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RECONNAISSANCE GEOLOGIC MAPS OF THE SOLOMON D-5 AND C-5 QUADRANGLES, SEWARD PENINSULA, ALASKA

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INTRODUCTION

The Solomon C-5 and D-5 15- by 30-minute quadrangles adjoin the Bering Sea about 25 miles east of Nome. Both were mapped previously, in 1906-1908, by Smith (1910). The Solomon D-6 quadrangle, mapped in 1968-71 (Sainsbury and others, 1971), adjoins the Solomon D-5 quadrangle on the west, and the Nome D-1 quadrangle, mapped by Hummel (1962a), on the east.

Placer gold deposits were mined at many places throughout both quadrangles, and a few small gold lodes or antimony lodes in the Solomon C-5 quadrangle have produced (Asher, 1969).

MAPPING METHODS

Both quadrangles were mapped by a combination of foot, helicopter, and light-aircraft traverses. Much of the Solomon C-5 quadrangle was mapped on foot and by helicopter, supplemented by about 25 hours of light-aircraft traverses (with numerous landings and foot traverses from the aircraft). The Solomon C-6 quadrangle was mapped principally by light-aircraft and foot traverses from the landed aircraft, supplemented by numerous helicopter stops.

GEOLOGY

All the bedrock units mapped correspond to similar units mapped elsewhere on the Seward Peninsula, and assigned Precambrian and Paleozoic ages. Although Smith (1910) named several different units, only one of those names is retained in this report, for most rocks belong to units named elsewhere on the Seward Peninsula prior to Smith's mapping.

Throughout both quadrangles, much of the bedrock is composed of the "Slate of the York Region" (York Slate in this report), a formation named by Collier (1902) in the York Mountains, some 100 miles west. As presently used, this name also includes rocks assigned by Brooks, Richardson, and Collier (1901) to the Kuzitrin Series, as well as the Puckmummie and Solomon schists of Smith (1910). The latter three names are not used in this report. A second major map unit of Smith (1910), the Casadepaga schist, is retained in the present report. It consists of a widespread metavolcanic unit.

Because all the rocks are discussed in detail by Smith (1910), only the salient features of the geology are discussed in this report.

Stratigraphy

York Slate

Wherever seen in its least disturbed form, the York Slate consists of highly siliceous rocks with carbonaceous and(or) graphitic dust, as well as variable amounts of calcite, phengitic white mica, and chlorite. Weathering generally to dark slabby rocks, other variations are easily created as a result of tectonic deformation. These variations range from dark phyllites to quartz gneisses with but minor amounts of graphite.

One variation, originally called the Puckmummie schist by Smith (1910) is shown on the present maps as simply a variation of the York Slate (p€su on maps). This unit weathers darker, and gives much smoother slopes and smaller fragments than most of the slate. Although Smith (1910) considered it to be the upper part of the slate unit, later studies show that it may be only a mylonitized facies of it. No matter what the physical appearance, the York Slate can be recognized by the very high percentage of silica, which can be as much as 92 percent.

Thin dark limestones or marbles are common in the slate, especially in the upper part. Many are mapped separately; others are too small to show.

Casadepaga Schist

These schists occupy chiefly the southeastern part of the Solomon D-5 quadrangle and the eastern part of the Solomon C-5 quadrangle, where they form a continuous belt. Hudson and Ewing, who examined the contact with the underlying(?) slate at several places, feel that the Casadepaga schist is transitional above the slate, and may take the stratigraphic position of the thin-bedded limestones which transitionally overlie the slate in nearby areas (Sainsbury and others, 1972).

Composed principally of albite-epidote-chlorite-sphene rocks, the Casadepaga schists differ from the chloritic schists to the west in being more feldspathic and weathering to more rounded slopes. Clasts with unmistakeable volcanic textures have been identified in thin sections.

Chloritic and Feldspathic Schists

Within the slates in the west parts of both the Solomon C-5 and D-5 quadrangles, a belt of chloritic schist is continuous with similar rocks that continue west into the Nome area, where they were included in the Nome Group by all previous workers (Brooks and others, 1901; Collier, 1902; Moffit, 1913; Hummel, 1962a, b). These rocks range from chloritic to feldspathic schists, with variable grain size and mineralogy. Within the Solomon C-5 and D-5 quadrangles, these rocks include albite-epidote-chlorite-sphene (rutile) rocks, as well as albite-garnet-amphibole (glaucophane)-sphene rocks. The variations are well described by Smith (1910, p. 70-75), and his descriptions are not repeated.

In this report, the chloritic schists in the west portion of the quadrangles are separated from the Casadepaga schists, described below.

Marble, Dolomite, and Impure Marble and Limestone of Undifferentiated Paleozoic Age and Limestone and Marble of Ordovician(?) Age

Carbonate rocks of great thickness are found throughout both the Solomon C-5 and D-5 quadrangles, generally forming belts or outcrop patterns elongated in a northwest direction. This distribution pattern is a result both of thrust faults and of high-angle faults, which trend northwest and which have cut the thrust plates. Although the carbonate rocks are at places thrust over the slates, at other places, especially in the Solomon D-5 quadrangle, slates are thrust over Paleozoic carbonates. On Mount Dixon, northeast of the Casadepaga River in the D-5 quadrangle, a thin thrust sliver of slate lies between thicker thrust plates of carbonate rocks.

Most of the carbonate rocks were assigned by Smith (1910) to the Sowik limestone of Ordovician(?) age. This designation also is dropped in this report, for it is believed now that rocks ranging in age from Precambrian to Devonian were included in the Sowik limestone.

A few of the least altered limestones contain relict bedding, chert, or deformed fossils; others are converted to white or light-gray marble with strong cleavage. At the base of the limestones in the west parts of the quadrangles, limestone has been mixed tectonically with the overridden rocks to give chloritic or graphitic marble schists, some of which are shown separately (Pzmi on maps). A belt of carbonate rock extending east from American Creek, in the northwest part of the Solomon D-5 quadrangle, consists principally of dolomite and dolomite breccia. The southeast continuation of these rocks forms two klippen on the slate west of Mount Dixon. Both klippen are dolomite breccia cut and veined by innumerable veinlets of silica derived from the underlying slate. Relict fossils were found west of American Creek.

The carbonate sequence in Mount Dixon contains limestones and marble with abundant argillaceous material and beds. The rocks are lithologically similar to Lower Ordovician limestones of the York

Mountains, some 80 miles west (Sainsbury, 1969a), and are correlated with them even though no fossils were found.

Relict fossils suggestive of Amphiphora(?) were found in marble south of the Casadepaga River and east of Big Four Creek. Light marble alternates with very dark shaly marble; these lithologic characteristics and the relict Amphiphora(?) suggest that these carbonate rocks are marbleized Devonian beds.

Elsewhere in both quadrangles, numerous large and small outcrops of limestone and marble have been mapped. Many are clearly intercalated in the slates; others could be fragments of thrust plates. Thin layers of carbonate rocks in the slates are assigned to the slate; other larger outcrops which could be thrust fragments are unassigned.

Gabbro and Metagabbro

Within the chloritic schists and slates are numerous outcrops of more massive rocks which were originally mafic intrusives. The silica content of these rocks ranges from 44 to 53 percent, suggesting that rocks originally ranging from gabbro to diorite are included. Most are now converted to garnet-bearing rocks in which glaucophane is sparse to common. These rocks are discussed at length by Smith (1910, p. 76-83), who notes that all are deformed. As it now appears that similar rocks were intruded into Paleozoic carbonate rocks, these mafic intrusives could be younger than Paleozoic, and might have been converted to glaucophane-bearing rocks during the eastward thrusting in Early Cretaceous time. In this report, they are not assigned by age.

Structure

Smith (1910, p. 111-125) gives many details of the structure, and shows photographs of isoclinal folds in the schist. He also shows a thrust plate of limestone over slate near Bonanza Creek (north of Mount Dixon in the D-5 quadrangle). Although Smith calls this an unconformity (p. 112), he clearly recognized thrusting in the area.

Perhaps the most indisputable evidence for thrusting is the thin sliver of slate in the limestones on Mount Dixon. No one who examines this sliver of slate can doubt the thrust faults. Extensive brecciation, dolomitization, silicification, and extreme deformation of rocks at the base of thrust plates of carbonate rocks give added proof of the widespread thrusting. Major changes in the lithology of the slates also are related to thrusting, a relation now known to be true over much of the Seward Peninsula. On a smaller scale, almost all thin sections of rock display intricately granulated grains in which several foliation planes are recognizable. Early planes are intricately deformed and are cut by later planes in various stages of deformation.

Obviously, all the rocks are tectonically deformed, and the almost universal westward dip of microfolds, cleavage, and dragfold axes is abundant proof that the rocks were thrust eastward. Such eastward transport of thrust plates has been recorded by Sainsbury and his coworkers at most localities examined throughout the Seward Peninsula (Sainsbury and others, 1970; Sainsbury, 1969b).

ECONOMIC GEOLOGY

Placer gold was produced from innumerable creeks and rivers in the Solomon D-5 and C-5 quadrangles. Several abandoned dredges attest to the extent of dredgeable gravels, and Smith's maps (1910) show that placer mining in some degree was common on many streams that now show no visible evidence of mining.

Because of the widespread placer gold, the State of Alaska undertook a reconnaissance geochemical survey of the Solomon C-5 quadrangle in the hope of defining lode sources of gold, silver, and antimony (Asher, 1969). Although several small lodes are known, and one mine (the Big Hurrah) has produced lode gold, no deposits were found of such size as to indicate that large tonnages of ore might be produced. Other conclusions are presented by Asher (1969, p. 29-30), and generally are in accord with the writers' opinions that large lodes of copper, gold, silver, or antimony are unlikely in the Solomon C-5 or D-5 quadrangles, even though sparse sulfides of copper and antimony are found at numerous localities (map, in Smith, 1910).

REFERENCES CITED

Asher, R. R., 1969, Geological and geochemical study, Solomon C-5 quadrangle, Seward Peninsula, Alaska: Alaska Dept. Nat. Resources, Div. Mines and Geol., Geol. Rept. No. 33.

Brooks, A. H., Richardson, G. B., and Collier, A. J. 1901, A reconnaissance of the Cape Nome and adjacent gold fields of Seward Peninsula, Alaska, in 1900, *in* Brooks, A. H., Richardson, G. B., Collier, A. J., and Mendenhall, W. C., Reconnaissance in the Cape Nome and Norton Bay region, Alaska, in 1900: U.S. Geol. Survey, 185 p.

Collier, A. J., 1902, A reconnaissance of the northwestern portion of Seward Peninsula, Alaska: U.S. Geol. Survey Prof. Paper 2, 70 p.

Hummel, C. L., 1962a, Preliminary map of the Nome C-1 quadrangle, Seward Peninsula, Alaska: U.S. Geol. Survey Mineral Inv. Field Studies Map MF-247.

______1962b, Preliminary geologic map of the Nome C-2 quadrangle, Seward Peninsula, Alaska: U.S. Geol. Survey Mineral Inv. Field Studies Map MF-248.

Moffit, F. H., 1913, Geology of the Nome and Grand Central quadrangles, Alaska: U.S. Geol. Survey Bull. 533, 140 p.

Sainsbury, C. L., 1969a, Geology and ore deposits of the central York Mountains, western Seward Peninsula, Alaska: U.S. Geol. Survey Bull. 1287, 101 p.

______1969b, The A. J. Collier Thrust Belt of the Seward Peninsula, Alaska: Geol. Soc. America Bull., v. 80, p. 2595-2596.

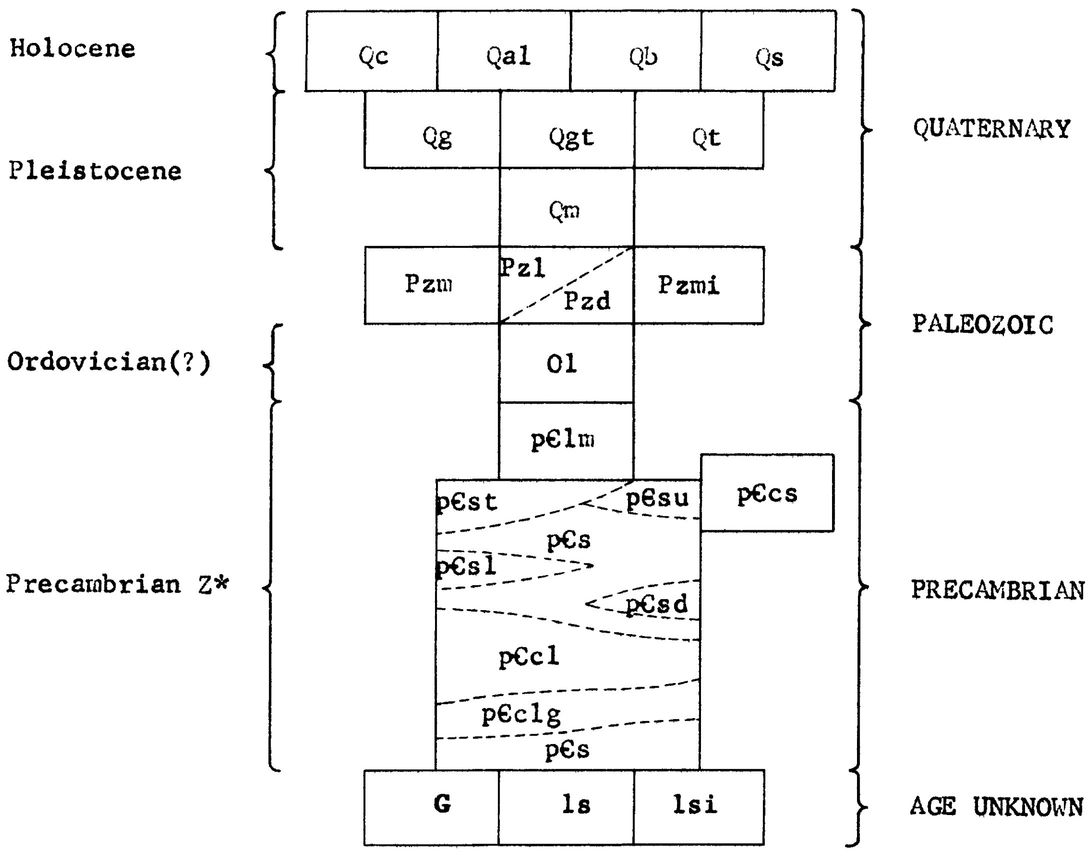
Sainsbury, C. L., Coleman, R. G., and Kachadoorian, Reuben, 1970, Blueschist and related greenschist facies rocks of the Seward Peninsula, Alaska: U.S. Geol. Survey Prof. Paper 700-B, p. B33-B42.

Sainsbury, C. L., Hudson, Travis, Ewing, Rodney, and Richards, Thomas, 1972, Reconnaissance geologic map of the Solomon D-6 quadrangle, Seward Peninsula, Alaska: U.S. Geol. Survey open-file report.

Smith, P. S., 1910, Geology and mineral resources of the Solomon and Casadepaga quadrangles, Seward Peninsula, Alaska: U.S. Geol. Survey Bull. 433, 234 p.

EXPLANATION

Correlation of map units



*In accord with an interim scheme for subdivision of Precambrian time recently adopted by the U.S. Geological Survey -- Precambrian Z: base of Cambrian to 800 m.y.; Precambrian Y: 800-1,600 m.y.; Precambrian X: 1,600-2,500 m.y.; Precambrian W: older than 2,500 m.y.

Description of map units

Qc	Surficial cover - principally tundra and soil; locally frost-riven regolith and colluvium partly covered by tundra
Qal	Alluvium - includes terrace gravels related to modern streams, reworked moraines or outwash gravels, and dredged gravels
Qb	Beach sands and gravels - modern beaches only
Qs	Silt - tundra-covered silts and sands at mouth of the Solomon River; in part represent washings from dredging
Qgt	Tundra-covered gravels and sands - thick gravels underlying the coastal plain; composed principally of shingled gravels derived from local drainage basins; grade to colluvium uphill and to silts near coastal areas
Qg	Gravels - shingled gravels exposed in and near the Solomon River; upper 8-foot layer of cutbank exposures consists of rounded cobbles as much as 18 inches in diameter; gravels beneath are smaller and markedly shingled; all consist predominantly of rocks in the drainage basin of the Solomon River
Qt	Gravels - extensive gravel deposits along the Ninkluk and lower Casadepaga Rivers; exposures in cutbanks only. Gravels consist principally of a mixture of local rock types and igneous and metamorphic rocks from the Kigluaik and Bendeleben Mountains; probably represent reworked glacial moraine intermixed with local gravels
Qm	Morainal deposits - principally ground moraine grading along streams to alluvium; shown only where bedrock is completely mantled. Deposits consist of rock types present in the Kigluaik Mountains. Referred to the Nome River glaciation

MARBLE, DOLOMITE, AND IMPURE MARBLE AND LIMESTONE OF UNDIFFERENTIATED PALEOZOIC AGE

Pzm	Marble and schistose marble - generally weathers gray to light gray with local color variations that reflect original variations in lithology; relict argillaceous bands and recrystallized chert are seen locally
Pzd	Dolomite - generally fractured to brecciated and replaced to varying degrees by silica; weathers light gray to very light gray or faintly reddish to light orange; all is of tectonic origin
Pzl	Limestone and schistose limestone - includes argillaceous limestone and partly marbleized limestone; differs from Pzm in having bedding clearly visible, and local lithologic variations are plainly visible

Pz	Impure marble or limestone - very schistose and contains varied amounts of graphite, chlorite, or phengite; calcite grains elongated. Could represent limestones originally impure, or rocks tectonically mixed near thrusts

LIMESTONE AND MARBLE OF ORDOVICIAN(?) AGE

Ol	Limestone and marble - near thrust faults largely marble or dolomite; well above thrusts becomes schistose limestone with argillaceous partings and argillaceous limestone beds. "Sowik limestone" of Smith. North of Mt. Dixon area is believed to be correlative with limestone of Early Ordovician age in the York Mountains

ARGILLACEOUS AND DOLOMITIC LIMESTONE

p€lm	Argillaceous and dolomitic limestones - highly cleaved and schistose, with white mica developing in argillaceous bands; weathers limonitic and has numerous small quartz veinlets. Normally overlies the York Slate transitionally. Recognized only on the small hill north of Canyon Creek, in the Solomon D-5 quadrangle

CASADEPAGA SCHIST

p€cs	Feldspathic and chloritic schists - for the most part similar to the p€cl unit of York Slate, but contains more feldspar and weathers differently. Unit is restricted from Smith (1910) to include only the wide expanse of schists in the eastern parts of the quadrangles. These schists are metavolcanic rocks that may have taken the part of the p€lm unit

YORK SLATE

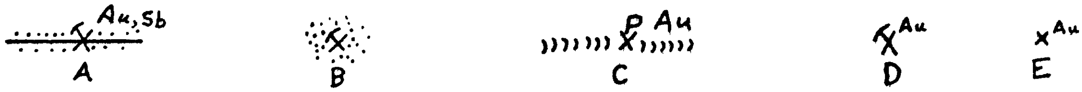
p€s	Carbonaceous to graphitic quartz siltite, faintly to moderately foliated; phyllite and calcareous phyllite highly lineated and crinkled, with white quartz veinlets; weathers dark gray
p€su	Siliceous carbonaceous to graphitic siltite, position and origin of which are unsettled; weathers to give very dark rounded hills, and in thin section is seen to be of extremely fine grain with textures resembling mylonite
p€st	Intensely deformed slate with quartz segregations and veinlets intricately folded. Unit is tectonically controlled, and is shown on map only where best developed
p€sl	Medium- to dark-gray limestones that weather medium gray to dark gray; where deformed they are schistose marbles. Most common in upper part of York Slate
p€sd	Dolomitized p€sl

p€cl	Chlorite-albite-epidote-sphene schists, believed to be at least in part of volcanic or volcaniclastic origin; may represent retrograded blueschist-facies rocks
p€clg	Graphite-chloritic schists which may represent tectonic mixing of mafic rocks and graphitic siltite

UNITS OF UNKNOWN AGE

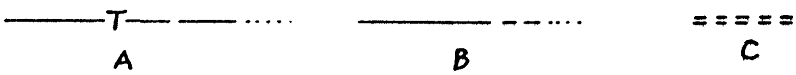
G	Gabbro, metagabbro, and related igneous rocks - locally intrude thrust sheets of Paleozoic carbonate rocks as well as chloritic schists; most are garnet bearing, and some contain glaucophane. May be as young as Early Cretaceous and may have been intruded during the early stages of thrusting. Only the more conspicuous bodies are plotted on the map
ls	Schistose limestone and marble - isolated exposures which are not assigned, but which belong to one of the known units
si	Impure limestone and marble schists containing chlorite, graphite, or phengitic mica

NOTE: All the symbols shown below may not appear on these maps



Veins and mineralized areas

A. Mineralized faults with old prospect pits or trenches containing elements as shown
B. Widespread gossans with old prospect pits or trenches; contained elements unknown
C. Placer gold mine extending along stream or beach as shown
D. Placer gold mine of localized extent. On coastal plain symbol represents surface placers as well as old drift mines on buried beaches. Symbols for metals contained in prospects or mines: Au, gold; Ag, silver; Pb, lead; Sb, antimony; Zn, zinc; Cu, copper; CaF_2, fluorite
E. Prospect pit containing element shown



Contacts

A. Transitional over a few feet to hundreds of feet
B. Sharp contact well exposed
C. Open ends indicate that bed continues an unknown distance beyond exposure

All contacts dashed where inferred or approximately located, dotted where concealed

Faults

A. Thrust fault; sawteeth on upper plate. Dashed where approximately located, dotted where concealed, queried where inferred or doubtful
B. High-angle fault, showing dip. U, upthrown side; D, downthrown side. Dashed where approximately located or inferred, dotted where concealed, queried where doubtful

A B C D E

Strike and dip of foliation or cleavage

A. Strike and dip estimated by observation from low-flying aircraft
B. Strike and dip direction as determined by observation from low-flying aircraft
C. Strike and dip as measured on the ground
D. Strike and dip direction as determined on the ground
E. Strike and dip of bedding as determined on the ground

Anticline **Syncline** **Drag folds**

Folds

Showing approximate crestline and direction and amount of plunge where known

Prospect pit or trench

Abandoned dredge

Sinkhole

Cold-water spring

Locality where fossils were collected or observed

Landing area