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

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CONTENTS

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About the frontispiece

Shaded map: Hillshaded image of Unga Island and, at the upper right, northwestern Popof Island. The image is a computer rendering of the land surface as it would appear if illuminated by a sun at 45 degrees above the horizon, shining from the northwest (upper left). Northwestern Unga Island is underlain by the homoclinally NW-dipping, Miocene Unga Formation (smooth topography). Northeastern Unga Island and northwestern Popof Island are underlain by flat-lying andesitic lava flows of the Oligocene Popof volcanic rocks. The prominent hill near the center of Unga Island is a Miocene dome encircled by carapace breccia and tuff; the encircling escarpment is artificially enhanced by the imaging process. The subcircular area of rugged topography, which extends from the center of Unga Island to the east shore, is underlain by high-silica andesitic lava flows and intrusive sills and domes. Low terrain in southeastern Unga Island is underlain by lava flows and tuff of the Popof volcanic rocks, while most of the prominent peaks are shallow intrusive domes. Southeastern Unga Island is also cut by east- to northeast-trending topographic lineaments. Two of these--the Apollo and Shumagin trends--extend across the full width of the island and have localized gold and silver mineralization. These two important trends are marked by lines at their ends; the Apollo trend bifurcates near the eastern coast of Unga Island. Other northeast-trending lineaments can be seen between the Shumagin lineament and the high peaks at the center of the island. (Image created from a digital elevation model that was constructed for this study and subsampled in 30-m horizontal cells.)

Oblique map: Perspective view toward the northeast, of the hillshaded surface of southern Unga Island. The Apollo lineament is labelled "1" and the Shumagin lineament "2". Other lineaments are marked but not named.

About the cover

Early view of the Apollo mine on Unga Island and, in the middle distance, probably the Sitka mine. View is eastward. G.C. Martin, U.S. Geological Survey collection, photo no. 147, September 3, 1904.

EXECUTIVE SUMMARY OF GEOLOGIC RESULTS

1. Geologic mapping at 1:63,360 scale confirms that Unga and Popof Islands were sites of recurring and intensive magmatism during mid-Tertiary time and provides new details about relations among magmatism, tectonism, and mineralization. Nonindurated marine sediments on the continental shelf were deformed and buried by andesitic lava flows or were interbedded with andesitic and dacitic ash-flow tuffs. Initially effusive volcanism (31-38 Ma) was joined by hypabyssal activity (31-34 Ma) as domes of basaltic andesite to rhyolitic composition were extruded from numerous vents. Ash-flow tuffs occur, but they are of small volume and probably originated at domes. There is no explicit evidence for a caldera structure.
2. Gold and silver mineralization is concentrated in two major, northeast-trending zones of faulting, brecciation, and quartz veining that extend across southeastern Unga Island. Total offset is minor, indicating only incipient faulting although multiple vein sets imply repeated movements. A K-Ar age of vein adularia (34 m.y.) and another of sericitic vein alteration (32 m.y.) show that veining was at least partly contemporaneous with magmatism.
3. Other physiographic lineaments having northeast trends also occur on southeastern Unga Island, which are also sites of silicification and alteration. The lineaments have been the focus of exploratory activity by industry. The multitude of northeast-trending lineaments is suggestive of northwest-directed extension. Northwest-trending lineaments cross-cut the northeast-trending lineaments; the younger lineaments are not as well developed and those that have demonstrable offsets appear to have been subjected mainly to strike-slip movements.
4. The reduced-to-the-pole magnetic field over southeastern Unga Island reflects mainly different rock types, such as lava flows, volcaniclastic rocks, or domes. Broad areas of anomalously conductive bedrock appear to reflect alteration of the volcanic rocks, which at least locally was probably selective of permeable volcaniclastic rocks. Discrete bedrock conductors define linear trends, most of which are northeasterly and coincide or are parallel with physiographic lineaments and mapped faults. Such linear conductive anomalies may be the result of fault-controlled sulfide mineralization. One such linear anomaly ends at the mapped contact with a hypabyssal dome, supporting the inference that faulting and veining were contemporaneous with magmatism.
5. Gold and silver abundances in stream-sediment and heavy-mineral-concentrate samples reflect one but not both of the major mineralized trends. Anomalous concentrations of Au, Ag, As, Mo, and Pb, however, occur in volcanic rock samples from throughout Unga and northwestern Popof Islands.
6. Vein mineralogy, geologic setting, and grade-tonnage data from the main mineralized trends were used to infer the likely deposit type. Types that were considered are Sado, Comstock, and Creede epithermal vein, polymetallic vein,

and no existing model. Neither the Comstock nor the Sado types can be rejected, so the "no existing model" option is unnecessary. The Sado model seems the most appropriate.

7. The precise nature of faulting that controlled mineralization is uncertain: Slickenlines indicate both strike-slip and normal faulting on the northeast-trending lineaments. Marine-seismic data, however, document northeast-trending growth faults on the continental shelf near Unga Island that are interpreted to have formed during early to mid-Tertiary time in response to northwest extension (Bruns and others, 1987). Possibly the Unga Island lineaments initially formed in response to extension and were later reactivated by strike-slip movements. In any case, minor but repeated movements on the lineaments would have provided recurring pathways for circulating geothermal waters above and adjacent to active hypabyssal domes.