THE MINERAL POTENTIAL OF ALASKA'S MT. MCKINLEY REGION: A SUMMARY REPORT

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by

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Abstract

A survey of mineral potential in the Mt. McKinley region indicates that mineral deposits and occurrences are relatively abundant. With the exception of deposits between Mt. Eielson and Slippery Creek, the known deposits occur mostly outside the present boundaries of Mt. McKinley National Park. Most metallic deposits are clustered within three major mineral belts or trends--(1) Chulitna-Yentna, (2) Kantishna, and (3) Dall.

The Chulitna-Yentna belt on the southeast flank of the Mt. McKinley region contains reserves and resources of gold, silver, copper, lead and tin in porphyry, vein and placer deposits.

The Kantishna trend, which is inferred to be deeply buried, in the northwest part of Mt. McKinley National Park, contains lead, zinc, silver, gold, and antimony deposits. The Kantishna trend has resources in excess of a billion tons of zinc-bearing shale and metavolcanic rocks, and has the potential for existence of large stratiform mineral deposits of mineable grade containing zinc, lead, and silver.

The Dall trend is in extremely rugged country on the southwest side of Mt. McKinley Park. Dominant metals are copper, gold, silver, nickel, chromium, and molybdenum.

Non-metallic deposits also exist in the area. Cement-quality limestone and coal deposits have definite commercial potential, but the major coal and limestone resources are peripheral to the region.

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The survey identified new mineralized areas, appraised and extended known mineralized areas and indicated areas where more data are needed. It cannot be considered as definitive of the ultimate mineral potential of the Mt. McKinley region.

INTRODUCTION

The present Mt. McKinley National Park is a 1.9 million acre rectangular area, approximately elongated along the arc of the Alaska Range (figure 1). On the north, it includes part of the foothill system and northeast plain. On the south it is mainly mountainous--but does not include all of Mt. McKinley itself. In Februaruy 1978, the Secretary of Interior proposed additions on three sides--north, west, and south.

This brief report summarizes data collected, mainly in 1976, and contained in a more extensive reprot to the Bureau of Mines in May, 1978. The investigation was undertaken as a result of a special congressional authorization of funds to the Bureau of Mines for a study of selected withdrawal areas.

The field work was of two types; semi-detailed mapping (1'=2,000'), geochemical, geophysical work in previously identified mineral areas, including Kantishna, Chulitna, Yentna, and Tonzona, and rapid reconnaissance of terrain not previously reported on--mainly the extremely rugged area on the southwest flank of Mt. McKinley.

The survey was sufficient to identify some new mineral areas, allow for the better appraisal of known mineral areas, and to suggest areas where further data are needed for evaluation. It cannot be considered definitive.

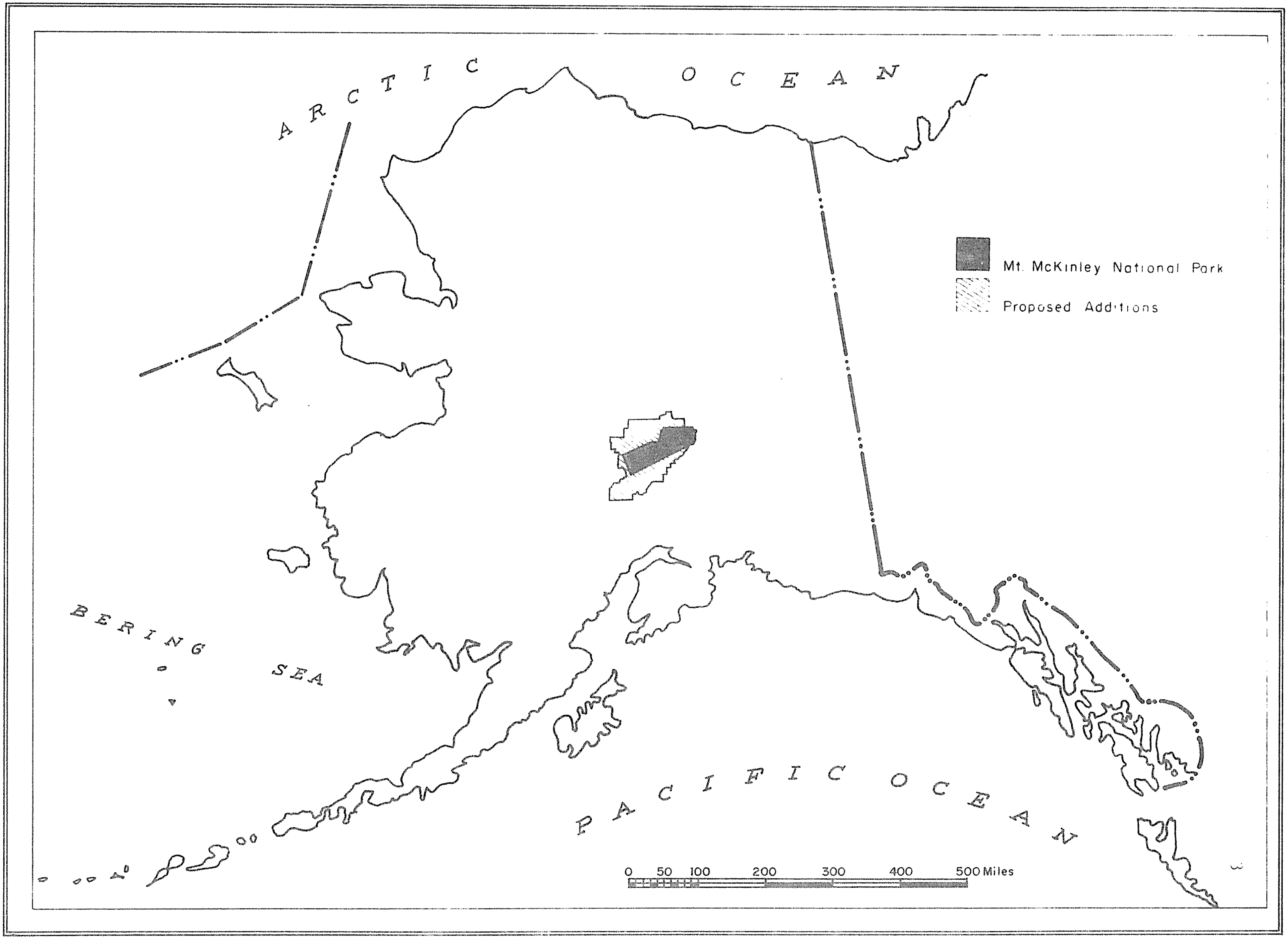

FIGURE 1. Location of the Mt. McKinley Area, Alaska.

GENERAL GEOLOGY

The geologic picture emerging from the McKinley region is of a complex series of fault-bounded fragments which range in age at least from lower Paleozoic to upper Mesozoic. The strata involved in the major blocks have been bent, locally converted by heat and pressure to schistose metamorphic rocks, and intruded by at least three series of igneous rocks. Since near the beginning of the Tertiary Era about 60 million years ago, the rock units have been warped, continental sediments deposited in local basins, and uplifted. In recent geologic time, they have been profoundly sculptured by glacial activity.

Extending entirely through the area in its long east-northeast direction is the McKinley strand of the Danali fault zone which is the youngest expression of the major fault activity affecting the region (figure 2).

ECONOMIC GEOLOGY AND MINERAL DEPOSITS

The Mt. McKinley region contains a variety of mineral deposits and mineral occurrences which can be grouped generally into metallic, non-metallic, industrial mineral, and mineral fuel groups. They are widely distributed, but most appear to be clustered, with the metallic deposits particularly occurring in crudely linear trends conincident with structural stratigraphic zones. Minerals or commodities with past production or definite economic potential include antimony, gold, silver, tin, lead, and zinc in the metallics, and limestone, uranium, and coal in the non-metallic or mineral fuel groups.

Distribution

The metallic deposits of the area are mainly concentrated in four linear belts or trends--Chulitna-Yentna, Kantishna, McKinley, and Dall--which correspond to stratigraphic-structural situations involving relatively metal-rich layered rocks (figure 3). Metallic deposits related to intrusives are relatively numereous in the belts named above. Of the non-metallic deposits, cement-quality limestone deposits occur on the southeast flank of the region in Devonian and Triassic layered series, and coal and clay deposits are found in Tertiary basins mainly on the flanks of the mountainous region.

The Chulitna-Yentna belt (figure 3) may be traced for about 100 miles on the southeast flank of the region. It coincides in the north or Chulitna segment with relatively metalliferous red beds and basalt faulted against a graywacke-argillite series. The southern or Yentna segment lies in the same structural alinement, but is mainly in the graywacke-argillite sequence.

The Kantishna trend can be traced about 50 miles southwesterly from near Chitsia Mountain (figure 3, No. 16), thence is buried for about 35 miles in Mt McKinley Park by younger sedimentary rocks and deposits to near the Herron River where it emerges and can be traced at least another 30 miles southwest in the park and beyond. The strata involved include relatively metalliferous carbonaceous shale, limestone, and latite-rhyolite, now metamorphosed.

The Dall trend (figure 3) can be traced at least 50 miles from the upper Lacuna Glacier to Cathedral Spires. It is coincident in part with Paleozoic terrane south of the McKinley strand of the Denali Fault (figure 3). Mineral occurrences are predominantly igneous affiliated. The McKinley trend, wholly within the present park, is a 40-mile long zone containing numerous mineral deposits.

Classification of Metallic Deposits

The metallic deposits of the McKinley region are exceptionally varied (table 1). In the past, most have been classified by contained metals, for example, an antimony deposit, or by form, grade, and size. It is also important, especially in mineral evaluation, to classify by origin or genetic types, so that environments which are likely to contain ore deposits can be recognized.

Such recognition is done by prospect, mineralogic and trace element data, as well as the establishment of the geologic environment in terms of the geologic processes which operated to form concentrations of valuable mineral materials. Recognition of the environments allows for projection of mineral trends where mineral deposits are more likely to occur. It is a task much easier than recognition of an actual ore deposit which requires detailed physical work, usually done over a period of several years.

The processes generally involved in the formation of mineral deposits are extensions of the processes involved in the formation of ordinary rocks-igneous, sedimentary, and metamorphic. In table 1, the first breakdown of possible deposit types is in terms of process, as igneous; the second by environment of deposition; some subsequent divisions are non-genetic, including by form and metal content.

Description of Deposits and Deposit Areas

Proposed Park Extensions

The mineralized areas included within the proposed park extensions (figure 3) are the northern segment and part of the southern segment of the Kantishna trend, the total presently recognized extent of the Dall trend, and a small part of the Chulitna district. The proposed extensions also include some coal deposits.

Kantishna District

The Kantishna mining area (figure 3), recently investigated by the State of Alaska (1) 2/, mainly coincides with part of Kantishna mineral trend.

TABLE 1.

CLASSIFICATION OF MINERAL DEPOSITS TYPES, WITH EXAMPLES, IN THE MT. MCKINLEY REGION

Process	Environment	Process	Host Rocks-Wall rocks	Form or type	Trace element Suite	Examples	Remarks
I. Igneous							
	A. Plutonic						
		1. Orthomagmatic					
			a. Granitic	Disseminated	Sn,W,Be,U	Granite of Lake Chilchukubena	Resource
			b. Ultramafic	Podiform-stratiform	Cr,Ni,Cu	Chromite deposits on Lacuna Glacier	
		2. Late stage magmatic-hydrothermal					
		a. McKinley-type granite	(1) Crystalline	Disseminated-pipe-vein	Sn,W	Ohio Creek and Coal Creek stocks.	
			(2) Carbonate	Stratabound	Zn,Pb,Ag,Sn	Jiles-Knudson (Tonzon stock) unnamed skarn-Coal Cree stock .	
			(3) Argillite	Vein-stock work	W,Ag,Sn	Unnamed adjacent-Ohi Creek stock.	
		b. Foraker-type granodinite	(1) ________				
			(2) Carbonate	Irregular-stratabound	Zn,Pb,Ag(Cu)	Mt. Eielson and Slippery Cree area tactite deposits	
			(3) ________				
		c. Yentna-type granodinite	(1) ________				
			(2) Carbonate	Irregular to stratabound	Au,Ag,Cu(Ni)	Mt. Dall occurrences	
			(3) ________				
	B. Hypabyssal						
		1. Late stage magmatic-hydrothermel					
		a. Yentna-equivalent porphyry	(1) Crystalline	Breccia-pipe, porphyry	Au,Ag,Cu	Golden Zone	
			(2) Carbonate	Skarn-vein		Par, Partin Creek	
		b. McKinley equivalent porphyry					
			(a) Argillite basalt	Disseminated	Pb,Zn,Ag,Sn	Ready Cash, Ohio Creek	
			(b) Carbonate	Skarn	Cu	Ready Cash, Ohio Creek	
			(c) Diorite (?)	Disseminated, porphyry	Cu,Mo,Au	Costello Creek area, Nim claims	
	C. Volcanic						
		1. Hydrothermal-submarine					
			a. Calc-alkaline series	Stratabound	Pb,Zn,Au,Ag, Ba	Chitsia Mt. occurrence	Only resou values knc
			b. Basaltic	Stratabound pod-like	Cu,Zn	Shellabarger Pass	
II. Epigenetic involving aqueous solutions, mainly hydrothermal							
	A. Mesothermal			Vein-replacement	Au,Ag,Pb,Zn,Cu	Kantishna	
	B. Epithermal			Vein-replacement	Sb, Sb-Hg	Stampede, Slate Creek	
III. Sedimentary							
	A. Marine						
	(1) Organic-mudstone Black shale, carbonaceous limestone			Stratabound	Zn, Pb, (Au), (Ag)	Kantishna-Stampede area in Kantishna trend; Dall Trend	Only resource values known
	B. Continental						
	(1) Fluvial-Placer		Gravel		Au(Ag)(Sb)	Kantishna, Yentna district	

Historically, four types of productive deposits have been recognized: (1) gold-bearing quartz veins, (2) silver-lead bearing veins, (d) antimony veins, and (4) gold placer deposits derived from erosion of the metalliferous deposits.

The gold-bearing veins range from narrow (less than three feet) rich veins containing more than one ounce per ton of gold, through veins like the Banjo (figure 3, No. 14), which averages about 0.5 oz/ton of gold in a ten-foot vein to 200-foot wide mineral shear zones like Jupiter-Mars (figure 3, No. 14) containing less than 0.5 oz per gold ton. They occur mainly in a ten-mile long zone northeast of the settlement of Kantishna. Silver-lead veins are of two classes, galena-sphalerite veins containing 25 to 30 oz of silver per ton, and galena-silver sulfosalt veins containing upward of 50 oz of silver per ton. Antimony deposits, consisting mainly of stibnite, quartz, and sheared country rock, have a wider distribution. The main recognized antimony deposits are at Slate Creek (figure 3, No. 10) and Stampede (figure 3, No. 15). The placer gold deposits fan out from the main vein mineralized district.

Not well recognized in early prospecting in the district are mineral zones and occurrences which are stratiform in character. Apparently unmineralized calcareous graphitic schist contains up to one-third ounce silver per ton and is strongly anomalous in lead, zinc, and molybdenum. The graphitic schist has the potential for local ore-grade concentrations of zinc.

Felsic schist of the Kantishna district, probably a metarhyolite or latite, locally contains visible chalcopyrite and is strongly anomalous in copper. Occurrences, such as those north of Kantishna airfield and near Wickersham Dome, bear this out. North of the main vein mineralized area,

2/ Underlined numbers in parentheses refer to items in the references listed at the end of this report.

zinc-silver-molybdenum-bearing black carbonaneous shales occur near Stampede (figure 3, No. 15) in Canyon Creek, and zinc-rich metarhyolite or latite occurs in the Totatlanika Schist near Chitsia Mountain (figure 3, No. 16).

Dall Trend

Mineral deposits or occurrences in the Dall trend belong to at least three major types: (1) granitic (igneous) affiliated contact and porphyry deposits, (2) ultramafic chromite or copper-nickel occurrences, and (3) metal-rich black shales.

The granitic affiliated deposits include molybdenum-bearing units in or near Foraker-type intrusives and copper-gold-silver-nickel zones in or near Yentna-type intrusives, especially within limestone and limestone cobble congolmerate. A high-grade contact deposit in Sec. 36 T29N, R16W, contains about 25 percent copper, 41 oz/ton silver, and 0.7 oz/ton gold over three feet in a wider free-gold bearing tactite. The mineralization extends into the northern part of T28N, R16W, and other Yentna-related mineralization is in Sec. 10, T28N, R17W. Molybdenite was found near Lacuna Glacier and Bruce L. Reed (communication, 1977) reports anomalous amounts of tungsten and tin in the southeastern part of the belt near Cathedral Spires.

The ultramafic zones are discontinuously present in a 24-mile long belt traceable from Lacuna Glacier, where podiform chromite is exposed in zones of apparent economic size.

Shellabarger Pass Area

The Shellabarger Pass area, discovered by B. L. Reed and field party in 1967, (5), is possibly in the same belt of Paleozoic rocks as the Dall trend. It contains massive sulfide volcanogenic deposits which range in metal content from about 1 to 4 percent copper, and 0.2 to 4 percent zinc.

Chulitna District

The part of the Chulitna belt in upper Ohio Creek is partly within the proposed park additions. It includes a tin-bearing granite with small greisen bodies first described by Hawley and others (4). Peripheral to the granite are altered and stockwork zones containing tin and tungsten, and at least a few silver-rich vein deposits (locally containing more than 100 oz/ton silver).

Adjacent Areas

Most of the Chulitna-Yentna belt and the southwestern part of the Kantishna trend in the Boulder Creek or Tonzona area are within the region peripheral to the proposed park additions.

Chulitna District

The northern part of the Chulitna-Yentna mineral belt, termed upper Chulitna district by Hawley and Clark (2, 3), extends about 35 miles along the south flank of the Alaska Range from Eldridge Glacier to the Bull River. In order of importance, recognized occurrence types are: (1) breccia pipe and porphyry-type deposits of copper, gold, silver, and locally molybdenum, (2) vein and skarn deposits containing lead, zinc, tin, silver, and gold, (3) disseminated and vein-type copper occurrences in basalt, and (4) deposits of chromite in ultramafic rocks.

The main breccia pipe deposit is at the Golden Zone mine (figure 3, No. 21), where a 100x300-foot zone within a more extensive mineralized area contains about 25,000tons/hundred feet as a low-grade gold-silver-copper resource. Disseminated or fracture-controlled bulk mineralization is also exposed on about a one-square mile area near Costello Creek, about seven miles northwest of the Golden Zone (figure 3, No. 21).

The main occurrence of vein-skarn type are at Coal Creek (figure 3, No. 17), the Ready Cash are in Ohio Creek (figure 3, No. 20), and in the upper part of

Partin Creek (figure 3, No. 18). At the Coal Creek and Ready Cash areas, mineral occurrences continaing lead, zinc, silver and up to one percent tin occur in numerous veins. In Partin Creek pyrrhotite-skarns contain as much as 2 oz gold/ton over a 5-foot thickness.

Yentna District

The Yentna district forms the southern part of the Chulitna-Yentna mineral belt (2). It is mainly a gold placer district, with main productive areas in the Dutch-Peters Hills (figure 3, No. 23) and the Collinsville (figure 3, No. 24) areas. Production exceeds 204,000 oz of gold.

Placer deposits include those in conglomerates of Tertiary age and deposits of both glacial and post-glacial age. The most productive deposits are buried by recent alluvium, but are generally in or adjacent to the modern stream valleys.

The deposits were at least partly derived by the erosion of gold-scheelite deposits contained in granitic dikes exposed in the Peters and Dutch Hills.

Boulder Creek (Tonzona) Area

Exploration in the Boulder Creek area has focused on the Tonzona stock of McKinley-type granite. Mineral occurrence types are: (1) beryllium-rich zones in the granite, (2) massive pyrrhotite skarn (figure 3, No. 5), (3) silver-lead-tin-tungsten-uranium bearing veins (figure 3, No. 4), and (4) tin-bearing repacement deposits (figure 3, No. 5).

In addition to Tonzona granite related occurrences, strata similar to those exposed at Kantishna are metalliferous, and mineralized ultramafic rocks are exposed over at least a 20-mile long zone.

Mineral Fuels and Construction Materials

The major non-metallic mineral resource of the McKinley region are coal in the Susitna, Nenana, Tonzona fields which are peripheral to the region, and cement-quality limestone in and adjacent to the southeast part of Mt.

McKinley National Park. Uranium occurs in the silver-lead bearing veins of the Tonzona area. McKinley-type granitic and rhyolitic units of the Totatlanika Schist are considered at least potentially favorable for uranium because of high radioactivity which at least locally accompanies high background uranium contents.

The recently discovered Tonzona coal field (A, figure 3) contains coal beds agregating over 100-feet thick just west of the (withdrawal area). Related deposits could be present in the Minchumina basin, but covered by later Tertiary or Quaternary deposits.

The main part of Nenana coal field (D, figure 3) is northeast of the region, but coal-bearing units do extend into Mt. McKinley National Park. The northern part of the Susitna field (B, figure 3) is largely coincident with the Yentna placer gold district. Coal has been mined for local use in the Cache Creek basin (figure 3, No. 23). A bed locally exceeding 50 feet thick is exposed in the Fairview Mountain-Collinsville area (figure 3, No. 24). Lignitic coal is present in amounts estimated to be in excess of 13 million tons in the Broad Pass basin (C, figure 3).

The great bulk of the billion ton class reserves of the Susitna, Nenana, and potentially the Tonzona coal fields are outside the Mt. McKinley region.

Uranium in concentrations of possible commercial interest has been reported from two occurrences--gossan at the Mespelt prospect (figure 3, No. 4), Tonzona area, and placer concentrates from the Yentna district. Relatively high radioactivity characterizes the McKinley and Totatlanika units, and very limited chemical analyses suggest that at least locally the radioactivity is caused by enrichment in uranium.

The main limestone resources identified are those in the Windy Pass, Foggy Pass, and Windy Fork areas and the Long Creek deposit (respectively areas A and B, figure 3). Potentially commercial clay occurs in the Nenana coal field, and apparently subcommercial perlite occurs locally in acidic volcanic rocks of Tertiary age in Mt. McKinley National Park.

Reserves and Resources

Essentially the only current mining activity in the McKinley region is for placer gold at Kantishna and in the Yentna district and for coal near Healy. Exploration at hard rock prospects is active in the Chulitna and Tonzona areas, and detailed prospect evaluation and minor production has taken place at Stampede and Kantishna since 1970. For resource analysis purposes, reserves have been assigned to those metallic deposits which could be mined by selective methods on the basis of $100/ton contained metal at current (1978) prices, and to bulk metallic deposits on the basis of $25/ton.

In the Kantishna district there are reserves of 10,000 tons or less in several small rich veins containing more than 100 oz/silver per ton, and probable reserves in the 100,000 to 1,000,000 ton class in larger veins containing about 20 oz/silver per ton, or equivalent amounts of gold. Major identified resources of more than 1,000,000,000 tons exist in zinc-bearing mineralized volcanic material in the Totatlanika Schist and in porphyry at the Bonnell prospect (figure 3, No. 11). It is not anticipated that these large tonnages would ever constitute ore, but based on reasonable analogy, they could contain extensive bodies of ore-grade material.

Reserves in excess of 5,000,000 pounds of contained antimony are estimated at Stampede (figure 3, No. 15). They include about 1.9 million pounds in stopefill, talus, and partly drilled ore shoots, and about 3.5 million pounds of antimony inferred to exist between the Mooney and Kobuk workings in the main Stampede vein structure.

In the Dall trend an apparent reserve of high-grade copper-silver-gold ore is present in massive sulfide tactite or skarn, and resources in the 10 to 100 million ton class of 0.1 to 0.9 percent metal equivalent can be calculated from mineralized volumes in altered gold and copper-bearing mineralized limestone conglomerate. Possible reserves of chromite are present in the Lacuna Glacier area. Based on a Geological Survey study (5) individual massive sulfide deposits at Shellabarger Pass contain resources up to 100,000 tons on an average of about 3 percent zinc and copper and one oz/ton silver.

Reserves and identified resources of the Chulitna area are in the Golden Zone, Nim, Lookout Mountain, Ready Cash, Partin Creek, and Coal Creek areas (figure 3, Nos. 21, 22, 19, 18, 17). The Golden Zone has measured reserves in excess of 500,000 tons ranging from 0.14 to 0.31 oz/ton of gold and a resource of gold in the 0.01 to 0.09 oz/ton range of several million tons. Based on surface sampling, other inferred reserves include fairly high-grade (0.68 oz/ton) gold ore at Partin Creek (figure 3, No. 18) and silver-lead-tin ore at Ready Cash. In the no. 4 vein of the Ready Cash property (figure 3, No. 19), for example, average grade is about 22 oz/ton silver, 4 percent lead, and 0.5 percent tin over a 3.3-foot vein width.

In the Boulder Creek or Tonzona district, reserves of less than 10,000 tons are present at Jiles-Knudson prospect (figure 3, No. 5) (tin) and at the Mespelt vein (figure 3, No. 4) (silver-lead-tungsten). Larger identified resources are present, and the area is essentially unprospected for deposits in ultramafic rocks reported by Reed (B. L. Reed, Geological Survey communication, 1977) or metalliferous layered rocks of the Kantishna trend cut by the Tonzona intrusive.

Placer reserves exist in unmeasured amounts at Kantishna--with relatively small, rich placer deposits exemplified by Glen Creek (figure 3, No. 13) and larger yardage possibilities in lower Caribou and Moose Creeks nearby. In the

Yentna district, exploration has been sufficient to indicate reserves in the 1,000,000-10,000,000 yard class in Cache and Peters Creeks (figure 3, No. 23) and at Collinsville (figure 3, No. 24). Less well explored creeks with similar size potential include Dutch, Bear, Camp and Cottonwood in the Peters Creek area (figure 3, No. 23).

CONCLUSIONS

The number of mineral occurrences and their wide distribution suggests, as would be inferred from its geologic setting, that the Mt. McKinley region is relatively well mineralized. Although other nearby regions in Alaska appear to have more potential for copper or molybdenum deposits, the Mt. McKinley region has a high potential for deposits of gold, silver, antimony, and also has a likelihood for deposits of relatively rare, strategic or critical minerals including tin, tungsten and beryllium.

Perhaps the most significant new development in the region is the recognition of the potential for stratiform deposits in both carbonaceous and metavolcanic units of Paleozoic age. Although only by inference, the recognition of metalliferous beds offers a clue to the origin of the high-grade depsoits formed by hydrothermal reworking of ancient metalliferous beds during Cretaceous or early Tertiary time.

The stratiform zinc occurrences in shale and metalliferous volcanics and the deposits of relatively rare metals, such as tin, have essentially been recognized only since 1969. None can be realistically assessed with present knowledge, but several of the exposed deposits are of the type which would ordinarily justify further exploration.

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