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A Perspective of Mining Exploration in Yukon & Northern B.C.

by A. E. Aho.

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A PERSPECTIVE ON MINERAL EXPLORATION

IN THE YUKON TERRITORY AND ADJACENT NORTHERN BRITISH COLUMBIA.

(GC)

To accompany Geological Map of Yukon Territory, Map 1048, 1957. Prepared for the Sixth Commonwealth Mining and Metallurgical Congress, September, 1957, by Aaro E. Aho, Geological Engineer.

INTRODUCTION

Physiographically, Yukon and adjacent northern British Columbia consist of an interior plateau region bounded on the southwest by the StElias and Coast Mountains and on the northeast by the Ogalvie, Selwyn, and Mackenzie mountain systems. Within the plateau area are the Cassiar, Pelly, and Dawson Range mountains. Access to the region and within it is provided by airlines to Whitehorse, Mayo, Dawson; by the White Pass and Yukon Railway from Skagway to Whitehorse; and by the Alaska Highway, the Haines Road, the Mayo-Dawson-Sixtymile road citcuit which rejoins the Alaska Highway in Alaska, the Atlin road, and the Canol road which leads inland but is virtually impassable at present.

Yukon and northern British Columbia comprise one of the largest undeveloped regions of Canada with ready access to ice-free tidewater ports. Most of the Yukon and northern British Columbia is within 400-mile radius of Skagway, Alaska or other ocean port offering year-round access to cheap water transportation and world commerce such as few other parts of Canada can rival. The Hydroelectric power potential of coastal regions from the Stikine in B.C. to Alsek River in Yukon is several times that of Kitamat, B.C. and is one of the cheapest sources of hydroelectric power in the world. Behind this coastal region, the interior plateau areas are ideal for development of major transportation routes.

with mountain passes leading to the coastal ports or to the eastern plains, and with the interior plateau and Rocky Mountain Trench system providing good routes to the south.

The chief detriment to development of this region in the past has been remoteness, inaccessibility, lack of population, and therefore the resultant high costs. Within the past ten years the Alaska Highway, the Canol road, the Haines road, the Atlin road, the Mayo-Dawson, road and the Cassiar road have helped greatly to open up the country and considerable mineral wealth has consequently been discovered. This is the period in which the mines of United Keno Hill and Cassiar Asbestos have proven very successful. Several large, lower-grade base metal deposits have also been found but these have remained undeveloped as yet, largely because transportation costs to existing smelters are too high. With additional discoveries of large enough tonnages, however, more roads or railways could be built, transportation costs could be decreased,and smelters and other industries might be developed using hydroelectric power, Further development of this region and its recourses therefore appears assured as Canadian industry and economy expand.

HISTORICAL BACKGROUND.

Mineral exploration in the Yukon was sparked by the great discovery of the Klondike gold fields by Robert Henderson and George Carmack in 1897. Gold mining experienced a boom with several tens of millions of dollars per year being produced from the Klondike area and with lesser placer disvoveries being made. Numerous creeks in nothern British Columbia and the Yukon also produced placer gold, notably from the Cassiar and Atlin districts of B.C. and from Livingstone, Scroggie, Henderson, Thistle, Miller, Clear, Highet and Haggart Creeks, the Sixtymile River, the Carmacks area, and from other creeks including those of the Kluane Range. Numerous hard-rock discoveries were made also by the stampeders: for example, the gold, gold-silver-lead, and antimonyveins of

Placer fields.

Klondike
Cassiar
Atlin
Livingstone
Scroggie
Henderson
Thistle
Miller
Clear
Highet
Haggart Cks
Sixtymile R.
Carmacks

metamorphic copper deposits of Aishihik Lake (7), the Whitehorse Copper Belt (5), and the south end of Atlin Lake; the gold, silver-lead, and zinc deposits near Cassiar, in B.C. (1); the silver-lead, gold, and copper showings of the belt from Livingstone Creek to Boswell River (40 miles northeast of Whitehorse); and a few gold veins in the Klondike and other areas. Only the Whitehorse copper belt, Windy Arm, and Tagish Lake properties, near the costal region, produced any ore.

Discovery of the rich Keno Hill silver-lead veins by Louis Beauvette in 1916 sparked a local prospecting and exploration boom in the Mayo area in the 1920's. This resulted in eventual development of several successful mines on Keno and Galena Hills, which ship concentrates by sternwheelers down the Stewart River and up Yukon River, then by rail to Skagway and by ship to smelters. Mining activity in this area continued intermittently until World War II with new discoveries being made from time to time. Prospecting of nearby areas revealed other lower-grade silver-lead deposits, notably in the Beaver River area.

Meanwhile, gold production had been declining since the Bonanza days of the early 1900's when the Yukon Gold Company of the Guggenheims installed dredges in the Klondike area. In the early 30's, however, the depression brought renewed strength and Yukon Consolidated Gold Corporation was born. Gold-quartz veins of the Brown-McDade and Laforma properties were discovered in the Carmacks area in the latter 1930's.

However, mineral production, population, and interest in the Yukon declined gradually and the early years of World War II intensified this decline until the Japanese threat in the Aleutian Islands spurred construction of the Alaska Highway and other military installations.

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interesting developments. United Keno Hill Mines were brought into production and the Mayo-Dawson road was built. American Smelting and Refining Company's lead-zinc deposit near Hyland River (4) and the Hudson Bay Exploration and Development Company's lead-zinc deposit near Macmillan Pass (14) were discovered and explored, but remain uneconomic at present. Cassiar Asbestos (1) was discovered in 1950 and brought into production, and the Cassiar road was built. The Atlin road was constructed. The Hudson Bay's Wellgreen nickel property at Quill Creek (8) was discovered in 1952 and explored until 1957. The resultant prospecting rush led to discover of the Canalask nickel deposit at White River (10) which is presently being explored underground with encouraging results. The Dawson road was built in 1953. Prospector Airways' lead-zinc deposit at Vangorda Creek (12) was discovered in 1953 and has been explored until the present time. The Ketza River silver-lead veins (9) were discovered largely in 1954 and have been explored and prospected until the present time. A zinc-lead deposit at Kathleen Lake, northeast of Mayo, was explored in 1955. Newmont's copper property at Wasson Lake (6) was staked in 1955 and has been explored until the present time. A short fibre asbestos property at Cassiar Creek, northwest of Dawson, was staked in 1955 and explored by Conwest in 1956. The resultant prospecting there led to discovery in 1957 of the more promising long-fibre asbestos deposit at Clinton Creek (16), which was explored by Conwest and now by Cassiar Asbestos who have taken over its development.

In spite of the apparently impressive amount of prospecing done in recent years, large parts of this vast region have been untouched and very few parts have been prospected in detail. A very large proportion of t he region is covered with talus or other overburden even in the most rugged mountains so that ore deposits, usually associated with zones of weakness, are very apt to be c"ered. Very detailed prospecting aided by geophysics and geoche estry is required to discover such deposits. The weathered mantle which covers nearly the entire surface in the unglaciated areas is particularly difficult for prospecting.

Other prospecting disadvantages or difficulties are the short effective prospecting season, limited to three or four months; the permafrost which hinders surface work in the northern and high altitude areas; and the lack of lakes or easy, cheap transportation routes in much of the region, especially in the unglaciated section where lakes are absent. The Cassiar-Stewart road now being constructed will change the economic picture in that region and open up much new country for prospecting. A projected new road across the Ogalvie Mountains to Eagle Plain would also open much territory. Improvement of the Canol road will soon provide access to the centre of the largest, favourable, unprospected part of the territory. The largest percentage of prospects in the Yukon are within a few miles of the main transportation routes which points to the need for more transportation and to the potential of the more inaccessible areas.

E.O.C

Modern prospecting methods using geochemistry, geophysics, photo geology, airborne equipment, helicopters, and other tools promise to offset some of the difficulties of this region.

.....GEOLOGIC ENVIRONMENT AND FUTURE MINERAL POTENTIALTIES.....

In general, the geologic environment of the Yukon and adjacent northern British Columbia is similar to that of the southern one-third of British Columbia, which has produced over three billion dollars' worth of mineral wealth, with promise of much more, chiefly from base metal deposits developed after the precious

metal deposits were exploited. Yukon and northern British Columbia, a much larger and more varied region, has by comparison produced chiefly precious metals and only recently has begun to produce silver-lead and asbestos, still products of high unit value, with no base metal mining as yet. To date the total production of Yukon is about a third of a billion dollars, mostly in gold; the present annual production is about 10 to 12 million dollars in silver-lead and 2 million dollars in gold, chiefly from United Keno Hill and Yukon Consolidated Gold Corporation respectively. It therefore seems quite reasonable to expect that this region will someday match or even outstrip southern British Columbia in production, especially since the patterns of geology and sequence of discoveries appear to be developing similarly. Even with little or no mapping of some of these regional units, major structural features generally favourable for ore deposits and similar to those in established mining camps can be noted. With the various degrees of complexity of rock types and of structure there is certainly a suitable environment for major ore deposits provided that mineralization is present. The discovery of considerable variety and quantity on mineralization in numerous parts of these areas, even with limited prospecting to date, shows that the requisite mineralization is indeed present and therefore it is statistically very probable that all the conditions necessary for occurrence of a number of major ore deposits are fulfilled.

The rocks of most of Yukon and adjacent northern British Columbia vary from sediments to volcanics. They are folded and metamorphosed to varying degrees, are intruded by a great variety of plutonic rocks ranging from acidic to ultrabasic in composition and from plugs to batholiths in size, and are cut by numerous regional and local faults. For convenience, the geologic and structural units can be subdivided and discussed as follows:

(a) St. Elias mountains, bounded on the northeast by the regional Shakwak valley fault zone:

This extremely high and rugged southwestern corner of Yukon is little explored, except at its fringes. Much of it is difficult to operate in. On the Alaskan side the Kennicott copper deposit testifies to the copper possibilities, and

(a) numerous copper discoveries in the area provide further encouragement. Basic and ultrabasic rocks along the Kluane Range have also yielded nickel-copper discoveries of which the most important are Hudson Bay's Kellgreen property (8) at Quill Creek (a out 700,000 tons of 2.4% Ni 1.34% Cu, plus cobalt and platinum group metals); and the promising Canalask deposit (10) at White River. Gold silver-lead, native copper, and other minerals including gypsum and coal have also been discovered. Hudson Bay have drilled other copper and nickel properties in this region and Teck Exploration drilled a copper-zinc deposit at Jarvis River in 1956. The area might also yield magnetite iron ore. Copper and nickel, however, might be considered the best economic possibilities.

(b) The Coast Mountains batholithic and metamorphic belt, branching into the Dawson Range:

The northeast contact of the Coast batholith from Tulsequah through Whitehorse to Aishihik has been locally well prospected, and numerous contact metamorphic copper deposits with magnetite have been discovered, notable at the south end of Atlin Lake; in Whitehorse copper belt (5) which once produced $2,711, 695 in copper; and near Aishihik (7). While they tend to be irregular, some of these deposits may well prove economic. Gold-silver-lead-zinc veins have also been explored, of which those of the Wheaton-Windy Arm districts (3) and the Atlin-Ruffner property near Atlin (2) are best known. The Windy Arm district has produced over $140,000 in gold, silver, and lead. Of the numerous gold properties, only the Engineed Mine on Taku Arm has produced significantly (over $330,000). Antimony veins and occurrences of tungsten, zinc, and nickel are also known.

This area is similar in geology and potential to the Coast Mountains belt of B.C. that has produced Britannia, Granduc, Pioneer, and Premier mines, the Tulsequah mines south of Atlin have been producing about $150,000 worth of gold-silver-lead-zinc-copper ore annually but were closed down recently. Many copper prospects in Tulsequah and Stikine regions of B.C. hold promise for this type of mineralization.

Copper, gold-silver-lead-zinc, and nickel appear to be

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EXPLORATION ACTIVITY IN 1957.

Twenty or more mining and exploration companies have been active in Yukon and adjacent northern British Columbia in recent seasons. In 1957 the following companies were active partly or chiefly in the areas mentioned:

1. American Metals - Stikine River region, B.C.
2. Asbestos Corporation - Helicopter prospecting of Serpentine belts, mainly from Dawson, Yukon.
3. BIK Syndicate - Helicopter prospecting Stikine River region B.C.
4. British Yukon Exploration - Prospecting Pelly Mountains & from Dawson, Yukon Trenched and drilled silver-lead vein at Seagull Creek in Pelly Mountains
5. Canadian Explorers - Trenching and preparing to drill millerite nickel property SE of Atlin, B.C.
6. Canalask Explorers - Underground exploration of nickel property at White River, Yukon.
7. Canex (Canadian Exploration) Prospecting chiefly from Dawson, Yukon and exploring asbestos claims at Clinton Creek, Yukon.
8. Cassiar Asbestos - Mining asbestos at Cassiar, B.C. and exploring asbestos deposit bought from Conwest at Clinton Creek NW of Dawson, Yukon.
   - Also holding asbestos deposit at Cassiar Creek between Dawson and Clinton Creek.
9. Conwest - Prospecting
   - Trenching asbestos deposit at Clinton Creek NW of Dawson, Yukon.
   Exploring silver-lead veins underground with adits at Tootsee Lake, B.C. (Mi. 701 Alaska Hiwy)
   - Trenched and drilled Letain asbestos property SE of Cassiar, B.C.
10. Continental Mining Corp. (formerly Newkirk) - Prospecting
11. Galkeno (Newkirk) - Mining silver-lead ore on Galena Hill near Mayo, Yukon. Drove part of lower level.
12. Gaymont (Teck HUghes) - Prospecting
13. Moneta Porcupine - Prospecting northern B.C. and Alaska.
14. Newmont - Prospecting in Yukon & Stikine River region, B.C.
    Drilling copper property at Wasson Lake, Yukon.
15. Northwestern Exploration - Helicopter prospecting Stikine River region, B.C.
16. Peel Plateau - Drilling for oil in the Eagle Plains concession.
17. Prospector Airways - Prospecting & exploring claims, Macmillan plateau
18. Texas Gulf Sulphur - Exploring Vangorda Creek, Yukon lead-zinc deposit
    - Stikine River region and Alaska
19. Transcontinental Resources - Mining placer gold at Nolan Lines, Atlin, B.C. and interest in Yukon Placers (below)
20. United Keno Hill Mines - Mining silver-lead ore on Galena Hill near Mayo, and exploring vicinity and Keno Hill.
    - Mining domestic coal at Carmacks.
21. Yukon Consolidated Gold Corporation - Mining placer gold in Klondike goldfields.
22. Yukon Placers - Mining placer gold on Sixtymile River, Yukon.

In contrast to the above number of companies the independent prospectors have been progressively diminishing in numbers due to economic and political factors yet most of the important discoveries have been made by individuals. Many individuals and small syndicates or companies also contribute considerably to development and production of placer gold and occasionally other metals.

(b) the best possibilities in this area, several properties of which may well become mineable with substantially better economic conditions. The potential of the less accessible area northwest beyond Aishihik is still unknown since it is relatively unprospected.

(c) Laberge Mesozoic geosynclinal trough, cut by the Teslin trench:

This area of Mesozoic sedimentary and volcanic rocks contains a few showings and some short asbestos but its important resource is coal. The reserves are largely unknown and perhaps much larger than estimated. This is resourse is well situated for development in the more accessible central part of the region.

(d) The Dawson Range batholithic and metamorphic area which supplants the Laberge geosyncline on the northwest as does another similar area around Atlin, B.C.

This region has received very little prospecting even to date because of difficult access, and overburden due to unglaciated terrain. Gold, tungsten, silver-lead, and copper have been discovered, of which the Brown-McDade and Laforma gold properties are most important but uneconomic at present. A copper discovery at Big Creek was drilled by Teck Exploration in 1955 but proved unsuccessful. Apart from the vicinity of these discoveries, much of this unglaciated area remains virtually unprospected. Geochemistry should be very useful here.

(e) The Klondike and Sixtymile granitic and metamorphic region bounded on the northeast by the regional Tintina Valley fault trench which separates it from the Mayo area:

This famous region is very similar to the Dawson Range in regional geology, lack of glaciation, and lack of prospecting other than for placer gold, even though it is more accessible now by roads and rivers. It lies along the projection of the main structural backbone of the Yukon and therefore constitutes favourable prospecting ground. Apart from production of about $230,000,000 in gold, the mineral potential is largely

(e) unknown. A few small silver-lead, copper, and antimony deposits have been found by cursory prospecting but only in 1956 and 1957 was the interest in base metals awakened here, so as yet little or no prospecting has been done. The asbestos discoveries near Dawson hold much promise for the serpentine belt that extends along the northeast border of the Klondike area.

(f) The Cassiar-Pelly mountains batholic and Precambrian metamorphic belt, incorporating folded and intruded Paleozoic strata on the east which are cut by the Tintina Valley fault trench:

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Bounded on the northeast by this Rocky Mountain Trench-type structure, the Cassiar batholithic and metamorphic structural belt extends, branching, through the Pelly Mountains northwest into the Glenlyon Range; and some structural trends such as the ultrabasic belt and the regional fault trench can be traced even past the Klondike area. This vast regional belt forms the main structural backbone of the Yukon just as its southward extension forms a similar backbone through British Columbia into Idaho. Mines along this structural region include the Coeur d'Alene silver-lead camps of Idaho, the Sullivan Mine at Kimberley, the Cariboo goldfields, the Cassiar Asbestos, and, if the belt is extended, the Klondike and Dawson. The complexity of the region in the Yukon can be considered favourable. Numberous prospects have been discovered along it even though many areas remain unprospected, and it may well turn out to be the chief metalliferous province of the region.

This belt has already yielded one million dollars in placer gold from Livingstone Creek, gold from the Liard River, asbestos from Cassiar, B.C and, if it can be considered a related part the gold from the Klondike and adjacent areas. Newmont's new copper property at Wasson Lake (6) near Liard River, and numerous other copper prospects have been found along this belt. Zinc-lead replacement deposits include Hudson Bay's Logjam Creek property and nearby showings near Swift River, Yukon, Haskins Mountain near Cassiar, B,C. and others.

(f) Silver-lead showings are numerous, such as Prospector Airways' Little Salmon Lake property, the Ketza River properties (9), Conwest's Tootsee Lake property in B.C. (1) & at Cassiar, B.C.

One of the most important potentials of this region is asbestos which has been discovered in several places along a very well defined belt, of ultrabasic bodies extending from the Cassiar Asbestos Mine through the former Bell Asbestos property at Quiet Lake, through Little Salmon Lake, through the White Mountains where asbestos is reported, and on through the Klondike to Cassiar and Clinton Creeks northwest of Dawson where recent large discoveries of low grade and high grade asbestos are now held by Cassiar Asbestos Corportation. This asbestos belt is one of the best defined areas in either glaciated or unglaciated areas.

On the northeast side of the regional Rocky Mountain trench and Tintina Valley fault trench which bound the Cassiar and Pelly Mountains belt, two major low grade lead-zinc finds have been made; the A.S. & R. deposit at Quartz Lake (1¼ million tons of 15% combined lead and zinc with a few ounces per ton of silver), and the Prospector Airways' Van-Gorda Creek deposit (10 million tons of 6% combined lead and zinc) (12) This is the type of deposit that will most likely revolutionize the region when sufficient tonnages are found.

(g) The Pelly, Macmillan and Hyland Plateau of Precambrian to Mesozoic rocks with local intrusions up to batholithic size:

This area has been prospected only recently and not extensively. Several discoveries of copper, silver-lead, and lead-zinc have been made but nothing sizeable has been found yet. The rolling, wooded terrain tends to discourage some prospectors and the difficulty of access leads to preference for other areas; therefore the potential remains unknown.

(h) The Mayo Precambrian area with the northwest and eastwest major folds and minor intrusions:

The rich silver-lead mines of the Mayo district have produced about $100 million worth of ore from veins which occur in an area where a south plunging anticline of the normal northwestern trend of the Cordillera is intersected by an

(h) east-west anticlinal structure. Elsewhere along this east-west trend the structure is punctuated by granitic stocks with associated gold, silver-lead, tin, tungsten, etc. This mineralized structural cross trend has not been adequately prospected yet and its true potential is unknown, It bears a marked resemblance to the mineralized structural trend which extends westward from the Uinta Mountains of Utah, U.S.A. and which contains the gold, silver-lead and copper deposits of Park City, Ophir and Bingham respectively.

Silver-lead mineralization in the adjoining Beaver River area may be regionally related.

The Mayo area may well contain other rich mines. Being partly unglaciated and therefore mantled with overburden, it has not been closely prospected.

(i) The vast Ogalvie and Selwyn mountain systems of the sedimentary and volcanic rocks with local intrusions, stretching to and forming the continental divide, and bounded locally on the northeast by Rocky Mountain Trench-type fault zones:

These ranges which extend to and beyond the continental divide are composed of sedimentary and metamorphic rocks intruded locally by small stocks and even batholiths to the southeast. Structural trends appear to be largely northeasterly but there are variations, as at Kathleen Lake and Rackla River where a northeasterly cross-trend predominates around a domal uplift in the Wernecke Mountains. This vast, relatively remote region has been only slightly prospected and little is known of its true potential. However, discoveries of silver-lead in several localities; copper veins as in the Hart and Wind River areas; and lead-zinc deposits as at Kathleen Lake northeast of Mayo, and at Macmillan Pass (13)(a minimum of 10 million tons of 5 to 6% combined lead and zinc); show that potential could be large. Fluorite and barium slats have also been explored and are now held by Conwest at Liard Hot-springs on the Liard River in B.C.

Hematite float found in some of the rivers, chiefly in the Ogalvie and Selwyn Mountains, holds promise for a Lake Superior-type sedimentary iron ore deposit. The consistent, reliable reports of this float and even of small low-grade

(i) Hemitite outcrops by technical personnel are encouraging to further prospecting.

(j) The Mackenzie Mountains are folded and faulted marine sedimentary rocks, chiefly of the Palaozoic age, similar to the Rocky Mountains of British Columbia:

The Mackenzie Mountains are chiefly composed of sedimentary rocks with little or no intrusive or mineralization. However, copper mineralization of the same type as at Hart and Wind Rivers is reported in association with the greenstone sills; and there is also a possibility of lead-zinc deposits.

(k) The Arctic slope, Richardson Mountains, and Mackenzie River area of Yukon and Northwest Territories, with folded and flat lying marine and sedimentary rocks:

The vast hinterland of flat and rolling country here, with folded and flat-lying rocks extending in a 700- or 800-mile arc in a radius of 400 or 500 miles from Skagway, is largely potentially oil bearing, except for the more mountainous sections. Coal might also be expected here, and some metals are known in the British Mountains to the north. The known occurrences of oilfields in the Plains Region from Texas to Alberta should give some indication of the future potential of this vast northern extension of the geologic province. The oil and natural gas development experienced in recent years in Alberta and northeastern B.C. can be expected to spread northward. The occurence of oil at Norman Wells, the terminus of the former Canol pipeline, and in the promising areas in Eagle Plains is only a beginning. Several large oil companies are studying the region and when exploration results warrant it, the region will be drilled, discoveries can be expecged, and pipelines will be built. A short Canadian pipeline route through Yukon to the coast and to world markets would be most central for oil fields of this northern Plains area and would help greatly in development of the mineral resources of the territory.

COSTS

Exploration costs in Yukon and Northern British Columbia are higher than in more accessible areas. E.O.Chisholm has summarized costs of exploration (Can. Min. Jour. April 1956, pp63-68) and pointed out that the overall cost of a well managed exploration campaign for one season in the Yukon, employing three parties headed by experienced geologists, would be of the order of $50,000. Exploration of isolated properties will run considerably higher. At that time some 22 million tons of base metal reserves valued at about $600 million had been discovered at a cost of about $9 million, or about 40¢ per ton of indicated ore. Further discoveries of reserves have averaged about the same in cost of exploration, which is reasonably low. It can be expected that the pace of discovery may increase substantially in the future.

Costs of mine development are somewhat higher than in more accessible and populated areas.

Costs of mining and milling at Keno Hill are of the order of $20 per tom of ore, and transportation costs to the smelters are about $45 to $50 per ton of consentrates. Smelter charges for this type of ore are about $15 per ton. With the large base metal deposits, using open cut methods, the mining and milling costs could be cut to less than $5 per ton, and transportation could be lowered from 7 or 8¢ per ton mile for trucking to about 3¢ per ton mile for large enough deposit using a railway. It seems likely that developments in the next few years may justify smelter installation in this region, thus cutting costs very considerably. With groth of a more stabilized mining industry, many costs can be expected to decrease, making many mineral deposits economical.