The Alaskan Mineral Resource Assessment Program: Background Information to Accompany Folio of Geologic and Mineral Resource Maps of the Nabesna Quadrangle, Alaska

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CONTENTS

ILLUSTRATIONS

TABLE

The Alaskan Mineral Resource Assessment Program: Background Information to Accompany Folio of Geologic and Mineral Resource Maps of the Nabesna Quadrangle, Alaska

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ABSTRACT

The Nabesna quadrangle in south-central Alaska is the first of the 1:250,000-scale Alaskan quadrangles to be investigated by an interdisciplinary research team in order to furnish a mineral resource assessment of the State. The assessment of the 17,600-km² (6,800-mi²) quadrangle is based on field and laboratory investigations of the geology, geochemistry, geophysics, and satellite imagery. The results of the investigations are published as a folio of maps, diagrams, and accompanying discussions. This report provides background information on the investigations and integrates the published components of the resource assessment. A comprehensive bibliography cites both specific and general references to the geology and mineral deposits of the Nabesna quadrangle.

INTRODUCTION

GOAL AND METHOD

This circular, together with a separately available folio of maps of the Nabesna quadrangle, Alaska, is the first of a planned series of U.S. Geological Survey reports designed to produce a rapid, yet accurate, inventory of Alaska's mineral resources. Under the sponsorship of the Alaskan Mineral Resource Assessment Program (AMRAP), authorized by Congress to begin on July 1, 1974, the reports are intended to furnish information both for long-range national minerals policy and for Federal, State, and industry decisions concerning the future use of Alaskan land and its resources. The Nabesna mineral resource assessment comprises an interrelated collection of U.S. Geological Survey publications and consists of this circular and a folio of maps that includes a modern geologic map, a variety of geochemical and geophysical maps, interpretations of satellite imagery, an analysis of the mineral endowment, and a land status map (table 1). Many of the basic data for this report were collected prior to July 1, 1974. Since then, an interdisciplinary team of earth scientists has completed additional field and laboratory studies required for resource appraisal under AMRAP and has collaborated in preparing this report.

TABLE 1.—*Component maps of the Nabesna quadrangle mineral resource assessment*

U.S. Geological Survey Miscellaneous Field Studies (MF) Map	*Subject*
MF–655–A (Richter, 1975a, b)[1]	Geology.
B (Marsh, 1975a)	Geochemical distribution and abundance of copper.
C (Marsh, 1975b)	Geochemical distribution and abundance of lead.
D (Marsh, 1975c)	Geochemical distribution and abundance of gold.
E (Marsh, 1975d)	Geochemical distribution and abundance of chromium.
F (Marsh, 1975e)	Geochemical distribution and abundance of cobalt.
G (Marsh, 1975f)	Perspective diagrams showing geochemical abundance of silver, lanthanum, molybdenum, nickel, vanadium, yttrium, and zinc.
H (Griscom, 1975)	Aeromagnetic map and interpretation.
I (Barnes and Morin, 1975)	Gravity map.
J (Albert, 1975)	Interpretations of satellite imagery.
K (Richter, Singer, and Cox, 1975)	Mineral resources.
L (U.S. Geological Survey, 1975)	Land status.

[1]U.S. Geological Survey Miscellaneous Field Studies Maps are printed in black and white; a companion multicolored Miscellaneous Investigations Series Map of this component (Richter, 1975b) is in press.

ADDITIONAL SOURCES OF INFORMATION

Traditional scientific publications such as books and maps inevitably face traditional problems, including limited space, timeliness, obsolescence, and cost. In the Nabesna mineral resource assessment, for example, the size of the maps limits the amount of known geological, geochemical, and geophysical data that can be published. To supplement the selected data contained on the maps, as well as to document the facts cited in the accompanying descriptions, this report contains an extensive bibliography of geological literature pertinent to the Nabesna quadrangle.

It may take months or even years to print scientific reports, which reduces their timeliness. In addition, the value of these publications commonly diminishes with time because new data or improved understanding, no matter how important, cannot be incorporated in a report after it is published. The usual remedy for such obsolescence is to publish revised editions. However, because of rising costs, manpower limitations, and lengthy delays, we plan no revised editions of this series.

Partly to compensate for these problems, the U.S. Geological Survey has created computer-based files of economic mineral occurrences for the State of Alaska. This approach allows new data to be added for any previously known Alaskan mineral occurrence, prospect, or mine, as well as for new discoveries and for mines that come into production. Such additions or revisions ("updates") probably will be made annually. For purposes of the Nabesna mineral resource assessment, we have added even more information to the file than currently is available for other Alaskan quadrangles. This information includes a classification for the level of development of mineral occurrences, as well as other data suggested by mineral resource specialists who used the file in 1974. Experience from the Nabesna quadrangle update will be applied to successive quadrangles under the Alaskan Mineral Resource Assessment Program.

LOCATION AND ACCESS

The Nabesna quadrangle covers approximately 17,600 km^2 (6,800 mi^2) in south-central Alaska (fig. 1) between lat 62° and 63° N. and long 141° and 144° W. It includes the eastern part of the Alaska Range (Mentasta and Nutzotin Mountains), the northern Wrangell Mountains, and parts of the Northway-Tanacross Lowland and Copper River Lowland. Drainage is chiefly to the north into the Tanana River and thence into the Yukon River; the western quarter of the quadrangle is drained by the Copper River. Elevations range from about 4,240 m (13,900 ft) above sea level on the slopes of Mount Wrangell in the extreme southwest corner of the quadrangle to 518 m (1,700 ft) above sea level where the Nabesna River flows north out of the quadrangle near Northway.

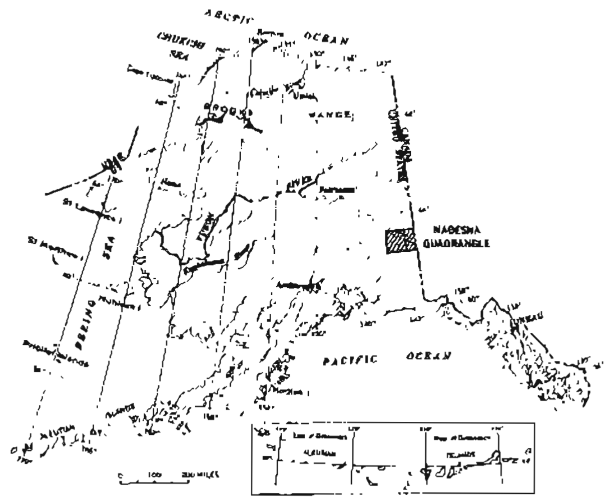

FIGURE 1.—Index map showing location of Nabesna quadrangle, Alaska

Highway access to the quadrangle is limited. The Alaska Highway crosses the northeast corner, and the Glenn Highway crosses the northwest corner (fig. 2). A maintained gravel road extends 74 km (46 miles) from Slana on the Glenn Highway to the inactive gold mine at Nabesna. Other short spur roads serve the native villages at Mentasta Lake and Northway. Resident population in the quadrangle is less than 500 people; it is concentrated chiefly at Slana, Mentasta Lake, and Northway, and the remainder is scattered along both the Glenn and Alaska Highways, the Nabesna Road, and at Chisana.

MINERAL PRODUCTION

Total mineral production from the quadrangle, excluding sand and gravel, has been about $2,900,000,[1] principally from lode and placer gold mining. Of the total, $1,870,000 was from the Nabesna mine, which closed in 1940; the remainder was from placer deposits, chiefly the Bonanza gold fields near Chisana. At present there are no producing mines in the quadrangle; a few small gold placer operations are currently active.

PREVIOUS GEOLOGIC AND MINERAL RESOURCE INVESTIGATIONS

Lieutenant H. T. Allen's remarkable explora-

[1]This figure is based on both $20 per ounce and $35 per ounce gold. At approximately $150 per ounce, value of production would be about $13 million.

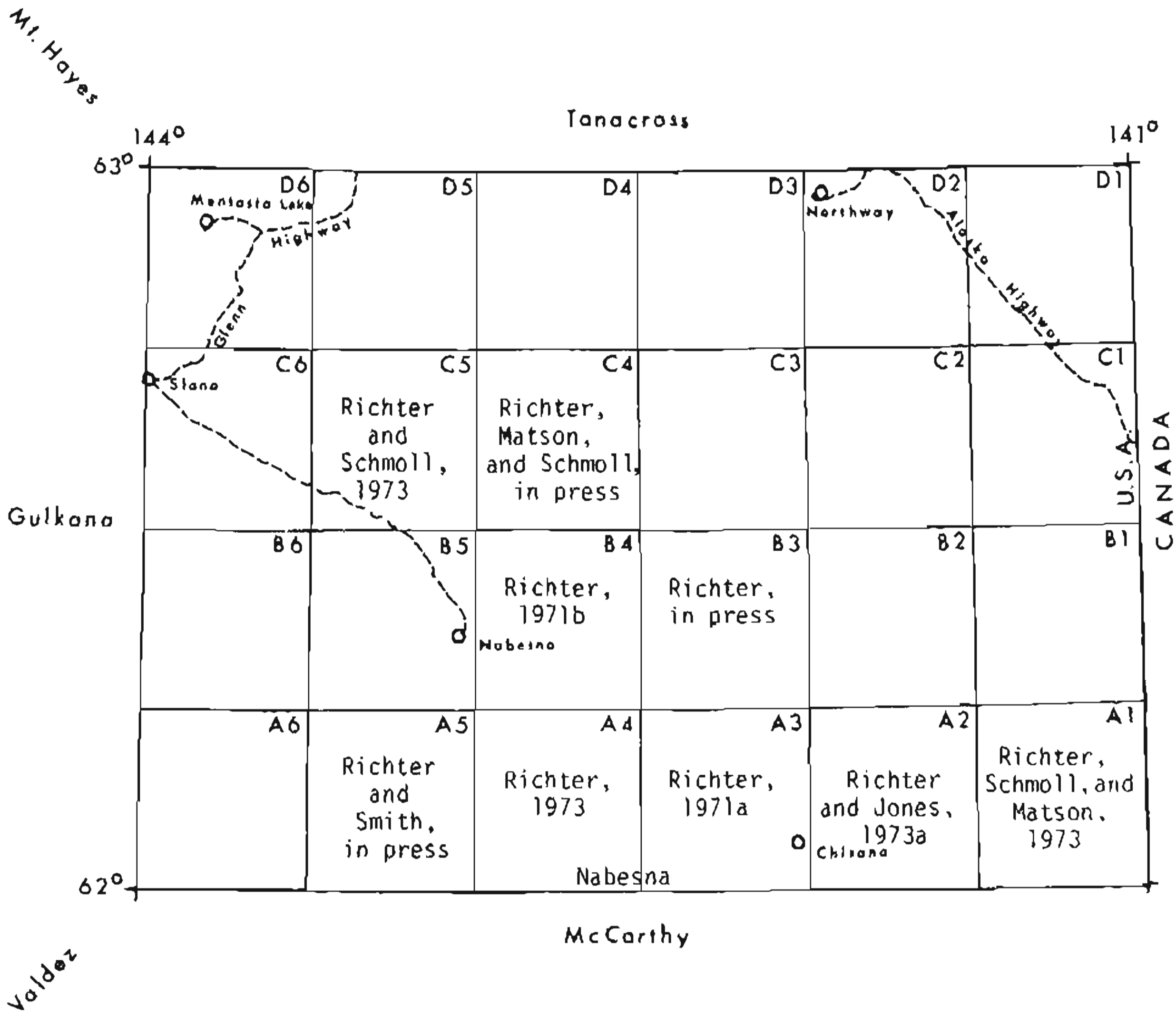

FIGURE 2.—Reference map of the Nabesna 1:250.000-scale quadrangle showing the 24 larger scale (1:63,360) quadrangles and the published maps.

tion journey across the eastern Alaska Range in 1885 for the U.S. War Department (Allen, 1887) marked the beginning of scientific observations in the Nabesna quadrangle. Geologic studies, however, did not begin until 1898 when Brooks (1900a), with a U.S. Geological Survey party, traversed a limited part of the northeast corner of the quadrangle. In 1899 Brooks (1900b) made a second and more extensive traverse through the northeast part of the quadrangle, and in the same year Rohn (1900), with the U.S. War Department, traversed north to south across the central part of the quadrangle. During the next 30 years, three geological reconnaissance and mineral resource surveys, which included parts of the Nabesna quadrangle, were undertaken by the U.S. Geological Survey. In 1902 Mendenhall and Schrader (1903a) surveyed the Copper River basin and east into the Nabesna River drainage. In 1908 Moffit and Knopf (1910) undertook a similar study in the McCarthy quadrangle between the Nabesna River and the White River, and in 1914, spurred by the discovery of placer gold near Chisana, Capps (1916b) mapped the remaining unexplored country between the Chisana and White Rivers.

Between 1929 and 1944, F. H. Moffit of the U.S. Geological Survey conducted a more thorough geologic reconnaissance of the eastern Alaska Range. Six of the many geologic reports authored by Moffit during this period concern the Nabesna quadrangle (Moffit, 1932, 1933, 1938, 1941, 1943, 1944). After his retirement in 1945, Moffit continued to work on a comprehensive summary report that was eventually published in 1954 and that has proved invaluable to those involved in the third generation of geologic investigations in the eastern Alaska Range.

PRESENT STUDY

Fieldwork for the present study, consisting principally of detailed reconnaissance mapping of the bedrock and geochemical investigations of stream sediments, began in 1967. By 1974, when the fieldwork was completed, approximately 25 geologist-months, 8 of which were helicopter supported, had been devoted to the field study. Data on the surficial geology are chiefly from interpretation of aerial photographs in collaboration with H. R. Schmoll and A. T. Fernald, who generously allowed the use of their unpublished material. The availability of more detailed, larger scale modern geologic maps of the Nabesna quadrangle authored by D. H. Richter and his colleagues is shown on the reference map in figure 2.

ACKNOWLEDGMENTS

Several members of the U.S. Geological Survey contributed significantly to preparing this report. The extensive bibliography was prepared for publication, using computer-assisted methods, by Betsy Yount and Marianne Fujii. Gerald Askevold summarized how interested readers can obtain additional background information for this study and described the computer-based methods that will be used to keep the Nabesna mineral resource assessment as up to date as possible. Henry Berg, AMRAP program manager, prepared table 1 and other parts of the introduction to this report and coordinated the published components of the Nabesna mineral resource assessment.

DESCRIPTIONS OF COMPONENT MAPS OF THE NABESNA QUADRANGLE MINERAL RESOURCE ASSESSMENT

GEOLOGY (MAPS MF-655A AND I-932)

The Nabesna quadrangle is separated into two grossly distinct geologic terranes by the Denali fault, a major and presently active dextral fault. North of the Denali fault the terrane consists chiefly of multiply deformed and regionally metamorphosed sedimentary rocks and subordinate igneous rocks as old as Devonian and possibly older. South of the fault the oldest exposed strata are volcanic flows, breccias, pyroclastic rocks, and volcaniclastic rocks of Pennsylvanian and Permian age that are parts of an extensive andesitic volcanic arc. Deposited on this arc are marine sedimentary rocks of Permian age and subaerial tholeiitic basalt flows and marine limestone of Triassic age. Rocks representing a second period of volcanic arc activity and associated marine sedimentation during Late Jurassic through Early Cretaceous time (the Gravina-Nutzotin belt of Berg and others, 1972) unconformably overlie remnants of the upper Paleozoic arc and the younger Permian and Triassic assemblages. Late Tertiary and Quaternary volcanic flows, tuffs, and breccias and associated sedimentary rocks of a third period of andesitic volcanic arc activity mantle all older rock units in the southwestern part of the quadrangle.

A number of complex plutons, chiefly granodiorite and quartz monzonite in composition, were emplaced during two distinct intervals in Cretaceous time (105–117 m.y. and 89–94 m.y.) and in early Tertiary time (51 m.y.) (Richter, Lanphere, and Matson, 1975). In addition, plutonic rocks of diorite and quartz diorite occur in a large plutonic-metamorphic complex of Late Triassic to Middle Jurassic age, and metaplutonic rocks of granite and granodiorite occur in a small plutonic-metamorphic complex of Miocene age within the Denali fault zone. The younger Cretaceous plutons and the Tertiary pluton are recognized only in the regionally metamorphosed Devonian and older terrane north of the Denali fault. Plutons of the older Cretaceous event and the large plutonic-metamorphic complex are restricted to the younger terrane south of the Denali fault. A variety of porphyritic intrusive rocks of Oligocene and Miocene age are also restricted to the terrane south of the fault and may represent the early hypabyssal phases of the Tertiary and Quaternary volcanic effusive rocks.

The absence of rocks older than Pennsylvanian south of the Denali fault and the close association of ultramafic bodies with the Pennsylvanian volcanic assemblage, as seen outside the Nabesna quadrangle, suggest that the upper Paleozoic volcanic arc was built directly on oceanic crust (Richter and Jones, 1973b). Between Late Permian and

Middle Jurassic time, this arc apparently impinged against a Devonian and older continent (terrane north of the Denali fault) and since then, together with superjacent strata, has been periodically deformed. The present Denali fault system, which may have been activated as recently as late Miocene time (Richter and Matson, 1971), appears to follow the old suture zone between the upper Paleozoic volcanic arc and the Devonian continent. The Totschunda fault system is an even younger active structure short-circuiting the southeast part of the Denali fault probably in response to changes in Pacific plate motion.

GEOCHEMISTRY (MAPS MF-655B-G)

Geochemical investigations in the Nabesna quadrangle were undertaken between 1967 and 1974 to help determine the mineral resource potential of the quadrangle and to outline areas of anomalous metal content. During this period, a total of 2,005 stream-sediment and rock samples were collected and analyzed. In the geochemical maps of this report, only data resulting from the stream-sediment sampling are used; data from the rock samples, which are chiefly samples of mineralized and altered rock and hence very selective, are available in open-filed maps by Matson and Richter (1971a-d and 1972a,b) and by Richter and Matson (1969a,b and 1970a,b) for nine of the 1:63,360-scale Nabesna quadrangles.

About 1,350 stream-sediment samples were collected from active streams, then air dried and sieved. The −80 mesh (−177 micrometres) fractions were analyzed by semiquantitative emission spectrographic methods for 30 elements. All gold and some copper and lead analyses were done by atomic absorption. The geochemical maps show the distribution and abundance of copper, lead, gold, chromium, and cobalt in stream sediments on a base map of the generalized geology. The elements depicted on the maps were selected for their economic importance and because their concentrations range widely enough to reflect the geochemical nature of the bedrock. A map of perspective drawings of seven other elements is included to show their regional distribution patterns.

Complete Geological Survey analytical data on the rock and stream-sediment samples collected in the Nabesna quadrangle are available on a computer tape (O'Leary, Van Trump, and others, 1975) that can be obtained from the National Technical Information Service, Department of Commerce, Springfield, Virginia 22161.

GEOPHYSICS

AEROMAGNETIC MAP AND INTERPRETATION (MAP MF-655H (2 SHEETS))

The aeromagnetic map (sheet 1) of the Nabesna quadrangle was made in 1971 and subsequently released by the State of Alaska as an open-file map (Alaska Division of Geological and Geophysical Surveys, 1973). The variations in the magnetic field on maps such as these provide valuable information concerning the lateral and vertical extent of rock units containing various percentages of magnetic minerals, usually magnetite. Aeromagnetic maps thus are a most useful support for a geologic mapping program as well as for mineral resource assessment. An interpretive map (sheet 2) identifies numerous rock units in the Nabesna quadrangle that possess characteristic magnetic anomalies and enables the interpreter to extrapolate geologic information from known areas into covered or inaccessible regions. In particular, the aeromagnetic map makes it possible to locate covered extensions of potentially chromite-bearing ultramafic rocks and to locate areas of altered plutonic rocks that may be associated with porphyry copper-type mineral deposits.

GRAVITY MAP (MAP MF-655I)

The Bouguer gravity map summarizes approximately 600 gravity measurements that have been made in the Nabesna quadrangle by the Geological Survey. The Bouguer gravity field reflects the variations in rock density within the quadrangle and probably shows deeper structures than any other map in this folio. One predominant feature of the map is a negative gradient that probably represents an increase in crustal thickness from about 35 km (21 miles) beneath the Tanana Valley near the northeast corner of the quadrangle to 45 km (27 miles) beneath the Wrangell Mountains at the southeast corner. Local anomalies correlate with some of the intrusive rocks associated with mineralization and suggest that more detailed gravity surveys, for which this map could serve as a framework, would help to define the form of the intrusion. Other features of the gravity map may be correlated with some fault movements and possibly with changes in the metamorphic grade of the rocks.

INTERPRETATIONS OF SATELLITE IMAGERY (MAP MF-655J (2 SHEETS))

Interpretations of satellite images of the Nabesna quadrangle are based on data supplied by ERTS-1, the Earth Resources Technology Satellite. Two types of images were used in these interpretations: (1) an ERTS photomosaic of the State of Alaska compiled by the U.S. Department of Agriculture and (2) computer-enhanced ERTS imagery processed by the U.S. Geological Survey in Flagstaff, Ariz.

The ERTS photomosaic of Alaska largely consists of images taken during the fall months. Because of the low sun angle and the synoptic view, the photomosaic is most useful for identifying regional linear and circular structural features. Computer-enhanced imagery, on the other hand, has proved to be valuable in detecting subtle surficial variations in reflectance due to differences in vegetation, rock types, soil, and other variables.

As a preliminary geologic mapping tool, ERTS imagery can be used effectively for reconnaissance studies. Remotely sensed information about geomorphology, structural features, and variations in spectral response of surficial materials, for example, can help in the plan and conduct of geologic mapping.

Applications of ERTS imagery directly to mineral appraisal are still developing. For example, using the images to correlate structural features, vegetation, and soil and rock variations with geochemical and geophysical data can contribute significant information bearing on mineral resource assessment. Another application has been to correlate linears with metallogenic provinces (Lathram and Gryc, 1973). Research on other techniques for applying this new tool to geologic and mineral resource problems in Alaska is being carried out under AMRAP.

MINERAL RESOURCES (MAP MF-665K)

The potentially favorable mineral resource areas of the Nabesna quadrangle based on the investigative components of this report—geology, geochemistry, geophysics, and satellite imagery—are shown on the mineral resources map together with the location and a brief description of the known prospects, mineral occurrences, and inactive mines. In addition, the resource potential of the principal mineral commodities is reviewed, and where data are deemed adequate, a quantitative estimate of the resource is provided. Terms used in defining the resource potential follow the classification that has recently been jointly adopted by the Bureau of Mines and the Geological Survey (McKelvey, 1973).

Copper is the principal mineral resource of the Nabesna quadrangle. It occurs in a number of porphyry copper, stockwork, contact metamorphic, vein, and volcanogenic deposits, many of which are virtually unexplored. Especially significant are the identified porphyry copper deposits that contain an estimated 1.08×10^9 metric tons of potential ore averaging about 0.3 percent copper, 0.02 percent molybdenum, and minor gold and silver. Volcanogenic copper in the basalt flows of the Nikolai Greenstone may also constitute a vast future resource of the metal.

Other resources are molybdenum, gold, silver, and possibly chromite. Molybdenum, a coproduct in the porphyry copper deposits, also occurs as the principal metal in at least two porphyry molybdenum deposits. The largest resources of gold and silver occur as byproducts in the copper porphyries; gold is also present in contact metamorphic, disseminated, and stockwork deposits. The placer gold deposits of the quadrangle are largely depleted, but small deposits are probably still present. Chromite has been found in the alpine ultramafic bodies north of the Denali fault and may constitute a significant resource.

Deposits of oil and gas, coal, and radioactive minerals are not known in the quadrangle, and the likelihood of an occurrence of these commodities is small.

LAND STATUS (MAP MF-655L)

The land status map shows the classifications and boundaries of 10 proposed and existing categories of land in the Nabesna quadrangle. The map was compiled from a much smaller scale map prepared in March 1974 by the U.S. Bureau of Land Management according to the terms of the Alaska Native Claims Settlement Act (ANCSA) of December 18, 1971.

BIBLIOGRAPHY

Starred references indicate those cited in this report.

1. SPECIFIC REFERENCES (Principally references restricted to the Nabesna quadrangle or references in which the Nabesna quadrangle constitutes a significant part of the paper.)

* Alaska Division of Geological and Geophysical Surveys, 1973, Aeromagnetic map, Nabesna quadrangle, Alaska: Alaska Div. Geol. Geophys. Surveys open-file rept. 13, 1 sheet, scale 1:250,000.

* Albert, N. R. D., 1975, Interpretation of Earth Resources Technology Satellite imagery of the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655J, 2 sheets, scale 1:250,000.

* Allen, H. T., 1887, Report of an expedition to the Copper Tanana, and Koyukuk Rivers, in the Territory of Alaska, in the year 1885: Washington, Govt. Printing Office, 172 p.

Anderson, G. S., 1970, Hydrologic reconnaissance of the Tanana basin, central Alaska: U.S. Geol. Survey Hydrol. Inv. Atlas HA-319, 4 sheets.

Barnes, D. F., 1967, Four preliminary gravity maps of parts of Alaska: U.S. Geol. Survey open-file rept., 5 p.

* Barnes, D. F., and Morin, R. L., 1975, Gravity map of the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655I, 1 sheet, scale 1:250,000.

* Berg, H. C., Jones, D. L., and Richter, D. H., 1972, Gravina-Nutzotin belt - Tectonic significance of an upper Mesozoic sedimentary and volcanic sequence in southern and southeastern Alaska, in Geological Survey research 1972: U.S. Geol. Survey Prof. Paper 800-D, p. D1-D24.

Bond, G. C., 1973, A late Paleozoic volcanic arc in the eastern Alaska Range, Alaska: Jour. Geology, v. 81, p. 557-575.

Bond, W. A., 1973, Permian sediments and stratigraphy in the Slana area, Alaska: Colorado Univ., Boulder, Colo., M.S. thesis.

Boucher, Gary, Matumoto, Tosimatu, and Oliver, Jack, 1968, Jour. Geophys. Research, v. 73, no. 14, p. 4789-4793.

* Brooks, A. H., 1900a, A reconnaissance in the White and Tanana river basins, Alaska, in 1898: U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 425-494.

* Brooks, A. H., 1900b, A reconnaissance from Pyramid Harbor to Eagle City, Alaska, including a description of the copper deposits of the upper White and Tanana Rivers: U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 331-391.

Brooks, A. H., 1914, The Chisana placer district: U.S. Geol. Survey Bull. 592, p. 309-320.

Cairnes, D. D., 1915, Upper White River district, Yukon: Canada Geol. Survey Mem. 50, 191 p.

Capps, S. R., 1915, Mineral resources of the Chisana-White River district: U.S. Geol. Survey Bull. 622, p. 189-228.

Capps, S. R., 1916a, An ancient volcanic eruption in the upper Yukon Basin: U.S. Geol. Survey Prof. Paper 95-D, p. 59-64.

* Capps, S. R., 1916b, The Chisana-White River district, Alaska: U.S. Geol. Survey Bull. 630, 130 p.

Deininger, J. W., 1972, Petrology of the Wrangell Volcanics near Nabesna, Alaska: Alaska Univ., College, Ak., M.S. thesis.

Dobey, P. L., and Henning, M. W., 1973, Evaluation of D2 land area, Nabesna quadrangle, Alaska, using aeromagnetic and geochemical data: Alaska Div. Geol. Geophys. Surveys open-file rept. 21, 10 p.

Fernald, A. T., 1965a, Glaciation in the Nabesna River area, upper Tanana River valley, Alaska, in Geological Survey research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C120-C123.

Fernald, A. T., 1965b, Recent history of the upper Tanana River lowland, Alaska, in Geological Survey research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C124-127.

Gillespie, C. D., 1970, Geology of the central Bond Creek area, Nabesna, Alaska: Oregon State Univ., Corvallis, Ore., Master's thesis.

* Griscom, Andrew, 1975, Aeromagnetic map and interpretation of the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655H, 2 sheets, scale 1:250,000.

Linn, G. W., 1973, Geology of Orange Hill, Alaska: California Univ., Berkeley, Calif., Master's thesis.

* Marsh, S. P., 1975a, Geochemical and generalized geologic map showing distribution and abundance of copper in the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655B, 1 sheet, scale 1:250,000.

* Marsh, S. P., 1975b, Geochemical and generalized geologic map showing distribution and abundance of lead in the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655C, 1 sheet, scale 1:250,000.

* Marsh, S. P., 1975c, Geochemical and generalized geologic map showing distribution and abundance of gold in the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655D, 1 sheet, scale 1:250,000.

* Marsh, S. P., 1975d, Geochemical and generalized geologic map showing distribution and abundance of chromium in the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655E, 1 sheet, scale 1:250,000.

* Marsh, S. P., 1975e, Geochemical and generalized geologic map showing distribution and abundance of cobalt in the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655F, 1 sheet, scale 1:250,000.

* Marsh, S. P., 1975f, Perspective diagrams showing geochemical abundance of silver, lanthanum, molybdenum, nickel, vanadium, yttrium, and zinc in the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655G, 1 sheet, scale 1:250,000.

* Matson, N. A., Jr., and Richter, D. H., 1971a, Geochemical data from the Nabesna A-1 quadrangle, Alaska: U.S. Geol. Survey open-file rept., 10 p.

* Matson, N. A., Jr., and Richter, D. H., 1971b, Geochemical data from the Nabesna C-4 quadrangle, Alaska: U.S. Geol. Survey open-file rept., 6 p.

* Matson, N. A., Jr., and Richter, D. H., 1971c, Geochemical data from the Nabesna C-5 quadrangle, Alaska: U.S. Geol. Survey open-file rept., 10 p.

* Matson, N. A., Jr., and Richter, D. H., 1971d, Geochemical data from the Nabesna D-5 quadrangle, Alaska: U.S. Geol. Survey open-file rept., 8 p.

* Matson, N. A., Jr., and Richter, D. H., 1972a, Additional geochemical data from the Nabesna C-4 and D-6 quadrangles, Alaska: U.S. Geol. Survey open-file rept., 5 p.

* Matson, N. A., Jr., and Richter, D. H., 1972b, Geochemical data from the Nabesna B-3 quadrangle, Alaska: U.S. Geol. Survey open-file rept., 41 p.

* McKelvey, V. E., 1973, Mineral resource estimates and public policy, in Brobst, D. A., Pratt, W. P., and McKelvey, V. E., Summary of United States mineral resources: U.S. Geol. Survey Circ. 682, 19 p.

* Mendenhall, W. C., and Schrader, F. C., 1903a, Copper deposits of the Mount Wrangell region, Alaska: U.S. Geol. Survey Bull. 213, p. 141-148.

Mendenhall, W. C., and Schrader, F. C., 1903b, The mineral resources of the Mount Wrangell district, Alaska: U.S. Geol. Survey Prof. Paper 15, 71 p.

Mertie, J. B., Jr., 1931, A geologic reconnaissance of the Dennison Fork district, Alaska: U.S. Geol. Survey Bull. 827, 44 p.

Mertie, J. B., Jr., 1937, The Yukon-Tanana region, Alaska: U.S. Geol. Survey Bull. 872, 276 p.

* Moffit, F. H., 1932, The Slana district, upper Copper River region: U.S. Geol. Survey Bull. 824, p. 111-124.

* Moffit, F. H., 1933, The Suslota Pass district, upper Copper River region, Alaska: U.S. Geol. Survey Bull. 844-C, p. 137-162.

Moffit, F. H., 1936, Upper Copper and Tanana Rivers: U.S. Geol. Survey Bull. 868-C, p. 135-143.

Moffit, F. H., 1937, Recent mineral developments in the Copper River region: U.S. Geol. Survey Bull. 880-B, p. 97-109.

* Moffit, F. H., 1938, Geology of the Slana-Tok district, Alaska: U.S. Geol. Survey Bull. 904, 54 p.

* Moffit, F. H., 1941, Geology of the upper Tetling River district, Alaska: U.S. Geol. Survey Bull. 917-B, p. 115-157.

* Moffit, F. H., 1943, Geology of the Nutzotin Mountains, Alaska, with a section on the igneous rocks, by R. G. Wayland: U.S. Geol. Survey Bull. 933-B, p. 103-174.

* Moffit, F. H., 1944, Mining in the northern Copper River region, Alaska: U.S. Geol. Survey Bull. 943-B, p. 25-47.

* Moffit, F. H., 1954, Geology of the eastern part of the Alaska Range and adjacent area: U.S. Geol. Survey Bull. 989-D, p. 63-218.

Moffit, F. H., and Knopf, Adolph, 1909, Mineral resources of the Nabesna-White River district: U.S. Geol. Survey Bull. 379, p. 161-180.

* Moffit, F. H., and Knopf, Adolph, 1910, Mineral resources of the Nabesna-White River district, Alaska, with a section on the Quaternary, by S. R. Capps: U.S. Geol. Survey Bull. 417, 64 p.

* O'Leary, R. M., Van Trump, George, and others, 1976, Spectrographic and chemical analyses of rock and stream-sediment samples from the Nabesna quadrangle, Alaska: Natl. Tech. Inf. Service (U.S. Dept. Commerce) Magnetic Tape No. PB240-488.

Richter, D. H., 1964, Geology and mineral deposits of the Ahtell Creek area, Slana district, south-central Alaska: Alaska Div. Mines and Minerals Geol. Rept. 6, 17 p.

Richter, D. H., 1965, Geochemical investigation of the Slana district, southcentral Alaska, 1963 and 1964: Alaska Div. Mines and Minerals Geochem. Rept. 2, 14 p.

Richter, D. H., 1966, Geology of the Slana district, southcentral Alaska: Alaska Div. Mines and Minerals Geol. Rept. 21, 51 p.

Richter, D. H., 1967, Geology of the upper Slana-Mentasta Pass area, southcentral Alaska: Alaska Div. Mines and Minerals Geol. Rept. 30, 25 p.

Richter, D. H., 1970, A corundum occurrence in the eastern Alaska Range, Alaska, in Geological Survey research 1970: U.S. Geol. Survey Prof. Paper 700-C, p. C98-C102.

Richter, D. H., 1971a, Reconnaissance geologic map and section of the Nabesna A-3 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-655, 1 sheet, scale 1:63,360.

Richter, D. H., 1971b, Reconnaissance geologic map and section of the Nabesna B-4 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-656, 1 sheet, scale 1:63,360.

Richter, D. H., 1973, Reconnaissance geologic map of the Nabesna A-4 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-789, 1 sheet, scale 1:63,360.

* Richter, D. H., 1975a, Geologic map of the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655A, 1 sheet, scale 1:250,000.

* Richter, D. H., 1975b, Geologic map of the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-932, 1 sheet, scale 1:250,000.

* Richter, D. H., Geologic map of the Nabesna B-3 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-904, 1 sheet, scale 1:250,000 (in press).

Richter, D. H., and Dutro, J. T., Jr., 1975, Revision of the type Mankomen Formation (Pennsylvanian and Permian), Eagle Creek area, eastern Alaska Range, Alaska: U.S. Geol. Survey Bull. 1395-B, p. B1-B25.

Richter, D. H., and Jones, D. L., 1973a, Reconnaissance geologic map and cross-section of the Nabesna A-2 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-749, 1 sheet, scale 1:63,360.

* Richter, D. H., and Jones, D. L., 1973b, Structure and stratigraphy of eastern Alaska Range, Alaska, in Arctic Geology: Am. Assoc. Petroleum Geologists, Mem. 19, p. 408-420.

Richter, D. H., Lamarre, R. A., and Donaldson, D. E., 1973, Soda Creek springs -- metamorphic waters in the eastern Alaska Range: U.S. Geol. Survey Jour. Research, v. 1, no. 5, p. 523-528.

* Richter, D. H., Lanphere, M. A., and Matson, N. A., Jr., 1975, Granitic plutonism and metamorphism, eastern Alaska Range, Alaska: Geol. Soc. America Bull., (in press).

Richter, D. H., and Matson, N. A., Jr., 1968, Distribution of gold and some base metals in the Slana area, eastern Alaska Range, Alaska: U.S. Geol. Survey Circ. 593, 20 p.

* Richter, D. H., and Matson, N. A., Jr., 1969a, Geochemical data from the Nabesna A-3 quadrangle, Alaska: U.S. Geol. Survey open-file rept., unpaged.

* Richter, D. H., and Matson, N. A., Jr., 1969b, Geochemical data from the Nabesna B-4 quadrangle, Alaska: U.S. Geol. Survey open-file rept., unpaged.

* Richter, D. H., and Matson, N. A., Jr., 1970a, Geochemical data from the Nabesna A-2 quadrangle, Alaska: U.S. Geol. Survey open-file rept., unpaged.

* Richter, D. H., and Matson, N. A., Jr., 1970b, Geochemical data from the Nabesna A-4 quadrangle, Alaska: U.S. Geol. Survey open-file rept., unpaged.

* Richter, D. H., and Matson, N. A., Jr., 1971, Quaternary faulting in the eastern Alaska Range, Alaska: Geol. Soc. America Bull., v. 82, p. 1529-1540.

Richter, D. H., and Matson, N. A., Jr., 1972, Metallic mineral resources map of the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-422, 1 sheet, scale 1:250,000.

Richter, D. H., and Schmoll, H. R., 1973, Geologic map of the Nabesna C-5 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-1062, 1 sheet, scale 1:63,360.

Richter, D. H., Schmoll, H. R., and Matson, N. A., Jr., 1973, Reconnaissance geologic map of the Nabesna A-1 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-807, 1 sheet, scale 1:63,360.

* Richter, D. H., Singer, D. A., and Cox, D. P., 1975, Mineral resources map of the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655K, 1 sheet, scale 1:250,000.

* Rohn, Oscar, 1900, A reconnaissance of the Chitina River and the Skolai Mountains, Alaska: U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 393-440.

Rowett, C. L., 1971, Reconnaissance biostratigraphy of the Lower Permian in the Slana area, eastern Alaska Range, Alaska: Pacific Geology, v. 3, p. 31-44.

Van Alstine, R. E., and Black, R. F., 1944, Mineral deposits at Orange Hill, Alaska: U.S. Geol. Survey open-file rept., 28 p.

Wayland, R. G., 1943, Gold deposits near Nabesna: U.S. Geol. Survey Bull. 933-B, p. 175-199.

Wright, H. E., Jr., 1953, Glacial history of the Mentasta Mountains, southeastern Alaska Range (abs.): Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1495.

II. GENERAL REFERENCES (Principally references of regional scope in which the Nabesna quadrangle is incidental to the main theme of the paper.)

Alaska Dept. Mines, 1954, Report of the Commissioner of Mines for the biennium ended Dec. 31, 1954: Juneau, Alaska, 110 p.

Alaska Division of Geological Survey, 1970, Report for the year 1970: College, Alaska, 86 p.

Alaska Division of Geological Survey, 1972, Annual report 1971: Anchorage, Alaska, 109 p.

Alaska Division of Mines and Geology, 1968, Report for the year 1968: College, Alaska, 67 p.

Alaska Division of Mines and Minerals, 1965, Report for the year 1965: Juneau, Alaska, 99 p.

Alaskan Geology Branch, U.S. Geological Survey, 1972, The status of mineral resource information on the major land withdrawals of the Alaska Native Claims Settlement Act of 1971: U.S. Geol. Survey open-file rept., 164 p.

Bain, H. F., 1946, Alaska's minerals as a basis for industry: U.S. Bur. Mines Inf. Circ. 7379, 89 p.

Berg, H. C., and Cobb, E. H., 1967, Metalliferous lode deposits of Alaska: U.S. Geol. Survey Bull. 1246, 254 p.

Bottge, R. G., 1974, Potential mineral resources in selected D.2 lands: U.S. Bur. Mines open-file rept. 9-74, 55 p.

Brooks, A. H., 1904, Placer mining in Alaska in 1903: U.S. Geol. Survey Bull. 225, p. 43-59.

Brooks, A. H., 1906a, The geography and geology of Alaska, a summary of existing knowledge, with a section on climate by Cleveland Abbe, Jr., and a topographic map and description thereof, by R. U. Goode: U.S. Geol. Survey Prof. Paper 45, 327 p.

Brooks, A. H., 1906b, The mining industry in 1905: U.S. Geol. Survey Bull. 284, p. 4-9.

Brooks, A. H., 1907, The mining industry in 1906: U.S. Geol. Survey Bull. 314, p. 19-39.

Brooks, A. H., 1909, Mineral resources of Alaska, in U.S. Geological Survey, Papers on the conservation of mineral resources (reprinted from report of the National Conservation Commission, February, 1909): U.S. Geol. Survey Bull. 394, p. 172-207.

Brooks, A. H., 1911, Geologic features of Alaskan metalliferous lodes: U.S. Geol. Survey Bull. 480, p. 43-93.

Brooks, A. H., 1914, The Alaskan mining industry in 1913: U.S. Geol. Survey Bull. 592, p. 45-74.

Brooks, A. H., 1915, The Alaskan mining industry in 1914: U.S. Geol. Survey Bull. 622, p. 15-68.

Brooks, A. H., 1916, The Alaska mining industry in 1915: U.S. Geol. Survey Bull. 642, p. 16-71.

Brooks, A. H., 1918, The Alaska mining industry in 1916: U.S. Geol. Survey Bull. 662, p. 11-62.

Brooks, A. H., 1921, The future of Alaska mining: U.S. Geol. Survey Bull. 714, p. 5-57.

Brooks, A. H., and Capps, S. R., 1924, The Alaskan mining industry in 1922: U.S. Geol. Survey Bull. 755, p. 3-56.

Brooks, A. H., and Martin, G. C., 1921, The Alaskan mining industry in 1919: U.S. Geol. Survey Bull. 714, p. 59-95.

Churkin, Michael, Jr., 1973, Paleozoic and Precambrian rocks of Alaska and their role in its structural evolution: U.S. Geol. Survey Prof. Paper 740, 64 p.

Cobb, E. H., 1973, Placer deposits of Alaska: U.S. Geol. Survey Bull. 1374, 213 p.

Eakins, G. R., 1969, Uranium in Alaska: Alaska Div. Mines and Geology Geol. Rept. 38, 50 p.

Grantz, Arthur, 1966, Strike-slip faults in Alaska: U.S. Geol. Survey open-file rept., 82 p.

Hamilton, Warren, and Myers, W. B., 1966, Cenozoic tectonics of the western United States: Rev. Geophys., v. 4, p. 505-549.

Hollick, Arthur, 1936, The Tertiary floras of Alaska, with a chapter on the geology of the Tertiary deposits, by P. S. Smith: U.S. Geol. Survey Prof. Paper 182, 185 p.

Imlay, R. W., and Detterman, R. L., 1973, Jurassic paleobiogeography of Alaska: U.S. Geol. Survey Prof. Paper 801, 34 p.

Joesting, H. R., 1942, Strategic mineral occurrences in interior Alaska: Alaska Dept. Mines Pamph. 1, 46 p.

Koschmann, A. H., and Bergendahl, M. H., 1968, Principal gold-producing districts of the United States: U.S. Geol. Survey Prof. Paper 610, 283 p.

Krinsley, D. B., Davies, W. E., Rachlin, J., and Newton, E. G., 1971, Existing environment of natural corridors from Prudhoe Bay, Alaska, to Edmonton, Canada: U.S. Geol. Survey open-file rept., 104 p.

* Lathram, E. H., and Gryc, George, 1973, Metallogenic significance of Alaskan geostructures seen from space: Proceedings, Eighth Internat. Symposium on Remote Sensing of Environment, Environmental Research Institute of Michigan, Ann Arbor, Mich., p. 1209-1211.

Lerbekmo, J. F., and Campbell, F. A., 1969, Distribution, composition, and source of the White River Ash, Yukon Territory: Canadian Jour. Earth Sci., v. 6, no. 1, p. 109-116.

Malone, Kevin, 1965, Mercury in Alaska, in U.S. Bureau of Mines, Mercury potential of the United States: U.S. Bur. Mines Inf. Circ. 8252, p. 31-59.

Martin, G. C., 1919, The Alaskan mining industry in 1917: U.S. Geol. Survey Bull. 692, p. 11-42.

Martin, G. C., 1920, The Alaskan mining industry in 1918: U.S. Geol. Survey Bull. 712, p. 11-52.

Martin, G. C., 1926, The Mesozoic stratigraphy of Alaska: U.S. Geol. Survey Bull. 776, 493 p.

Marvin, R. F., 1974, A tabulation of K-Ar, Rb-Sr, and Pb-α ages obtained from materials within the United States (including Alaska and Hawaii) dating the years 1969 through 1971: U.S. Geol. Survey open-file rept., 193 p.

McInnis, Wilmer, 1957, Molybdenum, a materials survey, with a chapter on geology and resources by S. C. Creasey: U.S. Bur. Mines Inf. Circ. 7784, 77 p.

Mendenhall, W. C., 1905, Geology of the central Copper River region, Alaska: U.S. Geol. Survey Prof. Paper 41, 133 p.

Miller, D. J., Payne, T. G., and Gryc, George, 1959, Geology of possible petroleum provinces in Alaska, with an annotated bibliography by E. H. Cobb: U.S. Geol. Survey Bull. 1094, 131 p.

Nelson, A. E., West, W. S., and Matzko, J. J., 1954, Reconnaissance for radioactive deposits in eastern Alaska, 1952: U.S. Geol. Survey Circ. 348, 21 p.

Packer, D. R., 1972, Paleomagnetism of the Mesozoic in Alaska: Alaska Univ., College, Ak., Ph.D. thesis.

Page, Robert, and Lahr, John, 1970, Geodetic triangulation for fault movement on the Denali and Fairweather faults in Alaska (abs.): EOS (Am. Geophys. Union Trans.), v. 51, no. 4, p. 427.

Resource Planning Team, 1974, Resources of Alaska, a regional summary: Joint Federal-State Land Use Planning Commission for Alaska, Anchorage, Alaska, 618 p.

Saunders, R. H., 1967, Mineral occurrences in the Yukon-Tanana region, Alaska: Alaska Div. Mines and Minerals Spec. Rept. 2, 68 p.

Smith, P. S., 1926, Mineral industry of Alaska in 1924: U.S. Geol. Survey Bull. 783, p. 1-30.

Smith, P. S., 1929, Mineral industry of Alaska in 1926: U.S. Geol. Survey Bull. 797, p. 1-50.

Smith, P. S., 1930, Mineral industry of Alaska in 1927: U.S. Geol. Survey Bull. 810, p. 1-64.

Smith, P. S., 1930, Mineral industry of Alaska in 1928: U.S. Geol. Survey Bull. 813, p. 1-72.

Smith, P. S., 1932, Mineral industry of Alaska in 1929: U.S. Geol. Survey Bull. 824, p. 1-81.

Smith, P. S., 1933, Mineral industry of Alaska in 1931: U.S. Geol. Survey Bull. 844-A, p. 1-82.

Smith, P. S., 1933, Mineral industry of Alaska in 1930: U.S. Geol. Survey Bull. 836, p. 1-83.

Smith, P. S., 1934, Mineral industry of Alaska in 1932: U.S. Geol. Survey Bull. 857-A, p. 1-91.

Smith, P. S., 1934, Mineral industry of Alaska in 1933: U.S. Geol. Survey Bull. 864-A, p. 1-94.

Smith, P. S., 1936, Mineral industry of Alaska in 1934: U.S. Geol. Survey Bull. 868-A, p. 1-91.

Smith, P. S., 1937, Mineral industry of Alaska in 1935: U.S. Geol. Survey Bull. 880-A, p. 1-95.

Smith, P. S., 1938, Mineral industry of Alaska in 1936: U.S. Geol. Survey Bull. 897-A, p. 1-107.

Smith, P. S., 1939, Areal geology of Alaska: U.S. Geol. Survey Prof. Paper 192, 100 p.

Smith, P. S., 1939, Mineral industry of Alaska in 1937: U.S. Geol. Survey Bull. 910-A, p. 1-113.

Smith, P. S., 1939, Mineral industry of Alaska in 1938: U.S. Geol. Survey Bull. 917-A, p. 1-113.

Smith, P. S., 1941, Fineness of gold from Alaska placers: U.S. Geol. Survey Bull. 910-C, p. 147-272.

Smith, P. S., 1941, Mineral industry of Alaska in 1939: U.S. Geol. Survey Bull. 926-A, p. 1-106.

Smith, P. S., 1941, Past lode-gold production from Alaska: U.S. Geol. Survey Bull. 917-C, p. 159-212.

Smith, P. S., 1942, Mineral industry of Alaska in 1940: U.S. Geol. Survey Bull. 933-A, p. 1-102.

Smith, P. S., 1942, Occurrences of molybdenum minerals in Alaska: U.S. Geol. Survey Bull. 926-C, p. 161-210.

Smith, S. S., 1917, The mining industry in the Territory of Alaska during the calendar year 1915: U.S. Bur. Mines Bull. 142, 66 p.

St. Armand, P., 1957, Geological and geophysical synthesis of the tectonics of portions of British Columbia, the Yukon Territory, and Alaska: Geol. Soc. America Bull., v. 68, p. 1343-1370.

U.S. Bureau of Mines, 1967, Production potential of known gold deposits in the United States: U.S. Bur. Mines Inf. Circ. 8331, 24 p.

U.S. Geological Survey, 1899, Maps and descriptions of routes of exploration in Alaska in 1898, with general information concerning the Territory: U.S. Geol. Survey Spec. Pub., 138 p.

U.S. Geological Survey, 1903, Investigations in Alaska, in U.S. Geological Survey: U.S. Geol. Survey 24th Ann. Rept., p. 78-107.

U.S. Geological Survey, 1968, Geological Survey research 1968: U.S. Geol. Survey Prof. Paper 600-A, p. A1-A371.

U.S. Geological Survey, 1969a, Geological Survey research 1969: U.S. Geol. Survey Prof. Paper 650-A, p. A1-A425.

U.S. Geological Survey, 1969b, U.S. Geological Survey heavy metals program progress reports, 1968 - Field studies: U.S. Geol. Survey Circ. 621, 35 p.

U.S. Geological Survey, 1970, Geological Survey research 1970: U.S. Geol. Survey Prof. Paper 700-A, p. A1-A426.

U.S. Geological Survey, 1971, Geological Survey research 1971: U.S. Geol. Survey Prof. Paper 750-A, p. A1-A418.

U.S. Geological Survey, 1972, Geological Survey research 1972: U.S. Geological Survey Prof. Paper 800-A, p. A1-A320.

U.S. Geological Survey, 1973a, Geological Survey research 1973: U.S. Geol. Survey Prof. Paper 850, 366 p.

U.S. Geological Survey, 1973b, United States Geological Survey Alaska program, 1973: U.S. Geol. Survey Circ. 683, 56 p.

U.S. Geological Survey, 1975, Status of land in the Nabesna quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-655L, 1 sheet, scale 1:250,000

Wahrhaftig, Clyde, 1965, Physiographic provinces of Alaska: U.S. Geol. Survey Prof. Paper 482, 52 p.

Waring, G. A., 1917, Mineral springs of Alaska, with a chapter on the chemical character of some surface waters of Alaska, By R. B. Dole and A. A. Chambers: U.S. Geol. Survey Water-Supply Paper 418, 118 p.

Wedow, Helmuth, Jr., Killeen, P. L., and others, 1954, Reconnaissance for radioactive deposits in eastern interior Alaska, 1946: U.S. Geol. Survey Circ. 331, 36 p.

Wedow, Helmuth, Jr., and others, 1953, Preliminary summary of reconnaissance for uranium and thorium in Alaska, 1952: U.S. Geol. Survey Circ. 248, 15 p.

Wedow, Helmuth, Jr., White, M. G., and Moxham, R. M., 1952, Interim report on an appraisal of the uranium possibilities of Alaska: U.S. Geol. Survey open-file rept., 123 p.

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