicating no dissolution. Calcite occurs as a minor and late mineral.

The Sitka vein was described as a shear zone trending at right angles to the Apollo, of subeconomic grade, and similar in the wallrock types and vein mineralogy to the Apollo vein (Atwood, 1911). However, geologic mapping (fig. 1) suggests that the Apollo system, like the Shumagin system, extends continuously across the full width of Unga Island and that the Sitka vein is simply a short segment of the Apollo system that deviates about 45 degrees from the average trend.

Brown (1947) reported three groups of 15 claims on the Apollo trend: the Apollo group, the Sitka group adjoining to the north, and the Delarof group to the southwest. Brown does not mention a King mine, which was reported by Martin (1905) to be 0.5 miles (0.8 km) north of the Apollo. The Apollo mine has two tunnels--one 1200 ft (360 m) long, the other 315 ft (95 m) lower and 3200 ft (970 m) long--that worked three subparallel veins less than 50 ft (15 m) apart. The main ore chute extended from the ground surface to 30 ft (9 m) below the upper tunnel, where it is faulted. The lower tunnel worked a second, zoned vein in which the ore chute is 800 ft (240 m) long and in which free gold gives way downward to galena, silver, copper, sphalerite, and iron. Exposures in exploratory tunnels suggest a former connection between the Apollo and Sitka vein systems, which are now faulted.

An anonymous reviewer of Brown’s report infers that two of the three Apollo veins join at depth, below which there are only two veins. The reviewer also concludes that there were four distinct ore shoots 400-800 ft (120-240 m) long on the Apollo system, between the surface and 1400 ft (425 m) below ground surface and distributed over 5000 ft (1500 m) of strike. A steep northwesterly dip is inferred of the veins, unlike the “vertical” reported by Becker. Finally, the reviewer includes the King mine reported by Becker (1898) in the Sitka group of claims (mine).

The Delarof group of claims lies along strike southwest of the Apollo group and has had no production. In an exploratory tunnel on the California claim, "andesite" occurs on the west wall and "porphyry" on the east wall (Brown, 1947), which suggests a faulted juxtaposition like at the Shumagin claims.

PRODUCTION HISTORY

The Apollo Consolidated mine produced from 1891 to 1904, during which time it yielded about $2 million in gold and secondary silver (Martin, 1905) at $20.67 per oz for gold (Berg and Cobb, 1967, p. 4). The main orebody averaged 0.4 oz/ton gold (Berg and Cobb, 1967, p. 5), which implies 242,000 tons of ore. The mine reopened briefly in 1908 to process previously mined ore. The King mine, reportedly 0.5 mile (0.8 km) north of the Apollo, and the Sitka mine, about 0.5 mile to the northeast, also reported minor production during the same period (Becker, 1898; Atwood, 1911). Gold has been sought at the Shumagin claims, 2 miles (3.2 km) north of the Apollo mine, but there is no recorded production (Atwood, 1911; Berg and Cobb, 1967). Gold was discovered in 1904 in beach placers on adjacent Popof Island and $12,000 was produced in 1904-05; thereafter, activity moved to lode claims in the hills behind the beach, where four short exploratory shafts yielded one sample rich in gold (Atwood, 1911). There is no documented placer production from Popof Island after 1905 (Cobb, 1973),

Although there has been no production from the Shumagin claims, drilling in the 1980's established estimated reserves of 245,106 tons grading 16.8 g/t gold and 68 g/t silver (Mining Journal, 1987).

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