

STATEMENT OF NEED AND REASONABLENESS

IN THE MATTER OF THE PROPOSED AMENDMENT OF THE  
RULES REGARDING PERMITS TO PROSPECT FOR AND  
LEASES TO MINE COPPER, NICKEL AND ASSOCIATED  
MINERALS (6 MCAR § 1.0094)

STATE OF MINNESOTA  
DEPARTMENT OF NATURAL RESOURCES

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STATEMENT OF NEED - AMENDMENT OF RULES REGARDING PERMITS TO  
PROSPECT FOR AND LEASES TO MINE COPPER,  
NICKEL AND ASSOCIATED MINERALS  
(6 MCAR SECTION 1.0094)

INTRODUCTION

On November 8, 1966, in accordance with Minnesota Statutes 1965, Sections 93.08-93.12 and 93.25, the Commissioner of Natural Resources, with the approval of the State Executive Council, adopted rules and regulations regarding "permits to prospect for and leases to mine copper, nickel and associated minerals." These rules, NR 94 (subsequently numbered 6 MCAR Section 1.0094), promote and regulate prospecting for, mining and removing copper, nickel and associated minerals from lands wherein an interest in the minerals is owned by the state.

Since the adoption of these rules, the state has held six copper-nickel lease sales. In total, 2,143,923 acres of state-owned mineral rights were offered for leasing; and this resulted in the issuance of 1,044 leases, covering 425,313 acres, to 22 companies and individuals. These leased lands were in the counties of Beltrami, Cook, Itasca, Koochiching, Lake, Lake of the Woods, Marshall, Roseau and Saint Louis.

In general, the lessees have made their preliminary evaluations of the leased properties within the first two years of the leases and, therefore, most of the leases are surrendered during that period. As of December 1, 1981, only 15 leases, covering 4,449 acres, were still in effect.

The copper-nickel leasing program has resulted in the payment of 1.66 million dollars of rental to the state as of December 1, 1981. As a result of the exploration conducted under the leases, representing an investment of over 25 million dollars by the exploration companies, the state has received an immense amount of geological, geophysical and geochemical data. This valuable information is used when the Department of Natural Resources makes management decisions to implement legislated mineral and other land use policy. With this data, actions are avoided

which could otherwise adversely affect future exploration, leasing and mining of state-administered mineral lands.

Mining companies, by exploring public and privately owned lands, have discovered large copper-nickel deposits, as well as significant amounts of titanium, iron and vanadium in the Duluth Gabbro Complex. Resource estimates indicate over 4.4 billion tons of copper-nickel deposits, of which approximately 1 billion tons are on state-owned land, occur along the northwestern basal contact of the Duluth Gabbro Complex in northeastern St. Louis and northwestern Lake counties.

Although no mineable deposits have as yet been found on state land in Minnesota's Greenstone formations, significant showings of iron, zinc and copper have been located. Interest in the Greenstone and other formations has continued to be demonstrated by a number of exploration companies.

The last state copper-nickel lease sale was held in 1973. The Environmental Quality Council (renamed the Environmental Quality Board) initiated in 1974, a regional study regarding the potential social, environmental and economic impacts associated with copper-nickel mining. The study covered a limited portion of the Duluth Gabbro Complex. The EQC imposed a moratorium on the acceptance of any site-specific environmental impact statements on any copper-nickel mining development proposal prior to the completion of the study. As a result of this action, the state lease sales were suspended during the period of the study.

Following completion of the "Regional Copper-Nickel Study" in the fall of 1979, the Department contacted the State Executive Council for its approval for the Department to hold a state copper-nickel lease sale. In response the Executive Council requested that the Department first amend the existing royalty provisions of 6 MCAR Section 1.0094 to address the possibility of what is colloquially referred to as a "bonanza" mineral deposit.

The term "bonanza" in the present context refers to an unusually high grade mineral deposit of significant size. With such a deposit, a mining company may

realize "windfall" profits, which are profits remaining after subtracting the normal profits that are necessary to induce investment in this industry. Under certain circumstances, a windfall profit situation may also briefly arise when the price of a metal increases substantially as a result of speculation or brisk demand in boom times.

In order to address a possible "windfall profit" situation, the Department reviewed royalty systems of base metal producing states and foreign countries, and various studies on the base metal mining industry. The Department presented this research to the State Executive Council and on August 22, 1980, recommended that the state continue the present royalty rate structure and add a "special royalty rate" for ore value exceeding \$50.00 per ton, of an extra .04% on each dollar increase in ore value. In order to account for inflation, it was also recommended that the \$50.00 be indexed to reflect changes in the refined metal prices for the ore produced. The State Executive Council approved this proposed special royalty rate structure.

After development of the language of the proposed amendment to the state copper-nickel rules, the Department solicited outside opinion on the proposed amendment. (The notice to solicit outside opinion was published in the State Register on June 22, 1981.) The responses from the public identified two concerns which seemed significant, and the Department saw the need to amend the proposed special royalty rate to address these concerns.

At the December 15, 1981 meeting of the State Executive Council, the Department recommended that the special royalty rate proposal be amended to index the special royalty rate of .04% to reflect the price changes in the metal market. The effect of this indexing is that the percentage change in the amount of special royalty payable will be the same as the percentage change in the metal prices. The Department also recommended that when the special royalty amount due for any calendar month exceeds 20% of that month's value of the metals and mineral products recovered in the mill

concentrate, the lessee may apply to negotiate a modification of the special royalty rate for the amount exceeding such 20%. The State Executive Council approved these modifications to the proposed special royalty rate structure.

The Department's amendment of 6 MCAR Section 1.0094, as now proposed, is limited to adding a special royalty rate provision to the state copper-nickel leases to address the possibility of a windfall profit due to a high-grade deposit or to substantial increase in the price of a metal or metals. No other changes in 6 MCAR Section 1.0094 are intended at this time.

#### I. EXISTING ROYALTY RATE STRUCTURE

The state copper-nickel leases are primarily issued through public sale with competitive, sealed bidding. For each lease, the applicants submit a bid royalty rate which is in addition to the basic royalty rates specified in the state leases in accordance with 6 MCAR Section 1.0094. The leases are awarded by the Commissioner of Natural Resources, with the approval of the State Executive Council, to the highest bidder for each lease. No bids are accepted that do not equal or exceed the basic royalty rates specified in 6 MCAR Section 1.0094 and the state reserves the right, through the Executive Council, to reject any or all bids.

The state copper-nickel leases provide that a lessee pays an annual rental and, whenever metals and mineral products are recovered from the ore mined and processed, a royalty on such metals and mineral products. The annual rental, which increases during the first ten years of the lease, is payable throughout the term of the lease, but under certain circumstances the rental can be credited toward earned royalties. The royalty rate consists of a base rate, an additional rate equivalent to the base rate on that portion of the value of the metals and mineral products recovered in the mill concentrate exceeding \$17 per ton of dried crude ore, and the bid rate.

The royalty rates are a percentage of the value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore mined.

This royalty rate mechanism has a built in escalation provision since it is tied to the market prices of metals and adjusts for the fluctuations in those prices.

The state copper-nickel lease provides that the base royalty rate increases during the term of the lease and the rate also varies according to whether ore is being mined by underground or open pit methods. For ore mined by either underground or open pit methods during the first ten years of the lease, the base rate is 2% of the value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore. For ore mined by underground methods, the rate increases an additional 1/4% for each subsequent ten-year period. For ore mined by open pit methods after the first ten years of the lease, the base rate is 33-1/3% greater than the base rate for mining by underground methods.

The additional royalty rate, which is equivalent to the base rate and changes as the base rate changes during the term of the lease, becomes applicable when the value of the metals and mineral products recovered in the mill concentrate exceeds \$17 per ton of dried crude ore. When 6 MCAR Section 1.0094 was adopted in 1966, ore valued in excess of \$17 per ton was considered high-grade ore.

The bid royalty rate is also a percentage of the value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore. This rate does not change during the term of the lease.

## II. THE NEED FOR A "SPECIAL ROYALTY" PROVISION

There are two main reasons why a "special royalty" amendment to the existing rules and regulations on copper-nickel mining in Minnesota is needed: (a) as landowner, the state has a legitimate right to share in the windfall profits derived by the mine operator from the discovery and development of high-grade mineral deposits on state lands or derived from metals price increases due to speculation or boom times; and (b) discoveries outside Minnesota (in Canada, Wisconsin and elsewhere) have indicated that potentially richer and more diverse mineral deposits

might be found in the Greenstone and other geological formations.

(A) Anticipating Windfall Profits

Firms operating in extractive industries may realize various kinds of "windfall profits". These are defined as profits remaining after subtracting normal earnings (or normal profits) which are necessary to induce investment in these industries, including rewards for capital risks.

These windfall profits may be realized when the mining firms strike exceptionally rich or high-grade ores. The high profits arise because the operator will receive more revenue for a higher grade of ore, while capital, operating and overhead costs will be about the same as for mining ore of an "average" grade. Although it must be recognized that unusually high-grade deposits of a significant size are extremely rare and it is highly unusual to find such deposits, the state ought to have a mechanism whereby, as landowner, its rights may be properly protected should such a possibility ever become a reality.

As mentioned previously, a windfall profits situation could also occur when metal prices received by the lessee increase substantially because of speculation or brisk demand in boom times. However, such increased prices are usually for a short duration. The mine operator could receive substantial benefit in this type of situation in regard to the precious metals, but normally precious metals are only a relatively minor by-product of a base metal operation.

(B) Anticipating the Discovery and Development of Richer Deposits

When the copper-nickel rules and regulations were adopted in 1966, the royalty provisions were partly based on known copper-nickel deposits in the Duluth Gabbro Complex. Since that time, further discoveries in the Duluth Gabbro Complex and in the Greenstone formation outside Minnesota have shown the potential for a more diverse mineral deposit with a higher value. The Kidd Creek mine near Timmins, Ontario indicates the possibility that an unusually high grade mineral deposit of a significant size might be found in Minnesota.

The value of ore does not depend solely on the primary ore grade, recoverability factor and market price of the contained primary metal. It is also determined by the presence or absence of the by-products or co-products associated with the primary metal, as well by their grades, recoveries, and market prices.

For example, using a "Greenstone Mine Model" (Ref. 6, p. 5-1), the value of ore obtained from such a diverse mineral deposit has been estimated to be worth about \$79 per short ton in 1981. This value can be converted to a "copper equivalent" amount by dividing the total value by the prevailing price of copper. Based on the 1981 average domestic producer price (f.o.b. Atlantic Seaboard) of about \$0.75 per pound of refined copper, \$79 is equivalent to about 105 lbs. of refined copper, which is equivalent to an average copper "grade" of 5.9 percent (assuming a mill recovery rate of 90%). Compared to the 1979 average yield of 8 lbs. of refined copper per ton of porphyry copper actually mined in the U.S. (Ref. 7, p. 13), this copper-equivalent grade of 5.9% represents a very "high grade".

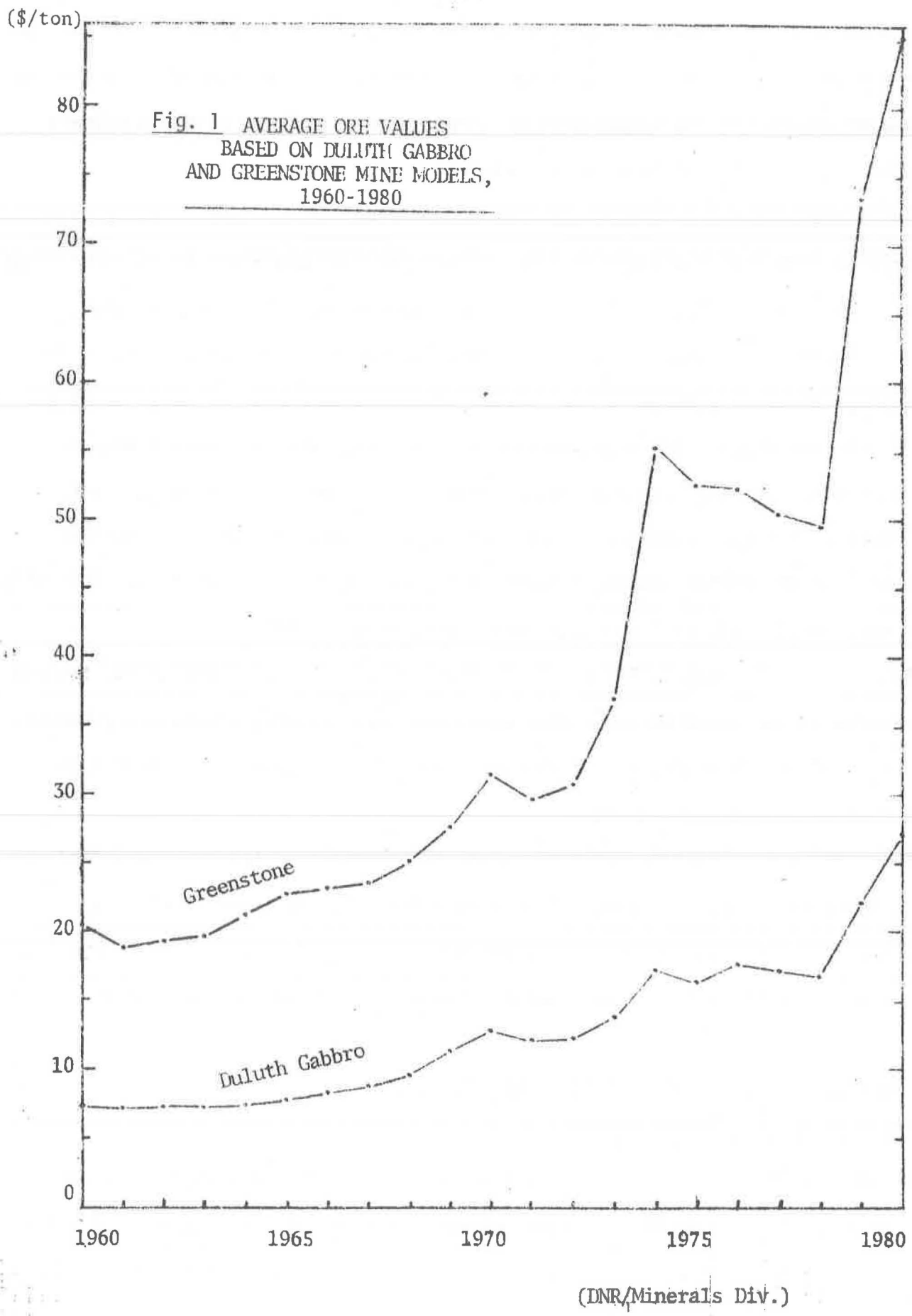
Also, as can be seen in Figure 1, in the twenty-year period 1960-1980, the ore value estimated for the Greenstone Mine Model has been not only consistently higher, but also has been increasing at a higher rate than that estimated for the Duluth Gabbro Mine Model (Ref. 6, p.5-11).

Thus, there is a need to amend the state copper-nickel rules and regulations to address the possibility of a windfall profits situation. It is only fair and reasonable that the state, on behalf of the trust and tax-forfeited funds, share in any windfall profits derived from a deposit found on state-administered land.

### III. PROPOSED "SPECIAL ROYALTY" RATE AND ITS IMPACTS

#### (A) Special Royalty Rate Structure

To address the possibility of a high-grade deposit, the Department proposes to add a special royalty rate to the state copper-nickel leases. This special royalty will be in addition to the existing base and additional royalty rates specified in 6





MCAR Section 1.0094 and any bid royalty rates.

The special royalty will start to apply when the value of the metals and mineral products recovered in the mill concentrate exceeds the special royalty base. The amount of special royalty that will be payable for ore mined and removed from the leased lands will be calculated by multiplying the special royalty rate by that portion of the value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore that exceeds the special royalty base.

The special royalty rate will be .04% of that portion of the value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore that exceeds the special royalty base. Furthermore, the special royalty rate will be subject to increase or decrease each calendar month by multiplying the special royalty rate by a fraction, the numerator of which will be that month's base value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore, and the denominator of which will be that month's value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore.

The special royalty base will be \$50.00 per ton of dried crude ore, subject to increase or decrease each calendar month. The special royalty base will be calculated each month by multiplying \$50.00 by a fraction, the numerator of which will be that month's value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore, and the denominator of which will be that month's base value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore.

The current month's value of the metals and mineral products recovered in the mill concentrate is determined by multiplying the total pounds of each metal and mineral product recovered during the month by that month's average market price per pound of each metal and mineral product. The base value of the metals and mineral products recovered in the mill concentrate is determined by multiplying the total

pounds of each metal and mineral product recovered during the current month by the respective average of the average market price per pound of each metal and mineral product for each of the twelve complete calendar months of 1981. (The third paragraph of 6MCAR Section 1.0094 (g) (9) specifies how the average market price of each metal and mineral product is determined.)

Finally, if the special royalty payable in any calendar month exceeds twenty percent of that month's value of the metals and mineral products recovered in the mill concentrate, the lessee may apply to negotiate a modification of the special royalty rate for the amount exceeding such twenty percent. Any modification of the lease terms must be approved by the State Executive Council.

(B) Special Royalty Formula

Let VB denote the base value of the metals and mineral products recovered in the mill concentrate, and VC denote the value of the metals and mineral products recovered in the mill concentrate in the current period. The proposed amendment defines the portion of the current ore value subject to special royalty (SR) treatment as that which exceeds \$50 per ton of dried crude ore, with such \$50 subject to increase or decrease by the ratio of VC/VB. Mathematically,

$$\text{Portion of VC subject to SR} = VC - 50(VB/VC) \dots \dots \dots (1)$$

The proposed special royalty rate (SRR) is .0004 times that amount of the current ore value that exceeds \$50 per ton of dried crude ore, with such rate subject to increase or decrease by the ratio of VB/VC. This may be expressed as follows:

$$\text{SRR} = .0004(VB/VC) \times [VC - 50(VB/VC)] \dots \dots \dots (2)$$

The special royalty amount payable is then obtained by multiplying the said SRR (equation 2) by the portion of VC subject to special royalty treatment (equation 1). Mathematically,

$$\text{Special Royalty Payable} = .0004(VB/VC) \times [VC - 50(VB/VC)] \times [VC - 50(VB/VC)] \dots \dots \dots (3)$$

Mathematically, this equation can be further reduced to: Special Royalty =  $\frac{VC}{VB} \times .0004(VB - 50)^2$ . However, we have chosen to use equation (3) for our amendment language because it explains the components and reasoning of the proposed special royalty amendment.

Finally, when the special royalty amount due for any calendar month exceeds 20% of that month's value of the metals and mineral products recovered in the mill concentrate, the lessee may apply to negotiate a modification of the special royalty rate for the amount exceeding such 20%. Any such modification of the lease must be approved by the State Executive Council.

(C) Computation of Special Royalty Rate: An Illustration

For the purpose of illustrating the computation of the proposed special royalty rate, the following assumptions are made:

- Amendment to NR 94 becomes effective in June 1982,
- State Lease Issued October 15, 1982,
- Bid royalty rate: 2%,
- Base and additional royalty rate: 2.25% (ore mined by underground methods, second ten-year period of lease),
- Average market prices of recovered metals in 1981 ("base" period) and in 1995 ("current" period) are as follows:

<u>Metals Contained in ore</u>	<u>Expected Recovery per ton of ore (1)</u>	<u>Average Market Prices of Refined Metals 12 Months of 1981 (2)</u>	<u>Prices of Refined Metals January 1995 (assumed)</u>
copper	23.94 lbs	\$0.75/lb	\$3.38/lb
zinc	113.28 lbs	\$0.45/lb	\$1.62/lb
silver	3.88 tr. ozs.	\$10.52/tr. oz.	\$55.70/tr. oz.

(Footnotes (1) & (2) are on top of page 12)

(1) Based on Kidd Creek Mine Model as discussed in Inter-Agency Task Force Report on Base Metal Mining Impacts, published by Minn. DNR, Jan. 1973, Table 5.1, p. 5.3, assuming concentrate recovery rates of 90% for copper, and 80% for zinc and silver.

(2) Actual 12 month averages as quoted by Engineering and Mining Journal. Copper price is that quoted for U.S. producer, FOB Atlantic Seaboard.

First, the current value (VC) of the metals and minerals recovered in the mill concentrate is calculated by multiplying the total quantity of each metal recovered by its respective average market price in January of 1995:

$$\begin{aligned} VC &= (\$3.38 \times 23.94) + (\$1.62 \times 113.28) + (\$55.70 \times 3.88) \\ &= \underline{\$480.55} \end{aligned}$$

Secondly, to obtain the ore's base value (VB) of the metals and mineral products recovered in the mill concentrate, the same quantities of the respective metals and mineral products recovered in January of 1995 are now multiplied by their respective average of the average market price for each of the twelve calendar months of 1981:

$$\begin{aligned} VB &= (\$0.75 \times 23.94) + (\$0.45 \times 113.28) + (\$10.52 \times 3.88) \\ &= \underline{\$109.75} \end{aligned}$$

Thirdly, the special royalty base (SRB) is calculated by multiplying \$50 by the fraction of the current value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore over the base value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore (VC/VB):

$$SRB = \$50.00 \times (\$480.55/\$109.75) = \underline{\$218.93}$$

Fourthly, the special royalty rate (SRR) is calculated by multiplying .04% by the fraction of the base value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore over the <sup>current</sup> ~~base~~ value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude

ore (VB/VC), then multiplying the resulting product by the amount of the current value of the metals and mineral products recovered in the mill concentrate from each ton of dried crude ore which exceeds the above SRB:

$$\text{SRR} = .0004 \times (\$109.75/\$480.55) \times (\$480.55 - \$218.93) = \underline{.023900}$$

Fifthly, the total minimum royalty payable on the one ton of ore mined would be calculated as follows:

		<u>% of Total</u>
Base royalty rate x VC = .0225 x \$480.55.....	\$10.81	39
Additional royalty rate x (VC-\$17)		
= .0225 x (\$480.55 - \$17.00).....	\$10.43	38
Special royalty rate x (VC-SRB)		
= .0239 x (\$480.55 - \$218.93).....	\$ 6.25	23
TOTAL ROYALTY PAYABLE (w/o bid)...	\$27.49	100

Finally if the bid rate is 2%, total royalty payable would be:

		<u>% of Total</u>
Base royalty.....	\$10.81	29
Additional royalty.....	\$10.43	28
Special royalty.....	\$ 6.25	17
Bid royalty (= .02 x \$480.55).....	\$ 9.61	26
TOTAL ROYALTY PAYABLE (with bid).....	\$37.10	100

(D) Impacts of Special Royalty on Total State Royalty Schedule

With the adoption of the proposed special royalty amendment to address the possibility of a windfall profits situation, the state's total royalty will consist of four elements: the base royalty, the additional royalty for ore value

exceeding \$17.00 per ton, the special royalty discussed above, and any bid royalty. The impact of the special royalty provision may be seen in Figures 2,3,4, and 5.

These graphs show that above the \$50 ore value, the special royalty is an increasing factor in the total royalty schedule. They also show that when the SR is equal to 20% of the value of the metals and mineral products recovered in the mill concentrate, it makes up about 72% to 83% of total royalty, depending on the relevant mining methods and ten-year lease period for which royalties are computed. Figure 5 shows the total royalty payable when there is a bid royalty of 2.0%.

#### (E) Impacts of Indexing Special Royalty

As Figure 6 shows, four distinct, but related consequences will result from indexing the special royalty base and the special royalty rate to reflect price changes in the metals market.

(1) The special royalty base fluctuates proportionately with metal prices. For example, if ore value rises by 50% between the base period and the current period, the special royalty base will rise from \$50 to \$75; and if ore value falls by 50%, the special royalty base will fall exactly in the same proportion, to \$25.

(2) The effective special royalty rate, as defined in equation (2) on page 10, will remain constant throughout the life of the lease, reflecting the rate it would be at the time when the amendment first becomes effective: that is, .04% per each 1981 dollar of that portion of ore value exceeding the special royalty base.

(3) The point at which the special royalty equals 20% of the value of the metals and mineral products recovered in the mill concentrate also fluctuates with metal prices. As shown by Figure 6, if the royalty schedule is not indexed, it takes an ore value of \$596/ton for the special royalty amount to equal 20% of the value of the metals and mineral products recovered in the mill concentrate. However, with the proposed indexing of the special royalty, if the ore value appreciates by 50%, the 20% point will not be reached until the ore value rises to \$894/ton (a 50% increase from \$596). Conversely, if the ore value depreciates by 50%, then the ore value

**Fig. 2 MINNESOTA STATE CU-NI ROYALTY SCHEDULES**

(1ST 10 YRS OF LEASE , OPEN-PIT AND UNDERGROUND)

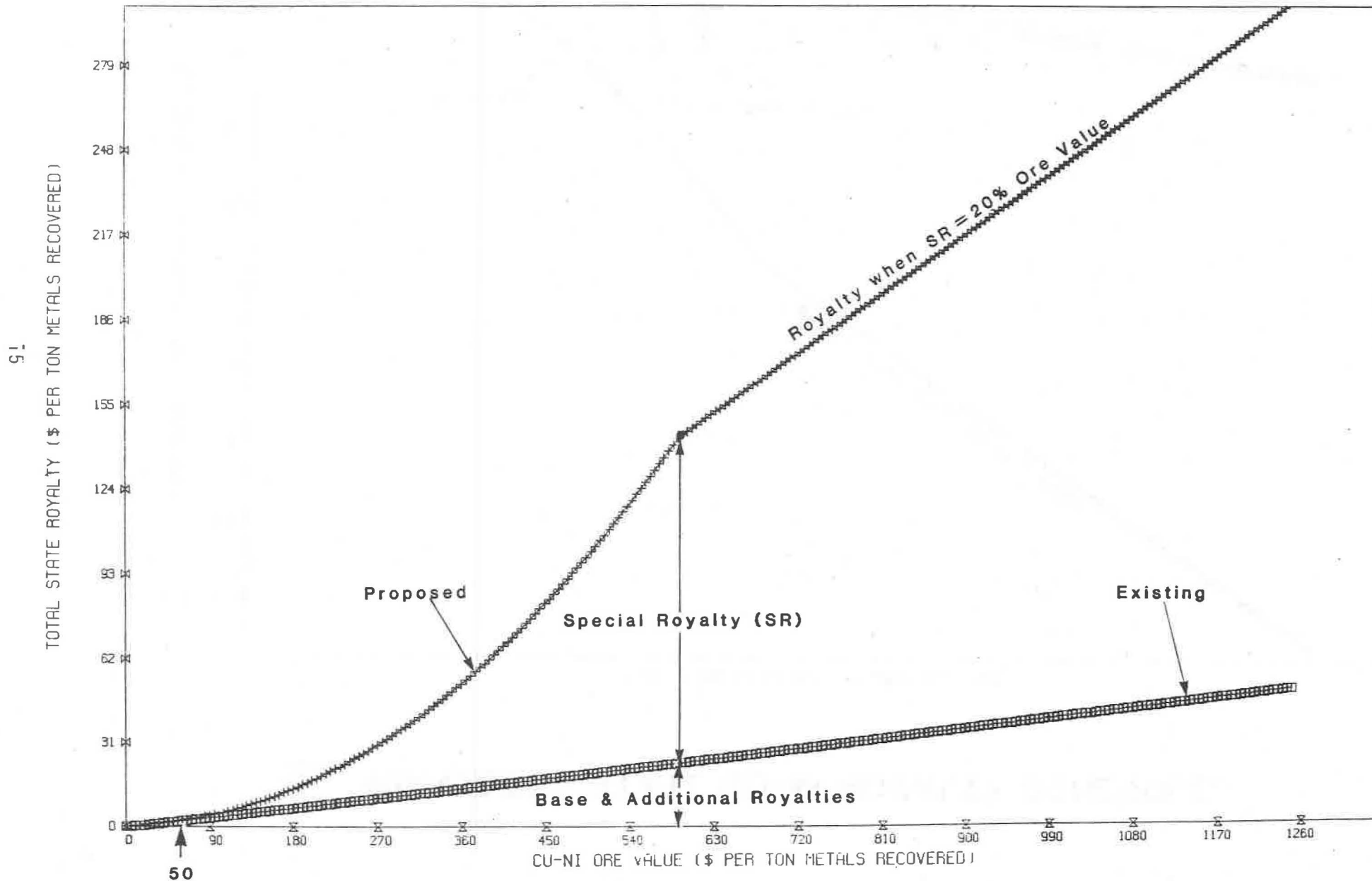


Fig. 3 MINNESOTA STATE CU-NI ROYALTY SCHEDULES

(5TH 10 YRS OF LEASE , UNDERGROUND ORES)

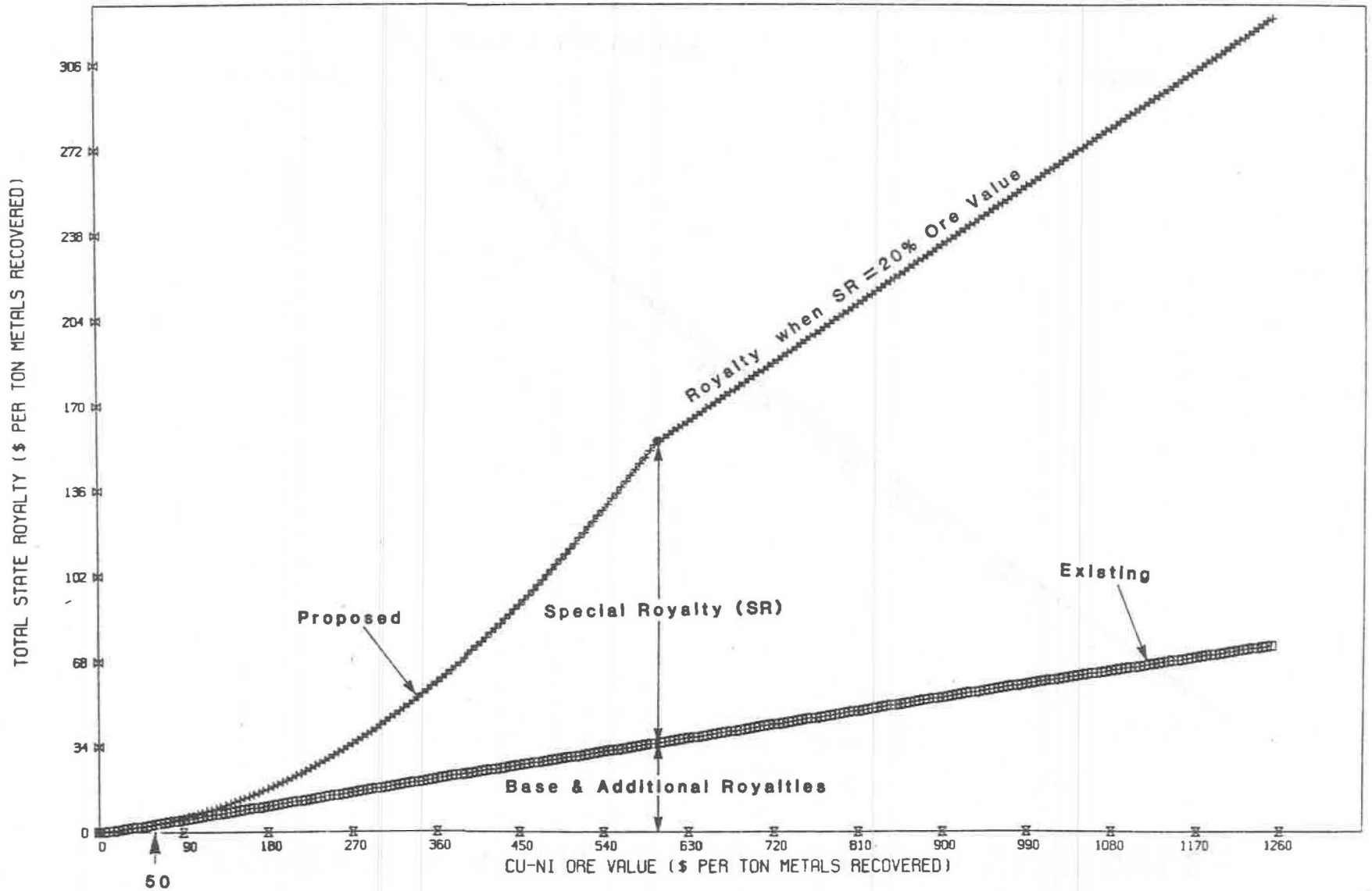
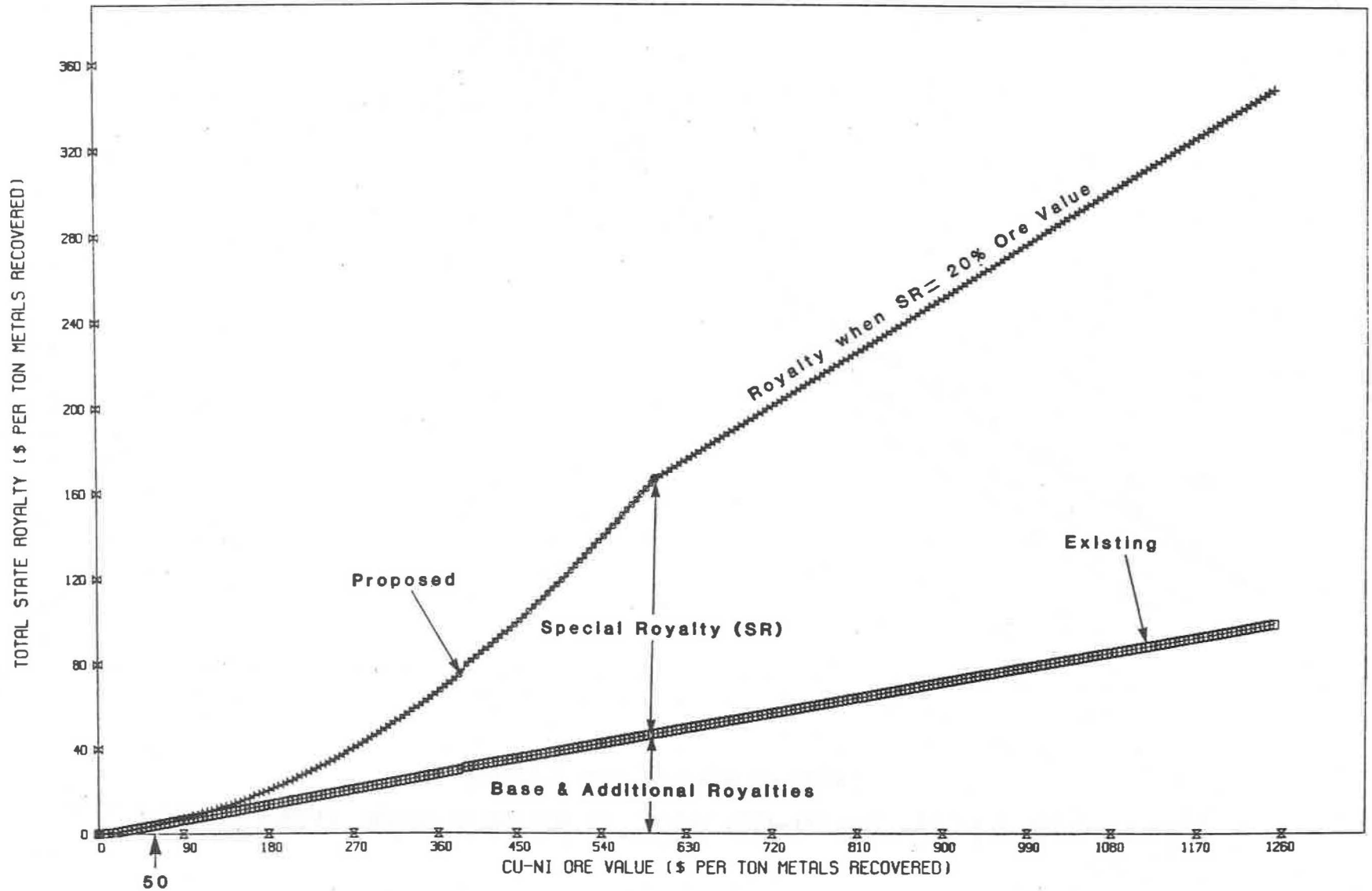




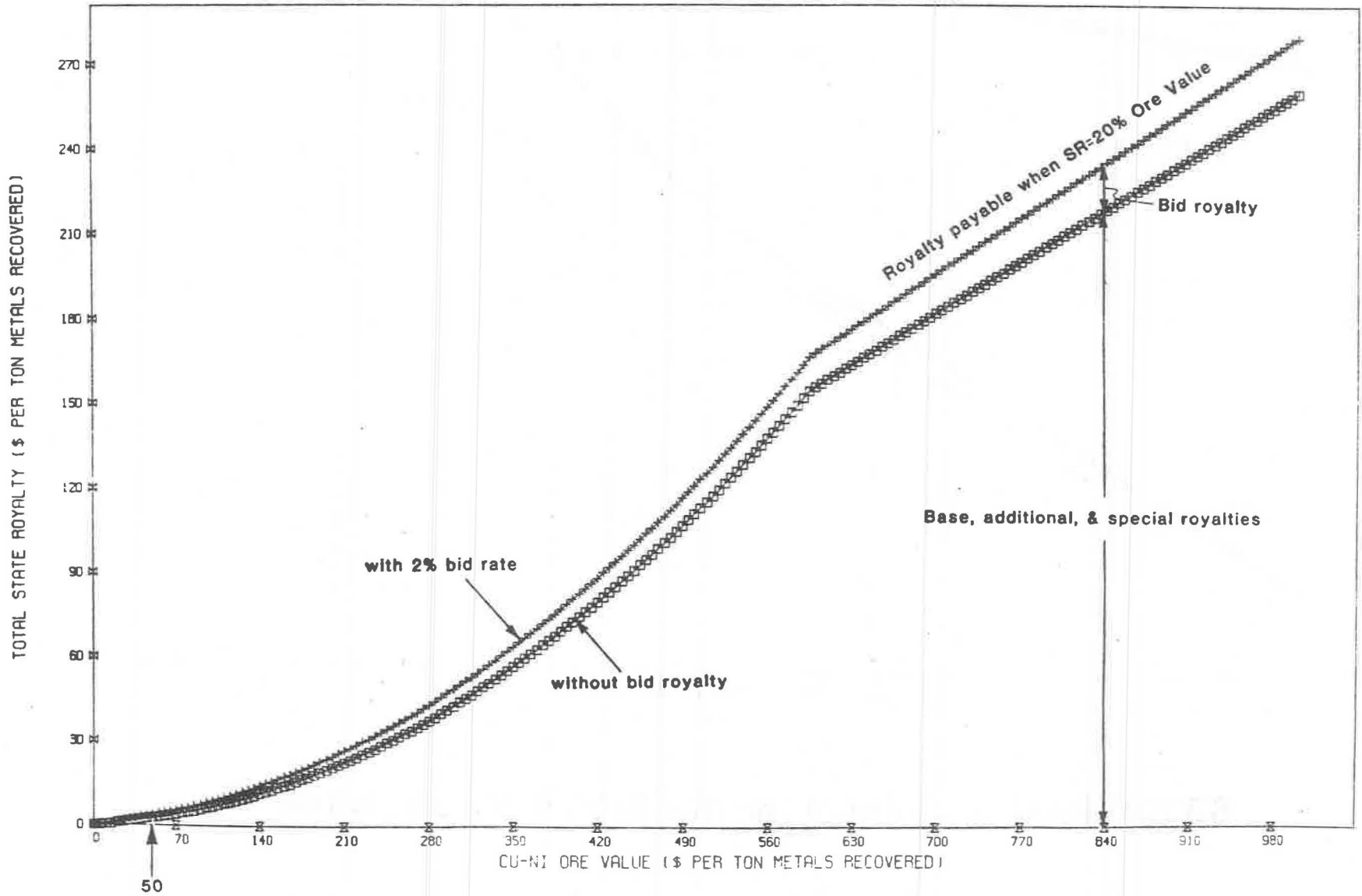
Fig. 4 MINNESOTA STATE CU-NI ROYALTY SCHEDULES

(5TH 10 YRS OF LEASE , OPEN-PIT ORES)



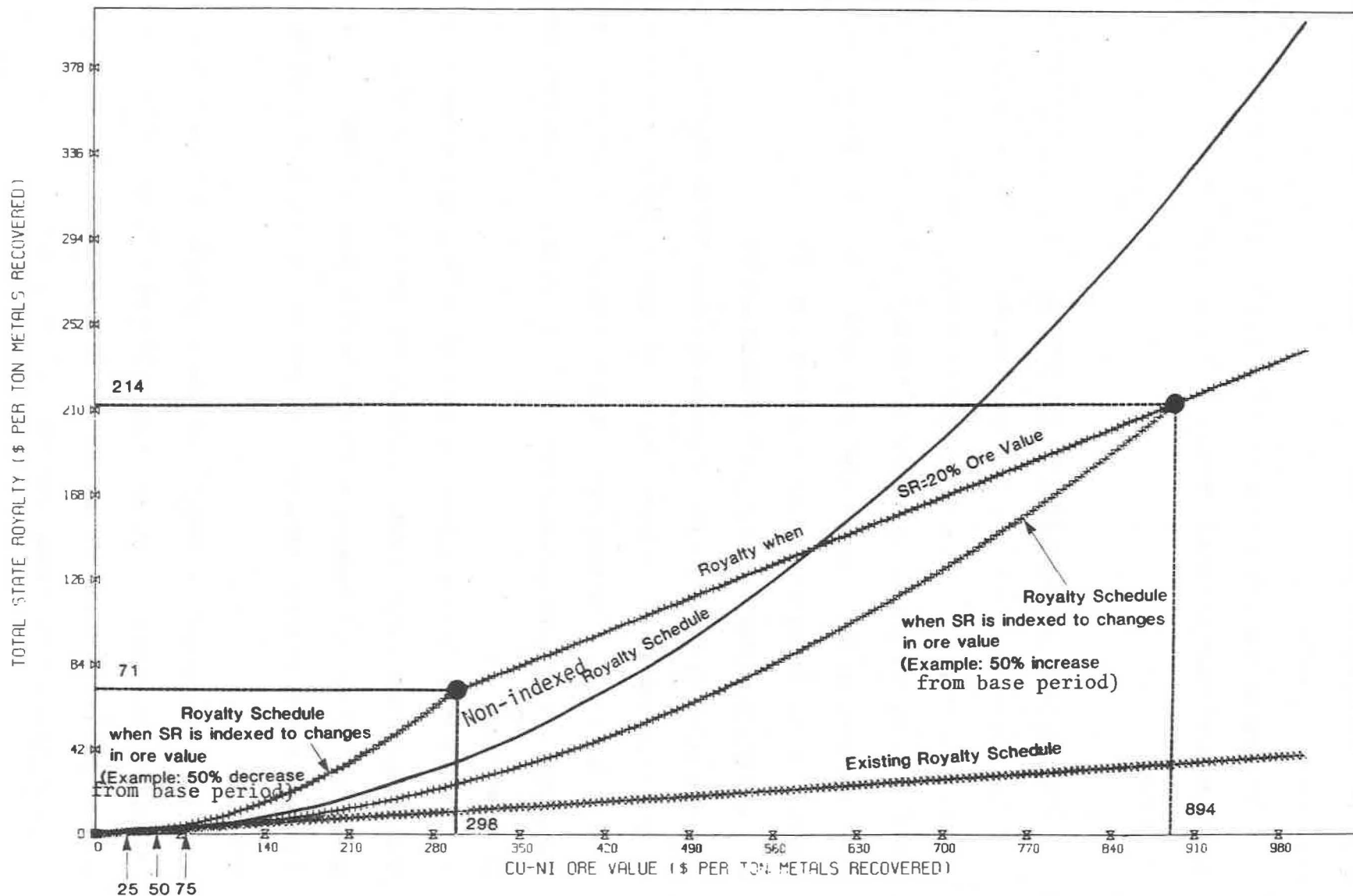
**Fig. 5 PROPOSED MINNESOTA STATE CU-NI ROYALTY SCHEDULES**  
**(with & without bid royalty)**

(1ST 10 YRS OF LEASE , OPEN-PIT AND UNDERGROUND)



**Fig. 6 IMPACT OF INDEXING SPECIAL ROYALTY (SR) RATE ON MINNESOTA STATE CU-NI ROYALTY SCHEDULE**

(1ST 10 YRS OF LEASE , OPEN-PIT AND UNDERGROUND)



would only be \$298/ton (a 50% decrease from \$596) when the 20% point is reached under the proposed indexing.

(4) Between the base period and the current period, the rate of change, if any, in the special royalty amount payable is proportional to the rate of change in the ore value.

#### IV. ANALYSIS AND REASONABLENESS OF THE PROPOSED "SPECIAL ROYALTY" PROVISION

The proposed special royalty provision, to be included in future copper-nickel leases, is a result of research in mineral economics literature and study of other non-ferrous metals producing states' and countries' practices. The following is a brief analysis of the proposed special royalty provision, and an explanation of the reasons for selecting the elements of such a provision.

##### (A) Existing Additional Royalty Rate at \$17/ton

The existing royalty rate structure provides for an additional royalty rate which is equivalent to the base rate and changes as the base rate changes during the term of the lease. The additional royalty rate becomes applicable when the value of the metals and mineral products recovered in the mill concentrate exceeds \$17 per ton of dried crude ore.

When 6 MCAR Section 1.0094 was adopted in 1966, ore valued in excess of \$17 per ton was considered high-grade. However, \$17 per ton ore was not considered "bonanza" ore. The \$17 was not indexed to fluctuate with price changes in the economy, and, for the past 10 or more years, \$17 per ton ore has not been considered a high-grade ore.

The State Executive Council and the Department of Natural Resources have viewed the additional royalty rate, which commences at \$17, as a part of the basic royalty rate of the state copper-nickel lease. In other words, the minimum royalty rate for a state copper-nickel lease, for the first 10 years of the lease, is just under 4% of the value of the metals and mineral products recovered in the mill concentrate. This

Is considered to be a fair and equitable rate, and no change is proposed to the existing additional royalty rate provisions of the copper-nickel lease. The proposed special royalty rate is being added to address the possibility of a windfall profit situation.

(B) The Special Royalty Base

To determine the value of ore above which the proposed special royalty becomes effective, one has to analyze the three components of this value: the grade of ore, the price of refined metals, and the recovery rate at the concentrator<sup>(1)</sup>. If copper ore is used as an example, then the ore value at which the special royalty becomes applicable, (the special royalty base) will have to be within the high-grade region of copper ore grade in the U.S.

The evidence exhibited by the historical average grade of copper ore mined in the U.S. (see Table 1) shows that the average amount of copper recoverable from copper ore sold and treated has been steadily declining since 1889. Further, according to the Bureau of Mines (Ref. 7, p. 12), some copper deposits currently under development contain an average of only about 8 lbs. of copper per ton (or 0.4% grade) with a cut-off grade of 4 lbs. (or 0.2% grade).

Table 1 - AVERAGE GRADE OF COPPER ORE MINED IN THE U.S. 1880-1980<sup>(2)</sup>

1880	.....3.0%	1911-20	.....1.7%	1951-60	.....0.9%
1889	.....3.3%	1921-30	.....1.6%	1961-70	.....0.7%
1902	.....2.7%	1931-40	.....1.6%	1971-80	.....0.6%
1906-10	.....2.1%	1941-50	.....1.0%		

(2) Figures for 1880 to 1930 from Ref. 1, p.224. Those for 1931 to 1980 from USBM.

(1) Although the recovery rate at the concentrator can change due to technological advances, we are assuming that it will remain constant for this brief explanation of the determination of the base value.

Although "high" or "low" is a relative concept, given the present average and declining grade of copper ore in the U.S. (.47% in 1980), an ore tenor of 3.0% copper equivalent and above is considered as high grade. Assuming a constant rate of recovery, a higher grade gives a higher ore value at a given price level.

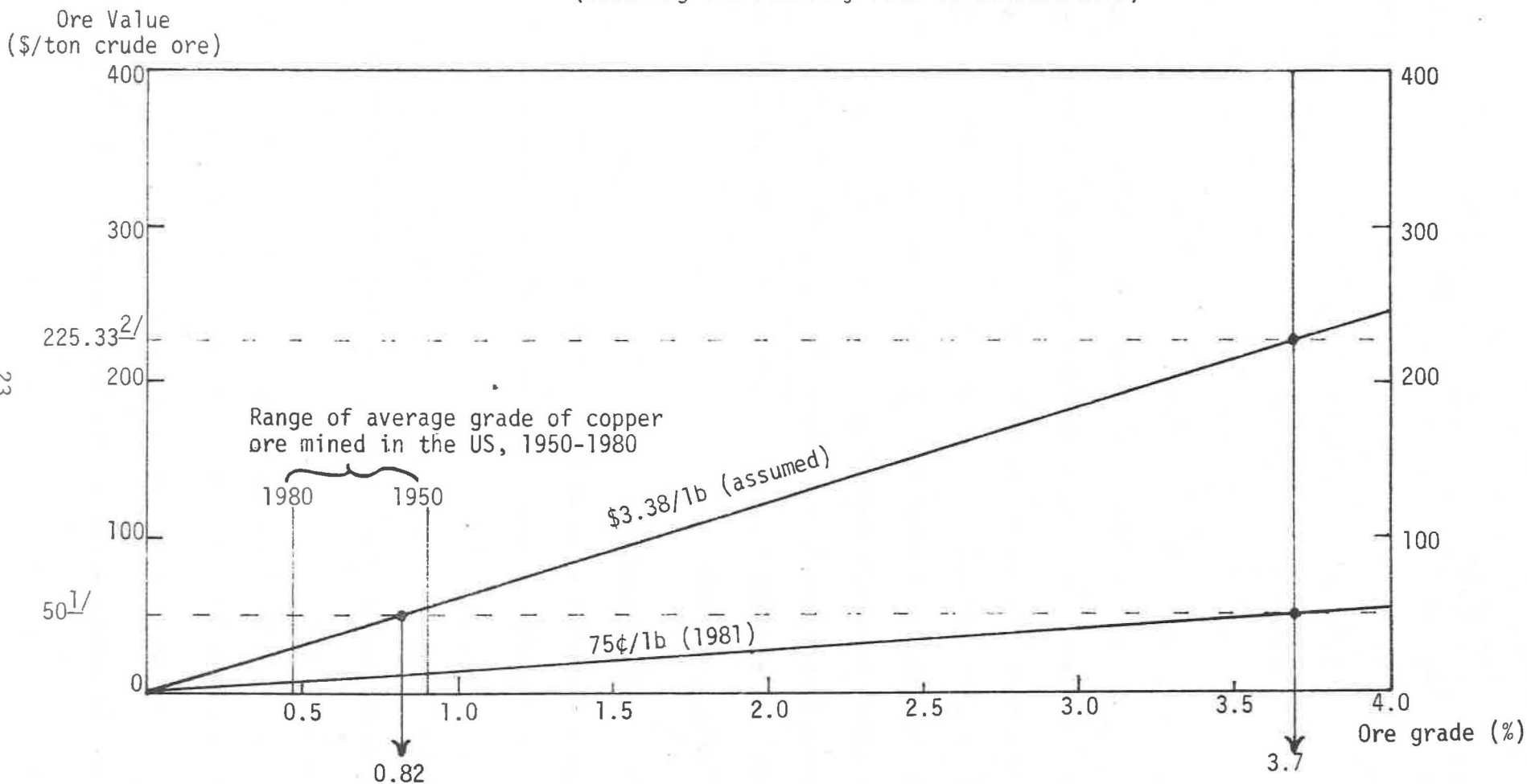
The second component of ore value is the producer price of refined metal excluding delivery charges. Assuming a constant rate of recovery, a higher price gives a higher ore value at a given ore grade.

Again using copper ore as an example, this interaction between price and grade can be seen in Figure 7, which describes the value-grade relationship for copper ore. As this chart shows, at the 1981 domestic average price level of refined copper, f.o.b. Atlantic Seaboard, of \$0.75/lb (which is also the average for the last five years), the proposed special royalty base of \$50/ton, which corresponds to a grade of 3.7%, falls within the high-grade region of copper ore. It therefore seems reasonable to use \$50/ton as the base value of the proposed special royalty provision.

The average price for other base metals has increased in the last twenty years. For the primary base metals, the increases basically reflect the increases in production costs. The prices for the precious metals also reflect production cost increases, and additionally reflect an inherent speculative or investment demand element.

Traditionally, precious metals are considered as real "stores of value," and consequently, there are speculation-induced changes in their prices, both in the futures market and the spot market. For example, the value of ore based on the Greenstone Mine Model has risen from about \$21/ton in 1960 to about \$79/ton in 1981, or about 276% in twenty-one years. Some of this increase is due to the extraordinary, speculation-induced increase in the prices of precious metals, the recovered quantities of which make up only a very small amount of ore, as shown by Table 2 below:

Fig. 7 VALUE-GRADE RELATIONSHIP FOR COPPER ORE  
 AT DIFFERENT REFINED COPPER PRICES  
 (assuming 90% recovery rate at concentrator)



<sup>1/</sup>Proposed Special Royalty Base at 1981 copper price, \$0.75/lb.

<sup>2/</sup>Proposed Special Royalty Base when copper price increases to \$3.38/lb.

TABLE 2 - GRADES & PRICES OF METALS CONTAINED IN GREENSTONE MINE MODEL

<u>Metals Contained In Ore</u>	<u>Expected Recovery per Ton Ore</u>	<u>Average Unit Prices</u> <sup>(1)</sup>		<u>Percentage Price Changes</u>
		<u>1960</u>	<u>1981</u>	
Copper	34.74 lbs	\$ .32/lb	\$ .75/lb	134 %
Nickel	2.52 lbs	.74/lb	3.43/lb	364
Zinc	61.60 lbs	.13/lb	.45/lb	246
Lead	.72 lbs	.12/lb	.37/lb	208
Gold	.02 tr.oz.	35.0/tr.oz	459.61/tr.oz.	1213
Silver	.704 tr.oz.	.91 tr.oz.	10.52/tr.oz.	1056

(1) Annual averages, from Engineering & Mining Journal, various Issues.

As discussed above, copper ore with a value of \$50/ton would be a high grade copper ore in today's market. The presence of other base metals associated with the copper ore, regardless of whether the copper ore was high grade in and of itself, could also result in a high grade copper-equivalent ore due to the grades and prices of those associated metals. With either situation, when the value of the ore exceeds the proposed special royalty base of \$50/ton, the ore will be subject to the proposed special royalty provisions.

(C) The Special Royalty Rate

The special royalty rate, of four hundredths of one percent (.04%) of that portion of the ore value exceeding the special royalty base, has been determined after reviewing royalty systems of base metal producing state and foreign countries and reviewing various studies on the base metal mining industry. In its review, the Department considered various percentage rates and discussed these rates with the State Executive Council.

The states surveyed included Arizona, Utah, New Mexico, Montana, Colorado and Idaho. These states are the principal producers of copper, lead, zinc and precious metals. The foreign countries surveyed included Australia, Canada and Papua New Guinea. Most of these royalty systems have a graduated royalty scale schedule, with



or without a maximum rate, or a flat-rate system with or without escalation. None of these royalty systems as yet have provision for a special royalty rate covering an unusually high grade mineral deposit of a significant size.

The studies reviewed concerned the profitability of the base metal mining industry and physical, financial and economic conditions facing the industry. These studies discussed typical average and cut-off grades of ore mined, historical rates of returns on equity and on investment in the base metal mining industry in the United States, and historical cost and price trends of the industry. (See Refs. 5,7,8 and 9). Briefly, the general outlook for copper and associated metal mining is favorable and the United States will probably remain a major producer. However, the low grade of U. S. copper ores, the high cost of labor as compared with grades of ore and costs in foreign countries, and heavy borrowing by some of the industry have reduced profitability.

After reviewing these studies and royalty systems, the Department reviewed information on some of the known greenstone deposits of Canada and Wisconsin. As indicated previously, it is not possible to draw an exact definition of a high grade deposit versus a "bonanza" deposit. However, the Kidd Creek Mine is generally described as a "bonanza" deposit. As shown on page 11, the Kidd Creek Mine has an average value in 1981 of \$109.75 per ton of crude ore. Other "bonanza" deposits in the greenstone formations of Canada include the Sturgeon Lake (Falconbridge) Mine and the Lyon Lake Mine. These mines had, respectively, an average value in 1981 of \$177.40 and \$132.54 per ton of dried crude ore.

With this data in mind, the Department looked at different possible royalty rates, including .02% through .08%. The goal was to find a special royalty rate that gradually increased with the value of the ore and that would result in a reasonable additional royalty rate for a "bonanza" deposit. The underlying considerations were to provide that the state receive a fair share in a windfall profits situation without the rate being onerous to the operator and without deterring competitive

bidding for leases.

The special royalty rate of .04% was selected since it most nearly meets these goals. For example, with an ore value of \$130.00 per ton, which is certainly "bonanza" grade ore in today's metals market, the proposed special royalty will constitute approximately 2% of the total value of the concentrated ore. The amount of 2% has been deemed reasonable in the past for royalty stages in the state copper-nickel leases, as evidenced by the 2% of ore value for the base, the additional 2% for ore value exceeding \$17 per ton, and an additional 2% of ore value due to the time progression of the lease.

The other possible rates, ranging from .02% to .08%, were rejected because they did not adequately meet these goals. The lower rates do not add a significant amount of royalty for a bonanza deposit situation, and the higher rates tended to increase so severely that they could become burdensome to a bonanza deposit operation.

The rate of .04% is equivalent to a 1% increase in special royalty per each \$25 increase in the ore value above the special royalty base. Rather than have a rate which increased an additional 1 percent or a specified fraction thereof at a certain value of the ore, it was decided that a gradual increase was more equitable for the mining operator and the state. A gradually increasing rate more clearly reflects the relation of royalty to the value of the ore.

The proposed special royalty rate will have a minimal impact on high grade ore worth slightly over \$50.00 per ton; and the rate will gradually have a larger impact as the value of the ore increases. Based upon the above described considerations and goals, the proposed special royalty rate of .04% is reasonable.

(D) Indexing of the Special Royalty Rate and Base

The rationale for subjecting the special royalty base to an indexing procedure as proposed is that the effect of price changes in the relevant metals market should be brought to bear on the definition of "high-grade ore value." What is considered as high-grade ore at today's prices may not be true ten or twenty years in the future.

Returning to our previous example, let's suppose that the domestic producer price of refined copper (or "copper equivalent") will rise to \$3.38/lb in some future time. If the proposed special royalty base of \$50 per ton of dried crude ore remains unaffected by this price change, and assuming a constant recovery rate of 90%, then \$50 will in fact correspond to only 0.82%, as shown in Fig. 7, which obviously can hardly be called a high grade.

Therefore, to qualify as high-grade ore value, the special royalty base should be made to change proportionately with the change in the ore value between the present time and the date of special royalty computation. Using the above illustration again, the adjusted special royalty base will then become:

$$\$50 \times \frac{\text{Future ore value/ton}}{\text{1981 ore value/ton}} = \$50 \times \frac{(\$3.38)}{(\$0.75)} = \$225.33$$

Further calculations (\*) show that this adjusted special royalty base can be readily translated into a copper grade of 3.7%, which again falls within the high-grade ore region.

The indexing procedure calls for making the special royalty rate constant throughout the life of the lease, reflecting the true rate as it would be at the time when the amendment first becomes effective; that is .04% per each 1981 dollar of that portion of ore value exceeding the special royalty base. For example, suppose a high-grade deposit is found and developed, and metal prices increase fourfold between the base period and that current period. If the special royalty rate is not indexed, the lessee will have to pay an effective rate of .64%, instead of .04% of each dollar of the ore value exceeding the special royalty base. Conversely, if the special royalty rate is not indexed and metal prices decrease twofold, the state will receive only .01% (instead of .04%) of each dollar of the ore value exceeding the special royalty base.

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$$(*) \text{ Ore grade} = \frac{\text{Value per short ton}}{\text{price} \times \text{recovery rate} \times 2000 \text{ lbs}} = \frac{\$225.33}{3.38 \times .90 \times 2000} = 3.7\%$$

(E) Authorized Negotiations When Special Royalty Reaches 20% of Ore Value

The need to set a level of special royalty at which negotiations between state and lessee are authorized arises from considerations of operating factors other than just the grade of ore, one of the more important among which being the industry's profitability. In fact, without such a level, the proposed royalty could, theoretically, exceed 100% of the value of the metals and minerals recovered in the concentrate should a high-grade deposit be found. However, it seems extremely unlikely that the level will be ever reached.

The Comstock Lode, Nev., discovered in 1859, and the Goldfield district Nev., discovered in 1902 are cases in point. Both were extremely rich gold-silver deposits. For example, it has been reported that in one shipment from Goldfield in 1907, one single carload of ore yielded gold valued about \$12,800 per ton (Ref. 3, p. 525). Using our proposed special royalty provision but without a ceiling, the special royalty alone for this ore would exceed \$65,000 per ton or 5 times that of the ore value.

The twenty-percent level itself has also been selected after considerations of the historical rates of return of the base metals industry in the U. S. For example, for the ten-year period 1969-78, copper mining companies have earned an average rate of return on equity which is roughly 37% lower than that of U.S. manufacturing (Ref. 8, p. 15). In view of the larger risk involved in mining as compared to manufacturing, this is significant. Normally, geologic uncertainty, long lead times in development (that tie up large amounts of capital), socio-economic concerns, and volatility of certain metals' prices tend to dictate that base metal mining yield a greater rate of return than the generally less risky manufacturing ventures.

It should also be noted that, to avoid possible interference with the bidding process, the level of 20 percent is set on the special royalty alone, and not on the total royalty payable.

## CONCLUSION

The state, as a landowner, has a legitimate right to share in the windfall profits derived by the mine operator from the discovery and development of a very high-grade mineral deposit on state lands, or from unusual price rises due to speculation or mineral shortages in the market. Also, the discovery of a "bonanza" deposit in Minnesota is a possibility. The state copper-nickel lease does not adequately address these windfall situations, so there is a need to amend the lease to do so.

The proposed special royalty becomes an increasing factor in the amount of total royalty payable as ore value increases. The special royalty base is indexed to fluctuate with metal prices to reflect the changes in the economy from the present time. The special royalty rate is indexed to metal prices to remain constant throughout the life of the lease, reflecting the rate as it would be at the time when the amendment first becomes effective. Finally, to allow consideration of operating factors other than just the grade of the ore, the lessee is eligible to negotiate a modification of the special royalty rate, if the amount of special royalty ever exceeds 20% of the value of the metals and mineral products recovered in the mill concentrate, for the amount exceeding such 20%. Based on its research and studies described herein, the Department of Natural Resources believes that the proposed special royalty is needed, reasonable and should be adopted.

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