C. 739

GEOLOGICAL SURVEY CIRCULAR 739

U.S. DEPARTMENT OF THE INTERIOR
March 3, 1849

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

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

By E. M. MacKevett, Jr., N. R. D. Albert, D. F. Barnes,
J. E. Case, Keith Robinson, and D. A. Singer

GEOLOGICAL SURVEY CIRCULAR 739

1977

United States Department of the Interior
CECIL D. ANDRUS, *Secretary*

March 3, 1849

Geological Survey
V. E. McKelvey, *Director*

Library of Congress catalog-card No. 77-73038

Free on application to Branch of Distribution, U.S. Geological Survey
1200 South Eads Street, Arlington, Va. 22202

CONTENTS

ILLUSTRATIONS

TABLE

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

By E. M. MacKevett, Jr., N. R. D. Albert, D. F. Barnes,
J. E. Case, Keith Robinson, and D. A. Singer

ABSTRACT

The McCarthy 1° by 3° quadrangle, in eastern south-central Alaska, contains potentially significant resources of copper and possibly of a few other commodities. This circular and a companion folio of maps represent results of integrated field and laboratory studies in the disciplines of geology, geophysics, geochemistry, and satellite imagery that are designed to provide a modern mineral resources assessment of the quadrangle. The maps are accompanied by descriptive texts, explanatory material, pertinent references, and by a few auxiliary tables and diagrams. This circular provides background information for the mineral resource assessment and integrates the component maps. It also includes a master list of references (see "Bibliography") relevant to the geology and mineral deposits of the quadrangle.

INTRODUCTION

PURPOSE AND SCOPE

This circular and the companion folio of related maps focus on providing modern, realistic estimates of the mineral resources and mineral resources potential of the McCarthy 1° by 3° quadrangle. The report was prepared under the auspices of the Alaskan Mineral Resources Assessment Program (AMRAP). Under AMRAP sponsorship a multidisciplinary team of earth scientists completed field investigations of the quadrangle during 1974 and the relevant laboratory and office studies during 1975. However, many of the fundamental geologic data were obtained during extensive investigations of the McCarthy quadrangle during the 1960's and early 1970's. The report also utilizes results of previous geologic investigations, notably those of F. H. Moffit and his co-workers. Moffit's studies during the early part of the century provide a nucleus of sound geologic information, and he well deserves our admiration and appreciation. Pertinent results of all the investigations, including those of the earlier geologists, are incorporated in the folio and this circular.

The folio consists of 15 maps that provide information on the geology, geochemistry, geophysics, telegeology, mineral resources, and land status of the quadrangle (table 1). The prime intent of the folio and circular is to furnish valid mineral resource data that are requisites for judicious land-use planning and a sound long-term national minerals policy. Other aims are to provide information germane to prudent minerals exploration and to enhance the geologic knowledge of the region. The report represents our attempt to integrate the most factual and fundamental data available that relate to the quadrangle's mineral resources, commensurate with limitations of knowledge and technology. Consequently, the report contains information from several disciplines including many of the diverse specialties of geology, geochemistry, geophysics, and telegeology. In addition, this circular contains an extensive bibliography relevant to geologic aspects of the McCarthy quadrangle, and maps in the folio contain references applicable to their subject matter. The liberal use of citations should enable the interested reader to obtain additional information on specific topics.

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

U.S. Geological Survey Miscellaneous Field Studies (MF) Map	Subject
MF–773–A (MacKevett, 1976a, 1977).[1]	Geology.
–B (MacKevett, 1976b)	Mineral deposits and occurrences.
–C (Singer and MacKevett, 1976).	Mineral resources.
–D (Case and MacKevett, 1976).	Aeromagnetic map and interpretation.
–E (Barnes and Morin, 1976).	Gravity map.
–F (Robinson and others, 1976a).	Geochemical distribution and abundance of copper in stream sediments.
–G (Robinson and others, 1976b).	Geochemical distribution and abundance of lead in stream sediments.
–H (Robinson and others, 1976c).	Geochemical distribution and abundance of gold in stream sediments.
–I (Robinson and others, 1976d).	Geochemical distribution and abundance of arsenic and mercury in stream sediments.
–J (Robinson and others, 1976e)	Geochemical distribution and abundance of molybdenum in rocks and veins.
–K (Robinson and others, 1976f)	Geochemical distribution and abundance of silver in rocks and veins.
–L (Robinson and others, 1976g)	Geochemical distribution and abundance of gold in rocks and veins.
–M (Robinson and others, 1976h)	Geochemical distribution and abundance of arsenic in rocks and veins.
–N (Albert and Steele, 1976)	Interpretation of satellite imagery.
–O (U.S. Geological Survey, 1976b)	Land status.

[1] U.S. Geological Survey Miscellaneous Field Studies Maps are printed in black and white; a companion multicolored Miscellaneous Geologic Investigations Series Map of this component (MacKevett, 1977) is in press.

GEOGRAPHY AND ACCESS

The McCarthy quadrangle includes about 17,910 km^2 (6,915 mi^2) in eastern south-central Alaska (figs. 1 and 2). The quadrangle is bounded by the 61° and 62° parallels and by the 141° and 144° meridians. It is dominated by the lofty and spectacular Wrangell Mountains. These mountains and their subsidiary ranges trend about N. 75° W. across most of the quadrangle. To the southeast they merge into the St. Elias Mountains and the Icefield Ranges of Canada. The northeastern part of the quadrangle contains part of the Duke Depression as well as irregular hills of moderate relief with intermontane valleys that are part of the Mentasta-Nutzotin Mountain segment of the eastern Alaska Range (Wahrhaftig, 1965, p. 35, pl. 1). In the southern part of the quadrangle, the Chitina Valley, which is part of the Copper River Lowland, separates the Wrangell-St. Elias physiographic complex from frontal ranges of the Chugach Mountains to the south.

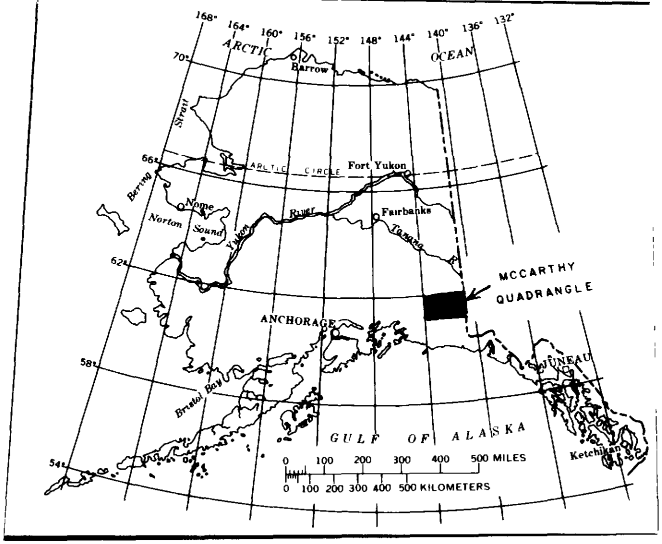

FIGURE 1.—Index map of Alaska showing location of McCarthy quadrangle.

The Chitina River is the master drainage artery for most of the quadrangle. It joins the Copper River near Chitina; the Copper discharges into the Gulf of Alaska near Cordova. A small area in the western part of the quadrangle is drained by the Kotsina River, which flows directly into the Copper River. Some northern parts of the quadrangle are drained by the White River, its tributaries, and tributaries of the Tanana River. To a large extent the rivers are nourished by the many large valley glaciers that emanate from the partly ice- and snow-bound mountainous upland terrains.

Topographic relief in the quadrangle is extreme. Several lofty, mainly volcanic, peaks of the Wrangell Mountains are more than 3,500 m (11,483 ft) high, and the two highest peaks, Mount Bona and Mount Blackburn, have altitudes of 5,005 m (16,421 ft) and 4,996 m (16,390 ft), respectively. The lowest areas, near the western boundary of the quadrangle along the Chitina River, have altitudes of about 250 m (820 ft).

Population in the quadrangle is sparse and fluctuates seasonally. It is centered at McCarthy, which has about 20 permanent residents. A few people reside at May Creek, in the Nizina River valley, near Long Lake, and during some years, elsewhere in the quadrangle. The transient population increases markedly during summer months owing to an influx of tourists, vacationers, summer residents, hunters and guides, personnel related to minerals exploration, and diverse scientists and nature enthusiasts.

A gravel road, about 97 km (60 mi) long, links McCarthy with the Alaska highway system at Chitina. This road, which follows the grade of the former railroad that served the Kennecott mines, is subject to slides, washouts, and damaged bridges and is, at times, impassable. Subsidiary roads extend from McCarthy to Kennicott and from McCarthy to May Creek and thence to nearby placer gold workings. During recent years damage to the Nizina River bridge has precluded road transportation between McCarthy and May Creek. A few other short roads are used intermittently, mainly in connection with minerals exploration, but generally these are in disrepair and require 4-wheel-drive vehicles. Scheduled air service is maintained between McCarthy and Chitina on at least a weekly basis. Much travel within and throughout the region is by means of small private or chartered fixed-wing aircraft. The more remote and rugged areas are best reached by helicopter. Some transportation is accomplished by horses, snow vehicles, or walking. The quadrangle's climate is rigorous and marked by long, cold winters; however, warm temperate conditions prevail at lower altitudes during much of the summer and early fall.

ACKNOWLEDGMENTS

Geologic investigations in the McCarthy quadrangle have benefited from the participation of numerous earth scientists, whose many important contributions are gratefully acknowledged. The project's overall accomplishments represent the combined efforts of many co-workers including project personnel, short-term visiting scientists, and laboratory special-

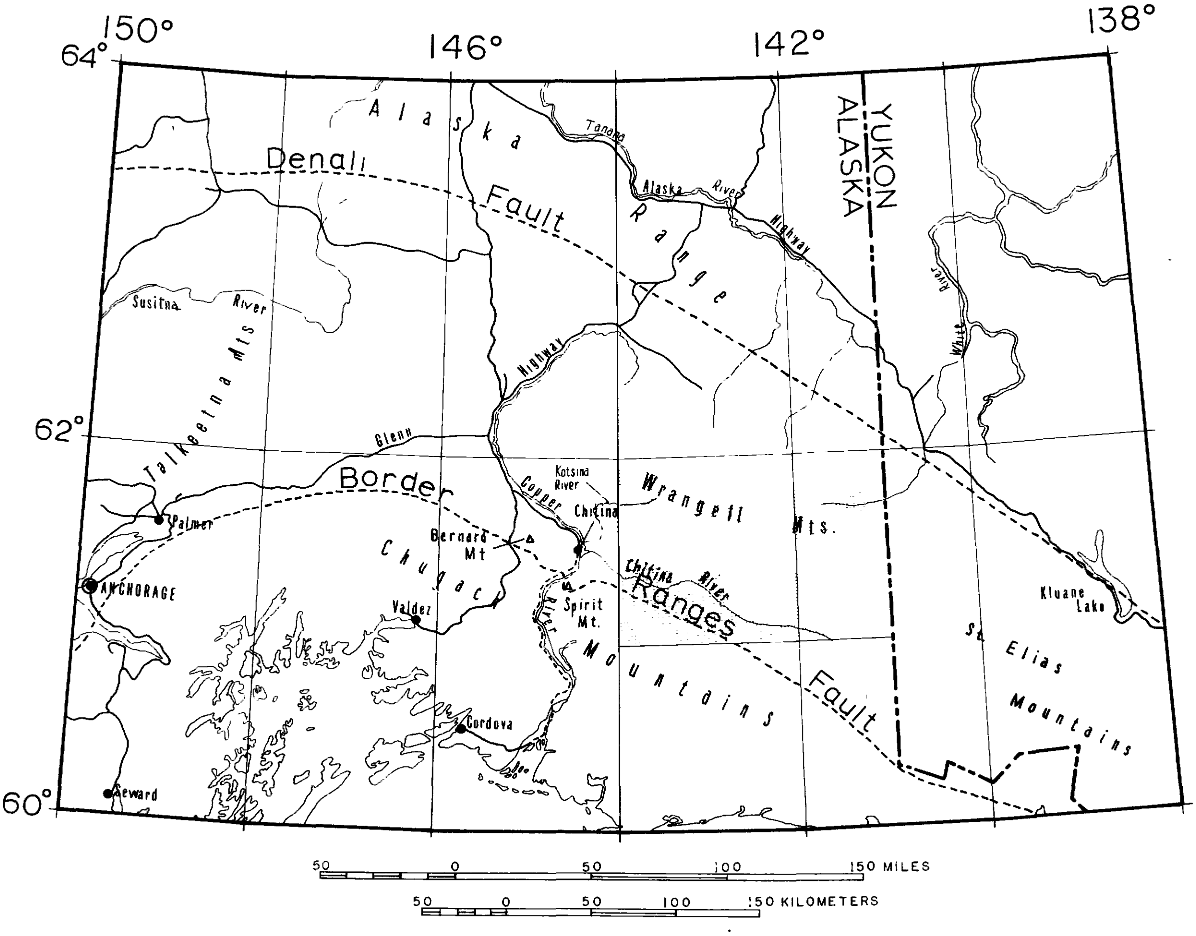

FIGURE 2.—Map showing McCarthy quadrangle (shaded) and nearby parts of Alaska and Canada.

ists. All are worthy of individual acknowledgment, but in order to avoid repetition, citations of their contributions are confined to the bibliography, specific maps such as map MF–773A, and figure 3. Even so, it would be remiss not to mention specifically a few geologists who made exceptional contributions. These include D. L. Jones, whose expertise in paleontology and stratigraphy was instrumental in understanding the geology of the diverse Cretaceous sedimentary sequences, and whose perceptive and stimulating ideas were important in relating the quadrangle's tectonic history to plate tectonic models; D. H. Richter, who headed geologic investigations in the northeastern part of the quadrangle and made valuable geologic interpretations; George Plafker, whose knowledge of the regional geology, particularly its structural aspects, was an important asset; and G. R. Winkler, who made many significant contributions in the field and laboratory during his long tenure on the project. Tribute is also paid to the memories of an outstanding Alaskan geologist, Don J. Miller, and his field assistant, R. S. MacColl, who drowned while mapping in the McCarthy A–4 quadrangle.

The cooperation of many people engaged in minerals exploration, particularly L. H. Greene, P. R. Holdsworth, and the late J. P. McKee, is appreciated. Geologic investigations in remote rugged areas are enhanced by the help of local residents, particularly with regard to logistics, geographic nomenclature, and local history. Our work was facilitated by a high degree of cooperation from local people, particularly the late Walter Holmes and his widow, Teresa, Tom and Molly Gilmore, "Bud" Bowen, J. L. Wilson, and C. H. Schulze. During early stages of fieldwork, competent and reliable fixed-wing aircraft service was provided by Jack Wilson (Wilson's Flying Service, Gulkana) and by Howard Knutson (Howard's Flying Service, Chitina). Most of the fieldwork was helicopter supported.

The preparation of this report also benefited from the efficient office and laboratory assistance of A. L. Cantelow and C. D. Holloway, and the advice and counsel of H. C. Berg, manager of the AMRAP program. M. E. Yount, using computer-assisted methods, prepared the bibliography, and F. A. Wahl was instrumental in integrating and processing the folio components for publication.

SUMMARY OF MINERAL EXPLORATION AND PRODUCTION

The metal output from the Kennecott mines far overshadows other mineral production from the quadrangle. During their major operations, between 1913 and 1938, the Kennecott mines produced about 1.2 billion pounds of copper and 9 million troy ounces of byproduct silver from 4,626,000 tons of ore that averaged about 13 percent copper (Douglass, 1964, p. 11). Intermittent small-scale production from the mines since 1938 accounted for another approximately 2,000 tons of high-grade copper ore, mainly selectively mined by surficial operations. Production data for the other copper mines are less accurately known. Prior to its acquisition by the Kennecott Copper Corporation in 1919, the Mother Lode mine produced several thousand tons of high-grade copper ore and some byproduct silver. Several other copper mines that have been worked on a small scale produced a few thousand tons of high-grade copper ore with subordinate silver. Of these, the Green Butte was the largest producer, and the Peavine, which made a small shipment in 1973, the most recently active.

Gold production is dominated by placers of the Nizina district. Prior to 1959 these deposits produced about 143,440 troy ounces of gold (Koschmann and Bergendahl, 1968, p. 14). Slightly more than half of this production was from Chititu Creek and its tributaries, and the remainder was largely from Dan Creek and its tributaries. Dan and Chititu Creek placers have been worked seasonally on a small scale since 1959 and account for minor additional production. The Golconda Creek placers produced between 2,000 and 3,000 troy ounces of gold. The gold placers also produced small, but unknown, amounts of silver. Lode gold production consists of approximately 750 troy ounces of gold from the Yellowband mine and substantially lesser amounts from nearby properties of the Bremner Mining Company. The Midas mine also produced small amounts of gold and silver. About 60 troy ounces of lode gold were mined from an undisclosed source in the Nizina district, probably the Crumb Gulch prospects. During recent years, native copper nuggets, mainly collected from residues of Nizina district gold placers, have had minor use in Alaska jewelry and curios.

The following historical account is, in part, summarized from Moffit and Capps (1911, p. 75, 76) and Douglass (1964). Native copper, largely derived from the quadrangle, was used by several Alaskan native tribes and represents the earliest known minerals-related activity in the quadrangle. Prospecting in the region dates from the late 1890's when a few prospectors digressed from the Valdez approach to the Klondike goldfields and explored parts of the Chitina Valley. The location of the Nikolai prospect was revealed to prospectors by emissaries of Chief Nikolai, and exploration commenced during the summer of 1900. Two miners engaged in the Nikolai exploration discovered the outcrop of the Bonanza lode in August 1900. Their find represents the initial discovery of a Kennecott-type deposit and is a milestone in the region's history. A. C. Spencer of the U.S. Geological Survey independently found the Bonanza lode later in August while mapping in what he thought was unexplored terrain. The other major Kennecott deposits and many other copper deposits that were found during the next few years reflect the intense prospecting incited by the Bonanza discovery.

Stephen Birch acquired early control of the properties that were to be consolidated into the Kennecott mines and, with financial backing of Guggenheim-Morgan interests, formed a company for their development. The company took its name from the nearby Kennicott Glacier, which was named by Rohn (1900) for Robert Kennicott, a pioneer surveyor, but somehow, probably inadvertently, an "e" was substituted for the "i" in "Kennicott". Developing the mines met with seemingly insurmountable, mainly logistic, obstacles. By 1911 a 316–km (196-mi)-long company railroad that linked the mines with the seaport of Cordova was completed. The construction and maintenance of the railroad, which crosses major rivers and much unstable terrain, represented a remarkable engineering feat. The railroad provided practical access to parts of the quadrangle and stimulated prospecting. The period of major mining at the Kennecott mines, between 1913 and 1938, was accompanied by the influx of several hundred people to the company town, Kennicott, and its satellitic community, McCarthy.

The initial placer gold locations were made at Dan and Golconda Creeks in 1901 and at Chititu Creek in 1902. Prospecting has waxed and waned since the early exploration impulses, but most mineral locations in the quadrangle were made prior to 1920. A flurry of prospecting in northeastern parts of the quadrangle during 1913 and 1914 reflects spinoff of the Chisana gold rush that centered in nearby parts of the adjacent Nabesna quadrangle. Similar surges in prospecting activity have recurred elsewhere in the quadrangle. During the past 20 years, helicopter-supported prospecting and exploration activities of mining company geologists and their consultants have largely supplanted the roles of traditional individual prospectors. Recent exploration, augmented by geochemistry and geophysics, has focused mainly on discovering Kennecott-type copper lodes or porphyry copper deposits. However, most of it has been of reconnaissance nature or local extent. Some modern exploration includes petroleum-related stratigraphic studies and uranium prospecting. As far as is known no major discoveries have been made during recent years; however, several discoveries, including some resulting from our investigations, are of potential significance and require additional exploration for meaningful appraisals.

GEOLOGIC INVESTIGATIONS

EARLY INVESTIGATIONS

The earliest recorded geologic data from the quadrangle were incidental products of two pioneering U.S. Army expeditions into the unexplored region. The first, under the direction of Lt. H. T. Allen, was during 1885 (Allen, 1887), and the second, which was led by Lt. Frederick Schwatka and included geologist C. W. Hayes, was during 1891 (Hayes, 1892). The earliest geologic expedition into the area was led by Oscar Rohn in 1899 (Rohn, 1900).

Systematic geologic investigations of the region by the U.S. Geological Survey commenced in 1900 and have continued intermittently. Most pre-World War II studies were by F. H.

Moffit and his co-workers, and they provide a wealth of basic geologic information. Reports resulting from these studies are listed in the "Bibliography" and in Moffit's (1938) bulletin. Moffit's protracted interest in the area provides a sound framework for subsequent geologic studies. The early investigations were mainly directed toward regional geology or mining districts, but they included some topical studies. A few notable contributions, such as Bateman and McLaughlin's (1920) outstanding report on Kennecott ore deposits, were by company-affiliated geologists.

RECENT INVESTIGATIONS

Post-World War II geologic studies include the U.S. Geological Survey's Wrangell Mountains project and other mainly government-sponsored topical investigations as well as studies supported by universities, mining and petroleum companies, and other private interests. Results of most company-sponsored investigations are unpublished.

Inasmuch as the Wrangell Mountains project provides the nucleus of geologic information for this AMRAP circular and folio, it will be described in some detail. The project, under the direction of E. M. MacKevett, Jr., began in 1960 and continued intermittently until 1974, when fieldwork was completed under the Prototype Alaskan Minerals Resource Assessment Program (PAMRAP). Although the project's scope and aims have varied, they fundamentally consisted of geologic mapping of the McCarthy 1° by 3° quadrangle, detailed geologic mapping of critical 15-minute quadrangles, and related topical studies aimed mainly at mineral deposits. The primary purposes of the project were to:

1. Produce modern multipurpose geologic maps,
2. Obtain reliable geologic information on the quadrangle's mineral deposits and mineral resources, and
3. Obtain pertinent structural and stratigraphic information that are requisites for understanding the regional geologic and tectonic histories of large parts of south-central Alaska and nearby Canada—the quadrangle is a key area for such information, as it contains well-developed stratigraphic successions, major faults, and igneous rocks that are all of regional significance.

These objectives have been largely achieved, and the pertinent results have been published or are being prepared for publication. The McCarthy 1° by 3° quadrangle and its 32 component 15-minute quadrangles are shown in figure 3, which also indicates the 15-minute (1:63,360-scale) maps that have been published. Sufficient geologic data are available for 1:63,360-scale maps of the C–7, C–8, and several other 15-minute quadrangles, and we intend to publish many of them. Besides the geologic maps, project work has resulted in many topical reports, which are listed in the bibliography. In addition to preparing the maps, laboratory and office studies are continuing on several topical investigations of the genesis of Kennecott-type copper deposits. Such studies include: isotope investigations under the direction of M. L. Silberman; sulfide mineralogy and fluid inclusions by R. W. Potter, and detailed petrography and stratigraphy of the carbonate host rock for the ore by A. K. Armstrong.

GEOLOGIC AND TECTONIC SUMMARY

The McCarthy quadrangle comprises four distinctive fault-bounded geologic terranes (fig. 4). Most of the quadrangle is underlain by rocks of the Taku–Skolai terrane (as defined by Berg and others, 1972), which is floored by upper Paleozoic oceanic crust. The Border Ranges fault (MacKevett and Plafker, 1974) marks the southern boundary of the Taku–Skolai terrane and separates it from the Valdez Group (Jurassic?[1] and Cretaceous) metamorphosed flysch that underlies southwestern parts of the quadrangle (fig. 4, area A). The Totschunda fault system (Richter and Matson, 1971) separates two regions that, although underlain by Taku–Skolai terrane, had different late Mesozoic geologic histories. Southwest of the Totschunda (fig. 4, area B), pre-Jurassic Taku–Skolai rocks are overlain by fossiliferous,

---

[1] No fossils have been found in the Valdez Group in the McCathy quadrangle. Rocks elsewhere in southern Alaska that are interpreted as correlative with the Valdez Group have yielded Early Cretaceous radiolaria and sparsely distributed Late Cretaceous megafossils (Plafker and others, 1977). Hence the Valdez Group is probably entirely Cretaceous in age, but the Jurassic(?) and Cretaceous age designation is retained to conform with previous usage in the McCarthy quadrangle.

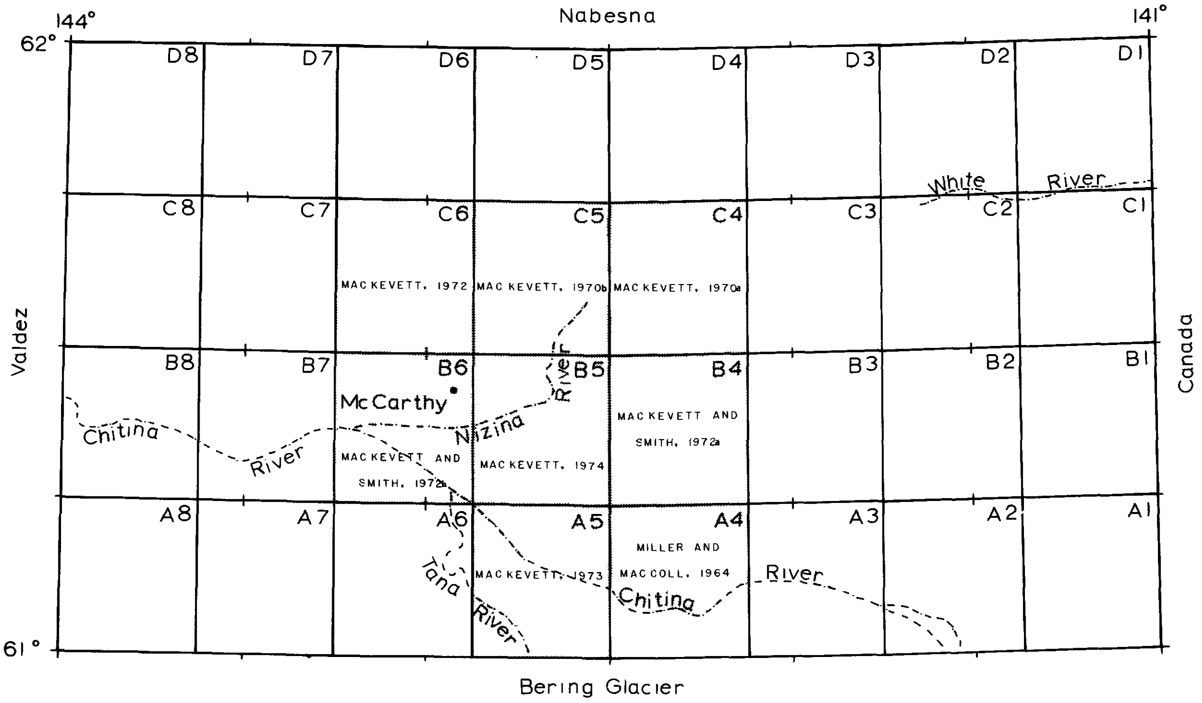

FIGURE 3.—Reference map showing the 32 15-minute quadrangles that constitute the McCarthy 1° by 3° quadrangle and the published 1:63,360-scale geologic maps (shaded).

mainly shallow marine, sedimentary rocks that include local Jurassic rocks and widespread Cretaceous rocks of the Matanuska–Wrangell terrane (Berg and others, 1972, p. D17). Northeast of the Totschunda (fig. 4, area C), pre-Jurassic Taku–Skolai rocks are overlain mainly by turbidites and andesitic volcanic and volcaniclastic rocks of the Middle(?) Jurassic to Lower Cretaceous Gravina-Nutzotin belt (Berg and others, 1972).

The Kaskawulsh Group of Kindle (1953) underlies the southeastern part of the quadrangle (fig. 4, area D). It is mainly a multiply folded low-grade metamorphic sequence that constitutes the westernmost known exposures of Berg, Jones, and Richter's (1972) Alexander terrane. The Kuskawulsh, which consists of allochthonous Paleozoic rocks that probably represent old continental crust, is fault bounded and tectonically justaposed against the Taku–Skolai terrane. However, at many places, contact relations between the two terranes are complicated by upper Paleozoic granitic plutons or are covered by surficial deposits or ice.

Older parts of the Taku–Skolai terrane represent an upper Paleozoic island arc that formed directly on oceanic crust. Paleomagnetic and structural data (Richard Doell, unpub. data, 1975; Jones and others, 1976) suggest that the Taku–Skolai and Alexander terranes both are allochthonous with respect to coeval rocks north of the Denali fault and that the Taku–Skolai terrane originated at low paleolatitudes in the proto-Pacific Ocean. Warm climates are further suggested by relict evaporites and sabkha facies in the Chitistone Limestone (Late Triassic) and by some of the fossil assemblages. When and how the Taku–Skolai and Alexander terranes were justaposed are not well understood, but their coupling may

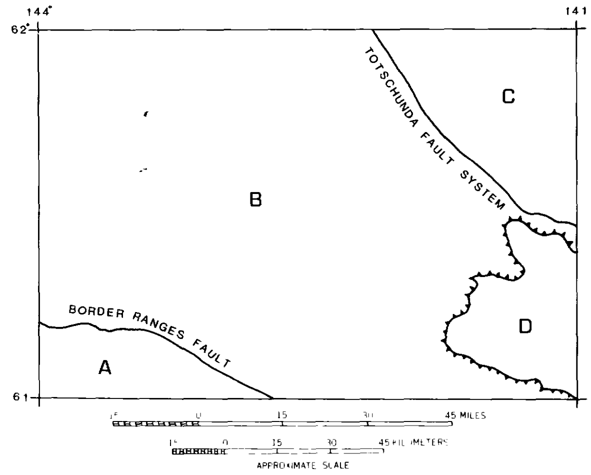

FIGURE 4.—Geologic terranes in the McCarthy quadrangle. The area is underlain by A, metamorphosed Valdez Group (Jurassic? and Cretaceous) flysch; B, Taku–Skolai terrane, upper Mesozoic rocks of the Matanuska–Wrangell marine sedimentary sequence, and Chitina Valley batholith (Jurassic), extensively mantled by Wrangell Lava (Cenozoic); C, Taku–Skolai terrane and upper Mesozoic rocks of the Gravina–Nutzotin belt that include turbidites, andesitic volcanic and volcaniclastic rocks, and Cretaceous granitic intrusive rocks, widely capped by Wrangell Lava; and D, Alexander terrane (Kaskawulsh Group of Kindle, 1953) and Wrangell Lava.

have started during the late Paleozoic and probably was completed during the Early Cretaceous.

Emergent conditions prevailed from the Late Permian to the Middle Triassic, when local marine sedimentation within Taku–Skolai terrane was succeeded by the largely subaerial volcanism of the Nikolai Greenstone. The Nikolai represents an extensive and voluminous lava field, and it and its feeder gabbroic bodies reflect tensional tectonics that tapped deep-seated magma. A marginal sea developed on parts of the widespread emergent Nikolai platform during the Late Triassic and, locally within area B (fig. 4), persisted until late in the Jurassic. However, during the Late Jurassic a different depositional environment, characterized by turbidite deposition in a successor basin, developed northeast of the Totschunda fault (fig. 4, area C).

Major orogenesis began during the Late Jurassic and probably culminated in the Early Cretaceous. The orogenesis was accompanied by the development of the Border Ranges fault, which is interpreted as a plate boundary along which the oceanward deep-water flysch was underthrust beneath Taku-Skolai rocks. Compressive forces, probably tectonically related to the Border Ranges faulting, generated a series of thrust faults within the upper plate (Taku–Skolai) rocks and superjacent lower parts or the Matanuska–Wrangell sequence. These faults, which are widespread along the southern flank of the Wrangell Mountains and throughout the Chitina Valley, document south to north overthrusting. The formation of the Kotsina Conglomerate and the Chitina Valley batholith was synchronous with some of the Late Jurassic orogenic activity. The orogeny continued into the Early Cretaceous and, in places, strongly deformed pre-Albian parts of the Matanuska–Wrangell sedimentary sequence.

The divergent late Mesozoic geologic history of the quadrangle is exemplified by deep-sea flysch deposits south of the Border Ranges fault (fig. 4, area A), shallow-marine sedimentary rocks and plutonic rocks between the Border Ranges fault and the Totschunda fault system (fig. 4, area B), and turbidites and extrusive and intrusive igneous rocks northeast of the Totschunda (fig. 4, area C). Parts of the quadrangle were intermittently emergent during the late Mesozoic, and by the close of the era emergent conditions prevailed. The emergence reflects epeirogenesis that was locally accomplished by minor faulting and gentle folding.

The Cenozoic history is dominated by extrusive products of Wrangell Lava volcanism that are widespread north of the Border Ranges fault. Widely distributed shallow-seated plutons are related to the Wrangell Lava volcanism. The Wrangell Lava and its associated subvolcanic plutons are interpreted as effects of northward-directed oblique underthrusting of the Pacific plate beneath the continent. The minor Cenozoic fault activity is mainly reflected by the Totschunda fault system, which connects with the Duke River fault of the Yukon Territory and bridges a major segment of the Denali fault system, and by the Border Ranges fault. The modern landscape of the region, to a large extent, is a product of glaciation and glacier-related processes combined with Wrangell Lava volcanism.

SCENIC AND ENVIRONMENTAL ASPECTS

The quadrangle's spectacular and diverse scenery largely reflects its geology and the effects of geologic processes. The Wrangell Mountains, with their lofty volcanic peaks accentuating a snow- and ice-clad upland, provide an exceptional panorama. Landscape features produced by glaciation are exceptionally well developed. Such features, combined with Cenozoic volcanism and the extreme topographic relief, make the quadrangle an outstanding natural laboratory for Quaternary studies. The quadrangle contains striking examples of valley and alpine glaciers, seracs, rock glaciers, and a variety of moraines. The walls of several deep glacially carved valleys furnish remarkable geologic cross sections that, besides being scenic, provide insight into the area's geologic history. Many Quaternary features are still being formed or modified—a partial manifestation of the rigorous climate and high relief. The quadrangle contains many excellent and well-exposed examples of faults and folds, unconformities, and well-developed stratigraphic and volcanic successions; these have scenic as well as scientific merit. Waterfalls, lakes, ponds, and a variety of streams that range from silt-clogged rivers to sparkling clear creeks, enhance the landscape. The multitude of exceedingly well developed scenic and geomorphic features deserves both scientific interest and an appreciation of their intrinsic beauty, as well as serious consideration in land-use designations.

MAPS OF THE McCARTHY QUADRANGLE FOLIO

GEOLOGY

(map MF–773–A)

The geology of the McCarthy quadrangle is shown on the geologic map (MF–733–A) and, in a generalized version, on base maps for many of the folio components, such as Map MF–773–B. A colored replica of the geologic map is being published in the U.S. Geological Survey's Miscellaneous Geologic Investigations map series. More detailed geologic information than is summarized in this circular and the accompanying maps is available for many of the 15-minute quadrangles that have been published as 1:63,360-scale maps (fig. 3). Additional geologic information can be obtained from publications listed in "Bibliography."

MINERAL DEPOSITS, OCCURRENCES, AND RESOURCES

(maps MF–773–B, C)

The quadrangle's mineral deposits and noteworthy occurrences, and its potential mineral resources are described in the two sheets of MF–773–B, which describes the mineral deposits and principal occurrences, and MF–773–C, an assessment of the potential for mineral resources.

Map MF–773–B shows locations of the quadrangle's 193 identified mineral deposits and principal occurrences and categorizes them into mines, recently active or inactive prospects, deposits, and noteworthy occurrences. The mineral deposits are also classified by type and by chief economic commodity (or commodities). A supplementary table provides brief descriptions of the map localities and, if available, analytical data and references for additional information. An accompanying text discusses the quadrangle's mineral commodities and presents information on their geologic setting, controls, mineralogy, size, and grade, and the genesis of the deposits. Copper, both historically and in terms of future potential, is the most economically significant mineral commodity. Gold and silver have been produced, and they both have potential for future production. Several other metals including molybdenum, antimony, and zinc may have some economic potential.

The mineral resources map (MF–773–C) is an assessment of the occurrence of mineral deposits in the quadrangle by area and by type of deposit. The assessment is based on known deposits and occurrences augmented by interpreting geologic, geochemical, geophysical, and telegeological information. Areas enclosing both known deposits and favorable terrane for undiscovered deposits of the same type are delineated. Evidence that led to selection and boundaries of each favorable area is presented with the map.

The known and potential mineral resources of the quadrangle include copper, gold, silver, molybdenum, antimony, zinc, and possibly a few other commodities. The copper resource potential of Kennecott- and porphyry-type deposits overshadows that of other metals. It is estimated that about seven large Kennecott-type copper deposits—comparable in size and grade to the major Jumbo and Bonanza deposits—and many more smaller Kennecott-type deposits are concealed and undiscovered in the quadrangle. The porphyry copper potential is assessed as follows:

1. A 90 percent chance that there are 7 or more deposits,
2. A 50 percent chance that there are 10 or more deposits, and
3. A 10 percent chance that there are 13 or more deposits.

Chance	*Grade*	*Tonnage*
90 percent	≧0.10 percent copper	≧ 60 million tonnes
50 percent	≧0.30 percent copper	≧180 million tonnes
10 percent	≧0.55 percent copper	≧500 million tonnes

Other types of copper deposits are regarded as having minor resource potentials. Additional, but smaller, resource potentials are for gold, mainly from placed deposits; silver and molybdenum, mainly as byproducts; and, more remotely, for antimony, zinc, and a few other metals.

Selection of favorable areas for mineral resources was based on the known deposits; on geologic, geophysical, geochemical, and telegeologic data presented in the McCarthy Folio; and on some additional geochemical data from O'Leary and others (1976). Previous studies suggest that regional differences in grades and tonnage of deposit types can be significant (Richter and others, 1975; Singer and others, 1975). Delineation of boundaries was made by the informed judgment of the team members, but final responsibility rests with the authors of MF–773–C. It should be recognized that without detailed studies and drilling, it is impossible to ensure that all favorable areas are shown or that areas selected actually contain deposits. Despite the difficulty of not having complete information, several favorable areas not previously recognized are delineated; the area between Chititu Camp and Pyramid Peak and the area near The Twaharpies are specifically noted for their potential for unfound porphyry copper deposits.

GEOPHYSICS

AEROMAGNETIC MAP AND INTERPRETATION

(map MF–773–D)

An aeromagnetic survey (sheet 1) of the McCarthy quadrangle was completed in 1975. Individual aeromagnetic maps of the 32 1:63,360-scale quadrangles that constitute the McCarthy 1:250,000-scale quadrangle map have been released as open-file maps by the U.S. Geological Survey (1976a). A geologic interpretation of the aeromagnetic map (sheet 2) indicates that many of the major rock units in the McCarthy quadrangle give rise to magnetic anomalies that enable tracing of the units beneath glaciers or sedimentary cover. Limestones that are host to the Kennecott-type copper deposits are not magnetic, but because they are stratigraphically underlain by the magnetic Nikolai Greenstone, they may be indirectly traced beneath cover of younger deposits by magnetic mapping of the Nikolai. Several plutons of the Klein Creek and Chitina Valley types, locally associated with geochemical anomalies, are well expressed magnetically. Alteration zones may be suspected where aeromagnetic lows occur over the plutons. Several major fault zones, such as the Totschunda, cause conspicuous magnetic lineaments. Magnetic lineaments that trend northwest through the central part of the McCarthy quadrangle may coincide with areas of somewhat concentrated geochemical anomalies.

GRAVITY

(map MF–773–E)

Only about 150 gravity measurements have been made in the McCarthy quadrangle, but even this small amount of data reveals some of the largest and steepest gravity gradients in Alaska. Furthermore, the quadrangle includes the termination of one of the longest and most pronounced gravity trends in the state. Other regional gravity data suggest that the quadrangle's gravity field differs significantly from that in adjacent quadrangles (Barnes, 1976). Because the gravity field reflects density contrasts that extend to great depth, the map suggests some deep structural contrasts and a complicated tectonic history.

Map MF–773–E provides a plot of the Bouguer anomalies, which have been corrected for terrain effects to a radius of 25 km. These terrain corrections were obtained by new techniques, which are briefly discussed on the map and which involve the use of digital terrain data on magnetic tapes provided by the Department of Defense Topographic Center. The 10-milligal contours show some pronounced gravity trends that can be partly explained by increased crustal thickness beneath the Wrangell Mountains and that may also be correlated with trends on the magnetic and satellite imagery maps and with some of the mineralization.

GEOCHEMISTRY

(maps MF–773–F–M)

Geochemical studies were made in the McCarthy quadrangle to define areas containing anomalous concentrations of metallic and nonmetallic elements. These studies are fundamental to a comprehensive evaluation of the mineral resource potential of the area and assist in the discovery of additional economic mineral deposits.

The earliest prospecting and geologic investigations in the region, during the late 1800's and the early 1900's, utilized the mineralogic identification of panned concentrates from stream sediments to discover economic mineral deposits (Moffit and Capps, 1911; Moffit, 1938) Modern geochemical exploration techniques were first applied in the quadrangle in the early 1960's. These techniques employ multi-element chemical analyses of a variety of sample media to detect mineral occurrences.

The geochemistry maps of selected element distributions and abundances incorporate analytical data from all reported and located samples collected in the quadrangle and analyzed by the U.S. Geological Survey since 1961. They also include the analytical results of a large part of the stream sediments sampled by the Alaska Division of Mines and Geology in the northeastern part of the quadrangle (Knaebel, 1970). In general, for most element determinations, the U.S. Geological Survey geochemical data are compatible with the analytical results obtained by the Alaska Division of Mines and Geology laboratory at College, Alaska. Of those elements examined in detail, only the analytical results for molybdenum, antimony, cobalt, chromium, bismuth, lanthanum, and tin in stream sediments are questionable as to compatibility. For these elements, the analytical values determined by the College laboratory appear significantly higher in comparison to U.S. Geological Survey results.

Data from a combined total of approximately 3,594 geochemical samples of varied media were processed by computer. Of the samples, 1,409 are stream sediments, 827 are samples of bedrock, mineralized rock, hydrothermal and other categories of altered rock zones, gossans, fault gouge, vein materials, silica-rich boxworks, veins adjacent to faults and fractures showing evidence of mineralization; 63 are samples of glacial debris collected on medial and lateral moraines; 414 are evaporated iron and manganese oxide-rich solutions obtained by the hot oxalic-acid leaching of stream sediments and glacial debris; 214 are magnetites and other ferromagnetic minerals separated from panned heavy-mineral concentrates by hand magnet and a Frantz isodynamic magnetic separator set at 0.2 amperes; 215 are paramagnetic minerals from the panned concentrates isolated on a Frantz separator between 0.2 and 0.6 amperes settings; 194 are the least paramagnetic and diamagnetic minerals from the panned concentrates obtained at 0.6 amperes and above on the Frantz separator; and 258 are ashed vegetation and other organic samples. All rock samples were routinely ground to a −80 mesh (180 micrometer) fraction for analysis.

In this report only maps showing the distribution and abundance of copper, lead, gold, arsenic, and mercury in stream sediments and glacial debris, and molybdenum, gold, silver, and arsenic in rock samples are presented. These elements were chosen because they appear to be the most informative and relevant to a regional mineral resource appraisal of the McCarthy quadrangle, and because they adequately reflect the economic potential of the area within the limits of this evaluation. Analytical data for all other elements together with sample locations are given in an open-file report (O'Leary and others, 1976) and on National Technical Information Service computer tape (Van Trump and others, 1976). These publications also contain complete analytical results for the various magnetic fractions of panned heavy-mineral concentrates. Because of insufficient data, no plans exist to prepare distribution and abundance maps showing analytical results of the iron and manganese oxide-rich oxalic-acid leachates nor of vegetation and other organic material.

The analyses of the 1,409 stream sediments were combined with those of the 63 samples of glacial debris. For the purpose of this study the two sample media are assumed to be synonymous. The glacial debris reflects dry, eroded, and weathered rock material that is being carried downvalley in lateral and medial moraines atop glaciers. Many of the lateral and medial moraines can be accurately traced to specific rock outcrops protruding through the ice cap. On reaching a terminal moraine much of the material is transposed into active stream sediment. Thus, such moraine-derived material was extensively sampled in the McCarthy quadrangle because many of the streams originally emanate from glaciers. Although a true moraine sample may represent a smaller provenance than sediment from an active stream draining a large area, it is comparable to a sample from a small tributary stream draining a limited outcrop area. At many sample sites, small streams or rivulets were flowing on top of the ice because of summer melt. In such cases it was possible to obtain a sample of sediment representing finely ground rock material. These are legitimate stream sediments. We believe that glacial debris from lateral or medial moraines is equivalent for geochemical exploration purposes to dry stream sediments occurring in many parts of the United States, particularly the southwest, in areas of intermittent and sporadic annual rainfall.

Both active stream sediments and glacial debris were air dried and sieved to obtain a less than 80 mesh (180 micrometer) fraction. However, it was not always possible to obtain sufficient fine material to yield a −80 mesh fraction, especially at moraine localities. In such areas a representative sample of the smallest available rock sediment was collected and ground to a −80 mesh size for analysis. Wherever possible, stream sediments were obtained from active stream channels as close to the center as feasible. Elsewhere the less desirable material from close to the streambank was sampled, or more frequently, sediment was collected from former high-water streambank deposits near the temporary main channel. Most samples are composites of material collected within a 30-m (100-ft) radius. Duplicate samples were collected at several localities in order to test the variance of analytical results and sampling error. Contamination by organic matter is not considered a serious problem in the McCarthy quadrangle because of the high relief and fast flowing streams over sparsely vegetated areas.

The geochemical data resulting from the analysis of 436 bedrock samples, considered representative of the background values of various rock units in the McCarthy quadrangle, were merged with analyses of 391 samples classified as mineralized, altered, and otherwise biased rock samples. Comparison of the geochemical maps of the two data sets shows generally the same distribution patterns and relative concentrations of elements. This similarity may indicate that there is no statistical difference between the two sets of samples; that the two data sets were not accurately separated into unique sets initially; or that most of the samples, including those collected for background, represent biased, mineralized, and altered rocks. The maps of combined data represent primary element dispersion throughout a large part of the quadrangle. The information on these geochemical maps is fundamental to a complete evaluation of the mineral resource potential of the area because the rock data help detect or predict occurrences of concealed mineral deposits. Rock samples are particularly useful in detecting buried porphyries because the distribution of anomalous samples may define peripheral dispersion halos.

Owing to changes in sampling and analytical procedures since the early geochemical investigations in the quadrangle, not all samples have been routinely analyzed for the same elements. Most were analyzed by a combination of standard semiquantitative emission spectrography for 30 elements and selective atomic absorption for gold, copper, lead, and zinc. However, the data set contains many combinations of analytical procedures and element determinations. An added complication has been the differences in the lower limits of detection of some elements by various laboratories, and changes in lower limits of detection over the years as analytical methods improved. In order to simplify plotting the data on geochemical maps, all element analyses qualified as not detected or present at a value below a specified lower limit of determinability have been assigned arbitrary unqualified values. These values do not influence calculated statistics and are set at an artificial value well below all present limits of detection. This procedure avoids the possibility of a qualified analytical result showing as a determined value.

The geochemical maps of stream sediments and glacial debris show the distribution and abundance of copper and lead determined by emission spectrographic methods, and of gold determined by atomic absorption procedures; one also shows both arsenic and mercury, which were respectively determined by colorimetric and flameless atomic absorption methods. The geochemical maps of rock samples show the distribution and abundance of molybdenum, silver, and arsenic determined by emission spectrography and gold determined by atomic absorption. Because of the biased and highly irregular sample distribution, individual values are not shown on the maps. Symbols have been used to show values falling within defined ranges.

The elements whose distribution and abundance are shown on the geochemical maps were selected because of their intrinsic value, their well-known association with economic deposits and their portrayal of the regional geochemical character of the McCarthy quadrangle. These elements also are considered diverse enough to cover the types of mineral deposits expected to occur in the McCarthy quadrangle.

A complete set of analytical data obtained in 1974–5 from stream sediment samples and glacial debris, oxalic-acid residues of those two media, rocks, three magnetic fractions of panned heavy-mineral concentrates, and vegetation and other organic material collected in the McCarthy quadrangle is available in O'Leary and others (1976) and Van Trump and others (1976). These publications also include data for geochemical samples collected earlier by the U.S. Geological Survey and for stream sediment samples used in this investigation that were collected and analyzed by the Alaska Division of Mines and Geology in the White River area.

INTERPRETATION OF LANDSAT IMAGERY

(map MF-773-N)

Interpretation of Landsat data was based on two types of images: (1) a Landsat photomosaic of the State of Alaska compiled by the U.S. Department of Agriculture, and (2) computer-enhanced Landsat imagery processed by the U.S. Geological Survey in Flagstaff, Arizona.

As a preliminary geologic mapping tool, Landsat 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 planning and conduct of geologic mapping.

The Landsat photomosaic of Alaska consists largely of images taken during fall and spring months. Because of the low sun angle and the synoptic view, the photomosaic is most useful for identifying regional linear and circular features. Computer-enhanced imagery, in addition to identifying some linear and circular features not detected on the Landsat photomosaic, is generally most useful in identifying subtle surficial reflectance variations due to differences in vegetation, rock types, soil, and other material. However, because of snow cover, clouds, sun angle, and other factors, few geologically significant surficial reflectance variations were observed in the McCarthy quadrangle.

Linear features observed on Landsat images correlate well with geophysical information, particularly gravimetric data, and appear to reflect deep crustal phenomena. The locations of many known mineral occurrences correlate well with the observed linear features, which form orthogonal sets of parallel linears spaced at approximately 30–35-km intervals. In addition, numerous extensions of mapped faults were detected by the Landsat imagery.

Applications of Landsat imagery directly to mineral assessment are still developing. Research on new techniques for Landsat data interpretation and their applications to geologic and mineral resource problems in Alaska is being carried out under AMRAP.

LAND STATUS

(map MF-773-O)

The land status map was compiled from a smaller scale map issued by the Bureau of Land Management in March 1974. It shows extents of the five land classifications proposed under the Alaska Native Claims Settlement Act within the quadrangle, including parts of a national park and a national forest. Such classifications and boundaries are valid as of March 1974 and are subject to change.

REFERENCES CITED

Albert, N. R. D., and Steele, W. C., 1976, Interpretation of Landsat imagery of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773-N, 3 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, U.S. Govt. Printing Office, 172 p.

Barnes, D. F., 1976, Bouguer gravity map of Alaska: U.S. Geol. Survey open-file rept. 76-70, scale 1:2,500,000.

Barnes, D. F., and Morin, R. L., 1976, Gravity map of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773-E, 1 sheet, scale 1:250,000.

Bateman, A. M., and McLaughlin, D. H., 1920, Geology of the ore deposits of Kennecott, Alaska: Econ. Geology, v. 15, no. 1, p. 1-80.

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.

Case, J. E., and MacKevett, E. M., Jr., 1976, Geological interpretations of an aeromagnetic map of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773-D, 2 sheets, scale 1:250,000.

Douglass, W. C., 1964, A history of the Kennecott mines, Kennecott, Alaska: privately published, 12 p.

Hayes, C. W., 1892, An expedition through the Yukon district: Natl. Geog. Mag., v. 4, p. 117-162.

Jones, D. L., Pessagno, E. A., Jr., and Csejtey Bela, Jr., 1976, Significance of upper Chulitna ophiolite for the late Mesozoic evolution of southern Alaska [abs.]: Geol. Soc. America Abs. with Programs, v. 8, no. 3, p. 385-386.

Kindle, E. D., 1953, Deza Jeash map area, Yukon Territory: Canada Geol. Survey Mem. 268, 68 p.

Knaebel, Jeff, 1970, Geochemical survey and geological reconnaissance of the White River area, south-central Alaska: Alaska Div. Mines and Geology Geochem. Rept. 21, 60 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.

MacKevett, E. M., Jr., 1970a, Geologic map of the McCarthy C-4 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-844, scale 1:63,360.

———1970b, Geologic map of the McCarthy C-5 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-899, scale 1:63,360.

———1972, Geologic map of the McCarthy C-6 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-979, scale 1:63,360.

———1973, Reconnaissance geologic map of the McCarthy A-5 quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-536.

———1974, Geologic map of the McCarthy B-5 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-1146.

———1976a, Geologic map of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773-A, 1 sheet, scale 1:250,000.

———1976b, Mineral deposits and occurrences in the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773-B, 1 sheet, scale 1:250,000.

———1977, Geologic map of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-1032, 1 sheet, scale 1:250,000 (in press).

MacKevett, E. M., Jr., and Plafker, George, 1974, The Border Ranges fault in south-central Alaska: U.S. Geol. Survey Jour. Research, v. 2, no. 3, p. 323-329.

MacKevett, E. M., Jr., and Smith, J. G., 1972a, Geologic map of the McCarthy B-4 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-943, scale 1:63,360.

———1972b, Geologic map of the McCarthy B-6 quadrangle, Alaska: U.S. Geol. Survey Geo. Quad. Map GQ-1035, scale 1:63,360.

Miller, D. J., and MacColl, R. S., 1964, Geologic map and sections of the northern part of the McCarthy A-4 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-410, scale 1:63,360.

Moffit, F. H., 1938, Geology of the Chitina Valley and adjacent area, Alaska: U.S. Geol. Survey Bull. 894, 137 p.

Moffit, F. H., and Capps, S. R., 1911, Geology and mineral resources of the Nizina district, Alaska: U.S. Geol. Survey Bull. 448, 111 p.

O'Leary, R. M., McDanal, S. K., Day, G. W., McDougal, C. M., and Robinson, Keith, 1976, Spectrographic and chemical analyses of geochemical samples from the McCarthy quadrangle, Alaska: U.S. Geol. Survey open-file rept. 76–824 806 p.

Plafker, George, Jones, D. L., and Pessagno, E. A., Jr., 1977, A Cretaceous accretionary flysch and melange terrane along the Gulf of Alaska margin: U.S. Geol. Survey Circ. 751-B, (In press).

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

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–655–K, 1 sheet, scale 1:250,000.

Robinson, Keith, McDougal, C. M., Day, G. W., and Billings, Theodore, 1976a, Distribution and abundance of copper in stream sediments and moraine debris, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF–773–F, 1 sheet, scale 1:250,000.

———1976b, Distribution and abundance of lead in stream sediments and moraine debris, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF–773–G, 1 sheet, scale 1:250,000.

Robinson, Keith, O'Leary, R. M., McDougal, C. M., and Billings, Theodore, 1976c, Distribution and abundance of gold in stream sediments and moraine debris, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF–773–H, 1 sheet, scale 1:250,000.

Robinson, Keith, O'Leary, R. M., McDougal, C. M., and Billings, Theodore, 1976d, Distribution and abundance of arsenic and mercury in stream sediments and moraine debris, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF–773–I, 1 sheet, scale 1:250,000.

Robinson, Keith, McDougal, C. M., McDanal, S. K., and Billings, Theodore, 1976e, Distribution and abundance of molybdenum in bedrock, mineralized, vein, and altered rock samples, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF–773–J, 1 sheet, scale 1:250,000.

———1976f, Distribution and abundance of silver in bedrock, mineralized, vein, and altered rock samples, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF–773–K, 1 sheet, scale 1:250,000.

Robinson, Keith, McDougal, C. M., O'Leary, R. M., and Billings, Theodore, 1976g, Distribution and abundance of gold in bedrock, mineralized, vein, and altered rock samples, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF–773–L, 1 sheet, scale 1:250,000.

Robinson, Keith, McDougal, C. M., McDanal, S. K., and Billings, Theodore, 1976h, Distribution and abundance of arsenic in bedrock, mineralized, vein, and altered rock samples, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF–773–M, 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. 399–440.

Singer, D. A., Cox, D. P., and Drew, L. J., 1975, Grade and tonnage relationships among copper deposits: U.S. Geol. Survey Prof. Paper 907–A, 11 p.

Singer, D. A., and MacKevett, E. M., Jr., 1976, Mineral resources map of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF–773–C, 1 sheet, scale 1:250,000.

U.S. Geological Survey, 1976a, Aeromagnetic maps of the McCarthy quadrangle, Alaska: U.S. Geol. Survey open-file rept. 76–170, 1 sheet at 1:250,000 scale, 32 sheets at 1:63,360 scale.

———1976b, Status of land in the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF–773–O, 1 sheet, scale 1:250,000.

Van Trump, George, Robinson, Keith, O'Leary, R. M., Day, G. W., and McDougal, C. M., 1976. Spectrographic and chemical analyses of geochemical samples from the McCarthy quadrangle, Alaska: Natl. Tech. Inf. Service (U.S. Dept. Commerce) computer tape, (in preparation).

Wahrhaftig, Clyde, 1965, Physiographic divisions of Alaska: U.S. Geol. Survey Prof. Paper 482, 52 p., 1 pl.

BIBLIOGRAPHY

(The asterisks (*) denote references that mainly or entirely pertain to the McCarthy quadrangle. References without asterisks are general, regional, or topical in scope but contain material relevant to the McCarthy quadrangle.)

Alaska Department of Mines, 1946, Report of the Commissioner of Mines for the biennium ended December 31, 1946: Juneau, Alaska, 50 p.

_____1948, Report of the Commissioner of Mines for the biennium ended December 31, 1948: Juneau, Alaska, 50 p.

_____1952, Report of the Commissioner of Mines for the biennium ended December 31, 1952: Juneau, Alaska, 66 p.

_____1954, Report of the Commissioner of Mines for the biennium ended December 31, 1954: Juneau, Alaska, 110 p.

_____1955, Report of the Commissioner of Mines for the biennium ended December 31, 1954: Juneau, Alaska, 110 p.

_____1958, Report of the Commissioner of Mines for the biennium ended December 31, 1958: Juneau, Alaska, 83 p.

Alaska Division of Geological and Geophysical Surveys, 1973, Annual report 1972: Anchorage, Alaska, 57 p.

_____1974, Annual Report 1973: Anchorage, Alaska, 59 p.

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

_____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, 1959, Report of the Division of Mines and Minerals for the year 1959: Juneau, Alaska, 80 p.

_____1960, Report for the year 1960: Juneau, Alaska, 88 p.

_____1961, Report for the year 1961: Juneau, Alaska, 108 p.

_____1965, Report for the year 1965: Juneau, Alaska, 99 p.

_____1967, Report for the year 1967: College, Alaska, 98 p.

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.

* Albert, N. R. D., and Steele, W. C., 1976, Interpretation of Landsat imagery of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773N, 3 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, U.S. 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.

Andreasen, G. E., Grantz, Arthur, Zietz, Isidore, and Barnes, D. F., 1964, Geologic interpretation of magnetic and gravity data in the Copper River basin, Alaska: U.S. Geol. Survey Prof. Paper 316-H, p. 135-153.

* Armstrong, A. K., and MacKevett, E. M., Jr., 1975, Relations between Triassic carbonate sabkhas and Kennecott-type copper deposits, Wrangell Mountains, Alaska (abs.): Geol. Soc. America, Abs. with Programs, v. 7. no. 7, p. 980.

* Armstrong, A. K., MacKevett, E. M., Jr., and Silberling, N. J., 1969, The Chitistone and Nizina Limestones of part of the southern Wrangell Mountains, Alaska - a preliminary report stressing carbonate petrography and depositional environments: U.S. Geol. Survey Prof. Paper 650-D, p. D49-D62.

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

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

_____1976, Bouguer gravity map of Alaska: U.S. Geol. Survey open-file map 76-70, scale 1:2,500,000.

* Barnes, D. F., and Morin, R. L., 1976, Gravity map of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773E, 1 sheet, scale 1:250,000.

* Bateman, A. M., 1932, Notes on a Kennecott-type copper deposit, Glacier Creek, Alaska: Econ. Geology, v. 27, no. 3, p. 297-306.

* Bateman, A. M., and McLaughlin, D. H., 1920, Geology of the ore deposits of Kennecott, Alaska: Econ. Geology, v. 15, no. 1, p. 1-80.

Becker, G. F., 1898, Reconnaissance of the gold fields of southern Alaska, with some notes on general geology: U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 1-86.

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

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.

Berry, A. L., and others, compilers and editors, 1976, Summary of miscellaneous K-Ar age measurements, U.S. Geological Survey, Menlo Park, California, for the years 1972-1974: U.S. Geol. Survey Circ. 727, 44 p.

* Birch, Stephen, 1925, Geology and mining methods of Kennecott mines (Chitina district, Alaska): Am. Inst. Mining Metall. Engineers Trans., v. 72, p. 499-511.

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

Bottge, R. G., 1974, Potential mineral resources in selected D.2 lands: U.S. Bur. Mines open-file rept. 9-74, 55 p. Also released as Natl. Tech. Inf. Service PB227 018/AS.

Brabb, E. E., and Miller, D. J. 1962, Reconnaissance traverse across the eastern Chugach Mountains, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-341, 1 sheet, scale 1:96,000.

Brooks, A. H., 1900, 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.

_____1900, A reconnaissance in the White and Tanana river basins, Alaska, in 1898: U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 425-494.

_____1904, Placer mining in Alaska in 1903: U.S. Geol. Survey Bull. 225, p. 43-59.

_____1906, 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.

_____1906, The mining industry in 1905: U.S. Geol. Survey Bull. 284, p. 4-9.

_____1907, The mining industry in 1906: U.S. Geol. Survey Bull. 314, p. 19-39.

_____1908, The mining industry in 1907: U.S. Geol. Survey Bull. 345, p. 30-53.

_____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.

_____1909, The mining industry in 1908: U.S. Geol. Survey Bull. 379, p. 21-62.

_____1910, The mining industry in 1909: U.S. Geol. Survey Bull. 442, p. 20-46.

_____1911, Geologic features of Alaskan metalliferous lodes: U.S. Geol. Survey Bull. 480, p. 43-93.

_____1911, The mining industry in 1910: U.S. Geol. Survey Bull. 480, p. 21-42.

_____1912, The mining industry in 1911: U.S. Geol. Survey Bull. 520, p. 17-44.

_____1913, The mining industry in 1912: U.S. Geol. Survey Bull. 542, p. 18-51.

_____1914, The Alaskan mining industry in 1913: U.S. Geol. Survey Bull. 592, p. 45-74.

_____1915, The Alaskan mining industry in 1914: U.S. Geol. Survey Bull. 622, p. 15-68.

_____1916, Antimony deposits of Alaska: U.S.Geol. Survey Bull. 649, 67 p.

_____1916, The Alaska mining industry in 1915: U.S. Geol. Survey Bull. 642, p. 16-71.

_____1918, The Alaska mining industry in 1916: U.S. Geol. Survey Bull. 662, p. 11-62.

_____1919, Alaska's mineral supplies, in McCaskey, H. D., and Burchard, E. F., Our mineral supplies: U.S. Geol. Survey Bull. 666, p. 89-102.

_____1921, The future of Alaska mining: U.S. Geol. Survey Bull. 714, p. 5-57.

_____1922, The Alaska mining industry in 1920: U.S. Geol. Survey Bull. 722, p. 7-67.

_____1923, The Alaskan mining industry in 1921: U.S. Geol. Survey Bull. 739, p. 1-44.

_____1925, Alaska's mineral resources and production, 1923: U.S. Geol. Survey Bull. 773, p. 3-52.

Brooks, A. H., and Capps, S. R., 1924, The Alaskan mining industry in 1922: U.S. Geol. Survey Bull. 755, p. 3-49.

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

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

Capps, S. R., 1910, Rock glaciers in Alaska: Jour. Geology, v. 18, p. 359-375.

* _____1915, Mineral resources of the Chisana-White River district: U.S. Geol. Survey Bull. 622, p. 189-228.

_____1916, An ancient volcanic eruption in the upper Yukon Basin: U.S. Geol. Survey Prof. Paper 95-D, p. 59-64.

* _____1916, The Chisana-White River district, Alaska: U.S. Geol. Survey Bull. 630, 130 p.

Carter, Claire, editor, 1974, United States Geological Survey Alaska Program, 1974: U.S. Geol. Survey Circ. 700, 63 p.

* Case, J. E., and MacKevett, E. M., Jr., 1976, Geologic interpretation of an aeromagnetic map of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773D, 2 sheets, scale 1:250,000.

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.

Clark, S. H. B., 1972, The Wolverine complex, a newly discovered layered ultramafic body in the western Chugach Mountains, Alaska: U.S. Geol. Survey open-file rept. 522, 10 p.

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

Cornwall, H. R., 1956, A summary of ideas on the origin of native copper deposits: Econ. Geology, v. 51, no. 7, p. 615-631.

Cox, D. P., Schmidt, R. G., Vine, J. D., Kirkemo, Harold, Tourtelot, E. B., and Fleischer, Michael, 1973, Copper, in Brobst, D. A., and Pratt, W. P., editors, United States mineral resources: U.S. Geol. Survey Prof. Paper 820, p. 163-190.

* Denton, G. H., and Armstrong, R. L., 1969, Miocene-Pliocene glaciation in southern Alaska: Am. Jour. Sci., v. 267, p. 1121-1142.

* Douglass, W. C., 1964, A history of the Kennecott mines, Kennecott, Alaska: privately published, 12 p.

Dunham, R. J., 1962, Classification of carbonate rocks according to depositional texture, in Classification of carbonate rocks, a symposium edited by W. E. Ham: Am. Assoc. Petroleum Geologists Mem. 1, p. 108-121.

Eisbacher, G. H., 1975, Operation St. Elias, Yukon Territory: Dezadeash Group and Amphitheatre Formation, in Report of activities, April to October 1974: Canada Geol. Survey Paper 75-1, pt. A, Dept. of Energy, Mines and Resources, Ottawa, p. 61, 62.

Ellsworth, C. E., and Davenport, R. W., 1914, Preliminary report on a water-power reconnaissance in south-central Alaska: U.S. Geol. Survey Bull. 592, p. 155-193.

Ellsworth, C. E., and Davenport, R. W., 1915, A water-power reconnaissance in south-central Alaska, with a section on southeastern Alaska, by J. C. Hoyt: U.S. Geol. Survey Water-Supply Paper 872, 173 p.

Fernald, A. T., 1962, Radiocarbon dates relating to a widespread volcanic ash deposit, eastern Alaska, in Short papers in geology, hydrology, and topography, 1962: U.S. Geol. Survey Prof. Paper 450-B, p. 1329-1330.

Ferrians, D. J., Jr., 1963, Glaciolacustrine diamicton deposits in the Copper River basin, Alaska: U.S. Geol. Survey Prof. Paper 475-C, p. C120-125.

* Forbes, R. B., and Barsdate, R. J., 1969, Trace metal zonation in a native copper nugget from the McCarthy district, Alaska: Econ. Geology, v. 64, p. 455-458.

Gardner, E. D., Johnson, C. H., and Butler, B. S., 1938, Copper mining in North America: U.S. Bur. Mines Bull. 405, 300 p.

Grantz, Arthur, 1964, Stratigraphic reconnaissance of the Matanuska Formation in the Matanuska Valley, Alaska: U.S. Geol. Survey Bull. 1181-I, 33 p.

* Grantz, Arthur, Jones, D. L., and Lanphere, M. A., 1966, Stratigraphy, paleontology, and isotopic ages of upper Mesozoic rocks in the southwestern Wrangell Mountains, Alaska, in Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-C, p. C39-C47.

Hayes, C. W., 1892, An expedition through the Yukon district: Natl. Geog. Mag., v. 4, p. 117-162.

Herreid, Gordon, 1970, Geology of the Spirit Mountain nickel-copper prospect and surrounding area: Alaska Div. Mines and Geology Geologic Rept. 40, 19 p.

Heyl, A. V., Hall, W. E., Weissenborn, A. E., Stager, H. K., Puffett, W. P., and Reed, B. L., 1973, Silver, in Brobst, D. A., and Pratt, W. P., editors, United States mineral resources: U.S. Geol. Survey Prof. Paper 820, p. 581-603.

Hoffman, Barry, 1974, Geology of the Bernard Mountain area, Tonsina, Alaska: Alaska Univ., College, Alaska, M.S. thesis, (unpublished).

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.

Hudson, Travis, Plafker, George, and Lanphere, M. A., 1976, A reconnaissance study of the intrusive rocks of the western St. Elias Mountains, Alaska: U.S. Geol. Survey Jour. of Research (in press).

Imlay, R. W., 1960, Early Cretaceous (Albian) ammonites from the Chitina Valley and Talkeetna Mountains, Alaska: U.S. Geol. Survey Prof. Paper 354-D, p. 87-114.

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

Jaffe, H. W., Gottfried, David, Waring, C. L., and Worthing, H. W., 1959, Lead-alpha age determinations of accessory minerals of igneous rocks (1953-1957): U.S. Geol. Survey Bull. 1097-B, p. 65-148.

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

Jones, D. L., 1967, Cretaceous ammonites from the lower part of the Matanuska Formation, southern Alaska, with a Stratigraphic summary, by Arthur Grantz: U.S. Geol. Survey Prof. Paper 547, 49 p.

* Jones, D. L., and Berg, H. C., 1964, Cretaceous stratigraphy of the McCarthy A-4 quadrangle, southern Alaska: U.S. Geol. Survey Bull. 1180-A, p. A1-A18.

* Jones, D. L., and MacKevett, E. M., Jr., 1969, Summary of Cretaceous stratigraphy in part of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Bull. 1274-K, 19 p.

Jones, D. L., MacKevett, E. M., Jr., and Plafker, George, 1971, Speculations on Late Mesozoic tectonic history of part of southern Alaska (abs.): International symposium on arctic geology, 2nd, San Francisco, California, Am. Assoc. Petroleum Geologists, p. 30.

Jones, D. L., Murphy, M. A., and Packard, E. L., 1965, The Lower Cretaceous (Albian) ammonite genera Leconteites and Brewericeras: U.S. Geol. Survey Prof. Paper 503-F, p. F1-F21.

Jones, D. L., Pessagno, E. A., Jr., and Csejtey, Bela, Jr., 1976, Significance of the Upper Chulitna ophiolite for the late Mesozoic evolution of southern Alaska (abs.): Geol. Soc. America, Abs. with Programs, v. 8, no. 3, p. 385-386.

Kindle, E. D., 1953, Dezadeash map area, Yukon Territory: Canada Geol. Survey Mem. 268, 68 p.

Kingston, Jack, and Miller, D. J., 1945, Nickel-copper prospect near Spirit Mountain, Copper River region, Alaska: U.S. Geol. Survey Bull. 943-C, p. 49-57.

* Knaebel, Jeff, 1969, Geochemical survey and geological reconnaissance of the White River area, south-central Alaska (abs.), in Alaska Division of Mines and Geology, Report for the year 1969: College, Alaska, p. 7-8.

* _____ 1970, Geochemical survey and geological reconnaissance of the White River area, south-central Alaska: Alaska Div. Mines and Geology Geochem. Rept. 21, 60 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.

Kummel, Bernhard, 1953, American Triassic coiled nautiloids: U.S. Geol. Survey Prof. Paper 250, 104 p.

Lamke, R. D., 1972, Floods in the summer of 1971 in south-central Alaska: U.S. Geol. Survey open-file rept., 88 p.

* Lasky, S. G., 1928, Transverse faults at Kennecott (Alaska), and their relation to the main fault systems: Am. Inst. Mining Metall. Engineers Tech. Pub. 152, 17 p.; also in 1929 Trans.; 1929 Year Book, p. 303-317.

* _____ 1930, A colloidal origin of some of the Kennecott ore minerals: Econ. Geol., v. 25, no. 7, p. 737-757.

Lathram, E. H., and Albert, N. R. D., 1975, Significance of space image linears in Alaska: International conference on the new basement tectonics, 1st, Salt Lake City, Utah, June, 1974, Proc., Utah Geol. Soc., 35 p.

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, p. 109-116.

Lerbekmo, J. F., Hansen, L. W., and Campbell, F. A., 1968, Application of particle size to determination of source of a volcanic ash deposit: Internatl. Geol. Cong., 23d, Prague 1968, Proc., v. 2, p. 283-295.

* Lerbekmo, J. F., Westgate, J. A., Smith, D. G. W., and Denton, G. H., 1973, New data on the eruptive history of the White River vent, Alaska: Internatl. Assoc. Quaternary Research, 9th Cong., New Zealand, 1973, Abs. vol., p. 20B.

* MacKevett, E. M., Jr., 1963, Preliminary geologic map of the McCarthy C-5 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-406, 1 sheet, scale 1:63,360.

* _____1965, Preliminary geologic map of the McCarthy B-5 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-438, 1 sheet, scale, 1:63,360.

* _____1965, Preliminary geologic map of the McCarthy C-6 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-444, 1 sheet, scale 1:63,360.

* _____1965, Nikolai Greenstone of Wrangell Mountains near Kennicott, Alaska (abs.): Geol. Soc. America Spec. Paper B2, p. 261.

* _____1965, Factors of probable significance in the genesis of copper deposits in the Kennecott district, Alaska (abs.): Econ. Geology, v. 60, no. 7, p. 1564-1565.

* _____1969, Three newly-named Jurassic formations in the McCarthy C-5 quadrangle, Alaska, in Cohee, G. V., and others, Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1967: U.S. Geol. Survey Bull. 1274-A, p. A35-A49.

* _____1970, Geologic map of the McCarthy C-4 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-844, B p., 1 sheet, scale 1:63,360.

* _____1970, Geologic map of the McCarthy C-5 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-B99, 1 sheet, scale 1:63,360.

* _____1970, Geology of the McCarthy B-4 quadrangle, Alaska: U.S. Geol. Survey Bull. 1333, 31 p.

* _____1971, Stratigraphy and general geology of the McCarthy C-5 quadrangle, Alaska: U.S. Geol. Survey Bull. 1323, 35 p.

* _____1972, Geologic map of the McCarthy C-6 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-979, scale 1:63,360.

* _____1973, Reconnaissance geologic map of the McCarthy A-5 quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-536, 1 sheet, scale 1:63,360.

* _____1974, Geologic map of the McCarthy B-5 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-1146, 1 sheet, scale 1:63,360.

* _____1976, Geologic map of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773A, 1 sheet, scale 1:250,000.

* _____1976, Mineral deposits and occurrences in the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773B, 2 sheets, scale 1:250,000.

* _____1976, Geologic map of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-1032, 1 sheet, scale 1:250,000 (in press).

* MacKevett, E. M., Jr., Albert, N. R. D., Barnes, D. F., Case, J. E., Robinson, Keith, and Singer, D. A., 1976, The Alaskan Mineral Resource Assessment Program: Background information to accompany folio of geologic and mineral resource maps of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Circ. 739.

* MacKevett, E. M., Jr., Berg, H. C., Plafker, George, and Jones, D. L., 1964, Preliminary geologic map of the McCarthy C-4 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-423, scale 1:63,360.

* MacKevett, E. M., Jr., and Blake, M. C., Jr., 1963, Jurassic stratigraphy in the McCarthy C-5 quadrangle, Alaska (abs.): Geol. Soc. America Spec. Paper 73, p. 49, 288.

* MacKevett, E. M., Jr., and Cobb, E. H., 1972, Metallic mineral resources map of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-395, 1 sheet, scale 1:250,000.

* MacKevett, E. M., Jr., and Imlay, R. W., 1962, Jurassic stratigraphy in the McCarthy C-5 quadrangle, Alaska, in Geological Survey research 1962: U.S. Geol. Survey Prof. Paper 450-D, p. D49-D51.

MacKevett, E. M., Jr., and Plafker, George, 1973, Tectonic significance of the Border Ranges fault in the western Chugach Mountains, Alaska (abs.): Geol. Soc. America, Abs. with Programs, v. 5, no. 1, p. 76-77.

_____1974, The Border Ranges fault in south-central Alaska: U.S. Geol. Survey Jour. Research, v. 2, no. 3, p. 323-329.

* MacKevett, E. M., Jr., and Radtke, A. S., 1966, Hydrothermal alteration near the Kennecott copper mines, Wrangell Mountains area, Alaska - A preliminary report, in Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-B, p. B165-B168.

* MacKevett, E. M., Jr., and Richter, D. H., 1974, The Nikolai Greenstone in the Wrangell Mountains, Alaska, and nearby regions (abs.): Canada Geol. Assoc., Cordilleran Sec. Programme with abstracts, p. 13, 14.

* MacKevett, E. M., Jr., and Smith, J. G., 1968, Distribution of gold, copper, and some other metals in the McCarthy B-4 and B-5 quadrangles, Alaska: U.S. Geol. Survey Circ. 604, 25 p.

* _____1972, Geologic map of the McCarthy B-4 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-943, 1 sheet, scale 1:63,360.

* _____1972, Geologic map of the McCarthy B-6 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-1035, 1 sheet, scale 1:63,360.

* Maloney, R. P., and Bottge, R. G., 1973, Estimated costs to produce copper at Kennecott, Alaska: U.S. Bur. Mines Inf. Circ. 8602, 35 p.

Maloney, William, 1916, Report of the Territorial Mine Inspector to the Governor of Alaska for the year 1915: Juneau, Alaska, 36 p.

_____1917, Report of William Maloney, Territorial Mine Inspector to the Governor of Alaska for the year 1916: Juneau, Alaska, 86 p.

_____1918, Report of the Territorial Mine Inspector to the Governor of Alaska for the year 1917: Juneau, Alaska, 50 p.

Martin, G. C., 1907, The Alaska coal fields: U.S. Geol. Survey Bull. 314, p. 40-46.

Martin, G. C., 1916, Triassic rocks of Alaska: Geol. Soc. America Bull., v. 27, p. 685-718.

_____1919, The Alaskan mining industry in 1917: U.S. Geol. Survey Bull. 692, p. 11-42.

_____1920, The Alaskan mining industry in 1918: U.S. Geol. Survey Bull. 712, p. 11-52.

_____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-alpha 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.

_____1974, A tabulation of K-Ar, Rb-Sr, and Pb-alpha ages obtained from materials within the United States (including Alaska and Hawaii) during the years 1956 through 1964: U.S. Geol. Survey open-file report, 174 p.

_____1974, A tabulation of K-Ar, Rb-Sr, and Pb-alpha ages obtained from materials within the United States (including Alaska and Hawaii) during the years 1965 through 1968: U.S. Geol. Survey open-file report, 245 p.

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

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

* _____1903, The mineral resources of the Mount Wrangell district, Alaska: U.S. Geol. Survey Prof. Paper 15, 71 p.

* Miller, D. J., 1946, Copper deposits of the Nizina district, Alaska: U.S. Geol. Survey Bull. 947-F, p. 93-120.

* Miller, D. J., and MacColl, R. S., 1964, Geologic map and sections of the northern part of the McCarthy A-4 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-410, 1 sheet, scale 1:63,360.

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.

* Moffit, F. H., 1909, Mining in the Kotsina-Chitina, Chistochina, and Valdez Creek regions: U.S. Geol. Survey Bull. 379, p. 153-160.

* _____1910, Mining in the Chitina district: U.S. Geol. Survey Bull. 442, p. 158-163.

* _____1912, The Chitina copper district: U.S. Geol. Survey Bull. 520, p. 105-107.

* _____1912, The Taral and Bremner River districts: U.S. Geol. Survey Bull. 520, p. 93-104

* _____1913, Mining in Chitina Valley: U.S. Geol. Survey Bull. 542, p. 81-85.

* _____1914, Geology of the Hanagita-Bremner region, Alaska: U.S. Geol. Survey Bull. 576, 56 p.

* _____1915, Mineral deposits of the Kotsina-Kuskulana district, with notes on mining in Chitina Valley: U.S. Geol. Survey Bull. 622, p. 103-117.

* _____1916, Mineral resources of the upper Chitina Valley, in Brooks, A. H., and others, Mineral resources of Alaska--report on progress of investigation in 1915: U.S. Geol. Survey Bull. 642, p. 129-136.

* _____1918, Mining in the lower Copper River basin: U.S. Geol. Survey Bull. 662, p. 155-182.

* _____1918, The upper Chitina Valley, Alaska, with a description of the igneous rocks, by R. M. Overbeck: U.S. Geol. Survey Bull. 675, 82 p.

* _____1921, Mining in Chitina Valley: U.S. Geol. Survey Bull. 714, p. 189-196.

* _____1924, The metalliferous deposits of Chitina Valley, Alaska: U.S. Geol. Survey Bull. 755, p. 57-72.

_____1927, Mineral industry in Alaska in 1925: U.S. Geol. Survey Bull. 792, p. 1-39.

* _____1930, Notes on the geology of the upper Nizina River: U.S. Geol. Survey Bull. 813, p. 143-166.

* _____1937, Recent mineral developments in the Copper River region, Alaska: U.S. Geol. Survey Bull. 880-B, p. 97-109.

* _____1938, Geology of the Chitina Valley and adjacent area, Alaska: U.S. Geol. Survey Bull. 894, 137 p.

_____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.

_____1954, Geology of the eastern part of the Alaska Range and adjacent area: U.S. Geol. Survey Bull. 989-D, 218 p.

* Moffit, F. H., and Capps, S. R., 1911, Geology and mineral resources of the Nizina district, Alaska: U.S. Geol. Survey Bull. 448, 111 p.

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

* _____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.

* Moffit, F. H., and Maddren, A. G., 1908, The mineral resources of the Kotsina and Chitina valleys, Copper River region, in Brooks, A. H., and others, Investigations of mineral resources of Alaska in 1907: U.S. Geol. Survey Bull. 345, p. 127-175.

* _____1909, Mineral resources of the Kotsina-Chitina region, Alaska: U.S. Geol. Survey Bull. 374, 103 p.

* Moffit, F. H., and Mertie, J. B., Jr., 1923, The Kotsina-Kuskulana district, Alaska: U.S. Geol. Survey Bull. 745, 149 p.

Moxham, R. M., and Nelson, A. E., 1952, Reconnaissance for radioactive deposits in south-central Alaska, 1947-49: U.S. Geol. Survey Circ. 184, 14 p.

Muller, J. E., 1967, Kluane Lake map area, Yukon Territory: Canada Geol. Survey Mem. 340, 137 p.

* O'Leary, R. M., McDanal, S. K., Day, G. W., McDougal, C. M., and Robinson, Keith, 1976, Spectrographic and chemical analyses of geochemical samples from the McCarthy quadrangle, Alaska: U.S. Geol. Survey open-file rept. 76-824, 806 p.

Payne, T. G., 1955, Mesozoic and Cenozoic tectonic elements of Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-84, 1 sheet, scale 1:5,000,000.

Péwé, T. L., 1975, Quaternary geology of Alaska: U.S. Geol. Survey Prof. Paper 835, 145 p.

Pilgrim, E. R., 1933, Mining investigations and mine inspection in Alaska, biennium ending March 31, 1933 (report of Alaska Supervising Mining Engineer), p. 88-90.

Plafker, George, and Mayo, L. R., 1965, Tectonic deformation, subaqueous slides and destructive waves associated with the Alaskan March 27, 1964 earthquake: an interim geologic evaluation: U.S. Geol. Survey open-file rept., 19 p.

Post, Austin, 1967, Effects of the March 1964 Alaska earthquake on glaciers: U.S. Geol. Survey Prof. Paper 544-D, p. D1-D42.

Post, Austin, and Mayo, L. R., 1971, Glacier dammed lakes and outburst floods in Alaska: U.S. Geol. Survey Hydrol. Inv. Atlas HA-455, 10 p., 3 sheets.

Purington, C. W., 1905, Methods and costs of gravel and placer mining in Alaska: U.S. Geol. Survey Bull. 263, 273 p.

Read, P. B., and Monger, J. W. H., 1975, Operation St. Elias, Yukon Territory: the Mush Lake Group and Permo-Triassic rocks in the Kluane Ranges, in Report of activities, April to October 1974: Canada Geol. Survey Paper 75-1, pt. A, Dept. of Energy, Mines and Resources, Ottawa, p. 55-59.

Renfro, A. R., 1974, Genesis of evaporite-associated stratiform metalliferous deposits--a sabkha process: Econ. Geology, v. 69, p. 33-45.

Richter, D. H., 1975, 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., 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, 25 p.

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

Richter, D. H., Lanphere, M. A., and Matson, N. A., 1975, Granitic plutonism and metamorphism, eastern Alaska Range, Alaska: Geol. Soc. America Bull., v. 86, no. 6, p. 819-829.

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

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.

* Robinson, Keith, McDougal, C. M., Day, G. W., and Billings, Theodore, 1976, Distribution and abundance of copper in stream sediments and moraine debris, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773F, 1 sheet, scale 1:250,000.

* Robinson, Keith, McDougal, C. M., Day, G. W., and Billings, Theodore, 1976, Distribution and abundance of lead in stream sediments and moraine debris, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773G, 1 sheet, scale 1:250,000.

* Robinson, Keith, O'Leary, R. M., McDougal, C. M., and Billings, Theodore, 1976, Distribution and abundance of gold in stream sediments and moraine debris, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773H, 1 sheet, scale 1:250,000.

* Robinson, Keith, O'Leary, R. M., McDougal, C. M., and Billings, Theodore, 1976, Distribution and abundance of arsenic and mercury in stream sediments and moriane debris, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773I, 1 sheet, scale 1:250,000.

* Robinson, Keith, McDougal, C. M., McDanal, S. K., and Billings, Theodore, 1976, Distribution and abundance of molybdenum in bedrock, mineralized, vein, and altered rock samples, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773J, 1 sheet, scale 1:250,000.

* Robinson, Keith, McDougal, C. M., McDanal, S. K., and Billings, Theodore, 1976, Distribution and abundance of silver in bedrock, mineralized, vein, and altered rock samples, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773K, 1 sheet, scale 1:250,000.

* Robinson, Keith, McDougal, C. M., O'Leary, R. M., and Billings, Theodore, 1976, Distribution and abundance of gold in bedrock, mineralized, vein, and altered rock samples, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773L, 1 sheet, scale 1:250,000.

* Robinson, Keith, McDougal, C. M., McDanal, S. K., and Billings, Theodore, 1976, Distribution and abundance of arsenic in bedrock, mineralized, vein, and altered rock samples, McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773M, 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.

* Sainsbury, C. L., 1952, Geology of the Nelson and Radovan copper prospects, Glacier Creek, Alaska: U.S. Geol. Survey open-file rept., 18 p.

Schrader, F. C., 1900, A reconnaissance of a part of Prince William Sound and the Copper River district, Alaska in 1898: U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 408-410, 413.

* Schrader, F. C., and Spencer, A. C., 1901, The geology and mineral resources of a portion of the Copper River district, Alaska: U.S. Geol. Survey Spec. Pub., 94 p.

* Seitz, J. F., 1963, Copper prospect in the upper Chitina Valley, Alaska: U.S. Geol. Survey Bull. 1155, p. 66-72.

Sharp, R. P., and Rigsby, G. P., 1956, Some rocks of the central St. Elias Mountains, Yukon Territory, Canada: Am. Jour. Sci., v. 254, p. 110-122.

* Singer, D. A., and MacKevett, E. M., Jr., 1976, Mineral resources map of the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-773C, 1 sheet, scale 1:250,000.

* Smith, J. G., and MacKevett, E. M., Jr., 1970, The Skolai Group in the McCarthy B-4, C-4, and C-5 quadrangles, Wrangell Mountains, Alaska: U.S. Geol. Survey Bull. 1274-Q, p. Q1-Q26.

Smith, J. P., 1927, Upper Triassic marine invertebrate faunas of North America: U.S. Geol. Survey Prof. Paper 141, 262 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.

_____1930, Mineral industry of Alaska in 1927: U.S. Geol. Survey Bull. 810, p. 1-64.

_____1930, Mineral industry of Alaska in 1928: U.S. Geol. Survey Bull. 813, p. 1-72.

_____1932, Mineral industry of Alaska in 1929: U.S. Geol. Survey Bull. 824, p. 1-81.

_____1933, Mineral industry of Alaska in 1931: U.S. Geol. Survey Bull. 844-A, p. 1-82.

_____1933, Mineral industry of Alaska in 1930: U.S. Geol. Survey Bull. 836, p. 1-83.

_____1934, Mineral industry of Alaska in 1932: U.S. Geol. Survey Bull. 857-A, p. 1-91.

_____1934, Mineral industry of Alaska in 1933: U.S. Geol. Survey Bull. 864-A, p. 1-94.

_____1936, Mineral industry of Alaska in 1934: U.S. Geol. Survey Bull. 868-A, p. 1-91.

_____1937, Mineral industry of Alaska in 1935: U.S. Geol. Survey Bull. 880-A, p. 1-95.

_____1938, Mineral industry of Alaska in 1936: U.S. Geol. Survey Bull. 897-A, p. 1-107.

_____1939, Mineral industry of Alaska in 1937: U.S. Geol. Survey Bull. 910-A, p. 1-113.

_____1939, Areal geology of Alaska: U.S. Geol. Survey Prof. Paper 192, 100 p.

_____1942, Occurrences of molybdenum minerals in Alaska: U.S. Geol. Survey Bull. 926-C, p. 161-210.

_____1942, Mineral industry of Alaska in 1940: U.S. Geol Survey Bull. 933-A, p. 1-102.

Smith, R. L., and Shaw, H. R., 1975, Igneous-related geothermal systems, in White, D. E., and Williams, D. L., editors, Assessment of geothermal resources of the United States--1975: U.S. Geol. Survey Circ. 726, p. 58-83.

Smith, S. S., 1914, Report of the mine inspector for the territory of Alaska to the Secretary of the Interior for the fiscal year ended June 30, 1914: Washington, D. C., 36 p.

_____1917, The mining industry in the Territory of Alaska during the calendar year 1915: U.S. Bur. Mines Bull. 142, 66 p.

_____1917, The mining industry in the Territory of Alaska during the calendar year 1916: U.S. Bur. Mines Bull. 153, 89 p.

Souther, J. G., and Stanciu, V. C., 1975, Operation St. Elias, Yukon Territory: Tertiary volcanic rocks, in Report of activities, April to October 1974: Canada Geol. Survey Paper 75-1, pt. A, Dept. of Energy, Mines and Resources, Ottawa, p. 63-70.

Stewart, B. D., 1921, Annual report of the Territorial Mine Inspector to the Governor of Alaska, 1920: Juneau, Alaska, 72 p.

_____1923, Annual report of the Mine Inspector to the Governor of Alaska, 1922: Juneau, Alaska, 175 p.

_____1924, Annual report of the Mine Inspector to the Governor of Alaska, 1923: Juneau, Alaska, 109 p.

_____1931, Report on cooperation between the Territory of Alaska and the United States in making mining investigations and in the inspection of mines for the biennium ending March 31, 1931: Juneau, Alaska, 145 p.

_____1933, Mining investigations and mine inspection in Alaska, including assistance to prospectors, biennium ending March 31, 1933: Juneau, Alaska, 192 p.

Stewart, B. D., and Dyer, B. W., 1922, Annual report of the Territorial Mine Inspector to the Governor of Alaska, 1921: Juneau, Alaska, 96 p.

Stonely, Robert, 1967, The structural development of the Gulf of Alaska sedimentary province in southern Alaska: Quart. Jour. Geol. Soc. London, v. 123, p. 25-57.

* Stuiver, Minze, Armstrong, R. L., and Denton, G. H., 1969, Quaternary glacial chronology, White River Valley, northern Wrangell and St. Elias Mountains, Alaska: Geol. Soc. America, Abs. with Programs, pt. 7, p. 218.

Stuiver, Minze, Borns, H. W., and Denton, G. H., 1964, Age of widespread layer of volcanic ash in southwestern Yukon Territory: Arctic, v. 17, p. 259-260.

Tarr, R. S., and Martin, Lawrence, 1912, The earthquakes at Yakutat Bay, Alaska, with a preface by G. K. Gilbert: U.S. Geol. Survey Prof. Paper 69, 135 p.

Thorne, R. L., 1969, Silver in Alaska, in U.S. Bureau of Mines, Silver in the United States - potential resources: U.S. Bur. Mines open-file rept., p. 32-38.

Twenhofel, W. S., 1953, Potential Alaskan mineral resources for proposed electrochemical and electrometallurgical industries in the upper Lynn Canal area, Alaska: U.S. Geol. Survey Circ. 252, 14 p.

U.S. Geological Survey, 1960, Geological Survey research, 1960, synopsis of geologic results: U.S. Geol. Survey Prof. Paper 400-A, p. A1-A136.

_____1962, Geological Survey research 1962: U.S. Geol. Survey Prof. Paper 450-A, p. A1-A257.

_____1963, Geological Survey research 1963, U.S. Geol. Survey Prof. Paper 475-A, p. A1-A300.

_____1964, Geological Survey research 1964: U.S. Geol. Survey Prof. Paper 501-A, p. A1-A367.

_____1965, Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-A, p. A1-A376.

_____1966, Geological Survey research 1966: U.S. Geol. Survey Prof. Paper 550-A, p. A1-A385.

_____1967, Geological Survey research 1967: U.S. Geol. Survey Prof. Paper 575-A, p. A1-A377.

_____1968, Geological Survey research 1968: U.S. Geol. Survey Prof. Paper 600-A, p. A1-A371.

_____1969, Geological Survey research 1969: U.S. Geol. Survey Prof. Paper 650-A, A1-A425.

_____1969, U.S. Geological Survey heavy metals program progress reports, 1968 - Field studies: U.S. Geol. Survey Circ. 621, 35 p.

_____1970, Geological Survey research 1970: U.S. Geol. Survey Prof. Paper 700-A, p. A1-A426.

_____1971, Geological Survey research 1971: U.S. Geol. Survey Prof. Paper 750-A, p. A1-A418.

_____1972, Geological Survey research 1972: U.S. Geological Survey Prof. Paper 800-A, p. A1-A320.

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.

_____1973, Geological Survey research 1973: U.S. Geol. Survey Prof. Paper 850, 366 p.

_____1973, United States Geological Survey Alaska program, 1973: U.S. Geol. Survey Circ. 683, 56 p.

* _____1976, Status of land in the McCarthy quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-7730, 1 sheet, scale 1:250,000.

* _____1976, Aeromagnetic maps of the McCarthy quadrangle, Alaska: U.S. Geol. Survey open-file rept. 76-170, 1 sheet at 1:250,000 scale; 32 sheets at 1:63,360 scale.

* Van Alstine, R. E., and Black, R. F., 1946, Copper deposits of the Kotsina-Kuskulana district, Alaska: U.S. Geol. Survey Bull. 947-G, p. 121-141.

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

Wahrhaftig, Clyde, and Cox, Allan, 1959, Rock glaciers in the Alaska Range: Geol. Soc. America Bull., v. 70, no. 4, p. 383-436.

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.

Wimmler, N. L., 1923, Placer mining in Alaska in 1922, in Stewart, B. D., Annual report of the Mine Inspector to the Governor of Alaska, 1922: Juneau, Alaska, p. 23-56.

_____1924, Placer mining in Alaska in 1923, in Stewart, B. D., Annual report of the Mine Inspector to the Governor of Alaska, 1923: Juneau, Alaska, p. 14-54.

* Winkler, G. R., and MacKevett, E. M., Jr., 1970, Analyses of stream-sediment samples from the McCarthy C-8 quadrangle, southern Wrangell Mountains, Alaska: U.S. Geol. Survey open-file rept. 426, 45 p.

* Winkler, G. R., MacKevett, E. M., Jr., and Smith, J. G., 1971, Geochemical reconnaissance of the McCarthy B-6 quadrangle, Alaska: U.S. Geol. Survey open-file rept. 457, 8 p.

Wolfe, J. A., Hopkins, D. M, and Leopold, E. B, 1966, Tertiary stratigraphy and paleobotany of the Cook Inlet region, Alaska: U.S. Geol. Survey Prof. Paper 398-A, p. A1-A29.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1977 O-240-961/26