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SHEEP MTN.
YAVAPAI CO.

SHEEP MTN.

A PRELIMINARY ECONOMIC EVALUATION OF THE CASTLE COPPER PROPERTY HUMBUG MINING DISTRICT YAVAPAI COUNTY, ARIZONA

FOR
ORCANA RESOURCES LIMITED
TORONTO, ONTARIO
CANADA

Toronto, Ontario
May 29, 1992

Watts, Griffis and McOuat Limited
Consulting Geologists and Engineers

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1. SUMMARY

Watts, Griffis and McOuat Limited (WGM) was requested by **Orcana Resources Limited** (Orcana) to carry out a preliminary economic evaluation of a project to explore the supergene copper mineralization of the Castle Copper property in Arizona owned by Orcana.

WGM has relied on the discussion of the geology and the development of a mineral inventory supplied by an independent geological consultant (Bourne, 1992) in addition to processing cost models developed by **EHA Engineering Ltd** (EHA). WGM has developed mining costs, based on Bourne's report, and incorporated these along with the processing models to estimate the economic viability of the deposit to determine if additional exploration expenditures are warranted.

Several mining and processing alternatives were investigated and it appears that the most economically attractive combination is that of ramp (decline) access with production using a conveyor system, and conventional flotation processing. This mine/processing model indicates that, from a potential of 30-40 million tons of ore grading 1.6% Cu contained in supergene copper minerals, the deposit has an estimated after tax, net present value in the range of $25 million to $44 million. This supergene copper zone also contains 0.04% MoS_2 and precious metals. No provision has been made for precious metal credits in this evaluation.

This economic model indicates that a reasonable rate of return will be achieved at a copper price of $0.94/lb but that revenues from the deposit will support the operation at a copper price of $0.68/lb. The possibility of decreasing estimated capital costs, by partial substitution of refurbished equipment, may further enhance the project economics. Capital and operating costs should be investigated in greater detail.

Our analysis also indicates a positive net present value of $11 million if the mineralization were to be processed using a solvent extraction-electrowining (SX-EW) recovery method with the 2.5 million tons of ore per year treated on heap leach pads. With this method, no precious metal or MoS_2 credits would be realized.

WGM concurs with Bourne's recommendation for a Phase I drill program and considers that, based on this preliminary economic analysis, the property has a significant economic potential which merits additional exploration expenditures.

2. INTRODUCTION

WGM was requested by the management of Orcana to carry out a preliminary economic evaluation of the Castle Copper property, specifically the supergene copper mineralization, located in Arizona. The purpose of this evaluation is to determine the economic viability of additional exploration on the Castle Copper property based on a mineral deposit model developed by an independent geological consultant (Bourne, 1992).

WGM has relied upon reports, drill logs and other data supplied to us by Orcana in addition to WGM reports relevant to this assignment, and reports by various government organizations.

Conceptual capital and operating cost data, suitable for assessing the merits of additional exploration, were developed for different mining alternatives using formulae developed by various government and private agencies as well as factoring techniques on a mining unit basis. Comparisons of these data were made with capital and operating cost data from producing or near producing mines that have been published in various technical journals.

Capital and operating cost data for the processing models for the property were developed by EHA. These data were incorporated into the overall economic models and EHA's report is included as an appendix to this report. EHA investigated cost data for five different processing methods thought to be applicable to the type of mineralization contained in the supergene copper deposit of the Castle Copper property .

Geological data and mineral inventory parameters for the Castle Copper deposit were derived from a report to Orcana by Donald A. Bourne, consulting geologist. Minor modifications to the mineral inventory parameters were made by WGM and incorporated into this report for the purposes of the economic evaluation. Bourne's 1992 report recommends additional drilling of the Castle Copper deposit to delineate and confirm the estimated mineral inventory.

3. LOCATION, ACCESS, INFRASTRUCTURE

3.1 LOCATION

The Castle Copper property is located in south central Yavapai, Arizona, approximately 50 miles northwest of the city of Phoenix. It is centered on latitude 34°00'N and longitude 112°30'W. The property is central to a triangle formed by the highways connecting Phoenix, Prescott and Wickenburg. Figure 1 indicates the general location of the property.

3.2 ACCESS

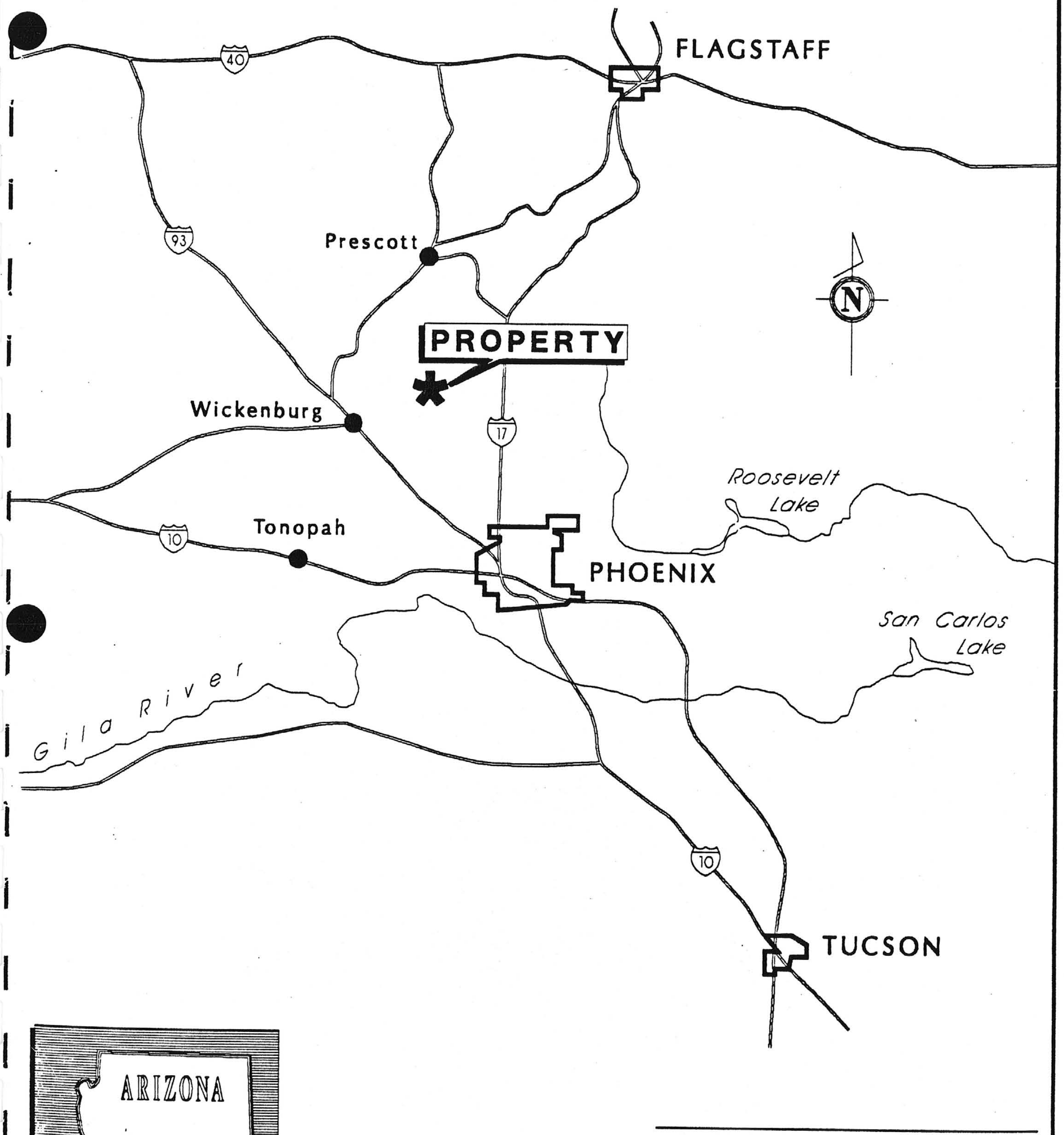
The property can be reached by driving north of Phoenix on Highway 17 to the Castle Hot Springs turn-off. Well maintained gravel roads give ready access to most portions of the property from the turn-off. The climate is typically arid with sparse vegetation consisting of cactus and a variety of desert shrubs and small trees.

3.3 INFRASTRUCTURE

There is abundance of skilled manpower available from the city of Phoenix as well as from Wickenburg and Prescott. There is no utility power available on the property but, if economically viable, utility power could be obtained from power lines near Highways 17 or 89.

The availability of water underlying the property is unknown but it is thought that the water table should be no more than 200-300 feet in depth from the lower (2,400 foot) elevations.

The copper smelter (Ray unit) of Asarco is located at Hayden, Arizona, south of Phoenix and may be available for custom smelting of copper concentrate. This smelter has a production capacity of 400,000 tons per year with a 900 ton per day acid plant. The smelter met all significant environmental constraints when last operated in 1982. The trucking distance from the property to the smelter at Hayden is approximately 150 miles. Other smelters readily accessible by road and/or rail are; in Arizona (Ajo-Phelps Dodge; Inspiration-Cyprus Miami; Morenci-Phelps Dodge; San Manuel-Magma Copper); and in New Mexico (Playas-Phelps Dodge; Hurley-Phelps Dodge/Mitsubishi). In addition, there is the possiblity of shipping the concentrate to Japan.



ORCANA RESOURCES LIMITED

CASTLE COPPER PROPERTY

HUMBUG MINING DISTRICT
VAVAPAI COUNTY, ARIZONA, U.S.A.

LOCATION MAP

0 10 20 30 40 50
MILES

Work by: TILLICUM RESOURCES LTD. May 1992
CAD by: RODEL E ORTIZ May 1992

Figure 1

4. PROPERTY DESCRIPTION

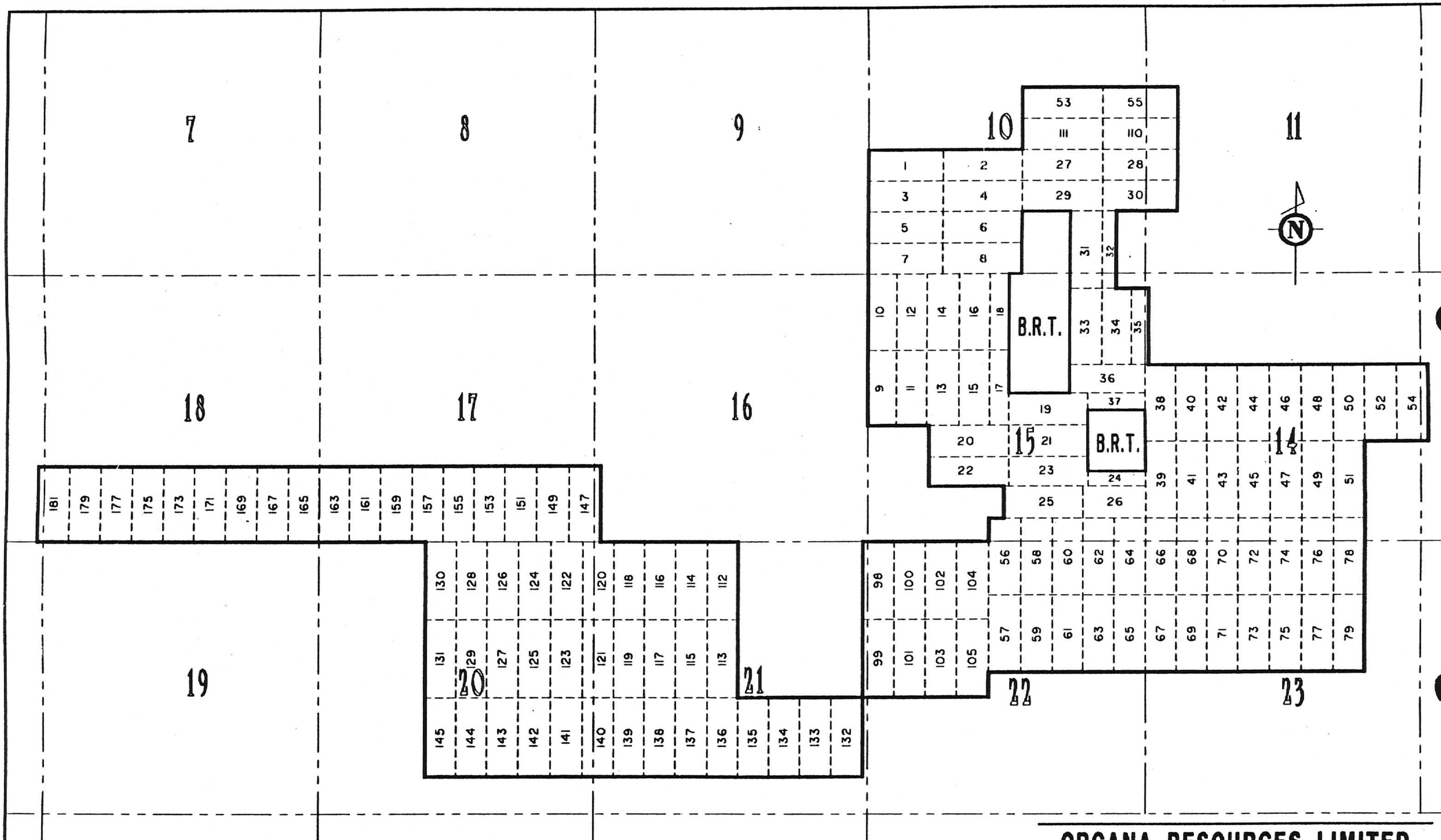
The Castle Copper property is comprised of a block of 141 unpatented lode claims covering approximately 2,500 acres. The claims are located (Figure 2) in Sections 10, 11, 14, 15, 17, 20, 21, 22 and 23 of Township 8 North, Range 1 West and in Section 13, Township 8 North, Range 2 West in the south-central portion of Yavapai County, Arizona, U.S.A. Bourne (Appendix 1) prepared a listing of the individual claims (Table 1).

The Castle Copper property is not situated in a National Park or designated conservation area and it is believed that there will be minimal environmental impact or other restrictions which would interfere with exploration or development.

TABLE 1

List of Claims

Section	Name	Number	Total
10	Ray	1-8,27, 29, 53, 111	12
10, 11	Ray	28, 30, 55, 110	4
10, 15	Ray	31-32	2
15	Ray	9-26, 33-34, 36-37	22
14, 15	Ray	35	1
14	Ray	38-52	15
13, 14	Ray	54	1
15, 22	Ray	56, 58, 60, 62, 64	5
22	Ray	57, 59, 61, 63, 65, 100-105	11
14, 23	Ray	66, 68, 70, 72, 74, 76, 78	7
23	Ray	37, 39, 71, 73, 75, 77, 79	7
21, 23	Ray	98-99	2
21	Ray	112-119, 132-139	16
20, 21	Ray	120-121, 140	3
20	Ray	122-131, 141-145	15
17	Ray	149, 151, 153, 155, 157, 159, 161	7
16, 17	Ray	147	1
17, 18	Ray	163	1
18	Ray	165, 167, 169, 171, 173, 175, 177, 179	8
18 (R1W), 13 (R2W)	Ray	181	1
Total			141



ORCANA RESOURCES LIMITED

CASTLE COPPER PROPERTY

Tp.8 N., R1 W., HUMBUG MINING DIST.
VAVAPAI COUNTY, ARIZONA, U.S.A.

CLAIM MAP

0 1000 2000 4000
FEET

Work by: TILLICUM RESOURCES LTD May 1992
CAD by: RODEL E ORTIZ May 1992

Figure 2

NOTE.

CLAIM NUMBERS WITH "RAY" PREFIX NOT PLOTTED

5. HISTORY

The original claims in the area were staked in the 1960s by two Arizona prospectors, Davis and Williams (see Bourne's report for additional detail and exploration results). During 1963 to 1966, **Phelps Dodge Corporation** (PD) explored the property. During this period PD drilled some 44,000 feet in rotary/core holes in an effort to delineate possible mineralization beneath a Tertiary volcanic cap overlying weakly mineralized Precambrian strata within the general area surrounding the Castle Copper property. Complete results of the drill program are not covered in Bourne's report, as his study and other studies commissioned by Orcana deal specifically with the supergene copper mineralization of the Castle property. WGM notes that three of the drill holes defining the mineral inventory of the Castle Copper supergene copper deposit were drilled by PD.

From 1966 to 1967 Bear Creek Mining Company, Kennecott's exploration subsidiary, leased the land and drilled 3,620 feet in two holes. Neither hole intersected ore grade mineralization and Bear Creek dropped the lease.

During the period 1968-1981, **Utah International Inc.** (Utah) entered into a lease agreement to explore the area. Utah conducted geological and geochemical surveys and drilled 21,241 feet in rotary/core holes before dropping the lease, prior to its merger with BHP Minerals. For the reasons noted above for the PD drill program, Bourne does not report detailed results of this exploration program. One of the drill holes used in Bourne's mineral inventory estimate was drilled by Utah. See Bourne's report for details on drill hole results and mineral inventory estimates.

Castle Copper Inc., a private Arizona company, acquired the ground by staking in June 1990.

6. GEOLOGY AND MINERALIZATION

6.1 GEOLOGY

The area of the supergene copper "blanket" mineralization is overlain by a thick (1,500-2,000 foot) cover of Tertiary volcanic and lesser sedimentary rocks. Pre-Tertiary geology and structures have been interpreted from the results of various drill programs. The oldest rocks underlying the Tertiary units are thought to be Precambrian schists (Yavapai Series) that have been intruded by granite/diorite rocks of the Bradshaw Complex. The Sheep Mountain Stock, of Laramide (?) age, intrudes the Precambrian rocks. Figure 3 indicates the general geology of the rocks underlying the Tertiary units in the area comprising the Castle Copper property.

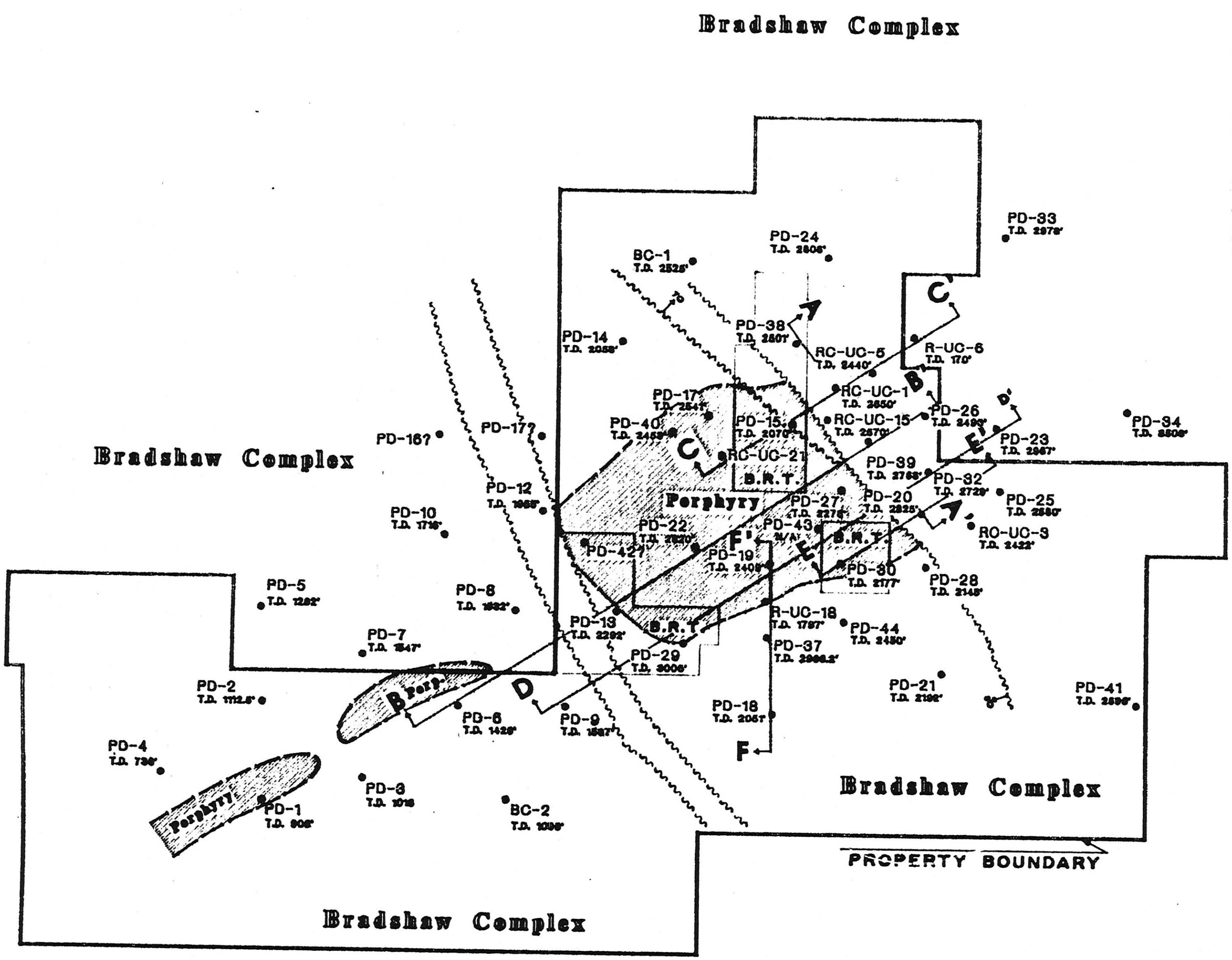
The reader is referred to the report by Bourne for additional details concerning the geology and mineralization of the Castle Copper property (see Appendix 1).

6.2 MINERALIZATION

Sulphide mineralization related to the Sheep Mountain Stock is widespread and underlies an area of three to four square miles. Figure 4 indicates the location of the mineralization underlying the Castle Copper property.

The hypogene (primary) mineralization comprises a typical suite of porphyry copper-molybdenum minerals: pyrite, chalcopyrite and molybdenite. Post-mineralization events formed a zone of supergene enrichment, usually overlain by a zone of oxidation. The zone comprising the supergene "blanket" is generally enriched in the copper minerals; chalcocite, bornite, covellite, with associated pyrite and molybdenite. The oxide zone mineralization usually consists of native copper, copper oxides and carbonates with minor pyrite and molybdenite.

Disseminated chalcocite may be present in minor amounts in the hypogene mineral zone for several hundred feet below the supergene "blanket". Figure 5 shows the typical vertical distribution of mineralization at the Castle Copper deposit.



LEGEND:

Mineralization / Geology beneath Tertiary volcanic cover

- GRANITE PORPHYRY
- BRADSHAW COMPLEX, dominantly granite, pegmatite, diorite, gneiss and minor schist
- Interpreted geologic contact
- Interpreted fault
- PD-41 T.D. 2596' — Drill hole location (showing total depth)
  - PD – Phelps Dodge drill hole
  - BC – Bear Creek drill hole
  - UC – Utah Const. and Mining

NOTE:
B.R.T. – Bard River Trust Lands

ORCANA RESOURCES LIMITED

CASTLE COPPER PROPERTY

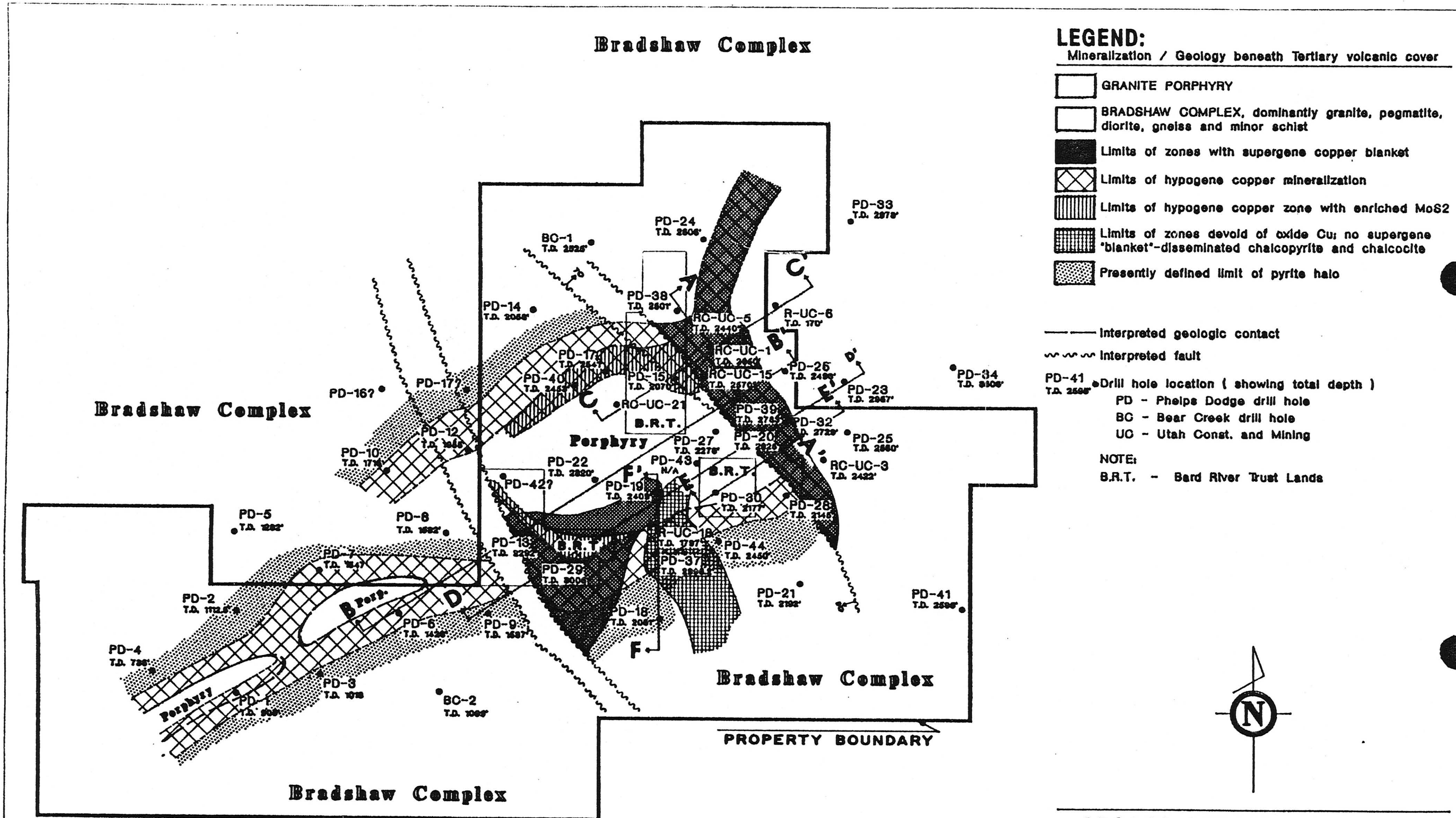
HUMBUG MINING DISTRICT
YAVAPAI COUNTY, ARIZONA, U.S.A.

GEOLOGY MAP

0 1000 2000 3000 4000
FEET

Work by. TILLICUM RESOURCES LTD. May. 1992
C.A.D. by. RODEL E. ORTIZ May 1992

Figure 3



ORCANA RESOURCES LIMITED

CASTLE COPPER PROPERTY

HUMBUG MINING DISTRICT
YAVAPAI COUNTY, ARIZONA, U.S.A.

ZONES OF MINERALIZATION

0 1000 2000 3000 4000
FEET

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C.A.D. by. RODEL E. ORTIZ May 1992

Figure 4

Castle Copper Property

Drillhole PD 20 Mineralization

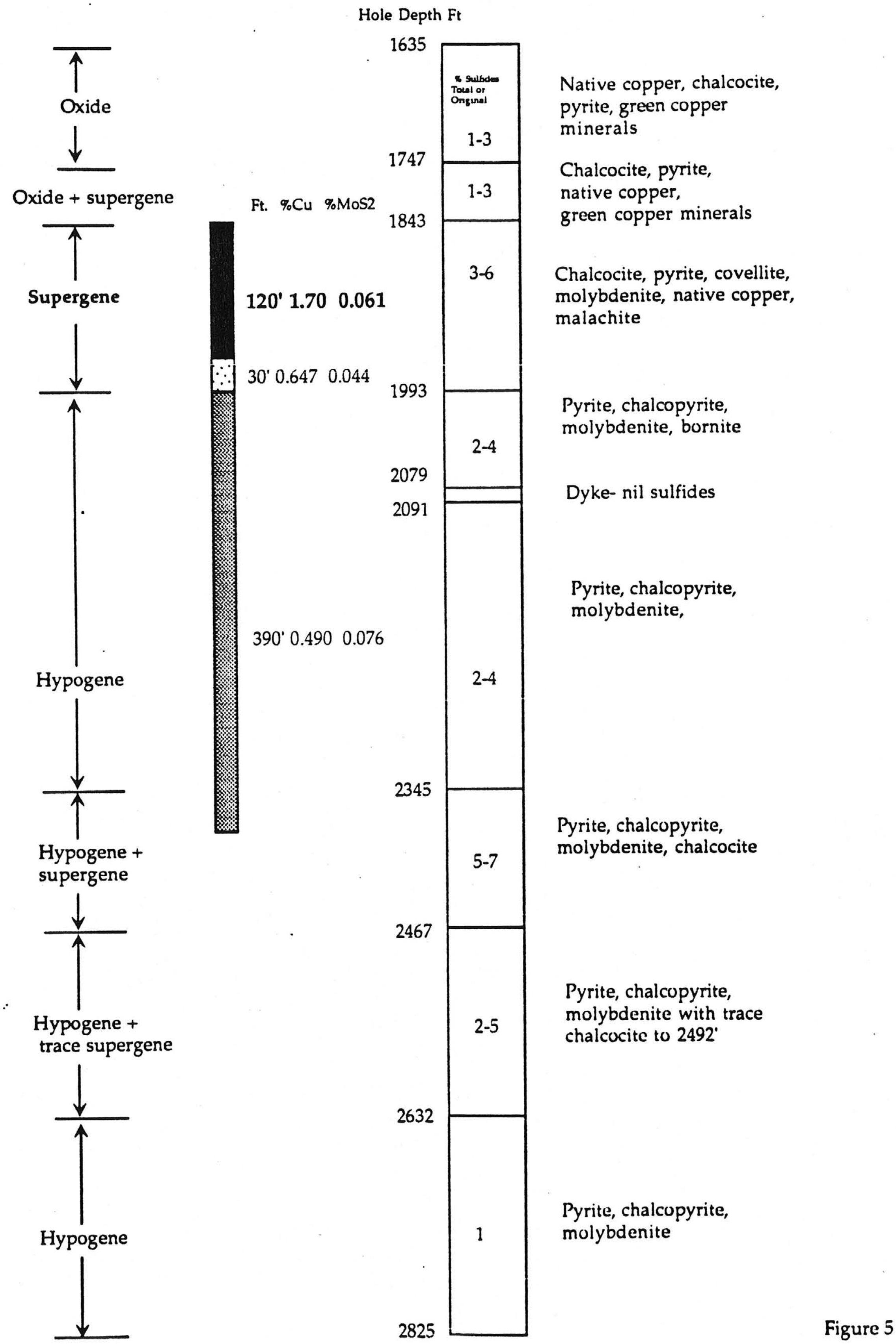


Figure 5

Tillicum Resources Ltd, June 1992

7. MINERAL INVENTORY

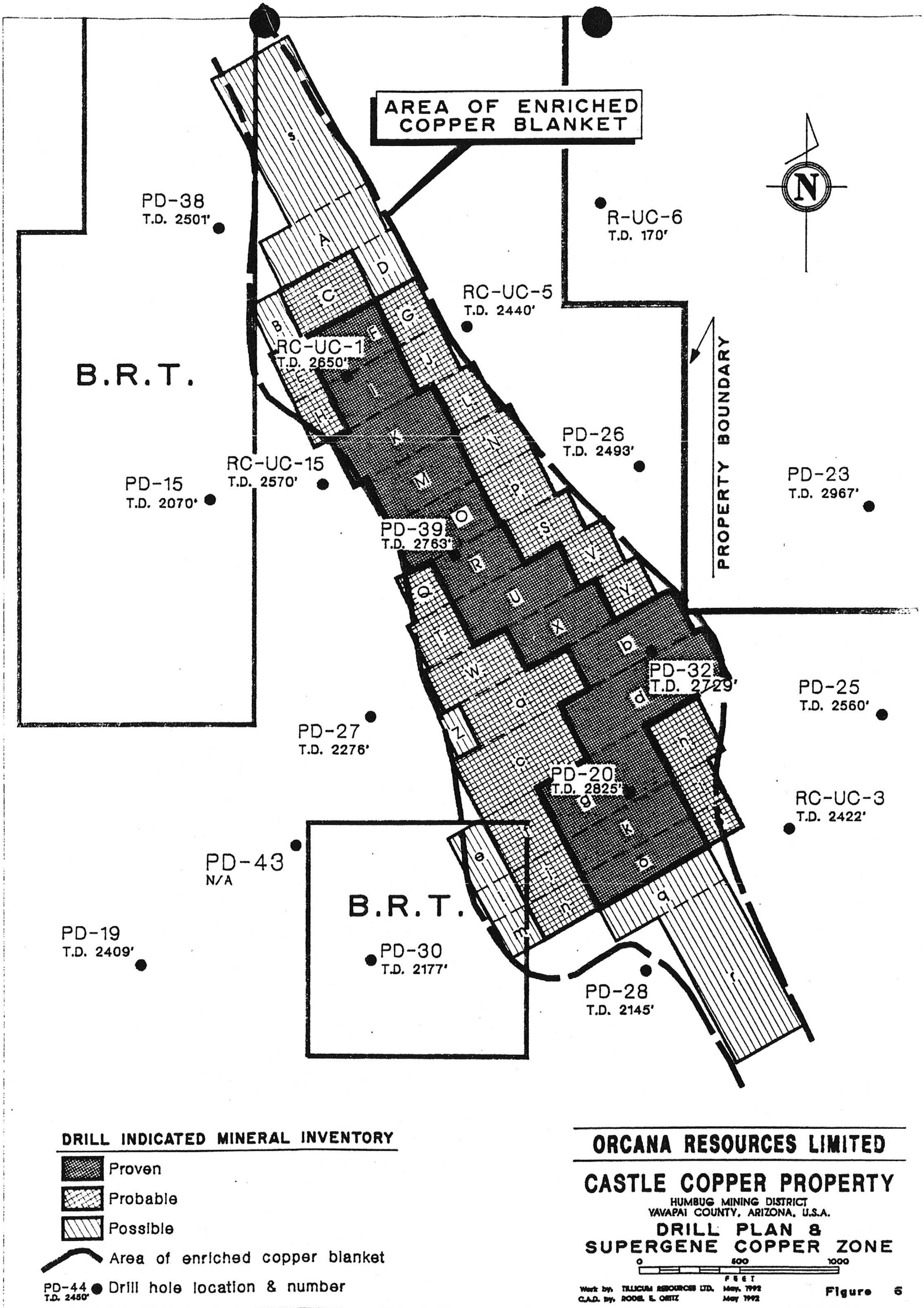
Four widely spaced drill holes intersected enriched (chalcocite, minor bornite) mineralization along a 5,500 foot by 1,100 foot wide northwest trending zone (Castle Copper supergene "blanket"), at an average depth of 1,975 feet, which appears to follow the Cow Creek fault. The average thickness of this zone is approximately 90 feet and is underlain by primary copper/molybdenum mineralization in a zone up to 390 feet thick grading 0.49% Cu (Figure 5).

Below the latter zone, the mineralization continues to an indeterminate depth but the grade drops off to 0.10% to 0.15% Cu. Better molybdenum values appear to correlate with better copper grades. The sulphide distribution appears to be spatially related to the Sheep Mountain Stock. Although the core of the stock contains less than 1% sulphides, an additional 1% to 3% sulphides has been introduced along the margins of the stock.

Bourne estimates, based on the four drill holes (see Figures 6 and 7), that there is a mineral inventory of approximately 39,434,000 tons grading 1.27% Cu and 0.044% MoS_2. The mineral inventory is divided into drill indicated "proven", "probable" and "possible" categories (Figure 6). Bourne assumes that the supergene mineralization in drill intersections represents a tabular body continuous between drill holes (a "blanket" deposit) rather than discrete shear zones or channels. He recommends that, for a Phase I exploration program, two additional rotary/core holes be drilled to further define the mineralization.

After reviewing the drill logs and noting the visual estimates of the type of copper bearing minerals, WGM recalculated the mineral inventory using Bourne's block parameters. Assayed intervals were reduced to minimize the inclusion of primary sulphide mineralization in the mineral inventory. WGM estimates that the Castle Copper deposit contains a drill indicated mineral inventory of approximately 28,110,000 tons grading 1.6% Cu and 0.04% MoS_2. The mineral inventory estimated by WGM, based on the area of the blocks defined by Bourne, is shown in Appendix 2.

WGM prefers to use the term "drill indicated" for our estimate, without reference to categories. However, based on the available data and Bourne's deposit model, WGM believes that the Castle Copper deposit represents a significant body of flat lying supergene copper.


AREA OF ENRICHED COPPER BLANKET
N
PROPERTY BOUNDARY
B.R.T.
B.R.T.
PD-38 T.D. 2501'
R-UC-6 T.D. 170'
RC-UC-5 T.D. 2440'
RC-UC-1 T.D. 2650'
PD-26 T.D. 2493'
RC-UC-15 T.D. 2570'
PD-15 T.D. 2070'
PD-23 T.D. 2967'
PD-39 T.D. 2763'
PD-32 T.D. 2729'
PD-25 T.D. 2560'
PD-27 T.D. 2276'
PD-20 T.D. 2825'
RC-UC-3 T.D. 2422'
PD-43 N/A
PD-19 T.D. 2409'
PD-30 T.D. 2177'
PD-28 T.D. 2145'
DRILL INDICATED MINERAL INVENTORY
Proven
Probable
Possible
Area of enriched copper blanket
PD-44 T.D. 2450' Drill hole location & number
ORCANA RESOURCES LIMITED
CASTLE COPPER PROPERTY
HUMBUG MINING DISTRICT
YAVAPAI COUNTY, ARIZONA, U.S.A.
DRILL PLAN &
SUPERGENE COPPER ZONE
0 500 1000
FEET
Work by. TILLICUM RESOURCES LTD. May, 1992
C.A.D. by. RODEL E. ORTIZ May 1992
Figure 6

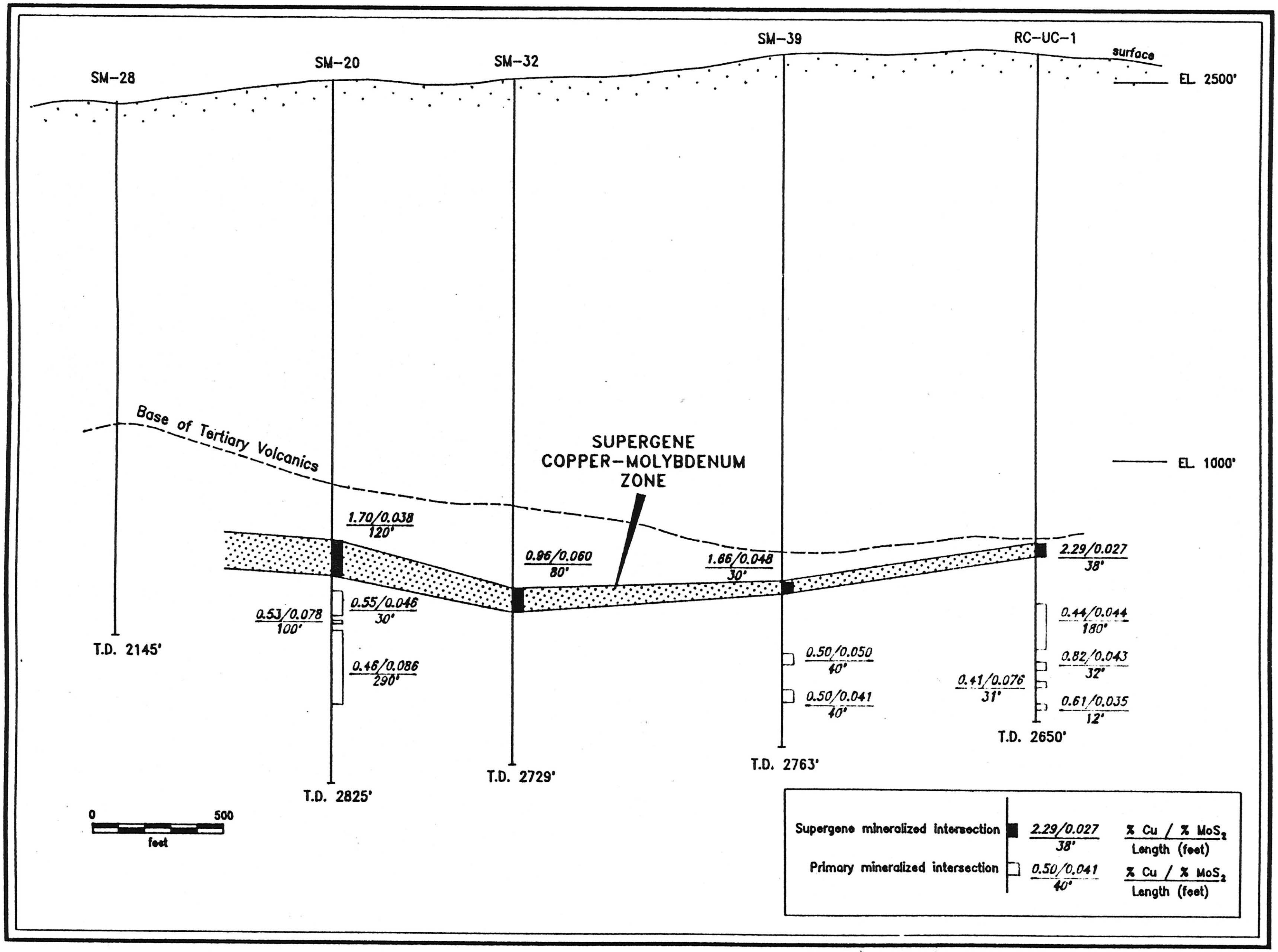


Figure 7
Schematic Longitudinal Section - Supergene Zone

We believe that there is ample opportunity to increase the mineral resource defined to date. For instance, the estimated mineral inventory does not take into account the significant drill hole UC-5 (approximately 15 feet grading 1.5% Cu). We concur with Bourne's recommendation for a Phase I program to better define the mineralization in the supergene zone and to increase confidence in its continuity. Infill drilling, as well as drilling of the periphery of the deposit, will be required to delineate the mineralization prior to a program of underground exploration.

8. MINING

8.1 MINING METHODS

No data are available to assess the geotechnical characteristics of the Castle Copper deposit, consequently mining methods thought to be applicable to this deposit are based solely on the presumed geometry of the mineralized zone. Two stoping methods thought to be applicable to this deposit are room and pillar and block caving. Due to the relatively critical geotechnical requirements for the successful application of the block caving method and the relatively thin (≈90 feet) mineralized zone, WGM believes that a room and pillar stoping method is more appropriate.

The room and pillar model incorporates the use of jumbo drills for production and drift development. Ore and waste are assumed to be moved with front-end loaders, scoop trams and trucks. Support is provided by rock bolts as well as pillars. In the latter stages of the mine life pillars are assumed to be recovered and the ore extraction recovery is 85%. Dilution is assumed to be 10%.

8.2 ACCESS/PRODUCTION

Several methods of access to, and production of, the mineralization have been investigated. The primary access/production methods assessed for the property are: a) shaft (access-production); b) shaft (production)/decline (access); and c) decline (access-production).

The top of the mineralization lies at an average depth below surface of 1,975 feet and the mineralized zone has an average weighted thickness (by area of influence) of approximately 90 feet. The average elevation of the surface is approximately 2,700 feet above sea level.

A shaft (access/production) is usually considered more appropriate at this depth, however if capital costs for the ramp are equivalent to that of a shaft WGM believes that this would be the optimum access/production route due to increased flexibility and lower operating costs.

The estimated optimal rate of mining production ranges from 8,000 to 10,000 tons/day or 2,000,000 to 2,500,000 tons/year based on 250 working days per annum.

Capital and operating cost estimates for the shaft/shaft, ramp/shaft and ramp/ramp access and production facilities are presented below. It is assumed that there are no physical or geotechnical considerations that would impact on these alternatives.

9. PROCESSING

Capital and operating costs for various processing scenarios were developed by EHA. WGM has incorporated EHA's cost estimates for the various processing scenarios in the overall economic evaluation. EHA's report is contained in this report as Appendix 3.

The processing scenarios, for which EHA estimated capital and operating costs at production capacities of 2,000,000 and 2,500,000 tons of ore/year, include:

1) Grind-Float-Roast-Leach-Electrowin (RLE);

2) Grind-Float-Pressure Leach-Electrowin (PLE);

3) Grind-Float-Ammonia Leach-Electrowin (NH_3);

4) Heap Leach-Solvent Extraction-Electrowin (SX-EW); and

5) Grind-Float-Filter-Ship Concentrate to Smelter (FLOAT).

To our knowledge, the metallurgical characteristics of the mineralization have not been investigated in any detail, consequently various scenarios were modeled to indicate the range of processing alternatives. A review of the drill logs indicates that visual identification of copper mineralization within the the zone of interest is primarily supergene in origin. The copper minerals noted include chalcocite, bornite, minor copper oxides and native copper.

10. ECONOMIC EVALUATION

10.1 MINING

Based on Bourne's report, WGM has made some simplified assumptions regarding the parameters to be used in an economic model of the deposit. These parameters are:

- an average head grade of 1.6% Cu and 0.04% MoS_2 ;
- tonnage of 40,000,000 tons;
- access to and clearing of mine and mill sites in place;
- metal prices constant at $US 1.20/lb Cu and $US 2.10/lb MoS_2 ;
- a room and pillar mining method appropriate for the deposit;
- continuity of grade and the average thickness of the mineralization;
- applicability of capital and operating cost estimates derived from power curves; and
- 10% dilution at zero% grade.

Mine capital and operating costs were derived from various sources including a USBM publication and computer program, models developed by a mining cost service and published cost data. These costs were compared to determine their consistency and a judgment made regarding their applicability to the present study. The various cost data which were considered most critical to the development of an economic model are discussed below.

A room and pillar mining method is thought to be most appropriate for this deposit. As noted in Section 8.1, several access/production openings were investigated for the deposit. Capital cost estimates, created by **Mining Costs Service** (MCS) in 1991, of a ramp access combined with shaft production appears to be similar to a ramp access/production mine model developed by WGM. Analyses of capital and operating cost models indicates that two straight ramps, one for access combined with a separate conveyor ramp for production, have a significant operating cost savings over a shaft production facility. An additional benefit to ramp/conveyor production is that it permits more flexibility in designing mine layout and operation. Mining models discussed in the remainder of this report are therefore restricted to ramp access and production by truck haulage and conveyor haulage.

All the costs are approximate and thought to be within ± 25-30% of actual costs. The model is believed to be of sufficient accuracy upon which to base a recommendation for further exploration expenditures.

Table 2 summarizes WGM's estimate of the capital and operating cost data developed for this study. Operating costs are given in terms of $US/ton of ore. All costs are in December, 1991 United States dollars ($US).

TABLE 2

WGM Mining Capital and Operating Cost Summary

Production	Ramp Access		Shaft Access	
Tons/Day	Capital	Operating	Capital	Operating
8,000	$34,492,000	$8.2	$50,784,000	$12.2
9,000	37,215,000	8.1	54,328,000	12.0
10,000	39,833,000	7.9	57,718,000	11.9

Cost estimates of the models developed by WGM were compared to a MCS model in order to check the validity of the assumptions and the estimated costs. The parameters of the MCS model, after conversion to per ton equivalent operating costs and 5% inflation of all costs, (Table 3) are based on:

- 9,400 tons ore/day production;
- Top slicing with jumbo drills and bench drilling with air-track drills;
- Shaft haulage of ore to surface;
- No crushing costs are included;
- Shaft and decline entry to 1,900 feet deep.

TABLE 3

MCS - Room & Pillar Shaft Haulage Mine

9,400 tons ore/day

Cost Center	Capital	Operating ($/ton)
Total	$58,058,000	6.1

Although the MCS model (Table 3) is not directly comparable to the model developed by WGM (Table 2), there is sufficient similarity to validate the cost models.

A factor in accounting for the capital and operating cost variances is the assumption in the MCS model of a combination shaft (haulage) and decline (access) for mining. Using WGM's 10,000 ton/day model (Table 2), it is apparent that WGM's estimated operating cost lies between $1.89/ton to $5.80/ton more than the MCS operating cost while WGM's capital costs are approximately $0.340 million (shaft) to $18.225 million lower than the MCS model. For the purpose of this study we have not analyzed this discrepancy in detail.

WGM has estimated the costs of a dual ramp system, with conveyor haulage, for access and production. Our estimate is based on a modification of the MCS model in which we have eliminated the capital and operating costs associated with a shaft and substituted our estimate of capital and operating costs associated with an additional ramp and a conveyor system. WGM's estimate of a dual ramp/conveyor haulage and access cost model has the effect of reducing capital and operating costs (Table 4). Development of this mining alternative is based on the following assumptions:

- 1,800 foot vertical depth, from portal elevation, to mineralization;
- 15% grade for ramps;
- Two 12,000 foot long ramps, one for access and the other for conveyor haulage, separated by 100 feet horizontally with cross cuts every 400 feet; and
- ramp and cross cut dimensions of 20 feet by 15 feet.

TABLE 4

WGM Capital & Operating Costs - Dual Ramp/Conveyor

Production Rate	Capital	Operating
2,000,000/year	$43,817,000	$5.6/ton
2,500,000/year	50,603,000	5.4/ton

10.2 PROCESSING

WGM has incorporated capital and operating costs for only two of the processing alternatives developed by EHA (see Appendix 3) as being the most economically viable. A summary of these costs are shown in Table 5 below.

TABLE 5

Processing Costs

Process	SX-EW	FLOAT
2 million tons/year		
Capital Cost ($000)	51,708	43,212
Operating Cost ($/ton)	5.8	4.3
2.5 million tons/year		
Capital Cost ($000)	60,903	49,403
Operating Cost ($/ton)	5.2	4.0

Processing alternatives noted in Table 5 are identified as:

SX-EW: Heap Leach-Solvent Extraction-Electrowin
FLOAT: Grind-Float-Filter-Ship Concentrate to Smelter

Details of the derivation of these costs are shown in Appendix 3.

10.3 ECONOMICS

The mining methods used in this study are dual ramp/conveyor, other mining methods are thought to be less economically attractive. The processing methods used are SX-EW and conventional flotation (FLOAT).

Simple discounted cash flow-rate of return (DCF-ROR) analyses are used only to indicate the relative merits of the various mining/process alternatives. We have developed simplified economic models based on the parameters noted in the Tables 4 and 5. Our analysis is restricted to the mining costs we have developed for a dual ramp (one for access and the other for conveyor haulage) combined with room and pillar stoping. It is WGM's opinion that the range of capital and operating costs, shown below in Table 6, are reasonable given the variability of the different sources of costs models.

TABLE 6

Economic Model Cost Parameters

Mine		Mill		Total	
Capital	Operating	Capital	Operating	Capital	Operating
$48,817,000 [1]	$5.6/ton	$43,212,000	$4.3/ton	$87,029,000	$9.9/ton
$48,817,000 [2]	5.6/ton	51,708,000	5.8/ton	95,525,000	11.4/ton
$50,603,000 [3]	5.4/ton	49,403,000	4.0/ton	100,006,000	9.4/ton
$50,603,000 [4]	5.8/ton	60,903,000	5.2/ton	111,506,000	10.6/ton

Notes: [1] Case 1 - FLOAT processing, 2.0M TPY
[2] Case 2 - SX-EW processing, 2.0M TPY
[3] Case 3 - FLOAT processing, 2.5M TPY
[4] Case 4 - SX-EW processing, 2.5M TPY

The following assumptions are used in the economic analyses of the deposit:

- constant metal prices of $1.20/lb Cu (in concentrate), $1.10/lb Cu (cathode copper F.O.B. mill) and $2.10/lb MoS_2 (F.O.B. mill);
- truck transportation charges of $0.10/ton-mile;
- 150 miles to nearest custom smelter;
- 3 year preproduction period;
- 100% equity financing;
- a hurdle rate (discount factor) of 15% is used to estimate NPV;
- precious metals are not recovered at all, nor is molybdenum in the SX-EW process; and
- combined state and federal tax rate is 51% beginning in the first year of production.

Revenues are derived from the above metal prices and the tabulated metal production from 2,000,000 tons of ore/year (p.12, Appendix 3) and 2,500,000 ton of ore/year (p.13, Appendix 3) for the relevant processes. Net smelter return per ton of ore is based on approximately 71% of the contained copper (FLOAT process) while 100% of the MoS_2 is paid F.O.B at the mine site. For cathode copper (SX-EW process), 100% of the copper is paid for F.O.B. the mine site.

The estimated net present values (NPVs) for the various mining/processing alternatives of Table 6 are indicated in Table 7.

TABLE 7

Net Present Value - Operating Alternatives

($ Millions)

Case		NPV (15%)
1	Flotation Processing - 2.0M TPY	$25.00
2	SX-EW Processing - 2.0M TPY	(3.04)
3	Flotation Processing - 2.5M TPY	44.13
4	SX-EW Processing - 2.5M TPY	11.26

In deriving the models dealing with SX-EW processing (Cases 2 and 4), no allowance was made for the delay in producing copper associated with heap leach processes. This would have the effect of lowering the estimated NPVs for Cases 2 and 4.

The relative effect of changes in capital and operating costs on NPVs for the mining/processing alternatives is shown in Table 8. It is apparent from this table that projected NPVs are most sensitive to changes in operating costs and that the relative increase in capital costs (Cases 1 to 3 and 2 to 4) is more than offset by the relative decrease in operating costs respectively.

TABLE 8

Effect of Costs on NPV

Case	Change in Capital Cost (%)	Change in Operating Cost (%)	NPV (@15%)
1-3	+14.3	-5.3	+76.5
2-4	+16.7	-7.5	+470.4

In considering these economic models, it must be kept in mind that they only indicate the relative merits of the various alternatives given the underlying assumptions. As an additional check on the validity of the assumptions, industry "rules-of-thumb" were applied to the estimated annual gross (NSR) revenue. These rules are:

1) Investment should be less than 2.5 times the annual revenue; and
2) Cash operating costs should be less than 50% of the annual revenue.

These rules-of-thumb generally indicate the viability of a potential mine, in lieu of detailed analyses, to generate a reasonable rate of return on investment (approximately 15% ROI). Application of these rules quickly indicate, in a preliminary economic analysis, where to focus attention in refining capital and operating costs. Table 9 tabulates the application of these rules to the estimated economic parameters of the Castle Copper deposit.

TABLE 9

Investment Rules of Thumb

Tons Per Year (Millions)		Est. Gross Rev. ($ millions/year)	Max. Invest. Rule 1 ($ millions)	Max. Op. Cost Rule 2 ($ millions/year)
2.0	SX-EW	$46.1	$115.3	$23.1
	FLOAT	52.7	131.6	26.4
2.5	SX-EW	57.6	144.0	28.8
	FLOAT	65.9	164.7	33.0

Estimated capital costs (Table 6), for all cases, are less than the maximum indicated by application of Rule 1, but application of Rule 2 to Case 2 (SX-EW @ 2.0M TPY with approximately $23.7M/year operating costs) indicates that this alternative is not viable.

Cases 1, 3 and 4 all have estimated annual operating costs less than the maximum indicated by application of Rule 2 and this is reflected in their estimated NPVs at a 15% discount factor (Table 7).

As the most economically viable alternative (Table 7), Case 3 was investigated further to determine the effect of metal price (Cu) on NPV. Copper price was varied from $0.90 to $1.00/lb Cu. The results of this analysis are shown in Figure 7. This figure indicates that, for Case 3, a copper price between $0.94 and $0.95/lb Cu is required for an investment break-even price. Investment break-even price gives a NPV of zero dollars at the required rate of return on investment (hurdle rate).

It is evident, from the steep slope of the curve (Figure 7), that the model is very sensitive to metal price. This figure indicates that a ± $0.05 Cu price change means an increase of approximately $7M or a decrease of $12M in the estimated NPV.

Figure 8 is a graph of the break-even (no return on investment) price of copper. This figure indicates that the break-even copper price, for Case 3, lies between $0.675 and $0.680/lb Cu. Figures 7 and 8 indicate that, given the model parameters, copper price may vary from approximately $0.95/lb Cu to $0.71/lb Cu to cover a range from a minimum return on investment to maintaining operations without infusion of additional capital.

Given near term projections of world copper supply and demand, and consequently copper prices, this preliminary economic analysis indicates that the deposit is economically viable, assuming the applicability of the financial and technical parameters of the model. It should be noted that any decrease in capital or operating costs will increase the NPV and decrease the break-even copper price of the mine/process economic model.

In terms of capital or operating cost reduction, the most likely area of cost reduction is associated with capital costs. Both mining and processing capital costs have been developed on the basis of acquisition of new equipment. It is likely that capital costs might be reduced by 15% to 20% by the acquistion of refurbished equipment. If this cost reduction is possible, there will likely be a significant increase in NPV for all of the cases modeled.

Figure 8

Investment Breakeven Copper Price

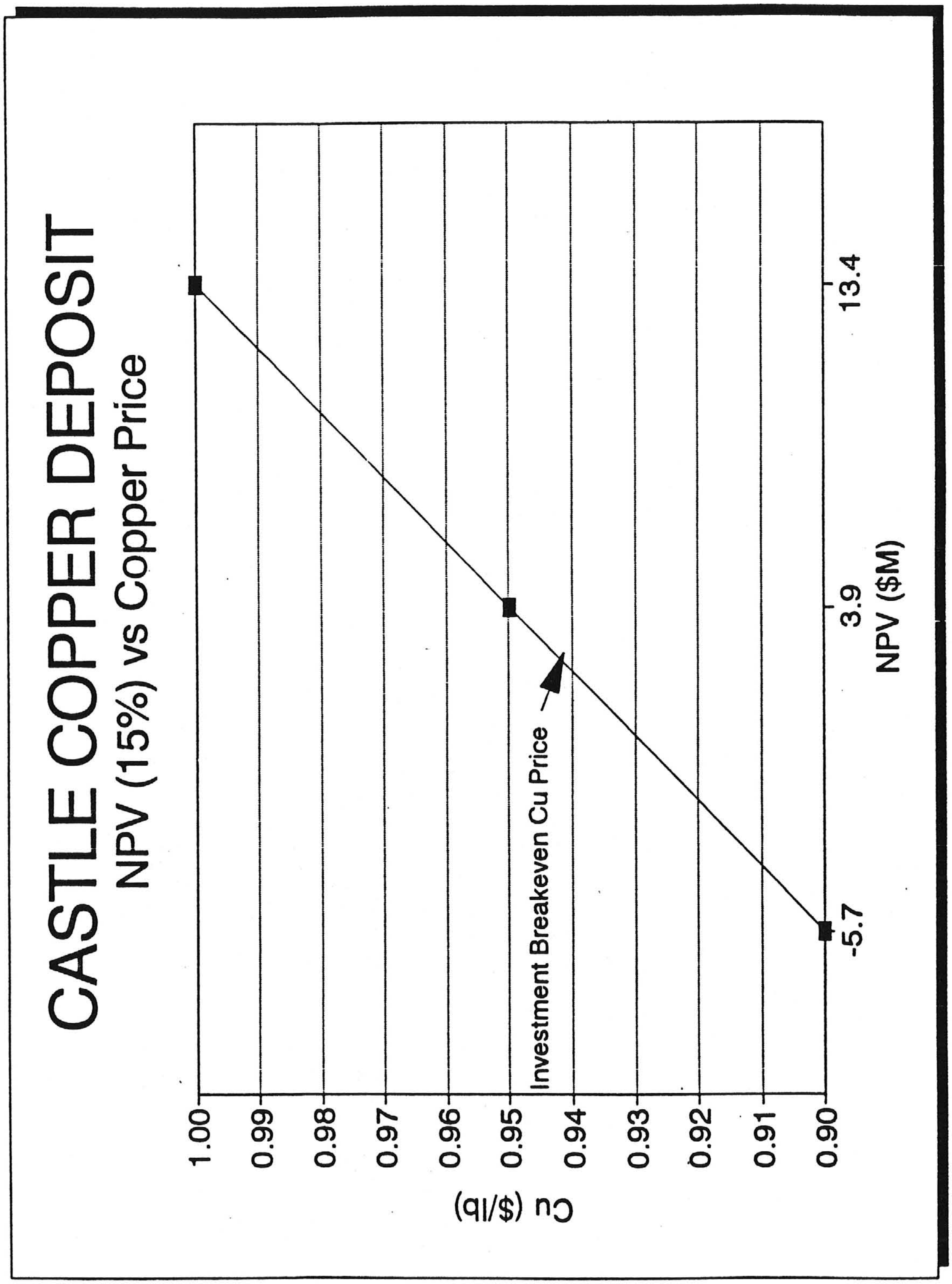
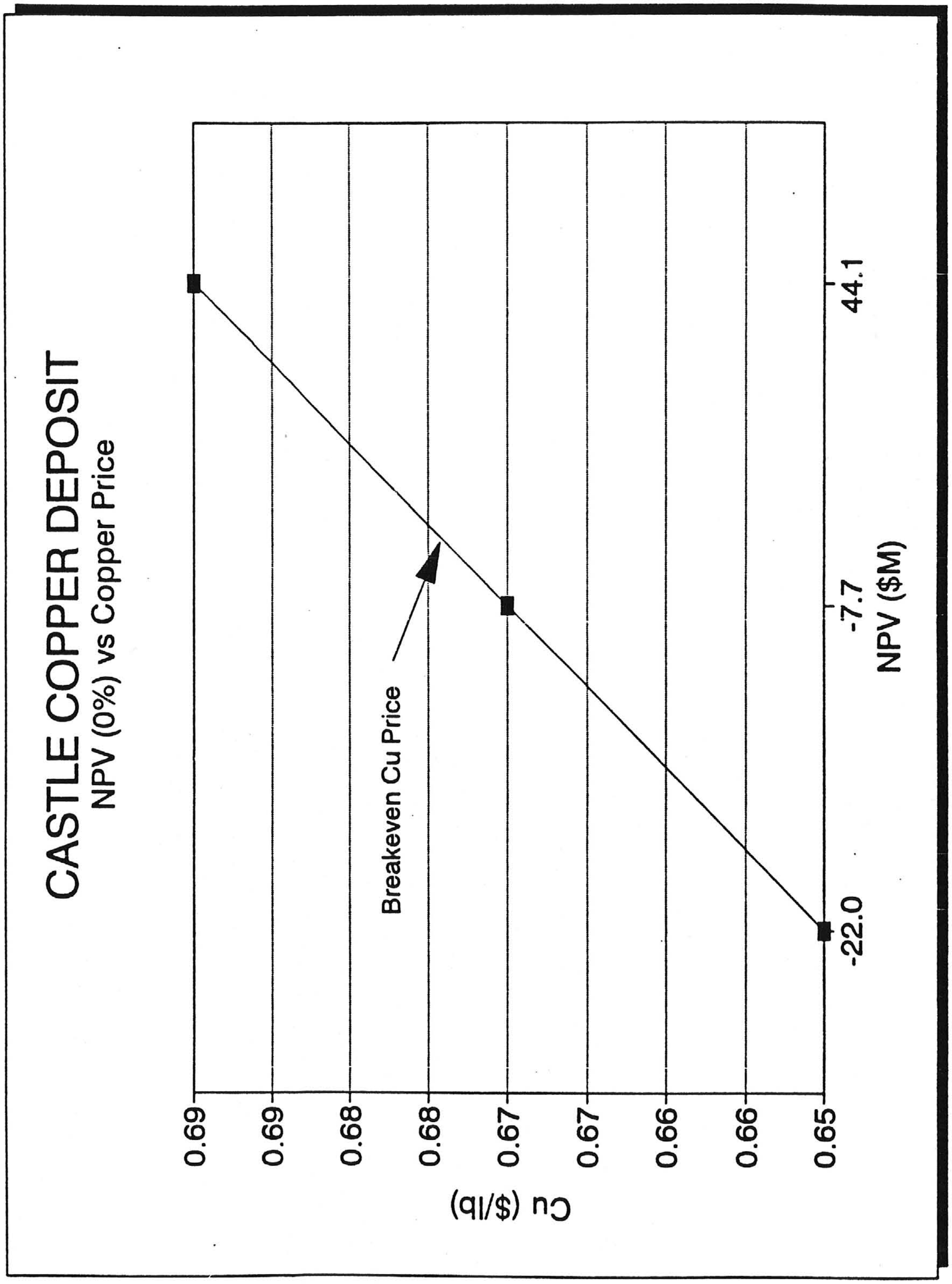


Figure 9

Breakeven Copper Price



11. CONCLUSIONS

Preliminary economic analyses of the Castle Copper deposit indicate that the expenditure of additional exploration funds is merited to determine the extent of the mineralized zone and its geotechnical and structural characteristics. The magnitude of the estimated net present values, using a 15% discount factor, for the various mining/processing alternatives ranges from approximately -$3.0M to $44.1M and, while not definitive, certainly indicate that additional exploration expenditures are justified.

This preliminary analysis indicates that conventional flotation processing is a more viable alternative than solvent extraction-electrowin processing. Mining by the room and pillar method appears viable but the capital and operating costs associated with the production/access workings (ramp vs. shaft) will have to be investigated in more detail. At the level of analysis of this study, it appears that ramp (decline) access with conveyor haulage is viable for this deposit despite the relatively great depth to the mineralized zone.

In deriving the estimated net present values no expenditures were incorporated for the amount of exploration needed to delineate the deposit to the point of a feasibility study. Such expenditures will have the effect of decreasing the estimated net present values associated with the economic models. It is our opinion that any such decrease, due to inclusion of a significant exploration budget, will still justify the allocation of the exploration funds recommended by Bourne.

The most viable economic model indicates that a reasonable rate of return will be achieved at a copper price of $0.94/lb but that revenue from the deposit will support operation at a copper price of $0.68/lb. The possibility of decreasing estimated capital costs, by partial substitution of refurbished equipment, may further enhance the project economics.

WGM recommends that Orcana pursue exploration of the deposit, as outlined by Bourne, in an effort to further define the technical and economic characteristics of the deposit.

SOURCES OF INFORMATION

Camm, T.W. (1991)	Simplified Cost Models For Prefeasibility Mineral Evaluations, United States Department of the Interior, Bureau of Mines, Information Circular 9298.
Bourne, D.A. (1992)	Report on Geology and Mineral Inventory, Castle Mountain, Sheep Mountain East Area, Humbug Mining District, Yavapai County, Arizona U.S.A. for Orcana Resources Limited.
Hayden, A. (1992)	Orcana Resources Limited, Castle Project, Cost Study of Selected Process Routes, EHA Engineering Ltd.
Smith, R.C. (1991)	PREVAL: Prefeasibility Software Program for Evaluating Mineral Properties, Version 1.1, United States Department of the Interior, Bureau of Mines, Information Circular 9307.
(1991)	Mining Cost Service by Western Mine Engineering. Updated periodically.
WGM	Various internal documents and reports.

A PRELIMINARY ECONOMIC EVALUATION OF THE CASTLE COPPER PROPERTY HUMBUG MINING DISTRICT YAVAPAI COUNTY, ARIZONA

Volume II

APPENDICES

FOR

ORCANA RESOURCES LIMITED
TORONTO, ONTARIO
CANADA

Toronto, Ontario
May 29, 1992

Watts, Griffis and McOuat Limited
Consulting Geologists and Engineers

APPENDIX 1

Report on Geology and Mineral Inventory, Castle Mountain,

Sheep Mountain East Area,

Humbug Mining District, Yavapai County, Arizona U.S.A.

for Orcana Resources Limited

by

D. Bourne (1992)

REPORT ON
GEOLOGY AND MINERAL INVENTORY
CASTLE COPPER-MOLYBDENUM PROPERTY
SHEEP MOUNTAIN EAST AREA
HUMBUG MINING DISTRICT
YAVAPAI COUNTY, ARIZONA
U.S.A.

FOR

ORCANA RESOURCES LIMITED
TORONTO, ONTARIO
CANADA

LICENSED PROFESSIONAL ENGINEER
D. A. BOURNE
PROVINCE OF ONTARIO

SCARBOROUGH, ONTARIO
MARCH 20, 1992

DONALD A. BOURNE, P.ENG.
CONSULTING GEOLOGIST

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SUMMARY

The Castle Copper-Molybdenum Property consists of 141 unpatented lode mining claims covering approximately 2,500 acres located in the Sheep Mountain East area about 50 miles northwest of Phoenix in south central Arizona, U.S.A. The property was acquired to cover a zone of enriched copper-molybdenum mineralization within and adjacent to a composite stock of Laramide (?) age which forms part of an extremely large mineralized system covering 3 or 4 square miles in aereal extent. Excess smelting capacity is available within trucking distance for custom treatment of copper concentrates.

The oldest rocks of the area are biotite schists of the Yavapai Series of Precambrian age cut by foliated granite alaskite and diorite of the Bradshaw complex also Precambrian in age. Intrusive into these rocks is the Sheep Mountain Stock, a composite body of Laramide (?) age which forms a slightly elongated dome measuring 3,400 feet by 2,300 feet whose long axis strikes N45° W and plunges 50° northwest. The copper-molybdenum mineralization on the Castle property appears to be related to this stock. Unconformably overlying the Precambrian and Laramide (?) rocks is a series of mid-Tertiary volcanic flows and pyroclastics from 1,500 to 2,200 feet thick which cover the entire Sheep Mountain East area. Post-mineral andesite dykes which are probable feeders for the overlying lavas cut both the Precambrian and Laramide (?) rocks along the eastern margin of the stock.

The mineral system at Sheep Mountain East is an extremely large one with significant sulphide mineralization having been identified over 3 or 4 square miles although the better copper-molybdenum appears to be located within or adjacent to the Sheep Mountain Stock. Hypogene sulphide mineralization

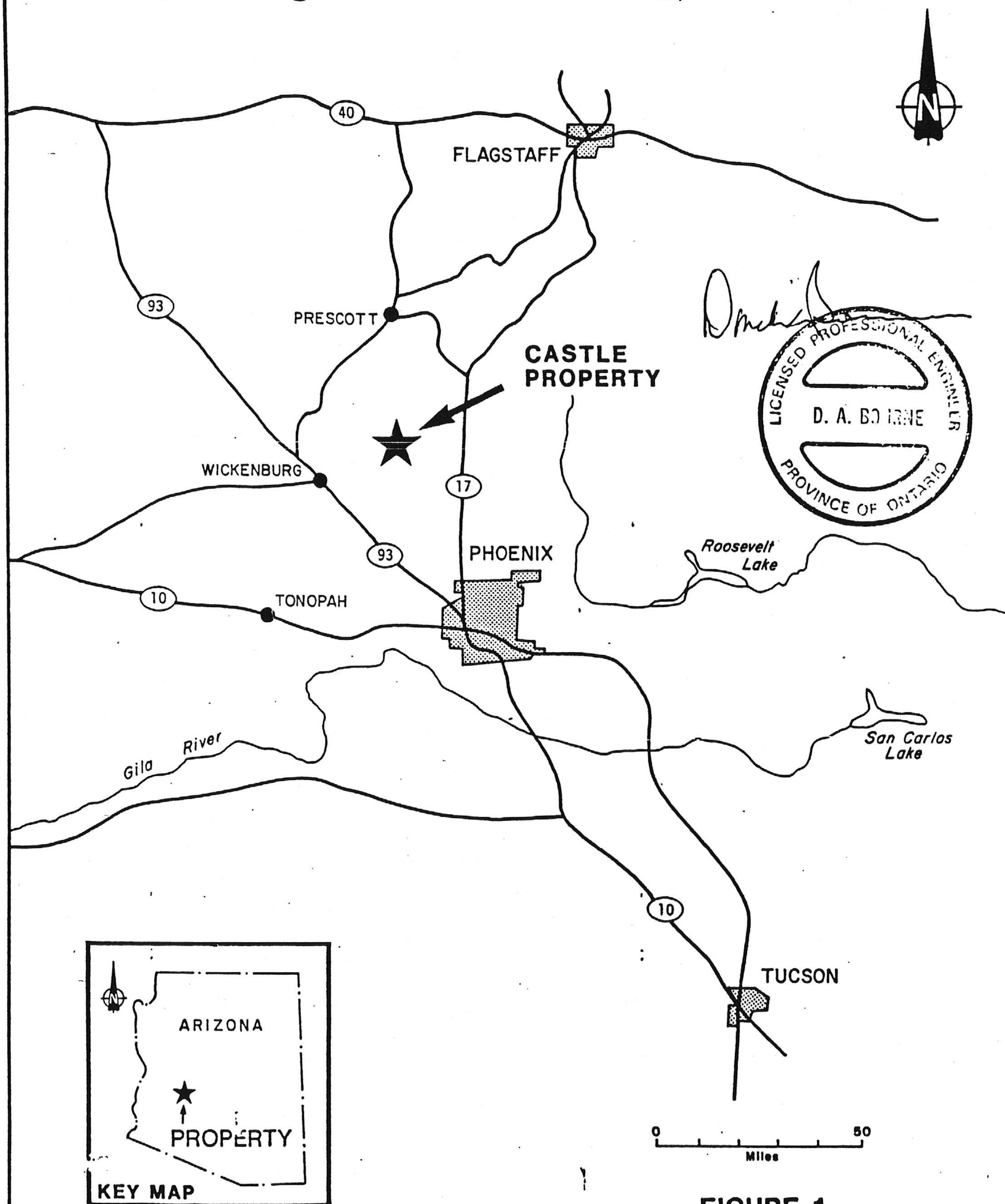


FIGURE 1

LOCATION MAP CASTLE PROPERTY

YAVAPAI COUNTY, ARIZONA, U.S.A.

August 27, 1990

consists principally of pyrite with lesser chalcopyrite and molybdenite. Minor amounts of galena, sphalerite, magnetite and specularite are present locally.

The drill indicated copper-molybdehum mineral inventory identified to date on the Castle property occurs in a north-westerly striking zone measuring 5,500 feet in length by 1,100 feet wide and has been intersected in 4 holes drilled by previous operators. The drill-indicated mineral inventory as calculated by the writer is summarized as follows:

	TONS	% CU	TXCU	% MoS_2	$TXMoS_2$
PROVEN	15,002,232	1.17	17,562,298	0.047	701,261
PROBABLE	14,070,869	1.17	16,459,752	0.047	655,998
SUB TOTAL	29,073,101	1.17	34,022,050	0.047	1,357,259
POSSIBLE	10,361,383	1.55	16,032,858	0.037	383,806
TOTALS	39,434,484	1.27	50,054,908	0.044	1,741,065

It is assumed that the intersections of supergene enriched copper-molybdenum mineralization used in the calculations represent a tabular body continuous between drill holes rather than a complex of enriched shear zones or channels.

The writer recommends that an additional two rotary/core holes be drilled each to a depth of 2,500 feet to further define the mineral inventory, together with preliminary metallurgical test work on drill core to bring the property to the prefea-sibility stage. The proposed program is divided into two parts, the total cost of which is estimated at $200,000 U.S.

PROPERTY DESCRIPTION

The Castle copper-molybdenum property centered on latitude 34° 00'N and longitude 112° 30'W consists of a block of 141 unpatented lode claims covering approximately 2,500 acres located in Sections 10, 11, 14, 15, 17, 20, 21, 22 and 23 in Township 8 North, Range 1 West, Gila and Salt River Meridian, in the south central part of Yavapai County, Arizona, U.S.A. The claims are numbered as follows:

SECTION 10 (12 claims)

RAY 1	RAY 5	RAY 27
2	6	29
3	7	53
4	8	111

SECTIONS 10 AND 11 (4 claims)

RAY 28
30
55
110

SECTIONS 10 AND 15 (2 claims)

RAY 31
32

SECTION 15 (22 claims)

RAY 9	RAY 15	RAY 21	RAY 33
10	16	23	34
11	17	23	36
12	18	24	37
13	19	25	
14	20	26	

SECTIONS 14 AND 15 (1 claim)

RAY 35

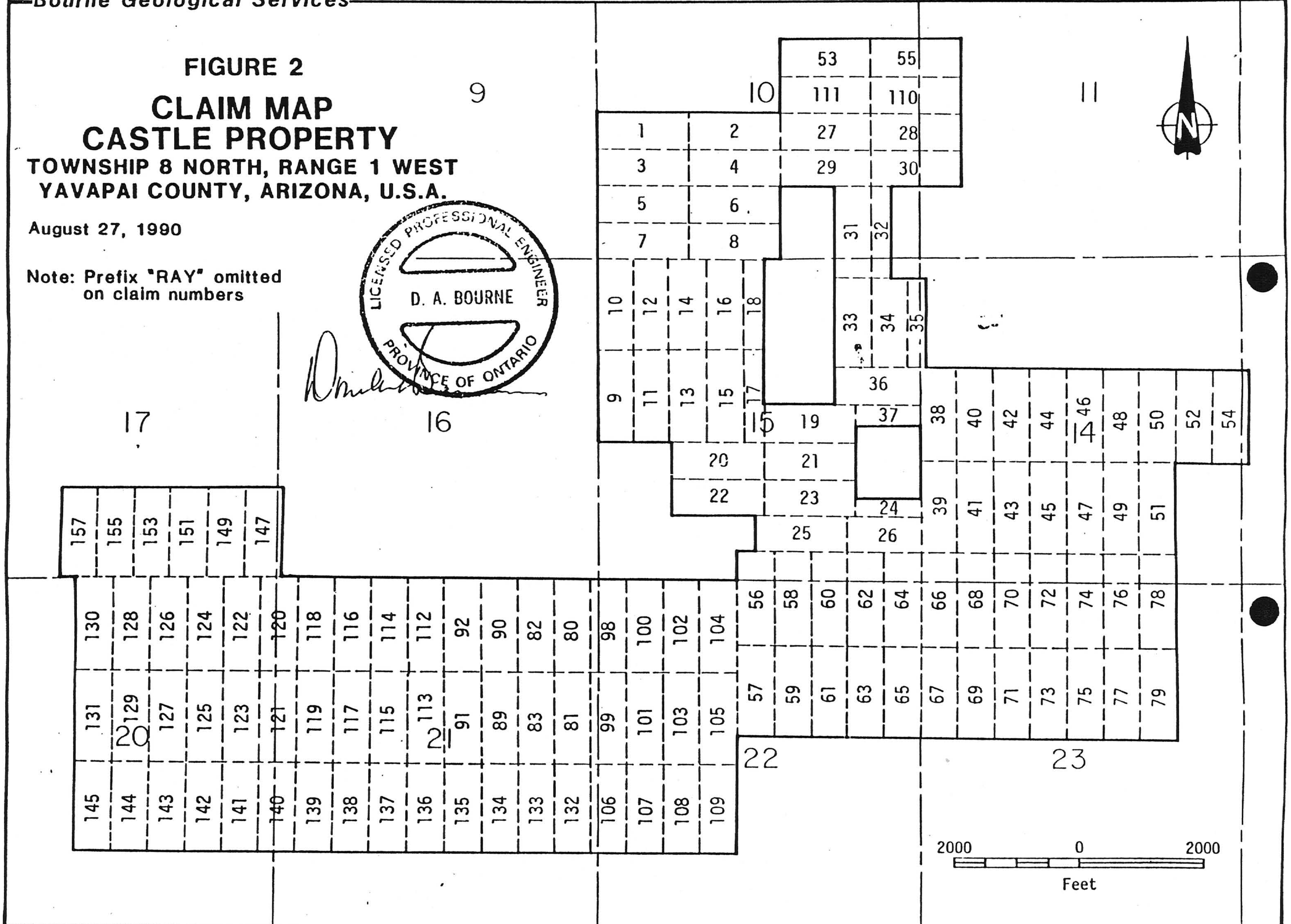
FIGURE 2

CLAIM MAP
CASTLE PROPERTY

TOWNSHIP 8 NORTH, RANGE 1 WEST
YAVAPAI COUNTY, ARIZONA, U.S.A.

August 27, 1990

Note: Prefix "RAY" omitted on claim numbers



SECTION 14 (15 claims)

RAY 38	RAY 43	RAY 48
39	44	49
40	45	50
41	46	51
42	47	52

SECTIONS 13 AND 14 (1 claim)

RAY 54

SECTIONS 15 AND 22 (5 claims)

RAY 56	RAY 62
58	64
60	

SECTION 22 (14 claims)

RAY 57	RAY 100	RAY 105
59	101	107
61	102	108
63	103	109
65	104	

SECTIONS 14 and 23 (7 claims)

RAY 66	RAY 74
68	76
70	78
72	

SECTION 23 (7 claims)

RAY 67	RAY 75
69	77
71	79
73	

SECTIONS 21 AND 22 (3 claims)

RAY	98
	99
	106

SECTION 21 (24 claims)

RAY	80	RAY	91	RAY	116	RAY	134
	81		92		117		135
	82		112		118		136
	83		113		119		137
	89		114		132		138
	90		115		133		139

SECTIONS 20 AND 21 (3 claims)

RAY	120
	121
	140

SECTION 20 (15 claims)

RAY	122	RAY	127	RAY	141
	123		128		142
	124		129		143
	125		130		144
	126		131		145

SECTION 17 (6 claims)

RAY	147	RAY	153
	149		155
	151		157

TOTAL NUMBER OF CLAIMS = 141

Ownership of the minerals is held by the Federal Government through the Bureau of Land Management. Federal statutes provide that not less than $100 worth of labour shall be performed or improvements made on each mining claim during each year in order to maintain the property in good standing. A lode mining claim on public lands may be brought to lease

> "...after at least $500 worth of work has been done upon it, for $5.00 per acre or fraction of an acre, plus various fees" (Butler, 1967, p.237).

As the Castle property is not in a national park or designated conservation area, there are no environmental or other restrictions which would interfere with exploration and development of the claim group.

The following report is based on data made available to the writer including copies of the original diamond drill logs, assay sheets, geological maps and reports of Phelps Dodge and Utah International both of whom carried out work on the Castle property. As the copper-molybdenum mineralization is not exposed on surface but lies beneath a 1,500 foot capping of post-mineral volcanics, a site examination was not considered necessary although the writer is familiar with the general area having carried out property examinations southwest of Wickenburg in Maricopa County.

LOCATION, ACCESS, LOCAL RESOURCES

The Castle property lies about 50 miles northwest of Phoenix, the major metropolitan centre in south-central Arizona at an elevation of between 2,600 and 3,000 feet above sea level. It can conveniently be reached by driving north on highway 17 to the Castle Hot Springs turn-off from which well-maintained gravel roads give ready access to all parts of the claim group. The climate is typically dry and arid with sparse vegetation consisting of cactus and low shrubs.

Of the several copper smelters remaining in Arizona, only three are currently being operated. Asarco's Hayden smelter and Cyprus' smelter at Miami have been brought into compliance with air pollution constraints and Magma's smelter at San Manuel has been retrofitted with an Outokumpu flash furnace to bring it into compliance. The Ray unit of Asarco at Hayden with a 400,000 ton year smelter and 900 ton per day acid plant met all significant environmental constraints when last operated in 1982 and is available for custom smelting of copper concentrates (Beard, 1989, p.8).

SHEEP MOUNTAIN EAST HISTORY

The original claims in the area were staked in the early 1960s by two Arizona prospectors, Davis and Williams, who located unpatented lode claims over weakly mineralized Precambrian strata exposed in two small "windows" in Tertiary volcanics in the Sheep Mountain West area.

1963-1966 Phelps Dodge Corporation drilled approximately 44,000 feet in 38 rotary/core holes to explore for possible mineralization beneath the post-mineral Tertiary volcanic capping. They began drilling adjacent to the weakly mineralized "windows" in the Sheep Mountain West area and gradually worked eastward to the Sheep Mountain East area.

> "It should be noted that the Phelps Dodge geologists favored continuation of the project, but the terms of the agreement with Davis and Williams were such that the property payments had become too high to justify further efforts" (Hoyt and Ascencios, 1981, p.1).

1966- 1967 Bear Creek Mining Company leased the property and drilled 3,620 feet in 2 holes. Neither of these holes intersected ore and the Company dropped its lease in 1967.

1968- 1981 Utah International Inc. entered into a lease agreement to continue exploration of the Sheep Mountain East area. During the period the Company carried out geological mapping at a scale of 1 inch to 400 feet, completed 21,241 feet of rotary/core drilling in 8 holes, conducted geochemical and thin section analyses plus fluid inclusion studies from selected drill core, all at a cost of approximately $825,000. Utah International dropped its lease agreement on the property prior to its merger with BHP Minerals.

SHEEP MOUNTAIN EAST GEOLOGY

As the only consolidated rocks exposed in the Sheep Mountain East area are gently dipping volcanics of Tertiary age, all data concerning the geology, structure and mineralization of the older underlying rocks have come from diamond drilling.

The oldest rocks of the area are biotite schists of the Yavapai Series of Precambrian age cut by foliated granite alaskite and diorite of the Bradshaw complex also Precambrian in age. Both the intrusive complex and schists are in turn cut by diabase dykes of Precambrian age.

Intrusive into the Precambrian rocks is the Sheep Mountain Stock, a composite body of Laramide (?) age which was possibly intruded as three main phases each with its own textural characteristics. The copper-molybdenum mineralization appears to be related to this stock. It is a slightly elongated dome measuring 3,400 feet by 2,300 feet whose long axis strikes N 45°W and plunges approximately 50° northwest. The stock appears to be composite in nature with the bulk of the pluton consisting of quartz monzonite porphyry as an outer shell apparently enveloping a biotite quartz latite porphyry which in turn appears to be intruded by a younger quartz latite porphyry at depth.

SHEEP MOUNTAIN EAST — STRUCTURE

A major fault zone, the Cow Creek Fault, strikes N 45°W and dips steeply northeasterly along the eastern edge of the Sheep Mountain stock. Although the displacement is unknown, the fault appears to show normal movement with Precambrian rocks to the east moving down relative to those on the west. A 200 foot wide andesite dyke of Tertiary age has been intruded along this fault zone at the northeastern contact of the Sheep Mountain stock. Some shearing and brecciation have been noted in the dyke indicating post-dyke movement along the fault. It is believed that the Cow Creek Fault is an old structural feature possibly Precambrian in age but with several periods of movement. It is further believed that this fault acted as a zone of weakness and helped influence the emplacement of the Sheep Mountain stock.

Rocks of Precambrian age which outcrop two miles southwest and one mile northeast of the Sheep Mountain East area show northeast striking, steeply dipping schistosity and foliation. In addition, these same rocks are cut by several narrow northeast trending quartz latite porphyry dykes of Laramide (?) age. It is believed that these dykes mark a vague Precambrian structural weakness which appears to have helped localize the Sheep Mountain stock at its intersection with the Cow Creek Fault zone.

From diamond drill hole data, the southwestern edge of the Sheep Mountain stock is marked by a 400 foot wide fault zone, termed the West Fault, which strikes N 60°W and dips from 50° to 60° northeasterly. It generally parallels the Cow Creek Fault and is believed to be part of the same system.

About two miles west of the Sheep Mountain stock, a strong, steeply dipping fault zone striking N 50°W is exposed near Ash Creek and is termed the Ash Creek Fault. It shows normal movement with volcanics of Tertiary age on the hangingwall being down faulted into contact with Precambrian strata on the footwall. The southeast continuation of this fault is indicated in Phelps Dodge drill hole SM-9 which shown post-volcanic dip-slip movement in the order of 1,400 feet.

Drill hole information and pre-volcanic topography strongly suggest the existence of a steeply dipping, north striking post-mineral (?) fault zone through the centre of the Sheep Mountain stock.

> "The significance of this fault zone is not fully understood but it is believed to be a complimentary shear to the Cow Creek, West, and Ash Creek fault zones. If this is the case, the movement on the Cow Creek, West, and Ash Creek fault zones, as determined by stress analysis, is left lateral, normal displacement. Additionally, the same stress analysis shows a northeast-trending tensional direction which corresponds with the trend of the Laramide? porphyry dikes" (Hoyt and Ascencios, 1981, p.7).

SHEEP MOUNTAIN EAST ALTERATION

The associated alteration assemblages and their characteristic minerals are:

- Potassic - quartz, K-spar, biotite and locally calcite
- Argillic - quartz, clay
- Phyllic - quartz, sericite, pyrite
- Propylitic - chlorite

Both alteration and mineral assemblages show a distinct relationship to the Sheep Mountain stock although their interrelationship is not clear.

Potassic alteration is best developed within and adjacent to the Sheep Mountain stock as stockwork veinlets and selvages of K-spar with lesser biotite and local calcite. Host rock chemistry governs whether K-spar or biotite is formed as Precambrian diabase and diorite readily host biotite while Precambrian granite and Laramide (?) porphyries normally host K-spar. Potassic alteration intensity appears to be strongest along the porphyry contacts.

Argillic alteration is strongest within and along the southern and eastern margin of the Sheep Mountain stock. It occurs as selective replacement of plagioclase feldspar most often within a halo surrounding quartz - K-spar veinlets. Overlapping of these halos produces a zone of pervasive argillic alteration. The mineralogy of the clay minerals has not been fully determined but is believed to be mainly montmorillonite and kaolinite.

Propylitic alteration has only been identified in four holes on the far east, north and south edges of the argillic zone and thus appears to form an incomplete halo surrounding the latter. Chlorite is the most diagnostic mineral of the prophylitic zone but K-spar and clay are also present.

Phyllic alteration is the youngest of all the alteration assemblages and occurs erratically throughout the Sheep Mountain area in varying degrees of intensity. It is found as fracture controlled, overprint, destructive alteration composed of quartz with coarse-grained sericite and pyrite as veinlets varying from ½ to 1 inch in width.

SHEEP MOUNTAIN EAST   MINERALIZATION

The mineral system at Sheep Mountain East is an extremely large one with significant sulphide mineralization having been identified over an area of 3 or 4 square miles although the better grade mineralization appears to be located within or adjacent to the Sheep Mountain stock.

Hypogene sulphide mineralization consists principally of pyrite with lesser chalcopyrite and molybdenite. Minor amounts of galena,sphalerite, magnetite and specularite are present locally. Pyrite and chalcopyrite occur predominately as discrete grains associated with quartz in randomly oriented veinlets up to ½ inch in width. Molybdenite occurs in a similar manner and also as a coating or "paint" along fractures with or without quartz.

> "At least 400 to 800 ppm Cu is present nearly everywhere in premineral rocks at Sheep Mountain East. Indeed, up to 0.25% Cu is not uncommon in intervals in many holes throughout the area. However, the best copper mineralization has been intercepted in Precambrian rocks adjacent to the eastern contact of the Sheep Mountain stock. Phelps Dodge drill hole SM-20 contains the best copper values which have been cut at Sheep Mountain to date. In this hole, about 120 ft of enriched ore averaging 1.70% Cu, plus an additional 550 ft of primary ore with some supergene? ore averaging 0.46% Cu, were cut before the hole was bottomed in about 0.10% Cu. This hole plus holes SM-28, 32, and 39 appear to outline

a narrow, 2500-ft-long, northwest-trending zone of better copper mineralization. this zone which appears to follow the Cow Creek fault zone contains an average of 50 to 70 ft of enriched ore averaging greater than 1% Cu. The primary ore plus some supergene? ore below this enriched zone appear to average about 425 ft thick and grade 0.35% Cu. The Cow Creek fault zone is believed to have played a vital role in the formation of copper enrichment in this zone. Better molybdenum values generally follow the better copper values and average about 0.05 to 0.07% MoS_2. Below this zone values drop to about 0.10% to 0.15% Cu and 0.02% to 0.04% MoS_2" (Hoyt and Ascencios, 1981, pp.8-9).

Total sulphide distribution appears to be spatially related to the Sheep Mountain stock. Although the core of this pluton contains only 1% or less total sulphides, an additional 1% to 3% total sulphide content has been introduced into the stock margins and adjacent wall rock to form a zone approximately 1,000 feet wide which except for the western contact, nearly surrounds the stock. Beyond this zone, total sulphide content drops to less than 1%.

SHEEP MOUNTAIN EAST GEOCHEMISTRY

A total of 61 composite samples of drill core was taken by Utah International and assayed for Au, Ag, Rb, K_2O, Sn and WO_3 as well as for Cu and MoS_2. The samples were taken from rocks showing varying degrees of potassic and argillic alteration as well as from zones of intense silicification in quartz veinlet stockworks.

"Results of these assays indicate that none of the elements mentioned occurs in anomalous concentrations. Additionally, no pattern could be established for the correlation of metal ratios nor were any of the elements or their ratios correlative with the hydrothermal alteration assemblages. Distribution appears wholly erratic.

"High molybdenum and copper values commonly occur together, although exceptions to this relationship are many. In general, better molybdenum and copper values appear to ring the Sheep Mountain stock; however, molybdenum more faithfully reflects this relationship than does copper. Additionally, molybdenum more commonly is associated with high K-spar-altered host rock" (Hoyt and Ascencios, 1981, p.15).

MINERAL INVENTORY

The drill indicated copper-molybdenum mineral inventory identified to date on the Castle property occurs in a northwesterly striking zone which appears to follow the Cow Creek Fault along the eastern margin of the Sheep Mountain stock. The zone measures 5,500 feet long by 1,100 feet wide and has been intersected by drill holes UC-1, SM-20, SM-32 and SM-39 spaced from 750 to 1,000 feet apart. Copies of the original logs, sampling intervals and assay sheets for each of these holes were made available to the writer.

In the following drill indicated mineral inventory calculation, the writer has weighted the individual intersections and sampling results from these logs and assay sheets to obtain an average for each hole. In general, the copper values represent individual 10 foot core lengths while molybdenum values, expressed as MoS_2, are composite assays taken over 50 foot intervals. Blocks were drawn around each drill hole and the tonnage obtained using a factor of 11.2 cubic feet per ton calculated by the writer from the specific gravity of the host rocks and assuming 5% sulphides. It is further assumed that these intersections of supergene enriched copper-molybdenum mineralization represent a tabular body continuous between drill holes rather than a complex of enriched shear zones or channels. The drill indicated mineral inventory for the Castle property is summarized as follows:

	TONS	% CU	TXCU	% MoS_2	$TXMoS_2$
PROVEN	15,002,232	1.17	17,562,298	0.047	701,261
PROBABLE	14,070,869	1.17	16,459,752	0.047	655,998
SUB TOTAL	29,073,101	1.17	34,022,050	0.047	1,357,259
POSSIBLE	10,361,383	1.55	16,032,858	0.037	383,806
TOTALS	39,434.484	1.27	50,054,908	0.044	1,741,065

The weighted averages for copper and MoS_2 for each of the four drill holes used in the mineral inventory calculation are shown on pages 19 and 20. The individual blocks are shown on Figure 5 (in back pocket) and the weighted averages for each block are shown on pages 21, 22 and 23. A composite longitudinal section, Figure 4 (in back pocket), illustrates the enriched Cu-MoS_2 intersection in each hole and its relationship to the base of the overlying mid-Tertiary volcanics. Also shown on this section are intersections of primary hypogene copper-molybdenum mineralization beneath the enriched supergene blanket indicating the widespread nature of sulphide mineralization in the Sheep Mountain East area.

CONCLUSIONS AND RECOMMENDATIONS

The Castle copper-malybdenum property consists of 141 unpatented lode mining claims covering approximately 2,500 acres located in the Sheep Mountain East area about 50 miles northwest of Phoenix, Arizona, U.S.A. The property was acquired to cover a zone of enriched copper-molybdenum mineralization within and adjacent to a composite stock of Laramide (?) age intrusive into Precambrian biotite schists and granitic to dioritic rocks.

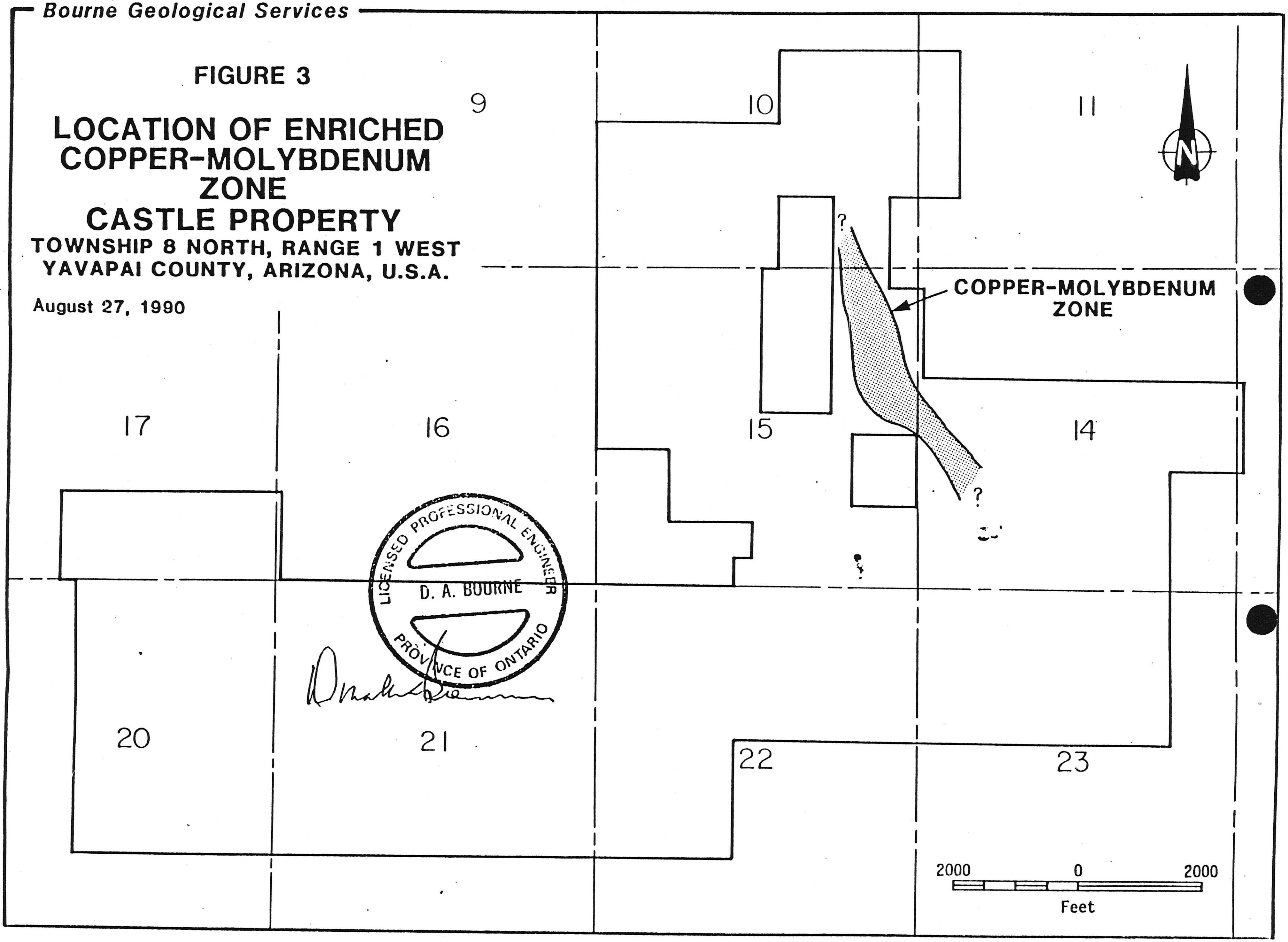
Bourne Geological Services

FIGURE 3

LOCATION OF ENRICHED COPPER-MOLYBDENUM ZONE CASTLE PROPERTY

TOWNSHIP 8 NORTH, RANGE 1 WEST
YAVAPAI COUNTY, ARIZONA, U.S.A.

August 27, 1990



DIAMOND DRILL DATA
FOR DRILL INDICATED
MINERAL INVENTORY CALCULATIONS
CASTLE COPPER-MOLYBDENUM PROPERTY
YAVAPAI COUNTY, ARIZONA

HOLE NO.	INTERSECTION FROM	TO	LENGTH	% CU	TXCU	% MoS_2	$TXMoS_2$
UC-1	1942'	1952'	10.0'	0.85	8.50	0.038	0.380
	1952	1962	10.0	1.24	12.40	0.038	0.380
	1962	1965	3.0	1.80	5.40	0.014	0.042
	1965	1971	6.0	0.16	0.96	0.010	0.060
	1971	1973	2.0	1.88	3.76	0.011	0.022
	1973	1980	7.0	6.74	47.18	0.013	0.091
	1980	1990	10.0	1.36	13.60	0.043	0.430
	1990	1995	5.0	0.76	3.80	0.029	0.145
			53.0'	1.80	95.60	0.029	1.550
SM-39	2091'	2101'	10.0'	0.45	4.50	0.020	0.20
	2101	2111	10.0	0.48	4.80	0.048	0.48
	2111	2121	10.0	1.21	12.10	0.048	0.48
	2121	2131	10.0	3.26	32.60	0.048	0.48
	2131	2141	10.0	0.51	5.10	0.048	0.48
			50.0'	1.18	59.10	0.042	2.12
SM-32	1986'	1996'	10.0'	0.56	5.60	0.036	0.360
	1996	2006	10.0	1.95	19.50	0.046	0.460
	2006	2016	10.0	1.28	12.80	0.046	0.460
	2016	2026	10.0	1.10	11.00	0.046	0.460
	2026	2036	10.0	0.41	4.10	0.046	0.460
	2036	2046	10.0	0.38	3.80	0.046	0.460
	2046	2056	10.0	0.76	7.60	0.082	0.820
	2056	2066	10.0	0.48	4.80	0.082	0.820
	2066	2076	10.0	0.49	4.90	0.082	0.820
	2076	2086	10.0	0.37	3.70	0.082	0.820
	2086	2096	10.0	0.63	6.30	0.082	0.820
	2096	2006	10.0	0.36	3.60	0.052	0.520
	2106	2116	10.0	0.53	5.30	0.052	0.520
			130.0'	0.72	93.00	0.060	7.800

DIAMOND DRILL DATA
FOR DRILL INDICATED
MINERAL INVENTORY CALCULATIONS
CASTLE COPPER-MOLYBDENUM PROPERTY
YAVAPAI COUNTY, ARIZONA

HOLE NO.	INTERSECTION FROM	TO	LENGTH	% CU	TXCU	% MoS_2	$TXMoS_2$
SM-20	1843'	1853'	10.0'	1.93	19.30	0.062	0.620
	1853	1863	10.0	1.13	11.30	0.062	0.620
	1863	1873	10.0	2.78	27.80	0.006	0.060
	1873	1883	10.0	1.40	14.00	0.006	0.060
	1883	1893	10.0	1.29	12.90	0.006	0.060
	1893	1903	10.0	0.95	9.50	0.006	0.060
	1903	1913	10.0	1.69	16.90	0.006	0.060
	1913	1923	10.0	1.72	17.20	0.061	0.610
	1923	1933	10.0	2.79	27.90	0.061	0.610
	1933	1943	10.0	1.81	18.10	0.061	0.610
	1943	1953	10.0	1.86	18.60	0.061	0.610
	1953	1963	10.0	1.08	10.80	0.061	0.610
	1963	1973	10.0	0.43	4.30	0.044	0.440
	1973	1983	10.0	0.77	7.70	0.044	0.440
	1983	1993	10.0	0.74	7.40	0.044	0.440
			150.0'	1.49	223.70	0.039	5.910

MINERAL INVENTORY CALCULATION
DRILL INDICATED
PROVEN ORE
CASTLE COPPER-MOLYBDENUM PROPERTY
YAVAPAI COUNTY, ARIZONA, U.S.A.

BLOCK	NE/SW	NW/SE	VERT	VOL(FT^3)	TONS	% CU	TXCU	% MoS_2	TXMoS_2	HOLE NO.
F	400	250	53.0	5,300,000	473,214	1.80	851,785	0 029	13,723	RC-UC-1
I	400	250	53.0	5,300,000	473,214	1.80	851,785	0.029	13,723	"
K	550	250	53.0	7,287,500	650,670	1.80	1,171,206	0.029	18,869	"
M	500	250	50.0	6,250,000	558,036	1.18	658,482	0.042	23,438	SM-39
O	500	250	50.0	6,250,000	558,036	1.18	658,482	0.042	23,438	"
R	400	250	50.0	5,000,000	446,429	1.18	526,786	0.042	18,750	"
U	575	250	50.0	7,187,500	641,741	1.18	757,254	0.042	26,953	"
x	500	250	130.0	16,250,000	1,450,893	0.72	1,044,643	0.060	87,054	SM-32
b	600	250	130.0	19,500,000	1,741,071	0.72	1,253,571	0.060	104,464	"
d	800	300	130.0	31,200,000	2,785,714	0.72	2,005,714	0.060	167,143	"
g	600	300	150.0	27,000,000	2,410,714	1.49	3,591,964	0.039	94,018	SM-20
k	600	175	150.0	15,750,000	1,406,250	1.49	2,095,313	0.039	54,844	"
o	600	175	150.0	15,750,000	1,406,250	1.49	2,095,313	0.039	54,844	"
				TOTALS	15,002,232	1.17	17,562,298	0.047	701,261	

D. A. BOURNE
LICENSED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO

MINERAL INVENTORY CALCULATION
DRILL INDICATED
PROBABLE ORE
CASTLE COPPER-MOLYBDENUM PROPERTY
YAVAPAI COUNTY, ARIZONA, U.S.A.

BLOCK	NE/SW	NW/SE	VERT	VOL(FT^3)	TONS	% CU	TXCU	% MoS_2	TXMoS_2	HOLE NO.
C	400	250	53.0	5,300,000	473,214	1.80	851,785	0.029	13,723	RC-UC-1
E	150	250	53.0	1,987,500	177,455	1.80	319,419	0.029	5,146	"
G	250	250	53.0	3,312,500	295,759	1.80	532,366	0.029	8,577	"
H	175	250	53.0	2,318,750	207,031	1.80	372,656	0.029	6,004	"
J	225	250	53.0	2,981,250	266,183	1.80	479,129	0.029	7,719	"
L	225	250	53.0	2,981,250	266,183	1.80	479,129	0.029	7,719	"
N	300	250	50.0	3,750,000	334,821	1.18	395,089	0.042	14,062	SM-39
P	300	250	50.0	3,750,000	334,821	1.18	395,089	0.042	14,062	"
Q	200	250	50.0	2,500,000	223,214	1.18	263,393	0.042	9,375	"
S	350	250	50.0	4,375,000	390,625	1.18	460,938	0.042	16,406	"
T	250	250	50.0	3,125,000	279,018	1.18	329,241	0.042	11,719	"
V	250	250	50.0	3,125,000	279,018	1.18	329,241	0.042	11,719	
W	450	250	130.0	14,625,000	1,305,804	0.72	940,179	0.060	78,348	SM-32
Y	225	250	130.0	7,312,500	652,902	0.72	470,039	0.060	39,174	"
a	600	250	130.0	19,500,000	1,741,071	0.72	1,253,571	0.060	104,464	"
c	600	300	130.0	23,400,000	2,089,286	0.72	1,504,286	0.060	125,357	SM-32
f	300	300	150.0	13,500,000	1,205,357	1.49	1,795,982	0.039	47,009	SM-20
h	300	300	150.0	13,500,000	1,205,357	1.49	1,795,982	0.039	47,009	"
j	300	175	150.0	7,875,000	703,125	1.49	1,047,656	0.039	24,422	"
l	200	175	150.0	5,250,000	468,750	1.49	698,438	0.039	18,281	"
n	300	175	150.0	7,875,000	703,125	1.49	1,047,656	0.039	27,422	"
p	200	175	150	5,250,000	468,750	1.49	698,438	0.039	18,281	"
				TOTALS	14,070,869	1.17	16,459,752	0.047	655,998	

D. A. BOURNE

MINERAL INVENTORY CALCULATION
DRILL INDICATED
POSSIBLE ORE
CASTLE COPPER-MOLYBDENUM PROPERTY
YAVAPAI COUNTY, ARIZONA, U.S.A.

BLOCK	NE/SW	NW/SE	VERT	VOL(FT ^{3})	TONS	% CU	TXCU	MoS2	% TXMoS2	HOLE NO.
A	600	250	53.0	7,950,000	709,821	1.80	1,277,678	0.029	20,585	RC-UC-1
B	150	250	53.0	1,987,500	177,455	1.80	319,419	0.029	5,146	"
D	200	250	53.0	2,659,000	236,607	1.80	425,893	0.029	6,862	"
Z	100	250	130.0	3,250,000	290,179	0.72	208,929	0.060	17,411	SM-32
e	200	300	150.0	9,000,000	803,571	1.49	1,197,321	0.039	31,339	SM-20
i	200	175	150.0	5,250,000	468,750	1.49	698,438	0.039	18,281	"
m	200	175	150.0	5,250,000	468,750	1.49	698,438	0.039	18,281	"
q	600	175	150.0	15,750,000	1,406,250	1.49	2,095,313	0.039	54,844	"
r	400	800	150.0	48,000,000	4,285,714	1.49	6,385,714	0.039	167,143	SM-2-
s	400	800	53.0	16,960,000	1,514,286	1.80	2,725,715	0.029	43,914	RC-UC-1
				TOTALS	10,361,383	1.55	16,032,858	0.037	383,806	

The Sheep Mountain Stock is a composite body of Laramide (?) age which forms a slightly elongated dome measuring 3,400 feet by 2,300 feet whose long axis strikes N45° W and plunges 50° northwest. The copper-molybdenum mineralization on the Castle property appears to be related to this stock. Unconformably overlying the Precambrian and Laramide (?) rocks is a series of mid-Tertiary volcanic flows and pyroclastics from 1,500 to 2,200 feet thick which cover the entire Sheep Mountain East area.

The mineral system in the Sheep Mountain East area is an extremely large one with significant sulphide mineralization occuring over 3 or 4 square miles although the better grade copper-molybdenum values forming the drill indicated mineral inventory on the Castle property appear to be located within or adjacent to the Sheep Mountain Stock. Hypogene sulphide mineralization consists principally of pyrite with lesser chalcopyrite and molybdenite. Minor amounts of galena, sphalerite, magnetite and specularite are present locally.

The drill indicated copper-molybdenum mineral inventory identified to date on the Castle property occurs in a northwesterly striking zone which appears to follow the Cow Creek Fault along the eastern margin of the Sheep Mountain Stock. The zone measures 5,500 feet long by 1,100 feet wide and has been intersected by four drill holes spaced from 750 to 1,000 feet apart. In the mineral inventory calculation, it is assumed that these intersections of supergene enriched copper-molybdenum mineralization represent a tabular body continuous between drill holes rather than a complex of enriched shear zones or channels. The drill indicated mineral inventory for the Castle property is summarized as follows:

	TONS	% Cu	TXCu	% MoS_2	$TxMoS_2$
PROVEN	15,002,232	1.17	17,562,298	0.047	701,261
PROBABLE	14,070,869	1.17	16,459,752	0.047	655,998
SUB TOTAL	29,073,101	1.17	34,022,050	0.047	1,357,259
POSSIBLE	10,361,383	1.55	16,032,858	0.037	383,806
TOTALS	39,434,484	1.27	50,054,908	0.044	1,741,065

As can be seen from Figure 4, there are substantial widths of primary copper-molybdenum mineralization below the supergene enriched blanket. Although perhaps of some future interest, no attempt has been made by the writer to calculate a tonnage for this material. Selected examples of this type of material are as follows:

HOLE NO.	INT.	% Cu	% MoS_2
SM-20	100.0'	0.53	0.078
	290.0	0.46	0.086
SM-39	40.0	0.50	0.050
	40.0	0.50	0.041
UC-1	180.0	0.44	0.044
	32.0	0.82	0.043
	31.0	0.41	0.076

The writer recommends a program of fill-in rotary/core drilling and preliminary metallurgical test work on the Castle copper-molybdenum property. Phase I would consist of 2 holes each 2,500 feet in length, the upper 1,000 feet of each hole to be drilled using a rotary bit at a cost of $10 per foot, the remaining 1,500 feet of each hole to be cored at a cost of $35 per foot. The estimated cost of Phase I complete with mobilization, site clean-up and report is estimated at $150,000 U.S.

Phase II of the proposed program would consist of preliminary metallurgical test work including mineralogical examination, determination of specific gravity and work index, recoveries for both copper and molybdenum as well as general milling characteristics. The estimated cost of Phase II is estimated at $50,000 U.S., the total cost of the proposed work program being $200,000 U.S.

COST ESTIMATES (U.S. Funds)

PHASE I

1.	Mobilization and demobilization	$ 2,000
2.	Diamond drilling: 2 holes each 2,500 feet in length, 0.0 to 1,000 feet rotary drilling @ $10 per foot, 1,000 to 2,500 feet core drilling @ $35 per foot to include logging and splitting.	125,000
3.	Assaying	15,000
4.	Site clean-up	3,000
5.	Report, typing drill logs, drafting, printing	5,000
	PHASE I	$ 150,000

PHASE II

1.	Preliminary metallurgical test work including mineralogical examination, determination of specific gravity and work index, metal recoveries and general milling characteristics	$ 45,000
2.	Final report incorporating results of both phases	5,000
	PHASE II	$ 50,000
	TOTAL ESTIMATED COST	$ 200,000

Dependant on favourable results being obtained from the above, an expanded program of in-fill rotary/core drilling, detailed metallurgical work and environmental studies is recommended, the cost of which cannot be estimated at the present time.

Respectfully submitted,

DONALD A. BOURNE, P.ENG.

LICENSED PROFESSIONAL ENGINEER
D. A. BOURNE
PROVINCE OF ONTARIO

SCARBOROUGH, Ontario
MARCH 20, 1992

LIST OF REFERENCES

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CERTIFICATE TO ACCOMPANY REPORT ON GEOLOGY AND MINERAL INVENTORY, CASTLE COPPER-MOLYBDENUM PROPERTY, SHEEP MOUNTAIN EAST AREA, HUMBUG MINING DISTRICT, YAVAPAI COUNTY, ARIZONA, U.S.A. FOR ORCANA RESOURCES LIMITED, TORONTO, ONTARIO, CANADA DATED MARCH 20, 1992.

I, Donald A. bourne of SCARBOROUGH, Ontario certify:

1. That I am a Professional Engineer and Consulting Geologist and reside at 16 Oakworth Crescent in the City of SCARBOROUGH in the Province of Ontario.
2. That I am a graduate of McMaster University and hold the degrees B.Sc. and M.Sc. in Honours Geology received in 1950 and 1951 respectively.
3. That I am a member of The Association of Professional Engineers of the Province of Ontario.
4. That I have practiced my profession as a geologist since 1951.
5. That I have no interest direct or indirect in the Castle Copper-Molybdenum Property nor in the securities of Orcana Resources Limited nor do I expect to receive any.
6. That the accompanying report is based on a review of copies of original reports, diamond drill logs, assay sheet and geological maps made available to the writer. A site examination has not been made.
7. That this certificate covers claim numbers:

RAY 1 - RAY 83 both inclusive	
RAY 89 - RAY 92 " "	
RAY 98 - RAY 145 " "	
RAY 147	RAY 153
RAY 149	RAY 155
RAY 151	RAY 157

all inclusive, being all the claims held by Orcana Resources Limited referred to in the accompanying report.

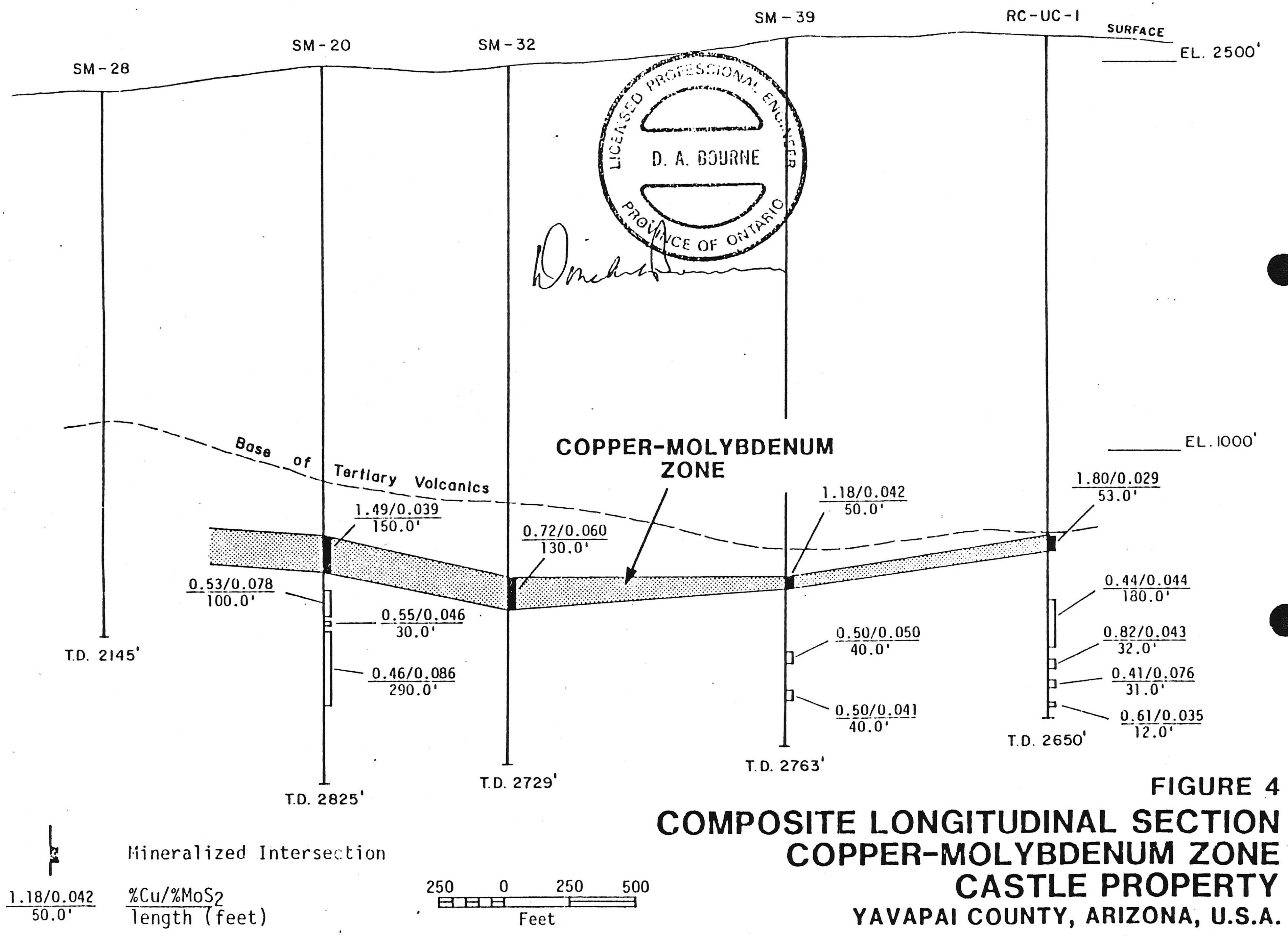
8. That I hereby consent to the inclusion of this report in the Prospectus, Statement of Material Facts or any amendment thereto, or any other regulatory filing of Orcana Resources Limited.

LICENSED PROFESSIONAL ENGINEER
D. A. BOURNE
PROVINCE OF ONTARIO

DONALD A. BOURNE, B.Sc., M.Sc., P.ENG.

SCARBOROUGH, ONTARIO
MARCH 20, 1992

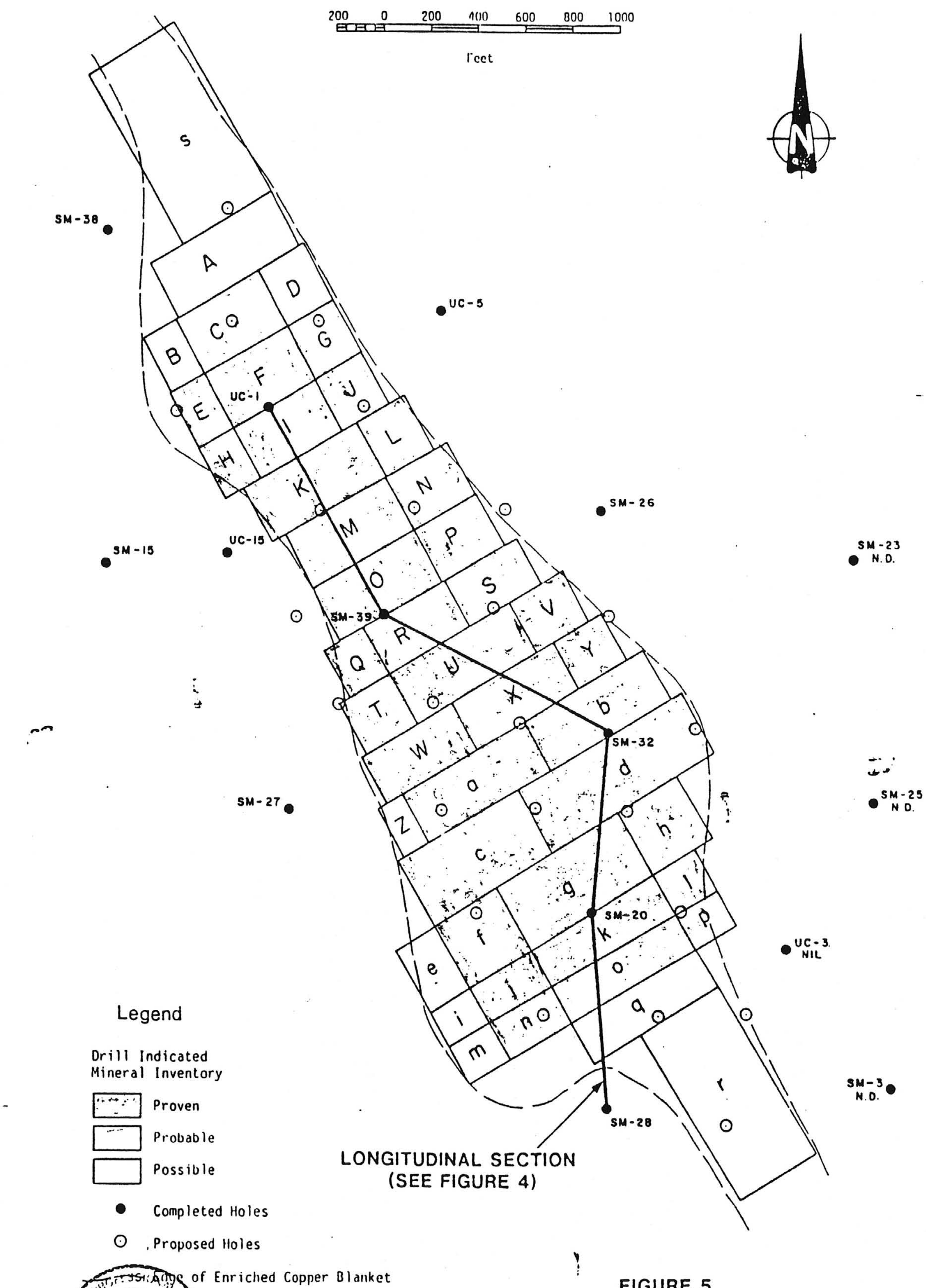
Bourne Geological Services



LICENSED PROFESSIONAL ENGINEER
D. A. BOURNE
PROVINCE OF ONTARIO

FIGURE 4
COMPOSITE LONGITUDINAL SECTION
COPPER-MOLYBDENUM ZONE
CASTLE PROPERTY
YAVAPAI COUNTY, ARIZONA, U.S.A.

August 27, 1990



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D. A. BOURNE
PROVINCE OF ONTARIO

FIGURE 5

MINERAL INVENTORY
CASTLE COPPER-MOLYBDENUM DEPOSIT

DIAMOND DRILL PLAN MAP AND LOCATION OF COPPER-MOLYBDENUM ZONE

YAVAPAI COUNTY, ARIZONA

August 27, 1990

APPENDIX 2

Mineral Inventory Estimate -Castle Copper Deposit

by T. Sills

Watts, Griffis and McOuat Limited

(1992)

Assays taken from Bourne's 1992 report and modified by inspection of the drill logs.

DDH	From	To	Int	Cu%	MoS_2%
UC-01	1952	1962	10	1.24	0.038
	1962	1965	3	1.80	0.014
	1965	1971	6	0.16	0.010
	1971	1973	2	1.88	0.011
	1973	1980	7	6.74	0.013
	1980	1990	10	1.36	0.043
			38	2.19	0.027

DDH	From	To	Int	Cu	MoS2
SM-32	1996	2006	10	1.95	0.046
	2006	2016	10	1.28	0.046
	2016	2026	10	1.1	0.046
	2026	2036	10	0.41	0.046
	2036	2046	10	0.38	0.046
	2046	2056	10	0.76	0.082
	2056	2066	10	0.48	0.082
	2066	2076	10	0.49	0.082
			80	0.86	0.060
SM-39	2111	2121	10	1.21	0.048
	2121	2131	10	3.26	0.048
	2131	2141	10	0.51	0.048
			30	1.66	0.048
SM-20	1843	1853	10	1.93	0.062
	1853	1863	10	1.13	0.062
	1863	1873	10	2.78	0.006
	1873	1883	10	1.4	0.006
	1883	1893	10	1.29	0.006
	1893	1903	10	0.95	0.006
	1903	1913	10	1.69	0.006
	1913	1923	10	1.72	0.061
	1923	1933	10	2.79	0.061
	1933	1943	10	1.81	0.061
	1943	1953	10	1.86	0.061
	1953	1963	10	1.08	0.061
			120	1.70	0.038

Recalculated mineral inventory based on assay intervals and drill holes noted above and using the horizontal dimensions of Bourne's mineral inventory blocks.

Block	NE/SW	NW/SE	Vert	Vol (ft3)	Tons	Cu %	MoS_2 %
F	400	250	38	3,800,000	339,300	2.19	0.027
I	400	250	38	3,800,000	339,300	2.19	0.027
K	550	250	38	5,225,000	466,500	2.19	0.027
M	500	250	30	3,750,000	334,800	1.66	0.048
O	500	250	30	3,750,000	334,800	1.66	0.048
R	400	250	30	3,000,000	267,900	1.66	0.048
U	575	250	30	4,312,500	385,000	1.66	0.048
X	500	250	80	10,000,000	892,900	0.86	0.060
b	600	250	80	12,000,000	1,071,400	0.86	0.060
d	800	300	80	19,200,000	1,714,300	0.86	0.060
g	600	300	120	21,600,000	1,928,600	1.70	0.038
k	600	175	120	~~12,600,000~~	~~1,125,000~~	~~1.70~~	~~0.038~~
o	600	175	120	12,600,000	1,125,000	1.70	0.038
					10,324,800	1.45	0.046

Equivalent to Bourne's "proven" category.

Block	NE/SW	NW/SE	Vert	Vol (ft3)	Tons	Cu %	MoS2 %
C	400	250	38	3,800,000	339,300	2.19	0.027
E	150	250	38	1,425,000	127,200	2.19	0.027
G	250	250	38	2,375,000	212,100	2.19	0.027
H	175	250	38	1,662,500	148,400	2.19	0.027
J	225	250	38	2,137,500	190,800	2.19	0.027
L	225	250	38	2,137,500	190,800	2.19	0.027
N	300	250	30	2,250,000	200,900	1.66	0.048
P	300	250	30	2,250,000	200,900	1.66	0.048
Q	200	250	30	1,500,000	133,900	1.66	0.048
S	350	250	30	2,625,000	234,400	1.66	0.048
T	250	250	30	1,875,000	167,400	1.66	0.048
V	250	250	30	1,875,000	167,400	1.66	0.048
W	450	250	80	9,000,000	803,600	0.86	0.060
Y	225	250	80	4,500,000	401,800	0.86	0.060
a	600	250	80	12,000,000	1,071,400	0.86	0.060
c	600	300	80	14,400,000	1,285,700	0.86	0.060
f	300	300	120	10,800,000	964,300	1.70	0.038
h	300	300	120	10,800,000	964,300	1.70	0.038
j	300	175	120	6,300,000	562,500	1.70	0.038
l	200	175	120	4,200,000	375,000	1.70	0.038
n	300	175	120	6,300,000	562,500	1.70	0.038
p	200	175	120	4,200,000	375,000	1.70	0.038
					9,679,600	1.45	0.046

Equivalent to Bourne's "probable" category.

A	600	250	38	5,700,000	508,900	2.19	0.027
B	150	250	38	1,425,000	127,200	2.19	0.027
D	200	250	38	1,900,000	169,600	2.19	0.027
Z	150	250	80	3,000,000	267,900	0.86	0.06
e	200	300	120	7,200,000	642,900	1.7	0.038
i	200	175	120	4,200,000	375,000	1.7	0.038
m	200	175	120	4,200,000	375,000	1.7	0.038
q	600	175	120	12,600,000	1,125,000	1.7	0.038
r	400	800	120	38,400,000	3,428,600	1.7	0.038
s	400	800	38	12,160,000	1,085,700	2.19	0.027
					8,105,800	1.79	0.036

Equivalent to Bourne's "possible" category.

Total tons/Average grades :	28,110,200	1.55	0.043

APPENDIX 3

Orcana Resources Limited, Castle Project

Cost Study of Selected Process Routes

by A. Hayden

EHA Engineering

(1992)

ORCANA RESOURCES LIMITED

CASTLE PROJECT

Cost Study of Selected Process Routes

REGISTERED PROFESSIONAL ENGINEER
A. S. HAYDEN
PROVINCE OF ONTARIO

A. S. Hayden, P.Eng.

Richmond Hill, Ontario, Canada
May, 1992

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1. INTRODUCTION

On April 14, 1992, EHA Engineering (EHA) were requested by Mr. R. J. Mongeau of Orcana Resources Limited to estimate surface plant capital and operating costs for recovery of copper from the Castle property in Arizona. Costs were to be developed on a conceptual basis, suitable only for assessing the merits of proceeding to the next phase of the project. Because of the current high smelter charges for concentrate processing, hydrometallurgical recovery of copper was to be considered.

The costs generated were to be provided to Watts, Griffis and McQuat Limited (WGM) for inclusion in an overall economic analysis to be conducted by them. WGM were to evaluate mining methods and costs, and provided the basic tonnage and grade criteria to EHA.

2. STUDY BASIS

Little mineralogical and no metallurgical information is available on the deposit, and a number of assumptions have been made, based primarily on a knowledge of generally similar deposits. The primary copper mineral is chalcocite, and the available evidence indicates that only minor oxide copper mineralization is present. For the purpose of this study, it is assumed that 90% of the copper is present as chalcocite, and 10% as oxides. Some molybdenite is present and is potentially recoverable; allowances have been made for moly recovery where applicable. Minor silver and trace gold are also present, and precious metal credits may be available in the case of concentrate shipment to a smelter. Precious metal recovery is unlikely to be economic in a hydrometallurgical operation.

Assumed flotation concentrate grade and recovery, based on the above mineralogical information and averaging data from other similar projects, are as follows:

Flotation concentrate grade, % Cu	30
Flotation recovery of copper, %	88

This study assumes that the same concentrate grade and recovery applies to both direct shipping concentrate and to concentrate for onsite leaching/electrowinning. In practice, a lower grade and a higher recovery may apply to the latter.

3. HYDROMETALLURGICAL PROCESSES

A variety of hydrometallurgical processes are available for the processing of chalcocite ores and concentrates. The ones most likely to be applicable are listed below. Certain processes that may be technically applicable but not recommended for consideration, such as chloride leaching, are not reviewed.

1) Roast-Leach-Electrowin

After flotation, the concentrate is roasted, leached with sulphuric acid, and copper directly electrowon. It is expected that sufficient acid can be recycled or produced from the roaster to satisfy requirements. Leach solution grades will be high enough to allow direct electrowinning without prior solvent extraction. Iron must be controlled in the roaster step and as a consequence, conversion of copper to acid soluble form is limited to about 96%. A bleed stream from electrowinning is required, and provision for recovery and recycle of the contained copper is necessary.

2) Pressure Leach-Electrowin

Flotation concentrate is leached at moderately elevated temperature and under an oxygen atmosphere to solublize the copper minerals. As in (1) above, direct electrowinning is used for copper recovery, and similar handling of a bleed stream is necessary. Tonnage oxygen is required, and the process is likely to be deficient in acid. It is anticipated that improved copper extractions relative to (1) will be obtained.

This process is an alternative to (1), and may be preferred on environmental grounds.

3) Ammonia Leach-Solvent Extraction-Electrowin

Ammonia leaching of flotation concentrate followed by SX/EW is a potentially attractive processing alternative, depending to some extent on relative reagent costs. Ammonia may be recycled within the process via a lime boil step, or may be bled from the circuit as salable ammonium sulphate.

This process is considered a potentially viable alternative to (1).

4) Ferric Sulphate Leach

Ferric iron content of solution is deliberately elevated to enhance the oxidation rate of chalcocite. Copper is recovered by solvent extraction/electrowinning.

This process is assumed to be applied to whole ore rather than concentrate, and overall copper recoveries may therefore be improved. However, plant size and operating costs are likely to be significantly higher. The process may have some merit, but is not considered for this study.

5) Heap Leaching

Bacterially assisted heap leaching of whole ore followed by solvent extraction and electrowinning is potentially the lowest cost route provided that leaching rates and ultimate extractions are satisfactory. It is an important option for future consideration and testwork because of the expected relatively low capital and operating costs.

All of the above processes, with the exception of pressure leaching, have been applied to chalcocite ores. Pressure leaching is a well established unit operation, and the associated technical risk is considered minimal.

4. PROCESSES CONSIDERED

The following processes have been selected for estimating:

Grind-Float-Roast-Leach-Electrowin	(RLE)
Grind-Float-Pressure Leach-Electrowin	(PLE)
Grind-Float-Ammonia Leach-SX-Electrowin	(NH3)
Heap Leach-Solvent Extraction-Electrowin	(SX-EW)
Grind-Float-Filter-Ship Concentrate	(FLOAT)

Costing is provided for mining rates of 2 million and 2.5 million short tons per year, corresponding to mill design tonnages of 6000 TPD and 7500 TPD respectively.

5. CAPITAL COSTS

5.1 Basis

Capital costs have been estimated to conceptual standards, based on general flowsheet outlines and comparisons with other similar south-western USA projects for which actual costs or detailed estimates are available from EHA files. Costs were developed using factoring techniques on a process area basis; in general, individual equipment items were not separately costed. Costs are reported in first quarter 1992 US dollars.

A contingency allowance of 20% has been incorporated in the total capital costs.

The following are not included in the estimated costs:

- Offsite costs
- Owners costs
- Initial spares and reagents inventory
- Tailings dams
- Mine underground and surface capital costs

The following basic criteria apply to the estimated costs:

Design tonnage, TPD (base case)	6000
, TPY (base case)	2000000
, TPD (alternate)	7500
, TPY (alternate)	2500000
Grade, % Cu	1.55
, % MoS2	0.043
Flotation concentrate	
Grade, % Cu	30
Recovery, Cu, %	88
Daily tonnage, TPD (base case)	272.8
, TPD (alternate)	341.0

Overall copper recovery:

Case	%	TPY (base case)	TPY (alternate)
RLE	83.6	25927	32409
PLE	85.4	26467	33100
NH3	85.4	26467	33100
SX-EW	65.0	20150	25200
FLOAT	88.0*	27280*	34100*

* prior to smelter deductions

Overall molybdenum recovery (to concentrate):

Case	%	TPY (base case)	TPY (alternate)
RLE	40.0	344	430
PLE	40.0	344	430
NH3	40.0	344	430
SX-EW	0	0	0
FLOAT	40.0	344	430

5.2 RLE Capital Costs

	$US (x 1000)	
Area	2.0M TPY	2.5M TPY
Site Development	6540	7477
Ore Receiving)		
Grinding)	25339	28969
Flotation)		
Roasting	14789	16908
Leaching/CCD	4476	5117
SX/EW	21700	26057
Reagents/misc	1100	1258
Ancillaries	1799	2056
Subtotal	75743	87843
Contingency @ 20%	15149	17569
Total cost	90892	105411

5.3 PLE Capital Costs

	$US (x 1000)	
Area	2.0M TPY	2.5M TPY
Site Development	6540	7477
Ore Receiving)		
Grinding)	25339	28969
Flotation)		
Leaching/CCD	12222	13973
SX/EW	21700	26057
Reagents/misc	1610	1841
Ancillaries	1799	2056
Subtotal	69210	80374
Contingency @ 20%	13842	16075
Total cost	83052	96449

5.4 NH3 Capital Costs

Area	$US (x 1000) 2.0M TPY	2.5M TPY
Site Development	6540	7477
Ore Receiving)		
Grinding)	25339	28969
Flotation)		
Leaching/CCD	12222	13973
SX/EW	31649	37431
Reagents/misc	7805	8923
Ancillaries	1799	2056
Subtotal	85354	98831
Contingency @ 20%	17071	19766
Total cost	102425	118597

5.5 SX-EW Capital Costs

Area	$US (x 1000) 2.0M TPY	2.5M TPY
Site Development	2860	3270
Ore Receiving	1749	2000
SX/EW	37212	44033
Reagents/misc	481	550
Ancillaries	787	899
Subtotal	43090	50753
Contingency @ 20%	8618	10151
Total cost	51708	60903

5.6 FLOAT Capital Costs

Area	2.0M TPY	2.5M TPY
	$US (x 1000)	
Site Development	4905	5608
Ore Receiving)		
Grinding)	28931	33076
Flotation)		
Roasting		
Leaching/CCD		
SX/EW		
Reagents/misc	825	943
Ancillaries	1349	1542
Subtotal	36010	41169
Contingency @ 20%	7202	8234
Total cost	43212	49403

OPERATING COSTS

6.1 Basis

Operating costs were developed by updating earlier estimates for generally similar projects; current local unit costs were not obtained.

Labour costs were escalated using an hourly earnings index.

Reagent and supplies consumptions and costs were developed based on performance assumptions and information available for similar projects.

Maintenance costs were estimated as a percentage of total capital costs.

Power consumptions were factored from other estimates, except for electrowinning and oxygen plant consumptions which were directly estimated. A unit cost of $0.06/kWh was used.

A contingency allowance of 10% has been added to total operating costs. The reported costs include only direct process plant operating costs and do not include general administration and similar expenses.

6.2 RLE Operating Costs

Item	2.0 M TPY			2.5 M TPY		
	$/a (x 1000)	$/Ton	$/lb Cu	$/a (x 1000)	$/Ton	$/lb Cu
Supervision	1024	0.512	0.020	1024	0.410	0.016
Operating Labour	3301	1.651	0.064	3301	1.320	0.051
Reagents & Supplies	4046	2.023	0.078	5058	2.023	0.078
Maintenance	3090	1.545	0.060	3584	1.434	0.055
Power	6701	3.351	0.129	7957	3.183	0.123
Miscellaneous	835	0.418	0.016	1023	0.409	0.016
Subtotal	18997	9.499	0.366	21947	8.779	0.339
Contingency, 10%	1900	0.950	0.037	2195	0.878	0.034
Total Operating	20897	10.449	0.403	24141	9.657	0.372

6.3 PLE Operating Costs

Item	2.0 M TPY $/a (x 1000)	2.0 M TPY $/Ton	2.0 M TPY $/lb Cu	2.5 M TPY $/a (x 1000)	2.5 M TPY $/Ton	2.5 M TPY $/lb Cu
Supervision	1024	0.512	0.019	1024	0.410	0.015
Operating Labour	3301	1.651	0.062	3301	1.320	0.050
Reagents & Supplies	7404	3.702	0.140	9255	3.702	0.140
Maintenance	2824	1.412	0.053	3279	1.312	0.050
Power	7649	3.825	0.145	9083	3.633	0.137
Miscellaneous	835	0.418	0.016	1023	0.409	0.015
Subtotal	23037	11.518	0.435	26965	10.786	0.408
Contingency, 10%	2304	1.152	0.044	2697	1.079	0.041
Total Operating	25340	12.670	0.479	29662	11.865	0.448

6.4 NH3 Operating Costs

Item	2.0 M TPY $/a (x 1000)	2.0 M TPY $/Ton	2.0 M TPY $/lb Cu	2.5 M TPY $/a (x 1000)	2.5 M TPY $/Ton	2.5 M TPY $/lb Cu
Supervision	1024	0.512	0.019	1024	0.410	0.015
Operating Labour	3301	1.651	0.062	3301	1.320	0.050
Reagents & Supplies	7804	3.902	0.147	9755	3.902	0.147
Maintenance	3482	1.741	0.066	4032	1.613	0.061
Power	7649	3.825	0.145	9083	3.633	0.137
Miscellaneous	825	0.413	0.016	1011	0.404	0.015
Subtotal	24085	12.043	0.455	28206	11.282	0.426
Contingency, 10%	2409	1.204	0.046	2821	1.128	0.043
Total Operating	26494	13.247	0.501	31027	12.411	0.469

6.5 SX-EW Operating Costs

	2.0 M TPY			2.5 M TPY		
Item	$/a (x 1000)	$/Ton	$/lb Cu	$/a (x 1000)	$/Ton	$/lb Cu
Supervision	705	0.352	0.017	705	0.282	0.014
Operating Labour	2362	1.181	0.059	2362	0.945	0.047
Reagents & Supplies	1068	0.534	0.027	1335	0.534	0.027
Maintenance	1758	0.879	0.044	2071	0.828	0.041
Power	4175	2.088	0.104	4912	1.965	0.098
Miscellaneous	390	0.195	0.010	475	0.190	0.009
Subtotal	10458	5.229	0.259	11860	4.744	0.235
Contingency, 10%	1046	0.523	0.026	1186	0.474	0.024
Total Operating	11503	5.752	0.285	13045	5.218	0.259

6.6 FLOAT Operating Costs

	2.0 M TPY			2.5 M TPY		
Item	$/a (x 1000)	$/Ton	$/lb Cu	$/a (x 1000)	$/Ton	$/lb Cu
Supervision	705	0.352	0.013	705	0.282	0.010
Operating Labour	899	0.450	0.016	899	0.360	0.013
Reagents & Supplies	2110	1.055	0.039	2638	1.055	0.039
Maintenance	1469	0.735	0.027	1680	0.672	0.025
Power	2340	1.170	0.043	2779	1.112	0.041
Miscellaneous	365	0.183	0.007	447	0.179	0.007
Subtotal	7888	3.944	0.145	9147	3.659	0.134
Contingency, 10%	789	0.394	0.014	915	0.366	0.013
Total Operating	8677	4.338	0.159	10062	4.025	0.148

7. SUMMARY

Estimated capital and operating costs for the various options are summarized in the following table for 2.0 million tons per year of ore (6000 tons per day design processing rate):

Route	Capital Cost $US (x 1000)	Capital Cost $/lb Cu*	Operating Cost $US/Ton	Operating Cost $/Lb Cu	Total Cost** $/lb Cu*
RLE	90892	0.50	10.45	0.40	0.90
PLE	83052	0.45	12.67	0.48	0.93
NH3	102425	0.55	13.25	0.50	1.05
SX-EW	51708	0.37	5.75	0.28	0.65
FLOAT	43212	0.23***	4.34	0.16***	0.39

* Based on a simple 3.5 year payback on capital.
** Mining and administration costs not included.
*** Per pound of copper in shipped concentrate.

The above data are based on the following recoveries of copper and molybdenum disulphide from 2.0 million tons per year of ore:

Route	Tons per Year Copper	Tons per Year MoS_2*
RLE	25927	344
PLE	26467	344
NH3	26467	344
SX-EW	20150	0
FLOAT	27280*	344

* Contained in shipped concentrate.

Estimated capital and operating costs for the various options are summarized in the following table for 2.5 million tons per year of ore (7500 tons per day design processing rate):

Route	Capital Cost $US (x 1000)	Capital Cost $/lb Cu*	Operating Cost $US/Ton	Operating Cost $/Lb Cu	Total Cost** $/lb Cu*
RLE	105411	0.46	9.66	0.37	0.83
PLE	96449	0.42	11.87	0.45	0.87
NH3	118597	0.51	12.41	0.47	0.98
SX-EW	60903	0.35	5.22	0.26	0.61
FLOAT	49403	0.21***	4.02	0.15***	0.36

* Based on a simple 3.5 year payback on capital.
** Mining and administration costs not included.
*** Per pound of copper in shipped concentrate.

The above data are based on the following recoveries of copper and molybdenum disulphide from 2.5 million tons per year of ore:

Route	Tons per Year Copper	Tons per Year MoS_2*
RLE	32410	430
PLE	33080	434
NH3	33080	430
SX-EW	25190	0
FLOAT	34100*	430

* Contained in shipped concentrate.

The above cost data suggest that direct concentrate shipment or heap leaching/SX-EW are likely to be economically viable, while the remaining three costed routes are not attractive. It should be noted that the suitability of heap leaching depends strongly on the metallurgical response of the material and this must be established by testwork.

With respect to heap leaching/SX-EW, the above costs do not account for the effects of leaching rate on economics. Initial copper production would be realized some months after mining is started, and peak production would occur many months later. This disadvantage is offset to some extent by the fact that all of the plant required to meet peak production does not need to be installed immediately.

APPENDIX 4

Cost Estimate Tables

by T. Sills

Watts, Griffis and McOuat Limited

(1992)

TABLE 1

Mining Capital and Operating Costs

8,000 tons/day

Cost Center	Ramp Access		Shaft Access Additional Costs		Shaft Access Total Costs	
	Capital	Operating	Capital	Operating	Capital	Operating
Labor	3,473,023	4.11	6,175,562	0.28	9,648,585	4.39
Equipment	23,512,965	0.56	4,649,943	0.09	28,162,908	0.65
Steel	1,340,141	0.75	1,390,671	0.27	2,730,812	1.02
Lumber	22,683	0.00	-	-	22,683	0.00
Fuel	217,889	0.41	-	-	217,889	0.41
Lubricants	60,260	0.13	294,660	0.00	354,920	0.13
Explosives	2,207,571	1.85	384,150	-	2,591,721	1.85
Tires	115,062	0.06	-	-	115,062	0.06
Cons. material	1,913,726	0.02	2,659,747	0.03	4,573,473	0.05
Electricity	24,686	0.17	70,357	3.12	95,043	3.29
Sales tax	1,603,996	0.18	666,014	0.21	4,263,743	0.39
Total	34,492,002	8.24	16,291,104	4.00	50,783,106	12.24

Note: Based on 31,000,000 in-situ tons with an 85% extraction factor and 10% dilution

TABLE 2

Mining Capital and Operating Costs

9,000 tons/day

Cost Center	Ramp Access		Shaft Access Additional Costs		Shaft Access Total Costs	
	Capital	Operating	Capital	Operating	Capital	Operating
Labor	3,729,098	4.00	6,472,713	0.25	10,201,811	4.25
Equipment	25,425,685	0.55	4,866,228	0.08	30,291,913	0.63
Steel	1,431,347	0.74	1,453,129	0.27	2,884,476	1.01
Lumber	24,543	0.00	-	-	24,543	0.00
Fuel	232,773	0.40	-	-	232,773	0.40
Lubricants	64,376	0.12	306,771	0.00	371,147	0.12
Explosives	2,359,478	1.83	402,161	-	2,761,639	1.83
Tires	122,907	0.06	-	-	122,907	0.06
Cons. material	2,066,723	0.02	2,828,407	0.03	4,895,130	0.05
Electricity	26,475	0.16	72,289	3.12	98,746	3.28
Sales tax	1,731,415	0.18	711,715	0.21	2,443,130	0.39
Total	37,214,820	8.06	17,113,413	3.96	54,328,233	12.02

Note: Based on 39,000,000 in-situ tons with an 85% extraction factor and 10% dilution

TABLE 3

Mining Capital and Operating Costs

10,000 tons/day

Cost Center	Ramp Access		Shaft Access Additional Costs		Shaft Access Total Costs	
	Capital	Operating	Capital	Operating	Capital	Operating
Labor	3,974,124	3.91	6,750,619	0.22	10,247,743	4.13
Equipment	27,268,148	0.55	5,068,213	0.07	32,336,361	0.62
Steel	1,518,180	0.74	1,511,373	0.27	30,295,553	1.01
Lumber	26,335	0.00	-	-	26,335	0.00
Fuel	246,946	0.40	-	-	246,946	0.40
Lubricants	68,296	0.12	318,027	0.00	386,323	0.12
Explosives	2,504,200	1.81	418,986	-	2,923,186	1.81
Tires	130,377	0.06	-	-	130,377	0.06
Cons. material	2,213,920	0.02	2,988,321	0.03	5,202,241	0.05
Electricity	28,185	0.15	74,063	3.12	102,248	3.27
Sales tax	1,853,949	0.18	755,847	0.20	2,609,796	0.38
Total	39,832,660	7.94	17,885,449	3.91	57,718,243	11.85

Note: Based on 42,000,000 in-situ tons with an 85% extraction factor and 10% dilution

AN EVALUATION REPORT

OF

THE CASTLE COPPER MOLYBDENITE DEPOSIT

SHEEP MOUNTAIN EAST AREA

YAVAPAI COUNTY, ARIZONA

BY

RAYMOND J. MONGEAU

JULY, 1990

SUMMARY

The Castle Copper Molybdenite deposit, a porphyry-type, copper deposit typical of that found in the southwest United States is located about 50 kilometers from Phoenix in Arizona. It is located on one of the largest porphyry-type copper-bearing sulphide mineralized systems in Arizona.

The supergene copper sulphide blanket within a large primary copper-molybdenite system is estimated to contain 40-50 million tons grading 1.25% Cu and 0.08% MoS_2. By including the lower portion of this blanket, inferred ore reserves stand at 200 million tons grading 0.55% Cu and 0.069% MoS_2. As shown in a separate evaluation report by John Steers Consulting, this deposit which is located at a depth of about 1500 feet and amenable to underground bulk mining appears to be economical at today's copper price. A major fill-in drilling program is, however, necessary to establish proven and probable ore reserves.

On a larger scale inferred ore reserves stand at 700 million tons grading 0.26% Cu and 0.056% MoS_2, or 400 million tons grading 0.334% Cu and 0.068% MoS_2. A portion of this zone is reported to contain 140 million tons grading 0.30% Cu and 0.10% MoS_2. This deposit underlies a thick (1200') post mineralized volcanic cap and therefore cannot be considered for open pit mining at this time.

An attractive exploration target also exists southwest of the Cow Creek zone along the West Fault where it intercepts the primary copper-molybdenite mineralization. Another similarly enriched secondary copper zone likely exists here and could contain an additional 15 million tons of 1.25% copper and 0.06% MoS_2.

It is known that copper leaching has been thorough in the vicinity of favourable structures such as faults. Considering the extensiveness of the primary copper-molybdenite mineralization and the number of faults in the area other attractive secondary enriched copper deposits likely exist on the property.

INTRODUCTION

Upon the completion of an evaluation study of copper properties in Arizona and its recommendation the writer acquired the Castle porphyry copper-molybdenite deposit located in Yavapai County near Phoenix. This deposit warrants serious exploration and fill-in drilling. At the current copper price of $1.10 - 1.25 US per pound this deposit appears to be economical, assuming, fill-in drilling is successful. The writer refers to an Economic Evaluation by John Steers Consulting Inc., enclosed with this report.

PREVIOUS WORK

The porphyry type copper-molybdenite mineralization identified by widely spaced, vertical diamond drilling (750 to 2000 ft apart) was carried out by Phelps Dodge during the 1960's and BHP-Utah during the 1970's and 1980's. Very little time and money was spent on the property by BHP-Utah during the 12 years they held the property. The previous drilling covered a large area of about 3-4 square miles.

The better grade primary (hypogene) copper-molybdenite mineralization appears to be localized along a contact between a monzonite porphyry intrusive and Precambrian rocks. It forms an envelope about 1000 and 2000 feet in width. A strong, but likely irregular, supergene copper sulphide blanket high in copper values has been traced along the eastern portion of the quartz monzonite intrusive located in the Sheep Mountain East Area (see Maps 1 and 2).

Attempts have been conducted by previous workers at estimating inferred ore reserves from widely spaced drill holes and these are summarized below:

Year	Ore Reserves-Tons	Cu %	MoS_2 %	Cu Equivalent %
1967	91,068,114	0.74	0.065	0.92
1969	40,000,000	-	-	1.25
"	90,000,000	-	-	0.90
"	74,600,000	0.60	0.07	0.71
"	17,500,000	1.29	0.058	1.41
"	790,000,000	0.245	0.037	0.318
1971-5	103,000,000	0.55	0.07	-
1981				
Copper Zone	91,000,000	0.74	0.065	1.00
Moly Zone	140,000,000	0.30	0.10	

CURRENT EVALUATION

An evaluation of the drill results in the vicinity of the supergene (secondary) copper sulphide blanket located along the Cow Creek fault zone (see Maps 1, 2 and 3 for details) indicates that there exists a great opportunity to define by fill-in drilling a richer copper zone amendable to underground bulk mining.

The degree of copper leaching in the area appears to have been rather complete and extensive having removed and concentrated copper by a multiple of between 5 to 10 times. The fact that the primary copper-molybdenite mineralization is extensive suggest that other similar supergene copper sulphide blankets likely exist in the area.

On the assumption that the secondary enriched copper continues along this fault zone (see Map 3) this area is estimated to contain 40-50 million tons grading 1.25% Cu and 0.06% MoS_2. By taking in the lower grade portion of this zone, reserves would stand at about 200 million tons grading 0.55% Cu and 0.069% MoS_2. No doubt, a major fill-in drilling program is necessary to establish more accurately tonnage and grade.

Based on the same premises as above an area in the vicinity of holes UC-18, SM-30, SM-37 and SM-44 should be seriously explored. At this juncture the northwest-trending West fault meets another north-trending fault with both faults intersecting the hypogene copper-molybdenite horizon. One should expect the existence of a rather thick supergene copper sulphide blanket at this juncture. Please note that the adjacent holes, namely SM-44 carries 0.11% Cu and 0.03% MoS_2 over 476 feet; UC-18, 0.20% Cu and 0.073% MoS_2 over 1052 feet; SM-30, 0.12% Cu and 0.10% MoS_2 over 558 feet; and SM-37, 0.23% Cu and 0.038% MoS_2 over 1258 feet. The potential enriched copper tonnage in this area (see Map 3) is 15 million tons of similar grade, being 1.20% Cu and 0.06% MoS_2.

The secondary sulphide copper mineral that constitutes most of the copper in the upper supergene sulphide blanket is chalcocite. Chalcocite is also found in lesser quantities at depth especially under the supergene blanket. It is interesting to note that holes SM-27, SM-44 and UC-18 and SM-19 carry low quantities of chalcocite over a wide width, suggesting that leaching was widespread in the general vicinity.

Since the predominant secondary copper sulphide mineral that makes up the supergene enriched copper sulphide blanket is chalcocite, it suggests that a leaching method may be available for extracting most of the copper, whether by in-situ method or by vat leaching of the ore after extraction from underground. This should be investigated as it could greatly reduce the cost of producing copper.

The size and horizontal configuration of the Castle Copper deposit described above lends itself to cheap underground bulk mining. An example of this is Magma's San Manuel copper deposit located just north of Tucson, Arizona. It has been operating since 1956 and currently mines 45,000 tons of ore per day utilizing an underground block caving method. Today the technology has greatly been improved utilizing new mining methods and more efficient and larger equipment. The San Manuel mine is currently generating a healthy cash flow at a mining grade of 0.72% copper.

The evaluation also reveals that a large, low grade copper-molybdenite deposit exists in the area. Results of widely spaced drill holes indicate inferred ore reserves of 700 million tons grading 0.26% Cu and 0.056% MoS_2 (see Map 3, Areas A, B and C and Table 1) or 400 million tons grading 0.334% Cu and 0.068% MoS_2 (Map 3, Areas A and B only). Obviously more detailed drilling is necessary to determine more accurately the true tonnage and grade.

As tabulated below a number of large open-pit copper-molybdenite mines in operation today in the southwestern United States that are generating large cash flows have similar ore reserve tonnage and grade. However, the Castle Copper deposit underlies a thick post-mineralized volcanic cap at least 1200 feet thick and therefore cannot be considered for open-pit mining at this time.

Mine Cyprus Mineral	Ore Reserves	Average Cu %	Grade % MoS_2
Bagdad	707	0.42	0.035
Sierrita	562	0.34	0.062
Miami	252	0.43	-
Asarco			
Continental	420	0.28	0.072

EXPLORATION PROGRAM AND ESTIMATED COST

As shown on Map 3 a total of 30 deep diamond drill holes totalling 75,000 feet is recommended to bring this deposit to the pre-feasibility stage. A total of 23 fill-in drill holes is recommended for the main enriched copper zone along the Cow Creek fault and seven additional drill holes in the vicinity of the West fault zone. This program is estimated to cost $5.0 million to complete. It also includes $500,000 for metallurgical testing. It does not include drilling of the main molybdenite zone located to the northwest, deep exploration drilling of Area B, or fill-in drilling of Area C.

TABLE 1

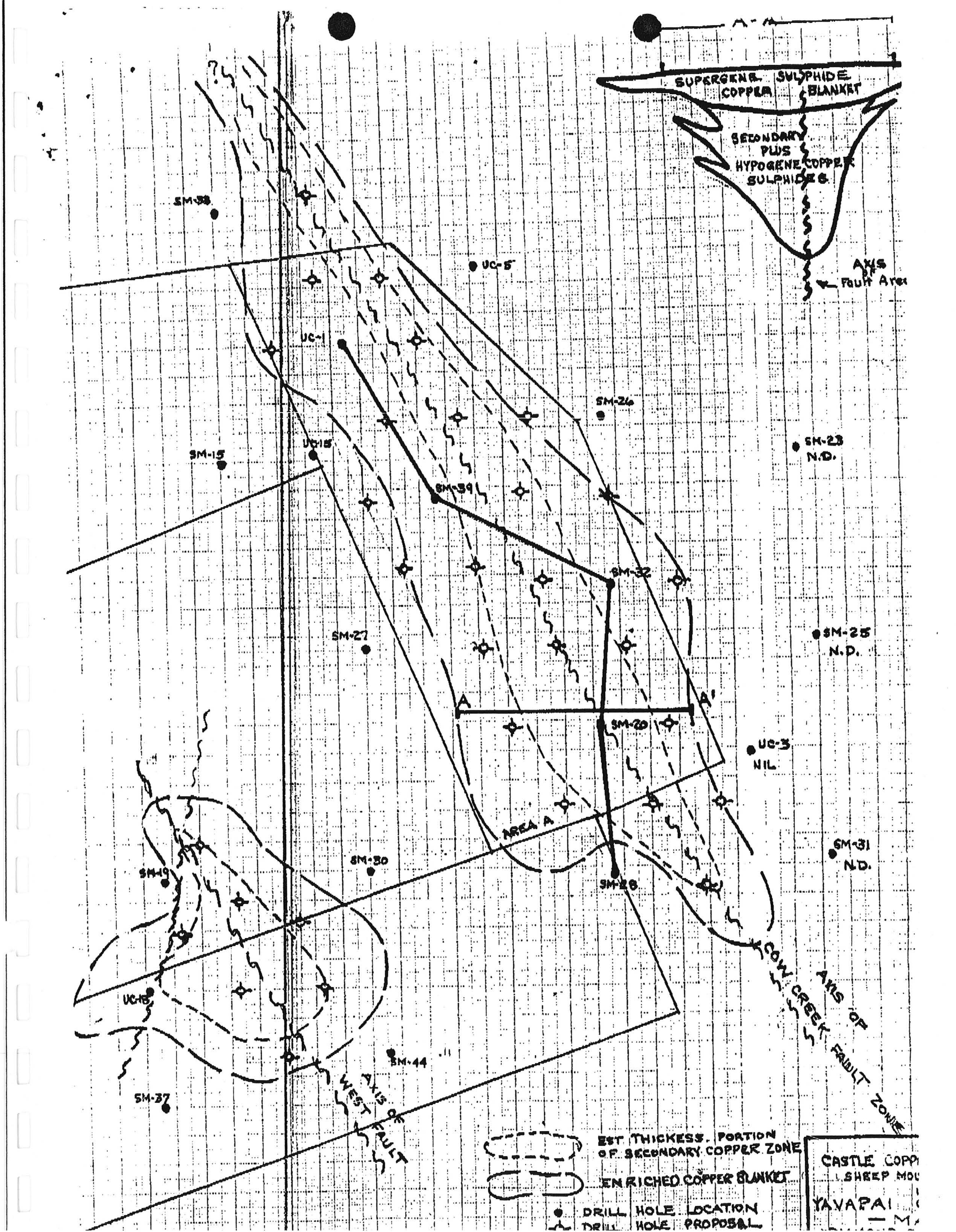
SELECTED DIAMOD DRILL ASSAY RESULTS

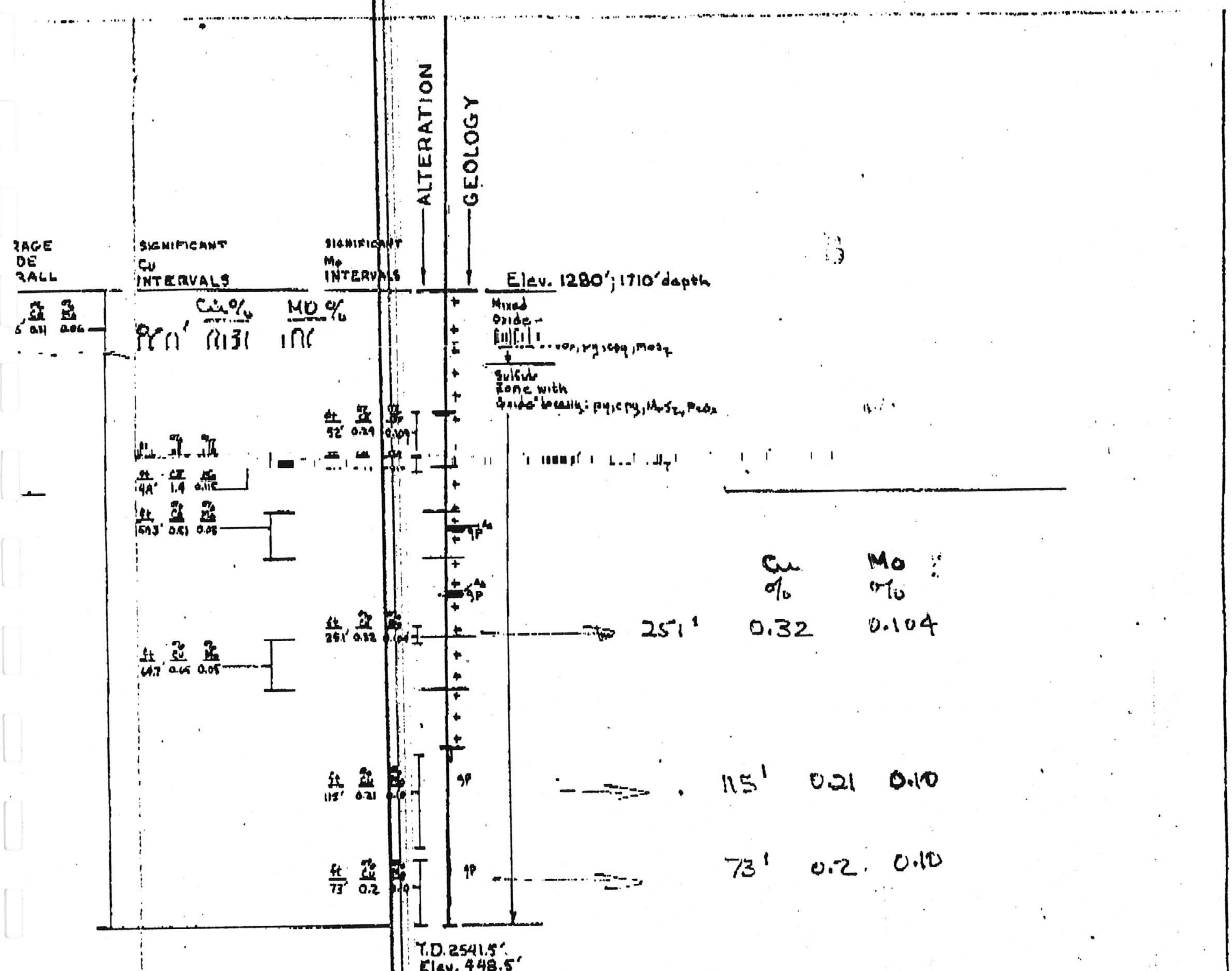
DDH NO.	THICKNESS FT	% CU	% MOS_2
UC-1	715	0.45	0.065
UC-5	240	0.23	0.005[-1]
UC-15	327	0.095	0.062
UC-17	832	0.36	0.109
UC-18	1052	0.20	0.073
SM-19	604	0.15	0.031
SM-20	1026	0.48	0.065
SM-22	390	0.025	0.011
SM-26	271	0.09	0.032
SM-27	810	0.10	0.027
SM-28	400	0.13	0.044
SM-30	558	0.12	0.10
SM-32	530	0.29	0.038
SM-37	1253	0.23	0.038
SM-39	600	0.37	0.052
SM-40	585	0.15	0.074
SM-44	478	0.11	0.03

-1 Higher grade section: 50 ft. average 0.60% Cu

HIGH GRADE SECONDARY COPPER ZONE

DDH NO.	THICKNESS FT	% CU	% MOS_2
UC-1	65	1.57	0.057
SM-20	150	1.49	0.063
SM-32	130	0.72	0.062
SM-39	50	1.18	0.053


A - A'
SUPERGENE SULPHIDE COPPER BLANKET
SECONDARY PLUS HYPOGENE COPPER SULPHIDES
AXIS OF Fault Area
SM-38
UC-5
UC-1
SM-26
SM-23 N.D.
SM-15
UC-15
SM-39
SM-32
SM-27
SM-25 N.D.
A
A'
SM-20
UC-3 NIL
AREA A
SM-31 N.D.
SM-19
SM-30
SM-28
COW CREEK
AXIS OF
FAULT ZONE
UC-18
SM-44
AXIS OF WEST FAULT
SM-37
EST THICKESS. PORTION OF SECONDARY COPPER ZONE
ENRICHED COPPER BLANKET
DRILL HOLE LOCATION
DRILL HOLE PROPOSAL
CASTLE COPP
SHEEP MOU
YAVAPAI



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...ry volcanics: andesite flows, tuffs, agglomerates & volcanic breccia.

...ry intrusive: quartz monzonite porphyry to quartz monzonite ...ntified as granite porphyry in Phelps Dodge logs).

...brian Bradshaw complex: dominantly granite to granite gneiss, ... alaskite, pegmatite and biotite schist.

TYPES

... sericite-clay: quartz-sericite veinlets and K sericite and/or clay alteration of the host rock ... rockmass.

quartz veinlets.

STRUCTURE NOTES

fault

zone of brecciation

TION

UTAH INTERNATIONAL INC.

FIG. 3:

RC-UC-17; SIGNIFICANT METALLIZATION INTERVALS

SHEEP MOUNTAIN - EAST AREA

YAVAPAI CO., AZ.

1" = 200'

By: STEVEN SMITH, OCT. 1975