DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TO ACCOMPANY MAP I-453

MAP OF EASTERN PRINCE WILLIAM SOUND AREA, ALASKA SHOWING FRACTURE TRACES INFERRED FROM AERIAL PHOTOGRAPHS

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Certain linear features of the Prince William Sound area, Alaska, mapped from aerial photographs, are believed to represent faults, shear zones, and joints which may have been significant in the localization of ore deposits. These features were interpreted from vertical aerial photographs of approximately 1:40,000 scale. Some control and verification of interpretations was possible locally through published geologic maps, descriptions of known fault systems, and data on faults and joints as they relate to ore deposits at some mines and prospects within the area.

This map covers the western half of the Cordova quadrangle, Alaska, and adjoins Miscellaneous Geologic Investigations Map I-273 (Condon and Cass, 1958), which covers parts of Seward and Blying Sound quadrangles to the west.

Previous mapping of faults

Faults have been described, inferred, or mapped in several publications on the Ellamar and Jack Bay districts by Capps and Johnson (1913, pl. IV, and 1915, pl. II), Johnson (1919, pl. II), Moffit and Fellows (1950, pl. IV), and Moffit (1954, pl. 8). Northeast of Cordova, Miller (1951, pl. 2) mapped a fault along Power Creek.

The general character of geologic evidence of faults and shear zones in the Ellamar district was briefly summarized by Capps and Johnson (1915, p. 33), who state that at many places faults cut folded rocks of marked lithologic uniformity within the Valdez Group (Mesozoic?) so that the amount of displacement cannot be determined and that faults of considerable magnitude may have escaped detection altogether. Topographic and geologic evidence suggested the presence of many faults which could not be located beneath the extensive cover of Quaternary deposits or vegetation. Capps and Johnson had earlier observed (1913, p. 101) that the soft filling of shear zones is readily removed by degradational agents, and the troughs formed are traceable over considerable distances. They state that the faults of that district are for the most part marked by shear zones and the faulting is probably of a reverse or overthrust type.

Interpretation of linear features

The Prince William Sound area is in large part a heavily forested and glaciated terrain that includes numerous long, deep fiords and many large islands. Linear elements in the terrain are stereoscopically expressed on aerial photographs as elongate narrow depressions, as visible fractures in bedrock, or as straight steep slopes or scarps. Their expressions vary in clarity and continuity from sharp, well-defined, and continuous linear traces to vague broader zones whose continuity is interrupted by other linear trends. In many places, the influence of the underlying fracture pattern can be seen in the geomorphic adjustment of streams. Many mines and prospects are located on or close to mapped linear features, and published data available on trends of rock fractures at these locations correspond closely to the trends of faulting inferred from the study of aerial photographs. The linear features thus mapped may be interpreted for the most part as attributable to faults, joints, and shear zones along which considerable accentuation or etching has taken place. Such accentuating factors would include the gross effect of glacial gouging and running water along these zones of weakness. Alternate interpretations of linear features are recognized. Some features mapped may be entirely, or in part, the expression of weaker rock layers within sequences of interbedded rocks of contrasting resistance to erosion and weathering. The combined effect of differential erosion and faulting parallel to or at slight angles to bedding may cause some of the linear features mapped. Glacial gouging alone may cause some of the narrow, elongate troughs along fiord slopes and on the islands.

Grouping of the various inferred fault and joint sets is suggested by the general clarity and continuity of their traces, their comparative abundance within a given area, the contrast in lithology, and the change of fracture trends across the traces. However, any interpretation of chronological order of initial deformation would be extremely tenuous. Reactivation of movement along faults has undoubtedly complicated any interpretation of age relations—not only from aerial photographs but from ground observations as well. Reactivation of a fault previously mapped from aerial photographs (Condon and Cass, 1958) on the southern end of Montague Island is demonstrated by the investigations of U.S. Geological Survey geologists. A vertical movement of approximately 33 feet associated with the Good Friday Earthquake of March 27, 1964 has been described (U.S. Geological Survey, 1964, Press Release, dated June 17, 1964).

The faults and fracture sets

Minor sets.--Vaguely expressed sets of northwest- to west- northwest-trending traces and locally strong northeast- to north-trending traces appear to have their continuity broken by all other fracture-trace sets. These sets are similar in trend to the general pattern observed to the west on Knight Island and vicinity (Condon and Cass, 1958). They are not as clear and continuous, however, in the sedimentary rocks of the Orca Group (Mesozoic?) in the Cordova quadrangle as they are in the greenstones of the Orca Group on Knight Island.

Hinchinbrook set.--The mapped area south from Port Fidalgo and from the inferred fault through Whalen Bay is dominated for the most part by the Hinchinbrook set of northeast-trending traces. The traces are generally well defined, although many are rather vaguely expressed along parts of their extent. They appear on aerial photographs to be much more continuous than the traces of the minor sets previously discussed and to definitely interrupt them. The Hinchinbrook set trends in a direction similar to the set on Montague Island to the west, is sharply cut by the Cordova-Hawkins Island set of east-trending faults, and appears to be almost completely terminated on the north by the east-trending inferred fault through Whalen Bay.

Chugach thrust faults.--The Chugach thrust faults consist collectively of a group of known and inferred thrusts which includes the well-known Landlocked Bay thrust, the fault zone through Galena Bay inferred to be one of thrusting, and a number of less definite zones to the north and northeast. Relations to other sets are vague but the Galena Bay and Landlocked Bay zones appear to cut the minor sets and the Hinchinbrook set.

Landlocked Bay thrust zone.--The Landlocked Bay overthrust fault of Moffit and Fellows (1950, p. 56, and pl. 4) was called the Landlock overthrust by Capps and Johnson (1913, p. 98, and 1915, p. 33, 62) and is described as the major fault of the area. It thrusts slate and graywacke of the older Valdez Group from the northeast over extensively sheared and faulted slate, argillite, graywacke, conglomerate, and greenstone of the younger Orca Group. The study of aerial photographs suggests that the zone of thrusting may widen slightly more to the southwest than previous mapping indicates.

Galena Bay fault zone.--This zone is inferred from photo study to be a thrust zone extending from upper Port Fidalgo to Valdez Arm about 1 mile north of the mouth of Galena Bay. It is here postulated that a thrust plate may have overridden the Landlocked Bay thrust zone north of Galena Bay. The terrain of this zone has much the same character as that of the Landlocked Bay thrust zone, and aerial photographs give an even stronger suggestion here of abrupt change in fracture pattern and possibly of lithology across its trace.

Other thrust segments are tentatively interpreted and not well expressed. Their continuity appears to be broken by the Valdez set of north-northwest- to northwest-trending traces. Along the northern edge of the mapped area, the zone inferred to be one of thrust faulting is believed to be a split from a zone passing through the area of the Midas lodes on Solomon Gulch north of the map area. Johnson (1919, p. 170) indicates that the east-trending shear zones near these lodes are apparently thrustlike in nature.

Cordova-Hawkins Island set.--This set of generally east-trending traces is strongly expressed and continuous across the northern half of Hawkins Island, the Cordova area, the northern part of the Heney Range, and south of Cordova, and occurs as a single strong trace across Hinchinbrook Island to the southern shore of Port Etches. In the east these traces may swing to join northeast-trending traces but do not appear to be interrupted by any other set. The set sharply cuts the Hinchinbrook set. One trace of the Cordova-Hawkins Island set corresponds to the fault mapped by Miller (1951, pl. 2) along Power Creek northeast of Cordova.

Whalen Bay fault.--The fault through Whalen Bay is very strongly expressed and extends eastward from Whalen Bay to pass beneath glacial ice east of the map area. It appears to truncate all traces connecting with it, with the possible exception of those of the Jack Bay fault zone. To the east, the Whalen Bay trace may swing into the east-northeast- to northeast-trending set as the Cordova-Hawkins Island set seems to do. It probably extends westward beneath Port Fidalgo.

Jack Bay fault zone.--The fault zone through Jack Bay appears to be a rather broad west-northwest- to northwest-trending zone of traces which passes from the head of Jack Bay along the upper part of Port Gravina. It appears to join the Whalen Bay fault at an acute angle but not to cross it. It is strongly expressed topographically and seems nowhere to be breached by other fracture trends. The zone may be a split from the Whalen Bay fault or possibly the southwesternmost major fault of the west-northwest- to northwest-trending Valdez set.

Valdez set.--The traces of the north-northwest- to northwest-trending Valdez set appear to dominate most of the other trends northeast of the Jack Bay fault zone. On the whole, other trends are too poorly expressed on aerial photographs to allow even a tentative inference as to their relation to the Valdez set. Locally, however, the prominent traces of the Valdez set appear to offset some of the rather vague traces of the inferred Chugach thrusts in a manner suggesting either right-lateral movement or normal dip-slip to the east, or a combination of the two. B. L. Johnson (written communication, 1918) noted northwest-trending faults around the head of Solomon Gulch at the northern edge of this quadrangle. These probably correspond to the Valdez set.

Ore deposits and metallization

The ore deposits of the Ellamar district were described by Capps and Johnson (1913, p. 102-103, and 1915, p. 64) as primarily impregnation and replacement deposits of sulfides in the crushed filling of shear zones in greenstone and in certain sheared and shattered sedimentary rocks. The copper ore bodies occupy, or are related to, two well-marked sets of shears striking east-northeast and west-northwest and generally having dips between 55° and 90°. The deposits are most abundant in the sheared zone just west of the Landlocked Bay overthrust fault. Capps and Johnson describe the mineralized area as lying between the overthrust and Tatitlek Narrows, and as being narrowed south of Landlocked Bay by the overlapping Valdez Group. North of Ellamar Mountain the slightly deformed Orca Group was not known to contain copper deposits. The most recent summation of the mineral deposits of the Prince William Sound area is given by Moffit and Fellows (1950).

Mines and prospects

The accomping list of mines and prospects is keyed by number to the map. It includes those sufficiently well located to show distribution with respect to the linear features mapped. The implication may be made that a spatial relation exists between mineral deposits and linear features interpreted as faults, joints, and shear zones. The details of such a relation, however, are necessarily a field problem. Location data were taken from geologic publications or topographic maps of the U.S. Geological Survey. For the most part, accurate positions in relation to individual linear features as mapped cannot be shown, but locations are plotted as closely as available data permits. The chief sources used in locating mines and prospects and for analyzing data at these locations to aid in the interpretation of the area as a whole are Capps and Johnson (1913, 1915), Grant and Higgins (1909, 1910), Johnson (1919), and Moffitt and Fellows (1950).

References cited

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MINES AND PROSPECTS

Orca Bay Area

1	Tansey group	Cu	Cordova	B-5
2	Tansey group	Cu		B-6
3	Flynn & Co.	Cu		B-6
4	(Hartney Bay)	Cu		B-6
5	Armstrong Exploration Co.	Cu		C-5
6	U.S. and Mountain Groups			C-5
7	Dalton, Boswell Lowe	Cu		C-5
8	Cordova Copper Co.(?)	Cu		C-5
9	Armstrong Exploration Co.	Cu		C-5
10	Emerald	Cu		C-5
11	Boswell & Lowe	Cu		C-5
12	Rosecrans & Co.	Cu		C-5
13, 13A	Wash and Waskey	Cu		C-5
14	Shepard & MacPherson	Cu		C-5
15	Flynn & Co.	Cu		C-5
16, 16A	Hanson & Co. (2)	Cu		C-5
17	Head-of-Bay Mine (Cordova-Tacoma Copper Co.)	Cu		C-5
18	Boswell, Holt, Flynn	Cu		C-5
19	Revenue	Cu		C-5
20, 20A	Flynn & Co. (Hawkins I) (2)	Cu		C-5
21	Kippin & Co.	Cu		C-6
22	Flynn & Scott	Cu		C-6
23	Kelly & Macormac	Cu		C-6
24, 24A, 24B	Ellis, Boone, Ibeck	Cu		C-6

Port Fidalgo-Gravina Area

25	Bratton	Cu		C-7
26	Whalen & Nelson	Cu		D-6
27	Guthrie & Bellola	Cu		D-7
28	Fidalgo Mine (loc.?)	CuAu		D-7
29	Merchant, Bell, Larsen	Cu		D-7
30	Dickey Copper Company(?)	CuAuZn		D-7
31	Schlosser (Fidalgo-Alaska Copper Co.)	CuZn		D-7
32	Neversweat (Dickey Copper Co.?)	Cu		D-7
33	Shamrock	Cu		D-7

Jack Bay Area

34	Bay View Claim	Cu		D-7
35	(Jack Bay)	Cu		D-7
36	(Jack Bay)	Cu		D-7

Ellamar Area

37	Banzer	AuCuZnPb		D-7
38	Threeman Mining Co.	Cu		D-7
39	Dolan & Rystrom	Cu		D-7
40	Chisna Consolidated Mining Co.	Cu		D-7
41	Landlocked Bay Copper Mining Co. (incl. Hoodoo or Grove claim)	Cu		D-7
42	Alaska, Pioneer and Sourdough (Alaska Comm. Co.)	Cu		D-7
43	Keystone Mine (and others of Threeman Mining Co.)	Cu+		D-7
44	Redemption (Threeman Mining Co.)	Cu+		D-7
45	Alaska Commercial Co. claim	CuZnPbAuAgAs		D-7
46	Hemple Copper Co. (several claims)	CuAuAgZn		D-7
47	Montezuma Mine (Threeman Mining Co.)	CuZnAu		D-7
48	Apex Claims (Standard Copper Mines) (6)	CuZn		D-7
49	Reynolds Alaska Development Co. (Falck, Standard, Tiger claims and others) (7)	Cu		D-7
50	Steinmetz	Cu		D-7
51	Tibbits	Cu		D-7
52	Prospects of Threeman Mining Co. (4 or more)	Cu		D-7
53	Mogul (of Galena Bay Mining Co.?)	CuZn		D-7
54	Copper Crown & others (of Galena Bay Mining Co.)	CuAuZn		D-7
55	Minnehaha (of GBMC)	Cu		D-7
56	Vesuvius & Wrangle Claim (of GBMC)	Cu		D-7
57	Starvation Claim (of GBMC)	Cu		D-7
58	Yellow Dog (of GBMC)	Cu		D-7
59, 59A	Summit (?) (of GBMC)	Cu		D-7
60	Sunnyside (of GBMC)	Cu		D-7
61	Simonstad & Hendrie (of GBMC)	Cu		D-7

62	Fielder & Hemple	Cu	D-7
63	Reynolds Alaska Development Co.	Cu	D-8
64	Rua Mine	Cu	D-8
65	Wagner Mine	Cu	D-8
66	McNaughton, Turner	Cu	D-8
67	Ellamar Mine	CuZnPbAuAg	D-8
68	Alaska Commercial Co. prospect	Au	D-8
69	(Cloudman Bay)	Au(+CuZn)	D-8