BOWDIDGE
Mineral Exploration Consultants

Ian G. Park, B.Sc., M.Sc., F.G.A.C.
137 Victor Avenue
Toronto, Ontario, Canada
M4K 1A9
(416) 465 8330

Colin R. Bowdidge, M.A., Ph.D., F.G.A.C.
442 Wellesley Street East
Toronto, Ontario, Canada
M4X 1H7
(416) 920 6145

NEW FORCE CRAG MINES LTD.

REPORT ON THE FORCE CRAG MINE, CUMBRIA, ENGLAND

- by -

C. R. Bowdidge, M.A., Ph.D.

25th October 1976

TABLE OF CONTENTS

	page
SUMMARY	1
EXPLANATORY NOTE	3
INTRODUCTION	4
PROPERTY	4
LOCATION AND ACCESS	5
TOPOGRAPHY	6
GEOLOGY	6
HISTORY AND PRODUCTION	11
DESCRIPTION OF MINE	14
MINERALIZATION	15
SAMPLING	18
RESERVES	18
POSSIBILITIES FOR EXTENSION OF MINERALIZATION	19
CONCLUSIONS AND RECOMMENDATIONS	22
REFERENCES	30
AUTHOR'S CERTIFICATE	31
APPENDIX I: SAMPLING RESULTS AND TONNAGE CALCULATIONS	32
APPENDIX II: PRELIMINARY STUDY OF ECONOMICS	36
APPENDIX III: PROPOSED DEVELOPMENT PROGRAMME	40

Figures and Maps	Following page
1: Location map	5
2: Topographic map of property	6
3: Outline geology of the Northern Lake District	7
4: Geology of the Western Skiddaw Slates	8
5: Geology of property	9
6: Possible interpretation of the Force Crag Structure	10
7: Illustration of possible controls of mineralization	17
8: Results of geochemical survey (copy)	21
9: Proposed grids for I.P. and geochemical surveys	26
10: Sampling plans, 0 and 1 levels	35
11: Plan showing proposed diamond drilling programme	41
12: Longitudinal section showing proposed development	41
Composite Plan of Mine Longitudinal Section of Mine } in pocket	

SUMMARY

The property of New Force Crag Mines Ltd. consists of a mining lease on an area of approximately 670 acres, including the Force Crag Mine, a former producer of lead-zinc-silver and barite.

The Force Crag Mine is situated 4½ miles WSW of the Town of Keswick, in the mountains of the Lake District of north-west England.

The property is underlain by slates, shales, ans sandstones of the Ordovician Skiddaw Slate Series, which have been subject to multiple deformation during the Caledonian Orogeny. The mineralized zones are located in a fault-like structure which is provisionally interpreted as a dislocation between two structural domains.

The Force Crag Mine is known to have produced lead and zinc intermittently between 1848 and 1922, and barite intermittently between 1867 and 1966. The closure of the lead-zinc operation in 1922 was reportedly the result of a general slump in metal markets.

The mine has been developed by a series of adits driven into the hillside. Known lead-zinc mineralization is accessible from the lowermost two adits, the "0" and "1" levels, which are equipped with track and pipe. Buildings for a mill and office are on the site, and the company owns sufficient mining equipment to carry out development.

The mineralization consists of clots and strings of sphalerite and galena in a breccia-like zone. It occurs as shoots up to 22 ft. wide distributed along the structure over a length of at least 1,000 ft. Barite occurs as veins up to 1 ft. wide cutting the sulphides. In the upper mine levels,

now abandoned, barite occurs alone, as veins up to 5 ft. or more wide.

Based on sampling data supplied by the company, a probable reserve was calculared as: 16,391 long tons averaging 1.75% Pb, 8.68% Zn, and 6.68% barite. Additional tonnages of lower grade material are available.

It is concluded that there are good possibilities for developing further reserves by (a) testing the full width of known shoots, (b) exploring for possible parallel shoots, (c) extending the zone at depth, and (d) exploring for a possible eastern extension of the zone across the valley, where it is quite untested.

It is recommended that a two-stage programme of exploration and development be initiated. Stage I would consist of: a programme of diamond drilling of short horizontal holes into the walls of the drifts on 0 and 1 levels to test the full width of known shoots and explore for parallel shoots; suitable raising and drifting in mineralization to further extend and develop known shoots; an I.P. survey to test the possible eastward extension of the zone; and a soil geochemical survey to test an area of interest in the eastern corner of the property. The target of Stage I would be to develop sufficient reserves on existing levels to sustain a minimum of three years mining at 50 long tons per day.

Stage II would be contingent upon satisfactory results from Stage I, and would consist of underground diamond drilling to test the zone at depths of 100 and 200 ft. below the 0 level. and surface diamond drilling to test any I.P. anomalies which might have been located.

A budget of $150,000. is proposed for Stages I and II of the above programme.

EXPLANATORY NOTE

All costs estimated in this report are in sterling, since this is the currency in which the original estimates were made and in which any disbursements will take place. Budget totals have been converted to Canadian dollars at the rate of £1 = $1.60.

Tonnages quoted herein are in long tons of 2240 lbs., to accord with British practice. Wherever the word "ton" occurs, it should be taken to mean a long ton, unless specifically designated otherwise.

INTRODUCTION

This report describes the Force Crag Mine, a former lead-zinc-silver, and subsequently a barite producer, in the Lake District of north-west England. It was undertaken at the request of New Force Crag Mines Ltd., and is based on a visit to the property by the writer from 29th Sept. to 5th Oct., 1976. Geology and mineralization were examined in the two levels now accessible, a number of samples were taken to check the validity of previous sampling data, and a limited amount of reconnaissance geological mapping was done.

While in the U.K., the writer held extensive discussions with Mr. R.I. Gunn, director of Force Crag Mines (U.K.) Ltd., and manager of the project. Mr. Gunn is a mining engineer with extensive experience in the British metal mining industry. Discussion also took place with Mr. W.T. Shaw, former manager of the mine, and with the factor of the Leconfield Estate, and the staff of Boyles Bros. Ltd. and Hunting Surveys Ltd. A literature study was made, which is believed to have included all relevant sources.

PROPERTY

The property of New Force Crag Mines Ltd. consists of a Mining Lease covering an area of approximately 670 acres, centred on the Force Crag Mine, and whose limits are defined by four peaks, as follows:

NE Boundary: From Grisedale Pike, in a straight line, to Outerside.

SE Boundary: From Outerside, in a straight line, to Crag Hill.

SW Boundary: From Crag Hill, via the height of land, to Sand Hill.

NW Boundary: From Sand Hill, via the height of land, to Grisedale Pike.

N.B., where the boundary follows the height of land, it also coincides with the parish boundary. The property outlines are shown on fig. 2.

The Mining Lease is held by the company under an agreement with the Rt. Hon. Baron Egremont, owner of the Leconfield Estate, and runs for 25 years from 25th March, 1967. An annual rent of £50.00 is payable, together with royalties of one-thirtieth of the selling price of metals or concentrates, f.o.b. at the mine site, and £0.12½ per ton of barite. It is understood from the factor of the Leconfield Estate that the rent is paid to date, and the lease is in good standing.

Although the property lies in the Lake District National Park, where severe restrictions are imposed on industrial development, it is understood from Mr. W.T. Shaw, that a Planning Permit was issued for the former barite operation, and that it remains valid for similar operations on the same site.

LOCATION AND ACCESS

The Force Crag Mine is situated in the Parish of Above Derwent, at the head of the Coledale Valley, approximately 4½ miles WSW of the town of Keswick, District of Cumbria, England.

Access is from the village of Braithwaite, on the Keswick-Cockermouth road (A 592), thence via the Whinlatter Pass road (B 5292) for ½ mile, from which a narrow but well-made gravel road leads to the mine site. The upper mine workings were formerly reached by a 4-wheel drive road, but this is now in disrepair.

The location of the property is shown on figs. 1 and 2.

TOPOGRAPHY

The Force Crag Mine lies in the mountains of the English Lake District. Topography in the immediate area is moderately rugged, with peaks up to 2,500 ft. O.D.* rising sharply from narrow valleys at 500-1,000 ft. Vegetation is mainly grass, with some patches of bracken.

The lower mine workings are beside the Coledale Beck, at about 850 ft. O.D., and are overlooked by Force Crag, a 400 ft. cliff, over which the Coledale and Pudding Becks descend in two waterfalls. Above this cliff is a glacial cirque, in which the upper mine workings are situated. The Pudding Beck enters the cirque by another waterfall, known as High Force.

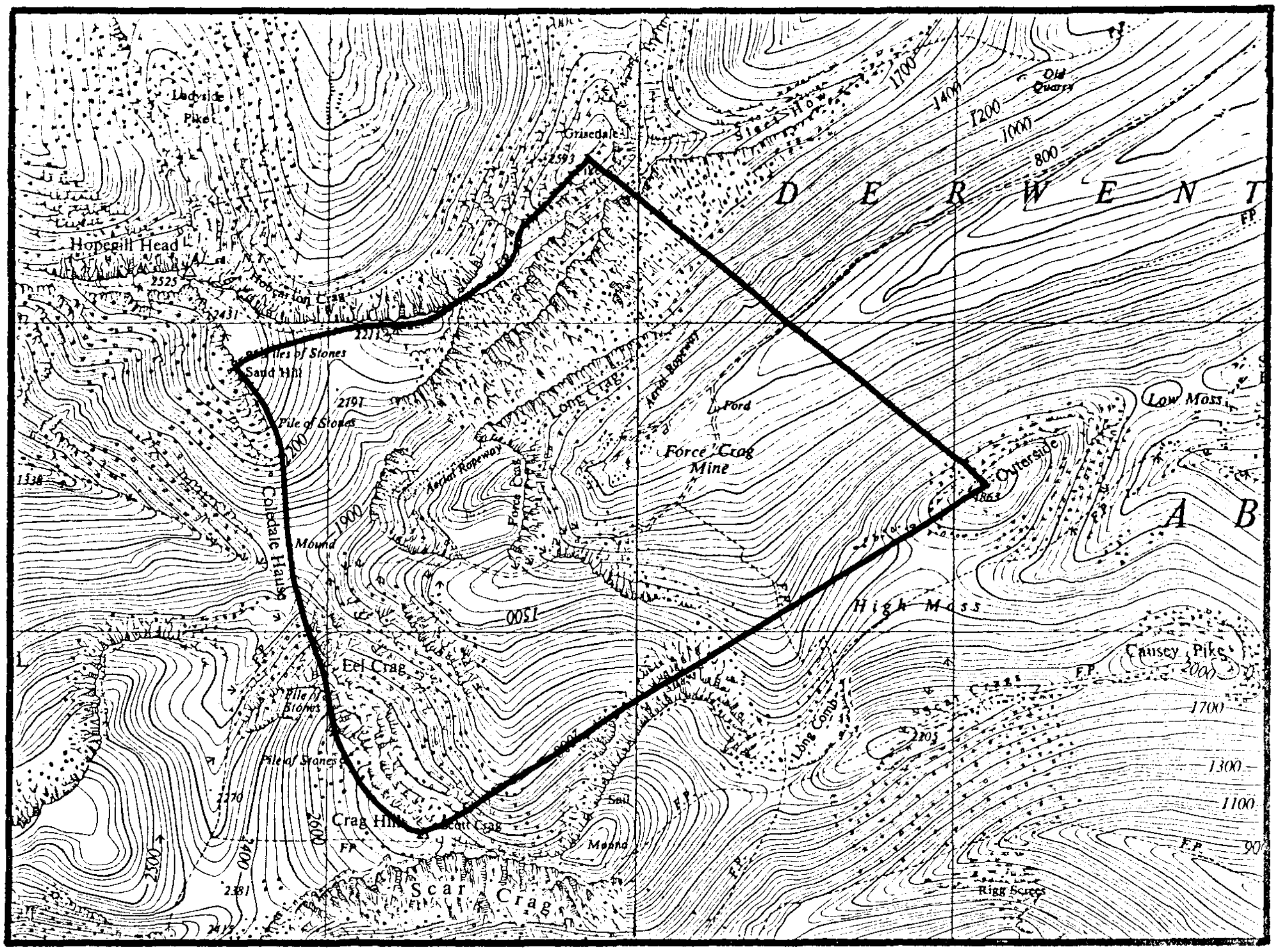
A copy of the 1:25,000 topographic map is appended as fig. 2.

GEOLOGY

The Lake District owes its existence to the presence of a roughly circular inlier, about 35 miles in diameter, of resistant Lower Palaeozoic rocks. A domal uplift has brought these rocks to surface and caused the unconformably overlying post-Silurian strata to dip radially outwards.

The rocks of the Lake District have been affected by the Caledonian Orogeny, with consequent deformation, igneous intrusion, and mineralization. The generalised structure consists of a broad anticlinorium on NE-SW axes, exposing a cross-section of the following stratigraphy:

* O.D. (Ordnance Datum) refers to the elevation above a standardised figure for mean sea level.



Ladyside Pike
Hopegill Head
Hobcarton Crag
Grisedale
D E R W E N T
Old Quarry
Long Crag
Aerial Ropeway
Force Crag Mine
Ford
Sand Hill
Pile of Stones
Coledale Hause
Mound
Outerside
Low Moss
A B
High Moss
Eel Crag
Causey Pike
Long Comb
Crag Hill
Scar Crag
Sail
Rigg Screes

		Thickness (ft.)[1]
Silurian:	Not divided	13,000
Ordovician:	Ashgill Series	100
	Coniston Limestone Series	1,000 or less
	---------- unconformity	
	Borrowdale Volcanic Series	10,000
	---------- unconformity	
	Skiddaw Slate Series	+30,000 (2)
	(bottom not seen)	

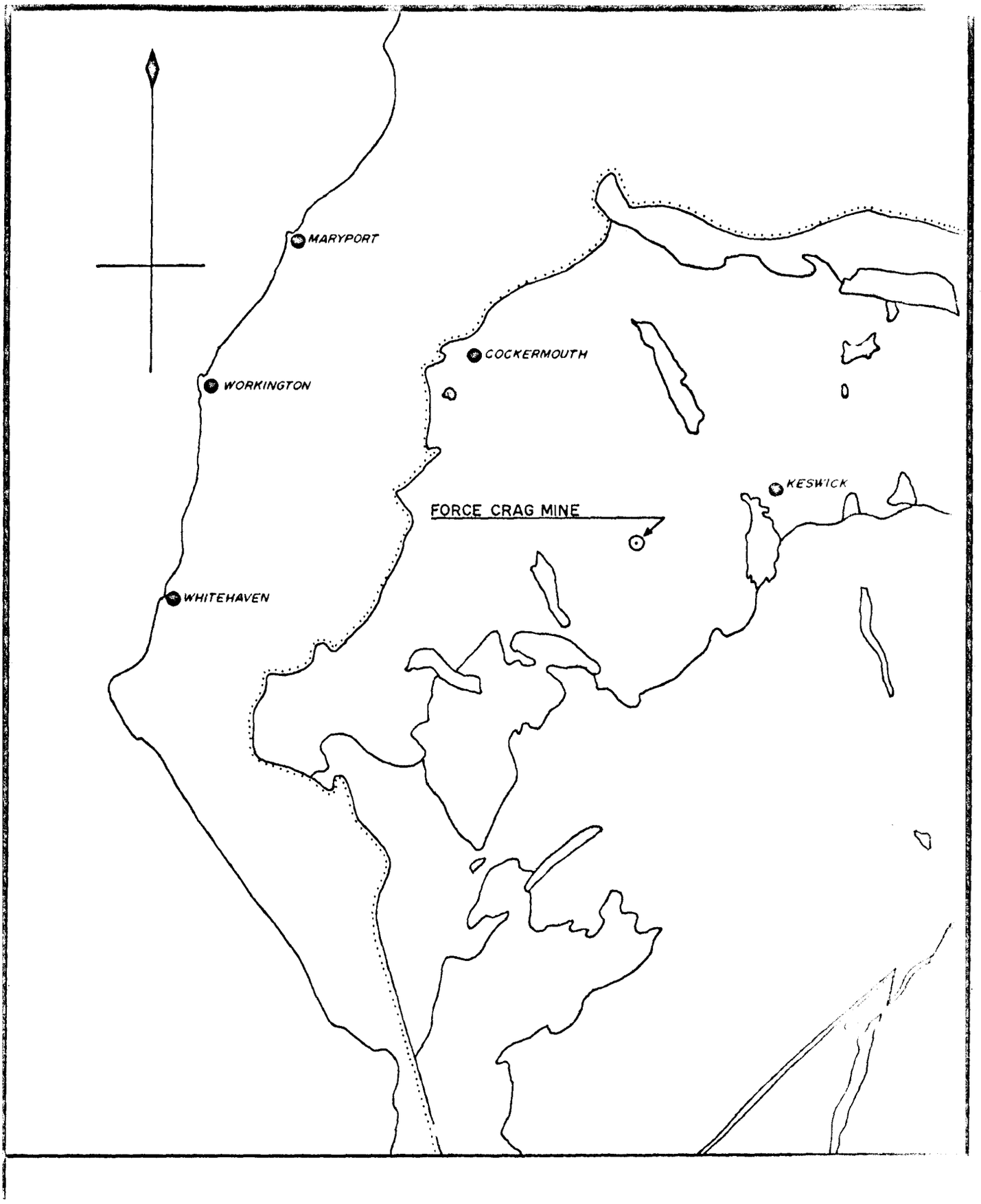
The generalised geology of the area is shown in fig. 3, after the Geological Survey[3].

Skiddaw Slates:

Since the Force Crag area is underlain entirely by Skiddaw Slates, the following summary is confined to that series.

The Skiddaw Slates consist of an extremely thick and quite monotonous sequence of eugeosynclinal sediments - shales, greywackes, black shales, arkose, flags (thin-bedded sandstones) etc. A number of attempts have been made to subdivide the stratigraphy on the basis of lithology and palaeontology[4,5] but unanimity has not been achieved, due to structural complexity and a paucity of fossils. The most recent study of the structure[2] has unravelled much of the folding, and recognises eight lithostratigraphic formations:

(8) Sunderland Slates: pelites of variable colour with ribs of sandstone.
(7) Watch Hill Grits & Flags: micaceous flags, sandy mudstone with ribs of sandstone, greywacke, and grit.
(6) Mosser Slates: dark slate with thin silt beds and ribs of sandstone.
(5) Loweswater Flags: alternating silstone, greywacke and grit.
(4) Kirkstile Slates: dark slate with flaggy beds increasing upwards.
(3) Blakefell Mudstone: pale-weathering brown mudstones.
(2) Buttermere Flags: alternation of siltstone, mudstone, slates of variable colour, and occasional greywacke.
(1) Buttermere Slates: dark striped slates.


MARYPORT
WORKINGTON
COCKERMOUTH
KESWICK
FORCE CRAG MINE
WHITEHAVEN

Structure of the Skiddaw Slates

Simpson's[2] study of the western part of the Skiddaw Slate area has indicated three phases of deformation, each accompanied by large- and small-scale folds, axial plane cleavage, and axial lineation:

F1: Open to tight folds on generally steep axial planes trending NE-SW. The axial plane cleavage S1 is a closely spaced strain-slip superimposed on a bedding cleavage (S0), assumed[2] to have been formed during F1 flexural slip. The axial lineation L1(S1-S0) plunges gently either to the NE or SW.

F2: Generally open but locally tight folds on flat-lying axial planes. The axial plane cleavage S2 is a strain-slip. The lineation L2(S2-S0) or L2(S2-S1) also plunges gently either NE or SW, along the strike of S0 or S1.

F3: Locally developed, generally open flexures on WNW-ESE to NW-SE axial planes with a steep dip to the NE. The axial plane cleavage S3 is again a strain-slip. The axial lineation L3(S3-S0) or L3(S3-S1) has a highly variable plunge according to the pre-F3 disposition of the rocks.

Of these structural features, only F3 affects the overlying Borrowdale Volcanic Series, thus indicating an intra-ordovician age for F1 and F2, i.e. the majority of the deformation of the area.

Fig. 4 is a map of part of the Skiddaw Slate area, after Simpson[2], showing the lithostratigraphy and major structures.

Geology of the Force Crag Area

It will be noted from fig. 4 that the Force Crag Mine is in an area underlain by the Mosser Slate Formation. The axial trace of the Braithwaite Syncline, a major F1 fold, runs along the Coledale Valley. A major fault, the Gasgale Slide (a slide is a fault formed during folding by dislocation of a limb), of F1 age, runs east-west a short distance to the south, and brings the Blakefell Mudstone Group to surface on its south side.

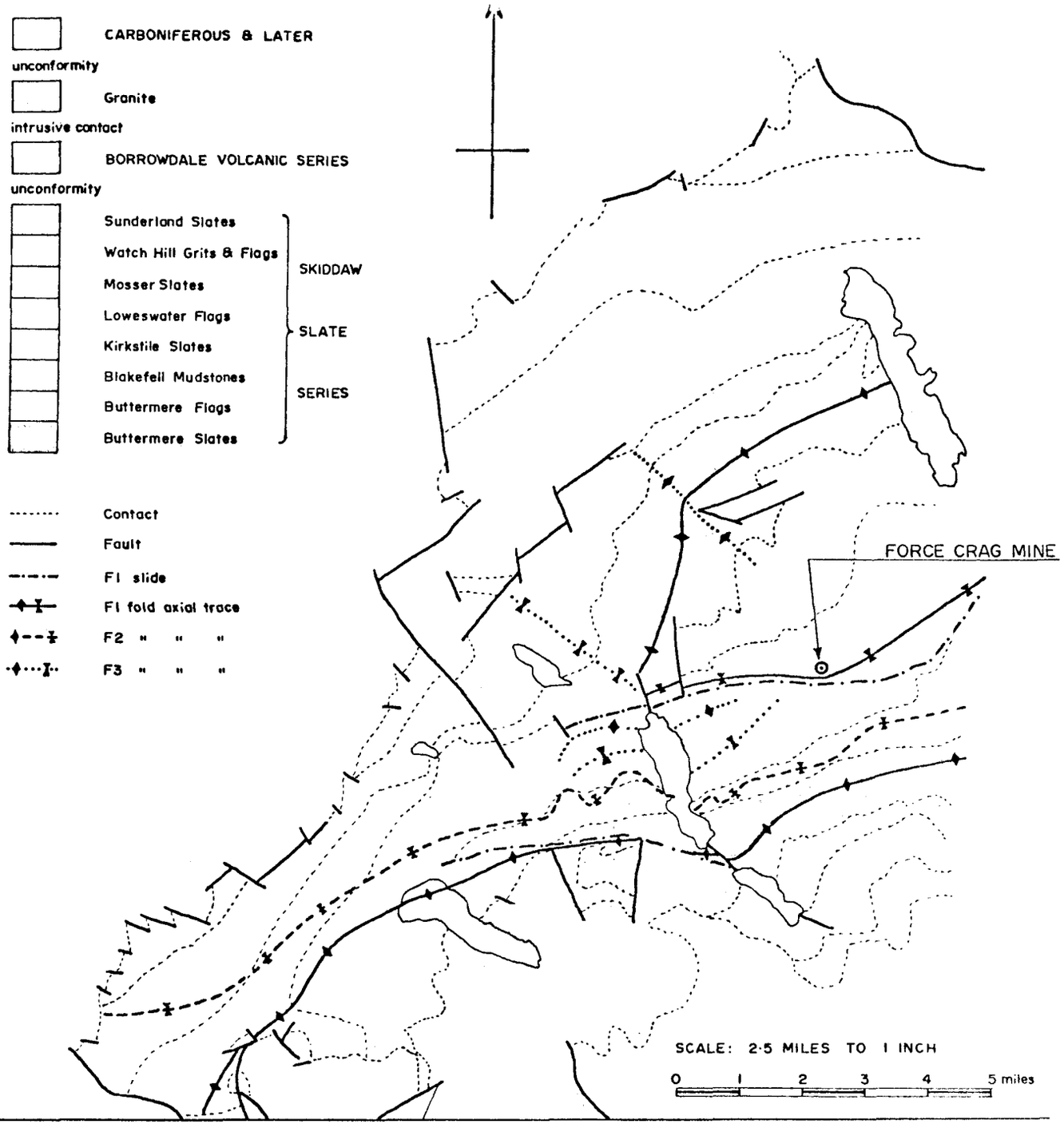


FIG. 4. GEOLOGICAL MAP OF THE WESTERN SKIDDAW SLATES SHOWING STRATIGRAPHY AND STRUCTURE after Simpson[2]

The following summary is based on reconnaissance mapping by the writer, and is generally corroborated by data from a thesis by Herriman[6]. A preliminary geological map is presented in fig. 5.

on Long Crag, on the north side of the valley, a sequence of rather homogeneous thin-bedded sandy shales and slates outcrops. F1 folding on vertical axial planes is quite intense, with numerous reversals of the dominantly southerly dip. The same rocks are seen on Force Crag, but they are folded only slightly by open F1 warps. A few F2 folds on flat axial planes are present. The dip of the strata is gently to the west, and this represents the axial region of the Braithwaite Syncline.

Around High Force a group of well-bedded light-coloured sandstones outcrop. They dip gently to the west, but when followed northwards across the barite-bearing vein, they assume a moderate to steep dip to the SSW, and are affected on all scales by south-facing F1 monoclines on steep axial planes.

The western part of the area is underlain by black shales which dip at moderate angles to the west on the crag SW of High Force. Further north, on the slopes of Sand Hill, these same shales are flat-lying and affected by gentle F1 warps on E-W axes.

To the south of the Gasgale Slide, outcrops of light-weathering, thick-bedded sandy shale were observed, with moderate dips to the west or NW.

Minor intrusions of "greenstone"[4], apparently a fine-grained intermediate porphyry, occur in the vicinity of High Force.

The Gasgale Slide is not exposed, and its dip is not known. Subsidiary slips dipping to the north at about 45° were noted, but the main fault is assumed

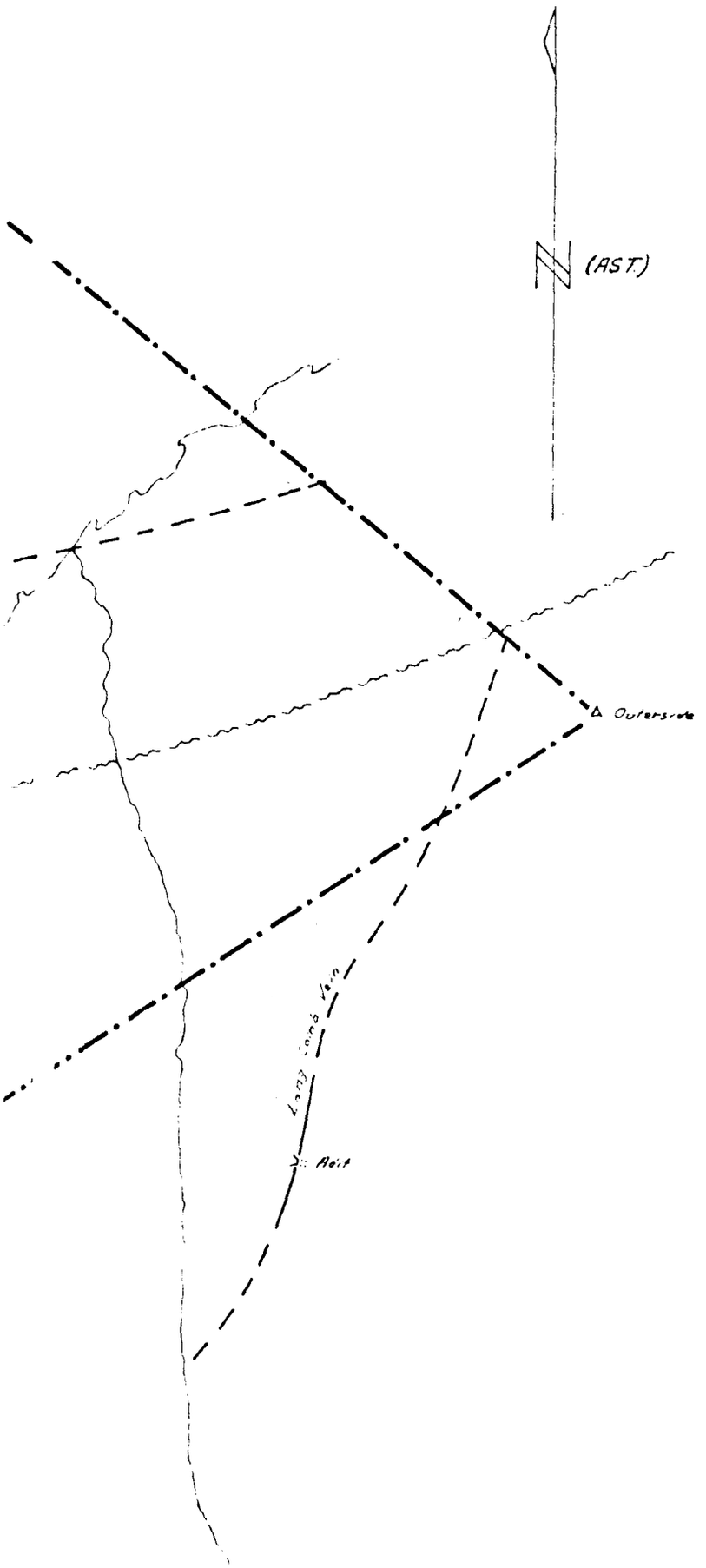


FIG. 5 GEOLOGY OF PROPERTY

From Geological Survey Maps and reconnaissance mapping

"Greenstone"

Black Shale

Sandstone, some Floggy shale

Floggy shale and slate

Thick-bedded sand's shale

Bedding - inclined, vertical

S1 " "

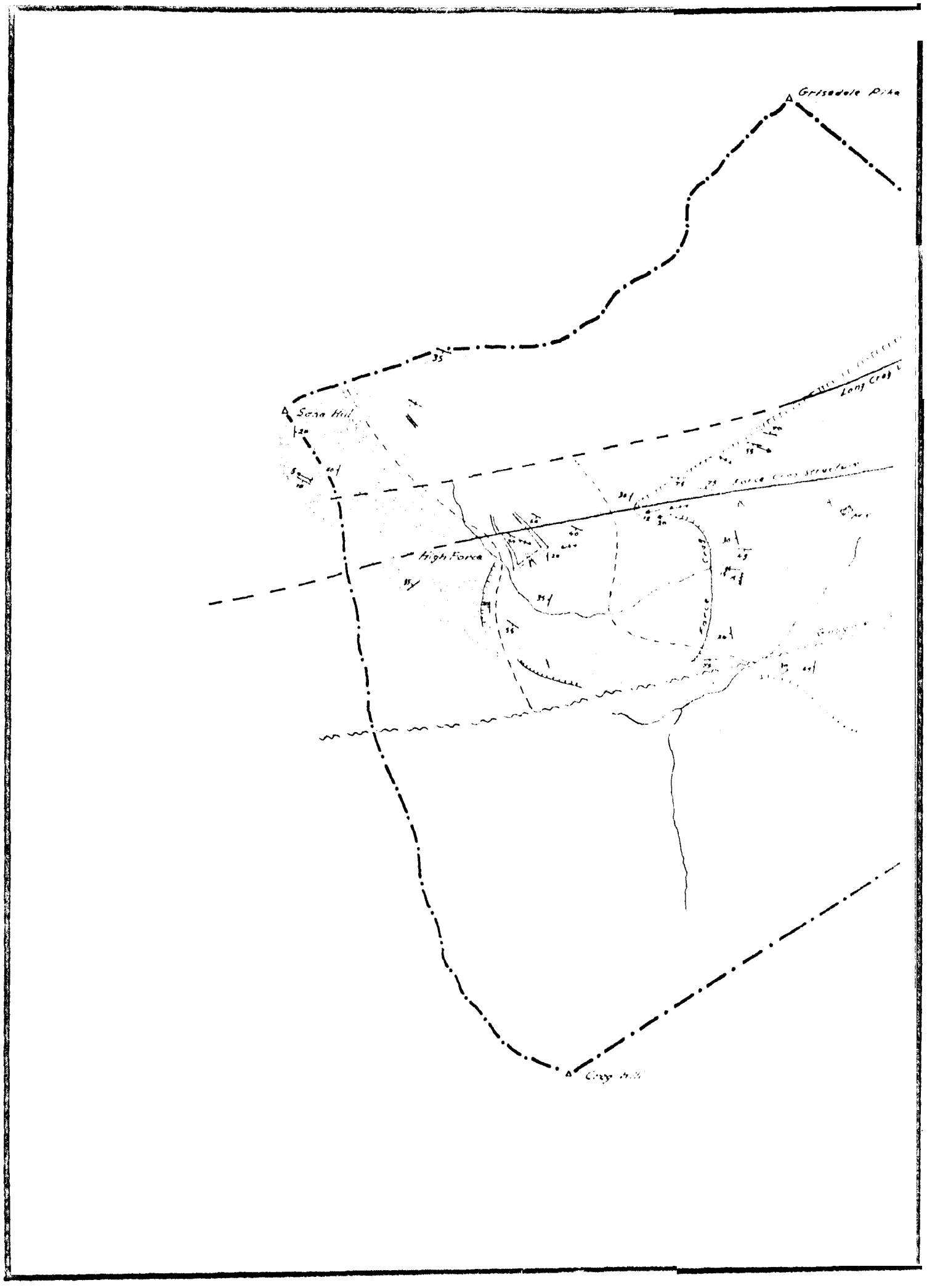
S2 " "

L1 lineation

L2 "

SCALE: 6 INCHES TO 1 MILE

0 1000 feet 2000 3000


Grisedale Pike
Sand Hill
Long Crag
High Force
Force Crag
Crag Hill

to have a steep dip, as its trace crosses the topography without significant change in direction.

A prominent barren quartz vein runs along Long Crag, with a strike parallel to that of the Gasgale Slide. It is generally 2-3 ft. wide and dips steeply to the north.

The Force Crag Structure

The structure which contains the mineralization at Force Crag has been cited as a fault[7], although there is little if any displacement of "greenstone" dykes[8] or of the sandstone-black shale contact.(fig. 5). The nature of the structure is as yet unresolved, and accordingly it is referred to here as the "Force Crag Structure".

The structure is a prominent linear feature striking N.85°E. and dipping about 75° to the north. The strike is parallel to that of the Gasgale Slide, and the dip and strike are both similar to those of the Long Crag Vein.

The Geological Survey map[8] shows the structure (mainly interpolated through overburden-covered areas) as extending 9,000 feet west of High Force. It has been followed in the mine workings for 4,000 feet east of this point. At both of these limits it disappears under very extensive overburden, so that its true extent is quite unknown.

Underground examinations by the writer indicate that where there are no veins or mineralized shoots within the structure, it is singularly ill-defined and must have been very hard to follow. In parts its course is defined by a zone of bluish clay-like gouge containing rounded blocks of wall-rock, and elsewhere the bedding of the wall-rocks has been brought into parallel-

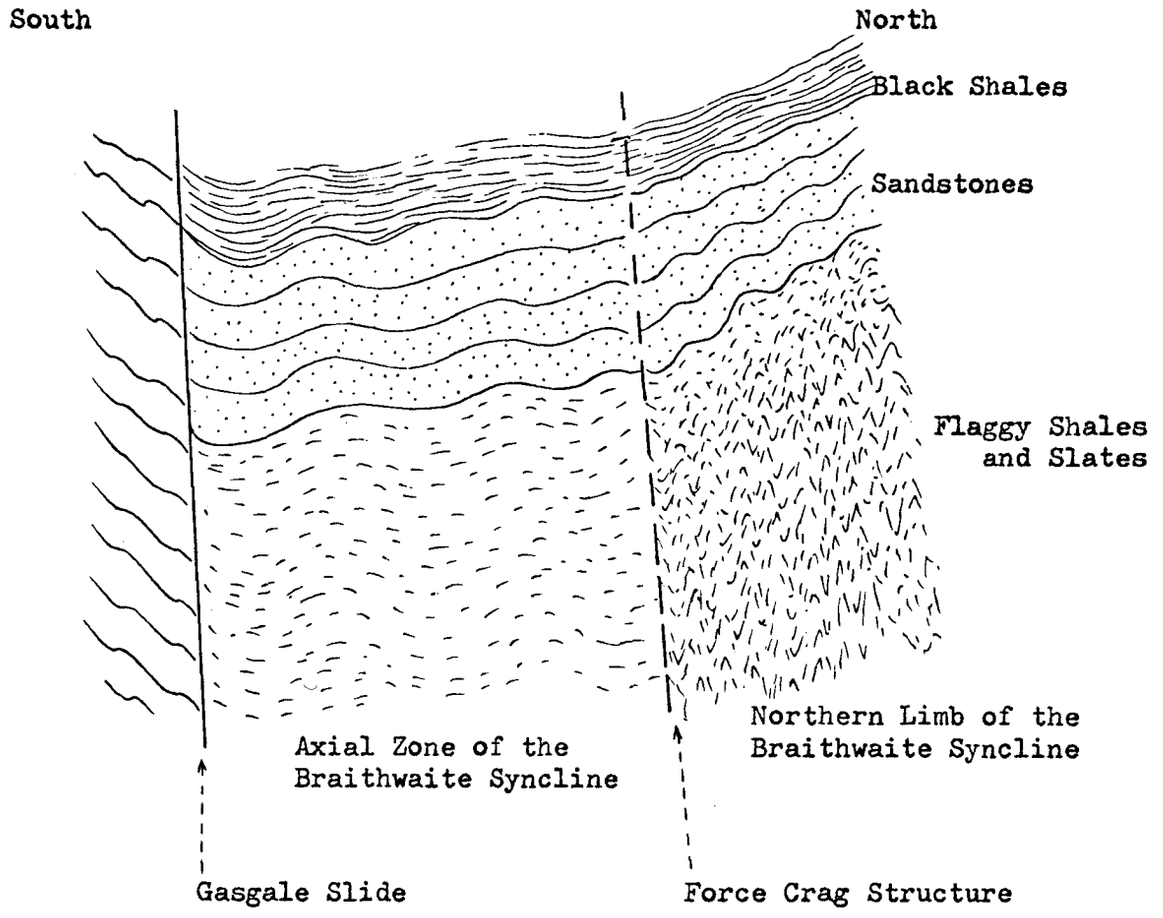


Fig. 6. Schematic cross-section showing a possible interpretation of the Force Crag Structure as a dislocation between two structural domains with different degrees of deformation. (Not to scale)

ism with the structure on a series of monoclinal rolls similar to the F1 structures described above.

It is provisionally suggested that the Force Crag Structure originated during F1 deformation as a zone of dislocation between the little-deformed axial zone of the Braithwaite Syncline and its more highly deformed northern limb. This postulate is illustrated in fig. 6. From the above description of the geology, it will be apparent that the contrast between the intensity of deformation in the two domains seems to increase downwards and eastwards from High Force. The structure may be the upward termination of a slide, symmetrically opposite the Gasgale Slide.

If the Force Crag Structure originated in F1 times, it must have been reactivated at a later date, with the formation of the blue gouge, and opening of fractures in which the mineralization was deposited.

HISTORY AND PRODUCTION

Lake District

Mining in the Lake District is known to have commenced as a major industry in the 16th century, and probably continued without interruption until 1966. The era of greatest activity was the 19th century, with 19 mines in production in 1874[9]. The principal commodities produced were (in approximate order of decreasing importance) lead, copper, zinc, barite, graphite, tungsten. Although many of the mines were small by present-day standards, not all seem insignificant. The Greenside Mine, 10 miles ESE of Force Crag, which closed in 1962, produced approximately 3,000,000 tons grading about 8-10% Pb[9] and probably 1 oz/ton Ag[10].

Force Crag Mine

The first recorded activity at Force Crag[11] was about 1830, when Messrs. Walton, Dowthwaite, & Cowper drove levels 1, 2, and 3. The first reported production was in 1848-50, when 78¼ tons of lead concentrate were produced[12]. Subsequently, from 1858 to 1863, J. Walton & Co. produced 256 tons of lead concentrate[12].

The mine was apparently reopened for barite by Straughton & Co. (1867-75), and then by Force Crag Mining Co. (1876-78). During this period, 4497 tons of barite were extracted[12]. Levels 4 and 5 must have been commenced at this time, but production was apparently from the original three levels[13].

The mine was closed from 1880 until 1905, when it was reopened for lead and zinc by Lobb & Co. A mill was erected, but the operation was unsuccesful due to the difficulty of separating sphalerite and barite[11], and the lead alone would not support the operation[9]. Operations were ceased in 1909, but were resumed in 1912 by the Coledale Mining Syndicate, who erected a flotation plant, which produced clean concentrates[11], but was again obliged to close in 1915 because of lack of water power[9].

Braithwaite Mines Ltd. was formed in 1916 to continue the operation, with a (coal-?) gas engine as power source[9]. Successful production was apparently maintained through World War I and up to 1922, when metals, particularly zinc, became unsaleable. This was reportedly due to long-term supply contracts signed during the war by the U.K. Government with overseas producers, which exceeded peacetime requirements[14]. During this period, the O level was commenced, but it missed the vein and was driven entirely in the hanging wall.

Total reported production of metals from 1848 to 1913, the only period for which figures are available, was 415 tons of lead concentrate and 750 tons of zinc concentrate, with silver running about 30 oz. per ton of pig lead[10]. Most of this came from the Nos. 1, 2, and 3 stopes[13], while the post-1913 production must have come from the Nos. 3 and 4 stopes only.

In 1929, M. Newbold & Partner[12] drove the High Force cross-cut and intersected a wide vein of barite[9], but no production resulted and the mine was dormant until 1939. At this time, Tampimex Oil Products Ltd. took it over, built an aerial ropeway from the High Force portal to the mill site, put up a new mill (the present structure), and produced, from 1940 to 1947, some 35,000 tons of barite[9]. This production came from the High Force level, the 5, 6, and 7 levels, and the 50 ft. and 80 ft. levels, which were reached by a winze from the High Force level. During the severe winter of 1947, the upper mine workings were inaccessible, and the winze became flooded, causing the operation to be abandoned[9].

In 1948, Laporte Chemicals Ltd. drove a long incline from the 3 level to just below the 80 ft. level, to drain it and to open up any barite which might be below it. However, a recession in the barite trade caused the operation to close down before production could commence[9].

In 1960, McKechnie Brothers Ltd. took up the mine, and recommenced production of barite from the upper levels, bringing it to the mill via the Laporte Incline, the 3 level, and truck[9]. The 650 ft., 900 ft., and 1100 ft. levels (the footages are distance up the incline), and the 100 ft. level (i.e. 100 ft. below the High Force level) were driven at this time, and the 3 level was driven to a point beneath the main barite stopes, but none of these developments brought any significant barite to light. The operation

was wound up in 1966 when McKechnie Brothers withdrew from the barium chemicals business, although there was still good barite in sight at the west end of the High Force level[9].

The history of the mine can be summarised in tabular form:

(A) 1848-50; 1858-63: lead mining probably unprofitable due to low grade (zinc not being sought at the time).

(B) 1867-78: barite mining on a modest scale.

(C) 1905-09: lead and zinc mining unsuccessful due to difficulty of effectively separating sphalerite from barite.

(D) 1912-22: lead and zinc mining successful and probably profitable following the introduction of flotation, terminated due to economic factors.

(E) 1940-47; 1960-66: profitable barite mining from upper levels, terminated for non-technical reasons.

Since 1967, Force Crag Mines Ltd. has carried out the following development: the 1 level was extended for 250 ft.; the 0 level was recommenced, was driven into the structure, and extended for 1,800 ft.; a raise was put in from the 0 to the 1 level; some underground diamond drilling was carried out, for which no written records seem to be available; a soil geochemical survey was conducted over the south-east side of the valley.

DESCRIPTION OF MINE

The accompanying plan and longitudinal section show the extent of the existing mine workings. At present, only the 0 and 1 levels are accessible. The portal to the 3 level is closed by a slide of loose rock on surface, and that to the 2 level is comletely collapsed. The No. 3 stope is filled with waste rock from the Laporte Incline.

Both the 0 and 1 levels are fitted with track on a 1'10" gauge, and with pipe. It is understood that considerable quantities of these could also be salvaged from the other levels.

The mill building, a solid structure of brick and stone on concrete foundations, appears to be in good repair and to need only minor attention to be usable. There is a two-roomed office which is also structurally sound, and a solid concrete magazine.

A 380 c.f.m. diesel compressor is on the site, and appears to be in good condition. The company is understood to own the following equipment, which is presently on hire to the fluorite mine of Swiss Aluminium Ltd.:

1 battery locomotive, with charger
6 1-ton mine cars
1 mucking machine
2 rock drills with hoses, steels, & sharpener

MINERALIZATION

The lead-zinc mineralization consists of irregular clusters and clots of massive or semi-massive sphalerite and strings of galena. Disseminated sulphides are present in the lower-grade material. Pyrite is minor, probably amounting to no more than 1%. The sulphides occur in slate, much of which has a breccia-like appearance, with tiny strings of quartz running through it. Black pyrolusite (MnO_2) is present in small quantities, and rare samples of stolzite ($PbWO_4$) have been reported[13]. It is relevant to note that the sphalerite is of a medium brown colour, and probably contains less than 5% of iron.

The lead-zinc mineralization occurs over widths up to 22 ft., as in the old No. 2 stope. In the No. 1 stope, where the back can be examined at the east end, two 4 ft. wide zones of high-grade zinc mineralization are separated by 20 ft. of essentially barren wall-rock.

It is the opinion of Mr. W.T. Shaw that the lead-zinc shoots have a slightly steeper dip than the structure in which they are found, and a more nearly east-west strike. If this is the case, then the shoots are terminated on reaching the walls of the structure, which explains the discontinuous nature of the mineralization. This "en echelon" arrangement appears to be borne out by an examination of the plans.

Veins of barite occur within the lead-zinc mineralization, but may also extend beyond it. The barite veins are clear-cut, with sharp, parallel walls, and are probably later than the sulphides. They vary usually from 3 to 12 inches in width, and may be several tens of feet long. The barite is of a fine white colour, and no difficulty is anticipated in marketing it in a possible mining operation.

Narrow and discontinuous veins of barite are observed along the outcrop of the structure above the 3 level, as far as the upper levels, where the vein system passes into sandstone. In this area, the barite is much more continuous and varies from 5 to 10 ft. in width[10].

An interesting theory of lithological control of mineralization has been put forward by Herriman[6], who recognised four sedimentary units in the mine area: Lower Shale, Upper Shale, Sandstone and Black Shale, in ascending order (the Lower and Upper Shales correspond to the thin-bedded flaggy shales and slates on fig. 5: the writer was not able to discern any signific-

ant variation in this unit. The other two units are the same as fig. 5). It was suggested that the Lower Shales and Sandstones were more competent than the Upper Shales and Black Shales. Refraction of the fracture (fig. 7a) caused wider opening in the competent units during late-stage movement on the structure, with consequent deposition of greater widths of mineralization. Since the traces of the lithological contacts on the Force Crag Structure plunge westwards at 30-40°, it follows that the zones of mineralization may rake in a similar manner (fig. 7b).

The writer would modify this hypothesis somewhat on the basis of observations from the 0 and 1 levels, which were not accessible to Herriman[6]. First, the barite veins appear to be later than the lead-zinc mineralization, which must have become sufficiently indurated to fracture at the time of barite deposition. Second, the sulphides appear to have been deposited as replacements or fracture fillings in a breccia-like zone, rather than in a simple fracture system. Third, a vertical zonation upwards from lead (-zinc) to barite is a common feature of the Lake District mineral veins[10].

These observations tend to lead towards the postulate that the termination of the lead-zinc mineralization close to the 3 level may be unrelated to the wall-rock lithology, and may take place against a front that is horizontal, or one that may rake at any angle, or indeed may be quite irregular. This postulate is illustrated in fig. 7c. Wall-rock control of barite deposition, from narrow veins in the shale/slate, to wide veins in the sandstone, to no veins in the black shale, seems reasonably established and is accepted as a working hypothesis.

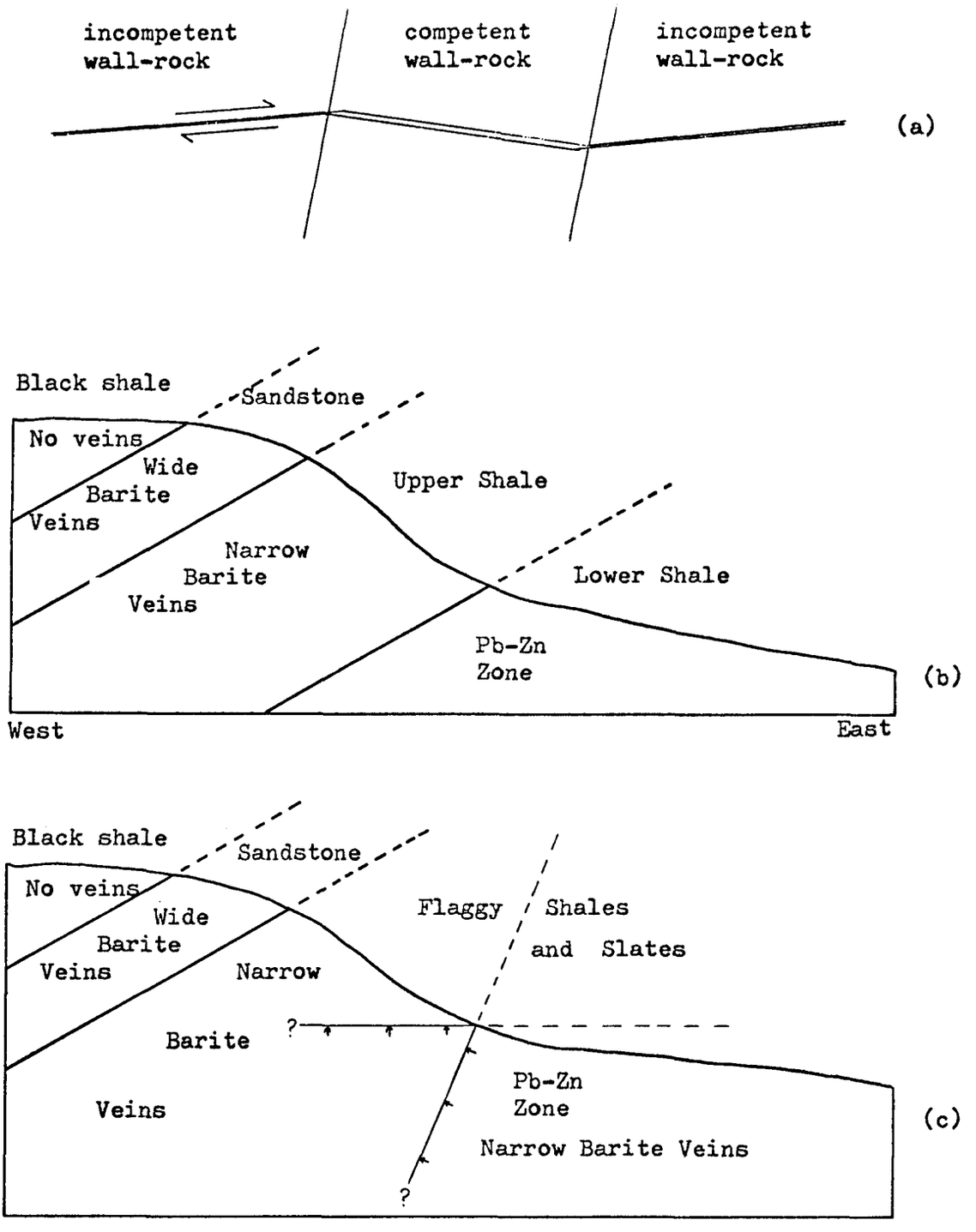


Fig. 7 (a) Illustration of refraction of a fracture in wall-rocks of varying competency. Wider openings occur in the more competent and brittle rock type.

(b) Schematic longitudinal section of the Force Crag Structure showing postulated control of mineral deposition by wall-rock lithologies, after Herriman. (Not to scale)

(c) Ditto, showing lithological control of barite veins only by wall-rock lithology. The earlier Pb-Zn mineralization has limits which may not be related to lithology.

SAMPLING

Sampling results from the 0 and 1 levels are presented in Appendix I. These data were supplied by the company, and are understood to have been based on samples taken in 1973 by a Mr. Graham, under the supervision of Mr. R.I. Gunn. The samples were stated to have been closely-spaced chip samples, usually taken across the full width of the drift.

The writer was able to verify visually that chip samples had been taken at several of the sample points. As a further check, ten duplicate samples were taken either at or close to previous sample sites. Assay results for these are also presented in Appendix I. Although individual sample results differ greatly from one set to the other, reflecting the extremely heterogeneous nature of the mineralization, arithmetic averages of all ten duplicates were as follows:

	% Zn	% Pb
Bowdidge -	6.78	2.25
Graham -	6.06	2.57

The writer thus feels a measure of confidence in using the previous sample data. The average seems to be free from bias, which is as much as one may ask of sampling in such heteregeneous material.

Barite contents were obtained by measuring the width of barite veins, rather than assaying. These data are also presented in Appendix I.

RESERVES

Tonnage calculations, based on sampling data, are given in Appendix I. A cut-off grade of 5% Pb+Zn was used, as cost estimates (Appendix II) show that this is likely to be the minimum grade that could be mined and milled at an operating profit in a 50 t.p.d. operation. On this basis, available

tonnages are estimated to be: (1) 0 level, block C, 104.12 long tons per vertical foot at 2.02% Pb, 9.35% Zn, 9.30% barite; (2) 1 level, block C, east of 2290E, 59.79 long tons per vertical foot at 1.29% Pb, 7.54% Zn, 2.09% barite. On the assumption that these tonnages persist for 50 ft. above and below their respective levels, and discounting material removed already, this gives a probable reserve of 16,391 long tons grading 1.75% Pb, 8.68% Zn, 6.68% barite.

In addition, the following tonnages of sub-cut-off mineralization are estimated: (3) 0 level, block A, over 2.5% Pb+Zn, 25.67 l.t.p.v.f. @ 1.97% Pb, 2.92% Zn, 10.58% barite; (4) 0 level, block B, over 2.5% Pb+Zn, 33.24 l.t.p.v.f. @ 1.78% Pb, 1.35% Zn, 16.64% barite; (5) 1 level, block C, west of 2290E, 92.00 l.t.p.v.f. @ 0.69% Pb, 2.25% Zn, 1.58% barite.

The dump near the portal of 0 level contains an estimated 2,000 tons of mineralized material, from the 0 level and the raise therefrom. Also, a further 2,000 tons are estimated to be available in already broken form in the No. 1 and No. 2 stopes, in the small stope between No. 3 and No. 4, and in the south cross-cut at 2800E on 1 level.

POSSIBILITIES FOR EXTENSION OF MINERALIZATION

(1) In most of the shoots sampled, especially on the 0 level, it is evident that the full width of the mineralization is not exposed by the drift. On the evidence from the No. 2 stope, it is possible that mineralization may exist over widths of up to 22 ft. or more. If such widths could be found on the 0 level, the available tonnage would be substantially increased.

(2) The "South Vein" shown on the plan is a mineralized zone exposed at two

points on the 0 level, and one point on the 1 level, although continuity has not been established between these locations. At two of these exposures it consists of a 1-2 ft. width with very weak galena and sphalerite, but in the "South Vein X-cut" where it has been followed for 25 ft. in a branch drift, one sample gave 1.4% Pb and 6.2% Zn over a 5.0 ft. width (Appendix I). This indicates a potentially interesting grade and width. It is concluded that in this and other parts of the mine, there is a distinct possibility of mineralized shoots parallel to the known zones, and perhaps not yet exposed by any working.

(3) Above block C on the 1 level, stoping was carried out on the 2 level in the past. There is thus a valid possibility that mineralization is continuous between the two levels, a vertical distance of 130 feet.

(4) Close to the west end of the 0 level drift weak mineralization is exposed in the north wall. A sample (Appendix I) assayed 3.1% Pb and 0.6% Zn. Since this point is below the No. 4 stope, it may well represent the tail end of this major shoot.

(5) There is a small stope between No. 3 and No. 4 stopes on the 1 level, in which a few hundred tons of broken mineralized material are lying, although the back is barren. This may represent the top of a small shoot extending below the level.

(6) The extension of the No. 3 stope below the 1 level has not been tested.

(7) It is assumed that the high-grade zinc mineralization in the No. 1 stope is continuous with block B on 0 level, and this raises the possibility of above-cut-off reserves in this area.

(8) There is the as yet untested possibility that mineralization continues substantially below the 0 level. In general, it is a characteristic of the metal mines of the Lake District that individual shoots have horizontal extents roughly equal to their vertical extents[10], and this is in some cases true for the zones as a whole. For instance, the lead-bearing vein at the Greenside Mine was mined over a length of 3,000 feet and a depth of 2,700 feet[10], exclusive of any levels which may have been removed by erosion. Lead-zinc mineralization at Force Crag is known over a length of at least 1,000 feet, but a vertical extent of only 350 feet above the 0 level. It is thus possible that similar mineralization may extend for some hundreds of feet below the 0 level.

(9) There is a potential strike length of 2,000 feet between the 0 level adit and the eastern limit of the property which is essentially unexplored. A soil geochemical survey was carried out over this area by the company, and a map showing the reported results is given in fig. 8. No report is available. No samples were taken downhill from the projected extension of the Force Crag Structure. One sample 50 ft. from the projected structure gave 11340 ppm Pb and 950 ppm Zn, but this was close to the stream and may have been contaminated by tailings.

(10) The possibility should not be overlooked of developing further reserves of barite in the High Force area. Allowing the postulated wall rock control of barite deposition, the zone of interest would be down the plunge of the sandstone/vein intersection. It is estimated that the sandstone contact is within 1100 ft. of the existing heading on the 3 level.

(11) The geochemical survey referred to above did outline one anomaly,

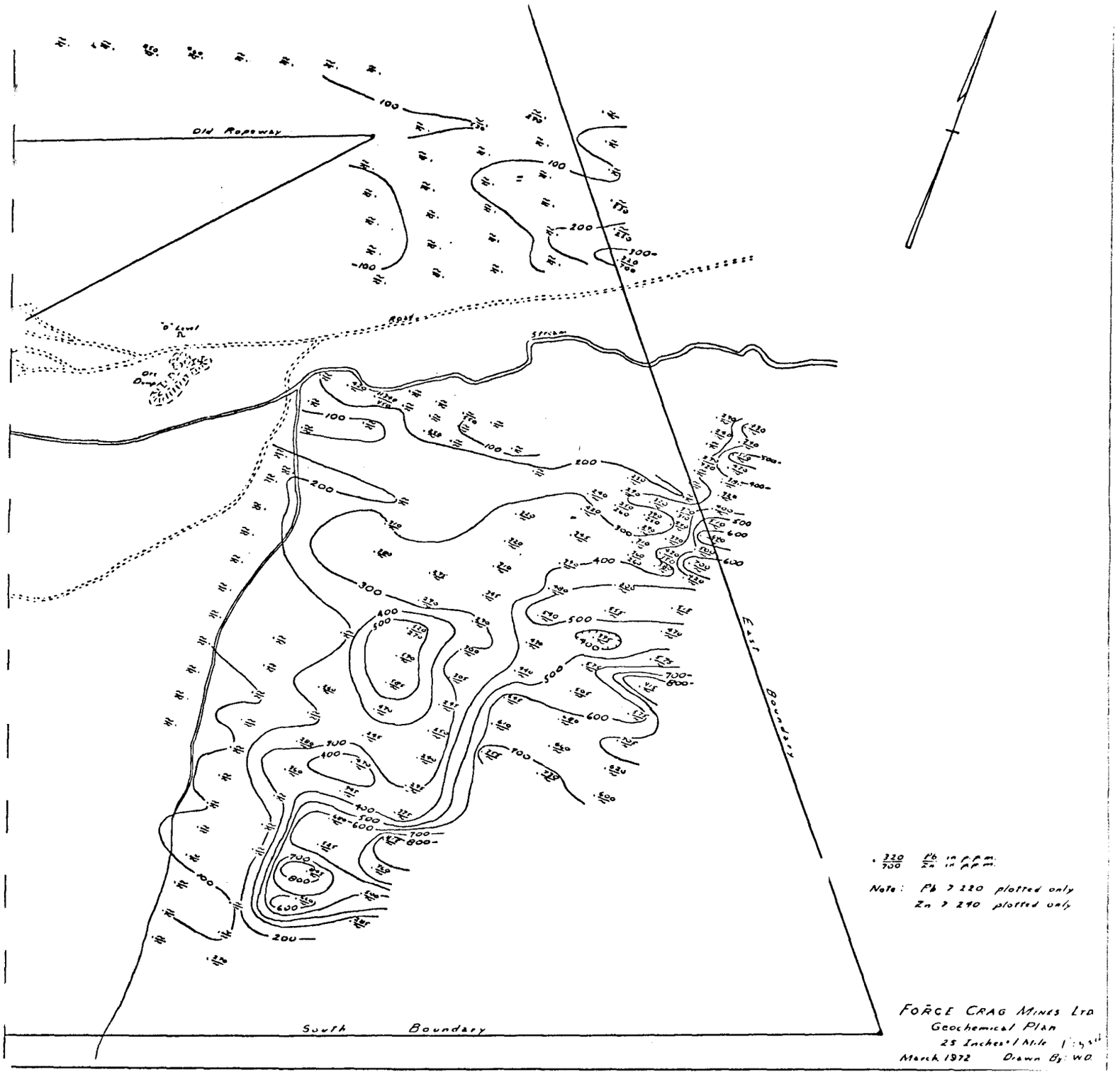


Fig. 8. Copy of plan showing results of soil geochemical survey. Scale has been reduced to approximately 1 inch = 470 feet.

extending some 2000 ft. in a NNE-SSW direction from the upper water of Braithwaite Beck to near the projected intersection of the Force Crag Structure and the property boundary. Only lead is anomalous - up to 915 ppm, against a background of 220 ppm. Somewhat uphill from this anomaly (off the present property) a vein known as the Long Comb Vein, which contained small amounts of cobalt-bearing arsenopyrite was the object of an abortive mining venture in the early 19th century[15]. The Geological Survey Map[8] indicates this vein, striking NNE, with its extrapolated extension crossing the south-east corner of the Force Crag property.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are indicated:

(1) The Force Crag Mine is situated in an area and a geological environment in which economic mineralization is widespread. Mining in the region has been a major industry in the past.

(2) The mine has been a producer of both lead-zinc and barite on a small scale in the past: its present dormant state cannot be attributed to exhaustion of reserves.

(3) Lead-zinc-silver-barite mineralization is present in three known shoots over a 1400 ft. strike length of the Force Crag Structure. Probable reserves are estimated as 16,000 long tons grading 1.75% Pb, 8.68% Zn and 6.68% barite.

(4) Known reserves are accessible from established levels and would require only small amounts of development to be mined, if sufficient additional reserves could be located to make this feasible.

(5) The lead-zinc deposit has the potential for extension along strike to the east, and down the dip from the existing levels. The possibility exists of developing additional reserves by testing the full width of mineralization and/or the discovery of yet unexposed shoots on the existing levels.

(6) The barite veins in the upper mine workings have the potential to extend down the plunge to the west. However, this area is not accessible from existing workings,

It is concluded that the Force Crag Mine warrants a systematic programme of exploration and development, and it is recommended that such a programme, directed at the area of lead-zinc mineralization, be initiated forthwith.

Economic Considerations

Preliminary calculations (Appendix II) suggest that a 50 t.p.d., 250 days per year operation, mining and milling a grade of 1.75% Pb, 8.68% Zn, and 6.68% barite, would yield an annual operating profit (after taxes) of about £50,000. Pre-production costs are likely to be from £100,000 to £150,000. In the light of these figures, a minimum of three years' reserve (37,500 tons) at a comparable grade would have to be in sight before any production decision is made.

It is estimated that a cost of £35,000 would be involved in developing each successive level at 100 ft. intervals below the 0 level, over and above the development allowed for in the production cost estimate. It is therefore suggested that a reasonable expectation of 18,000 tons of reserves per level (180 t.p.v.f.) should be possible to justify the development of new levels. This would give a development cost of £2 per ton or less.

Recommendations

Diamond drilling will, in general, be an unsatisfactory method for blocking out reserves. The heterogeneous nature of the lead-zinc mineralization, with clots of massive sulphide alternating with almost barren rock, and its occurrence in shoots of relatively small dimensions, would make closely-spaced drilling mandatory, with a consequent high cost per ton indicated. For this reason, diamond drilling should not be relied on too heavily. Rather, raising and drifting in mineralization should be the primary technique, with car sampling for grade estimation. This approach would also make any reserves more accessible, should production become feasible.

The following generalised programme is therefore proposed:

(I) To explore as fully as possible, all mineralization between the 0 and 2 levels by suitable raising, drifting, and cross-cutting, and by an extensive series of short, closely-spaced diamond drill holes into the walls of the drifts. The target should be to develop proven/probable reserves of at least 37,500 tons grading over 10% Pb+Zn above the 0 level. If achieved, this will (a) give a sufficient reserve for the minimum 3-year operation postulated above, and (b) allow, by inference, a reasonable expectation of about 20,000 tons per level for the down-dip extension of the zone, should this be demonstrable.

(II) If the above reaches its target, it is further recommended that a limited programme of contract diamond drilling be undertaken to test the downward extension of the zone at depths of 100 and 200 ft. below the 0 level. The object would not be to block out reserves, which would be very costly, but to establish the presence of mineralization, comparable with that known on the 0 and 1 levels, at these depths. It

would then be possible to infer similar tonnages to those established on the existing levels.

(III) If both of the above campaigns achieve their respective objects, it would then be possible to undertake a detailed feasibility study in the light of the prevailing economic conditions, and to make a production decision accordingly.

In order to explore the possible eastward extension of the zone, an I.P. survey is recommended. The small proportion of conductive sulphides (0.8% galena and 1% pyrite by volume), and the absence of any magnetic minerals, makes this approach essential. This survey should be included in Stage I, with provision for surface diamond drilling in Stage II, to test any anomalies that may be found.

An extension of the soil geochemical survey over the south-east corner of the property, to cover the probable extension of the Long Comb Vein, should be included in Stage I.

A modest amount of underground diamond drilling to test the "South Vein" properly belongs in Stage I, but it will be cheaper if included with the larger contract envisaged for Stage II.

Details of the proposed programme are as follows:

Stage I

(a) Rehabilitation of 0 and 1 levels: This will entail cleaning up a number of rock falls, scaling of loose material, minor repairs to timbering, repairs to track and pipe near the portals, and replacement of sections of ventilation tubing. Mobilization is also included here.

(b) Short diamond drilling programme: It is envisaged that this will be done by mine staff using a "Bazooka" drill, manufactured by Boyles Brothers Ltd. This is a small machine which can be operated in a 5 ft. drift. The proposed programme consists of 25 ft. long horizontal holes into both walls of the drifts on 0 and 1 levels, at 50 ft. intervals. A list of the proposed holes is given in Appendix III. They total 2215 ft., and allowance has been made for a 40% increase in this figure to allow for in-fill drilling and/or lengthening of holes in areas of interest. The drill will have to be purchased: operating costs are estimated at £2 per foot.

(c) Raise from 1 to 2 level: This is proposed as a 50° raise with a reversal at 65 ft. above 1 level. A 150 ft. long sub-level drift is allowed for to test the ground above the No. 2 stope, the back of which is partly inaccessible at present.

(d) Raising from 0 to 1 level: Four raises are proposed: from the mineralization at the west end of 0 level up to the No. 4 stope (this will incidentally establish a natural ventilation system for both levels); below the No. 3 stope, to test its downward extension; in the western part of block C to further test its continuity; and from block B to the No. 1 stope, to establish continuity between these two mineralized locations.

(e) I.P. Survey: The extrapolated zone should be covered by nine lines, at 200 ft. spacings, each line to be 2000 ft. long. A time-domain survey is envisaged, using pole-dipole configuration with a = 100 ft., n = 1,2,3. Fif. 9 shows the proposed grid.

(f) Soil Geochemical Survey: This would entail approximately 1.5 line miles, or 75 samples. The proposed grid is also shown in fig. 9.

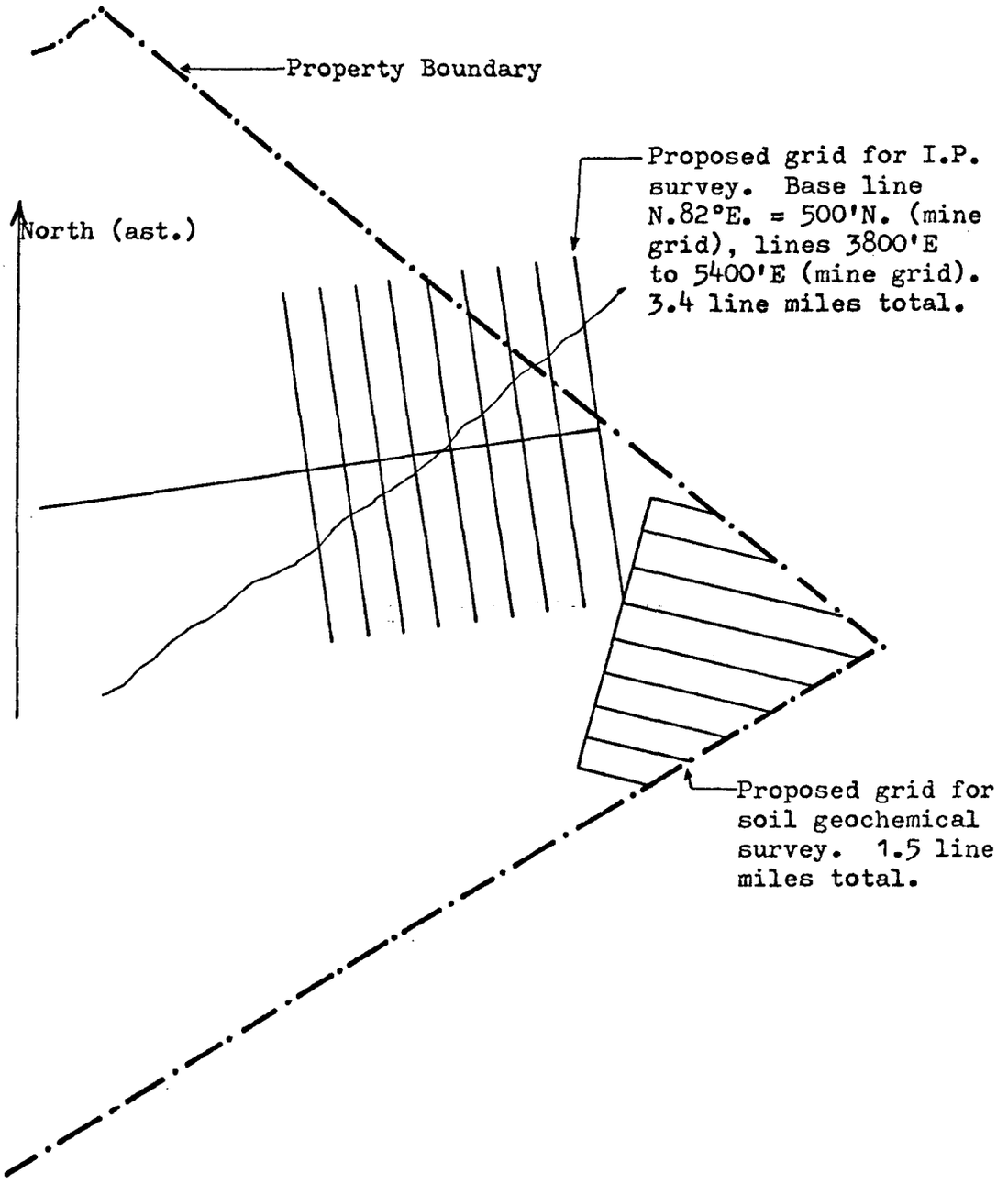


Fig. 9. Plan of eastern part of property, showing proposed grids for I.P. and soil geochemical surveys.
Scale: 1 inch = 1000 feet.

Stage II

(a) Underground Diamond Drilling: A 150 ft. cross-cut to the north should be established on the 0 level, as shown on the plan in Appendix III, and the existing north cross-cut on the 1 level at 1830E should be lengthened by 50 ft. Provision is made for slashing out of drill stations. Two fans of inclined drill holes are proposed to test the projected extension of the zone at depths of 100 and 200 ft. below the 0 level at 100 ft. intervals from 1750E to 2350E. Also three horizontal holes are proposed to test the "South Vein" on 0 level from 2750E to 2950E.

(b) Surface Diamond Drilling: 2,000 ft. is allowed for, but the magnitude and details of the programme are entirely contingent on the results of the I.P. survey.

Cost of the Programme

The following estimated costs are based on verbal quotes from Boyles Brothers Ltd. for diamond drilling, and from Hunting Surveys Ltd. for an I.P. survey, and on costs supplied by the staff of Force Crag Mines (U.K.) Ltd., for development work.

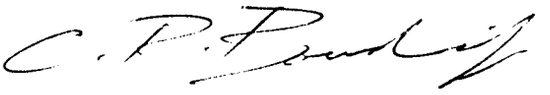
STAGE I

(a) Rehabilitation of 0 and 1 levels		£4,000
(b) Short diamond drilling programme		
2215 + 40% = 3100 ft @ £2/ft.	£6,200	
Purchase of drill	£3,000	
	£9,200	£9,200
(c) Raising from 1 to 2 level		
Raising, 170 ft. @ £25/ft.	£4,250	
Sub-level drift, 150 ft. @ £30/ft.	£4,500	
X-cuts & slashes	£1,000	
	£9,750	£9,750
		c/f £22,950

		b/f £22,950	
(d) Raising from 0 to 1 level			
Below No. 4 stope, 120 ft @ £25/ft.	£3,000		
Below No. 3 stope, 90 ft @ £25/ft.	£2,250		
At W end block C, 90 ft @ £25/ft.	£2,250		
Below No. 1 stope, 120 ft @ £25/ft.	£3,000		
X-cut & slashes	£1,000		
	£11,500	£11,500	
(e) I.P. Survey			
Mobilization	£ 600		
6 days @ £200/day	£1,200		
2 days standby @ £150/day	£ 300		
Supervision	£ 600		
	£2,700	£2,700	
(f) Geochemical Survey	£ 300	£ 300	
Sampling, assays		£3,000	
Supervision, consulting		£3,500	
Total - Stage I		£43,950	$70,320
STAGE II			
(a) Underground Diamond Drilling:			
X-cutting, 200 ft @ £30/ft.	£6,000		
Drill stations	£1,000		
4790 ft. d.d. @ £4/ft.	£19,160		
	£26,160	£26,160	
(b) Surface Diamond Drilling:			
2000 ft. @ £8/ft.	£16,000	£16,000	
Assaying		£ 500	
Supervision, consulting		£3,000	
Total - Stage II		£45,660	$73,056
Grand Total - Stages I and II		£89,610	$143,376
Contingencies, 5%			$ 6,624
Total Budget Required			$150,000

It is emphasised that the programme should be flexible, to take account of any favourable indications of mineralization that may be located as the work progresses.

Respectfully submitted,



C. R. Bowdidge, M.A., Ph.D., F.G.A.C.

October 25th, 1976.

REFERENCES

(1) British Regional Geology, Northern England, by T. Eastwood, H.M.S.O., 1963.

(2) The Stratigraphy and Tectonics of the Skiddaw Slates in Part of the Lake District, by A. Simpson. Geol. Journ. 5, 391-418, 1967.

(3) Geological Survey (England & Wales), 1" = 4 miles map, sheet 3.

(4) Mem. Geol. Surv., The Geology of the Northern Part of the English Lake District, by J.C. Ward, 1876.

(5) Mem. Geol. Surv., The Geology of the Country Around Cockermouth, by T. Eastwood, S.E. Hollingworth, W.C.C. Rose & F.M. Trotter, 1968.

(6) Geology of the Force Crag Mine, Cumberland, by N. Herriman, unpubl. B.Sc. Thesis, Royal School of Mines, 1964.

(7) Geology and Near-Term Mining Potential of the Force Crag Mine, Cumbria, unpubl. report, B.L. Hodge & Partners, 1975.

(8) Geol. Surv. (England & Wales), 6" = 1 mile map, Cumberland sheet 63.

(9) Mining in the Lake Counties, by W.T. Shaw, Dalesman Books, 1975.

(10) The Lake District Mining Field, by T. Eastwood, in The Future of Non-Ferrous Mining in Great Britain and Ireland, a symposium, pp 149-174, Inst. Min. Met., London, 1959.

(11) Mem. Geol. Surv., Special Reports on the Mineral Resources of Great Britain, Vol XXII, The Lead and Zinc Ores of the Lake District, by T. Eastwood, 1921.

(12) Compilation of data from official U.K. Government Sources, by. G.W. Hall.

(13) Mines and Mining in the Lake District, by J. Postlethwaite, Whitehaven, 1913.

(14) G. Hall, pers. comm.

(15) W.T. Shaw, pers. comm.

C E R T I F I C A T E

I, COLIN RICHARD BOWDIDGE, do hereby certify as follows:

(1) THAT I am a Mining and Exploration Geologist and reside at 442, Wellesley Street East, in the City of Toronto, Province of Ontario.

(2) THAT I am a Graduate of the University of Cambridge, with the degree of Master of Arts in Geology and Mineralogy, 1965, and a Graduate of the University of Edinburgh, with the degree of Doctor of Philosophy in Geology, 1969.

(3) THAT I have been practising my profession continuously since 1969.

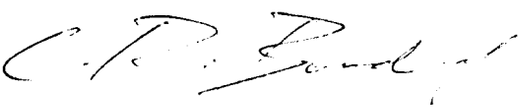
(4) THAT I am a Fellow of the Geological Association of Canada.

(5) THAT my Report, dated October 25th, 1976, and titled "Report on the Force Crag Mine, Cumbria, England" is based upon a personal examination of the Force Crag property, and is based on my own observations, except where otherwise indicated in the text.

(6) THAT I have no personal interest, direct or indirect, in the property or securities of New Force Crag Mines Ltd., nor do I expect to receive such an interest in the future.

C. R. Bowdidge, M.A., Ph.D.

Dated at Toronto, Ontario,
This 25th day of October, 1976



APPENDIX I

SAMPLING RESULTS AND TONNAGE CALCULATIONS

As stated above, sampling data from a 1973 programme were supplied by the company. Ten of the sample sites were re-sampled by the writer (assay certificates appended), with the following comparison (a = Bowdidge, b = Graham)

Sample nos.		% Pb		% Zn	
(1)	(2)	(1)	(2)	(1)	(2)
FC3	66	11.7	3.2	0.31	1.1
FC4	64	1.79	1.5	4.32	7.6
FC5	42	0.29	1.4	1.98	2.1
FC6	40	1.55	7.4	7.74	10.6
FC7	34	1.70	5.1	11.8	11.1
FC8	24	1.08	1.7	11.9	14.0
FC9	140	1.67	0.8	8.03	5.7
FC10	131	1.39	1.7	10.8	3.9
FC11	114	0.40	1.4	3.88	2.3
FC12	120	0.89	1.5	7.06	2.2
Averages		2.25	2.57	6.78	6.06

It is concluded that these comparisons, although they reveal the heterogeneity of the mineralization, and the inadequacy of chip sampling for grade estimation in this type of deposit, do not show any systematic bias.

Three samples were assayed for silver: FC3 gave 1.94 oz/ton, FC4 gave 0.28 oz/ton, and FC11 gave trace. These results indicate a lower silver content than expected on the basis of the old reports of 30 ounces per ton of pig lead, cited above. They correspond to 18.6, 17.5, and less than 2.8 ounces per long ton of lead, respectively, assuming that all the silver is in galena.

A spectrographic analysis for trace elements, on sample FC7. Cadmium, gallium, and germanium showed up in small quantities; these elements are normally associated with sphalerite. No unexpected elements were detected.

Sampling results are tabulated below, and plans showing the sample locations are given in fig. 10. The length given to each sample is the strike length allowed to it for calculating the tonnage, which is given in long tons per vertical foot in a separate column. A calculated average density of 12 cubic feet per long ton was used. Barite contents were derived by measuring the width of barite veins. The barite width as a proportion of the sample width gave a volume percentage, which was increased by a factor of 1.5 to give a weight percentage.

BLOCK "A", O LEVEL

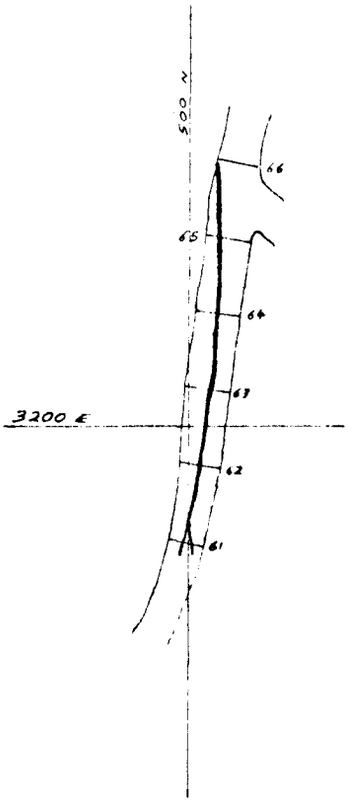
Sample no.	ft W of ref. pt.	length ft.	width ft.	% Pb	% Zn	Barite width	Barite wt %	t.p.v.f.
66	0	5	5.5	3.2	1.1	6"	13.8	2.29
65	10	10	6.0	1.5	2.6	6"	12.4	5.00
64	20	10	6.7	1.5	7.6	9"	16.9	5.58
63	30	10	6.0	2.5	0.5	6"	12.4	5.00
62	40	10	6.0	2.4	2.4	1"	2.1	5.00
61	50	5	5.0	1.0	1.2	2"	5.0	2.08
				1.97	2.92		10.58	25.67

BLOCK "B", O LEVEL

58	0		6.5	0.1	0.1	6"		
57	10		5.5	0.3	0.1	6"		
56	20		5.0	0.3	0.1	2"		
55	30		5.0	0.4	0.1			
54	40		6.0	0.2	0.3			
53	50		6.5	0.8	0.4	6"		
52	60		6.5	0.4	0.2	6"		
51	70		7.3	1.4	0.6	4"		
50	80		6.0	0.1	0.6	4"		
49	90		5.7	1.1	0.6	6"		
48	100	10	6.5	1.5	1.3	9"	17.2	5.42
47	110	10	6.7	1.9	1.8	9"	17.0	5.58
46	120	10	5.5	1.1	1.6	12"	27.3	4.58
45	130	10	6.0	0.9	0.3	12"	25.1	5.00
44	140	10	5.5	3.7	1.0	6"	13.6	4.58
43	150	10	5.2	2.0	1.5	3"	7.2	4.33
42	160	10	4.5	1.4	2.1	2"	5.6	3.75
41	170		6.7	0.1	0.1	9"		
				1.78	1.35		11.09	33.24

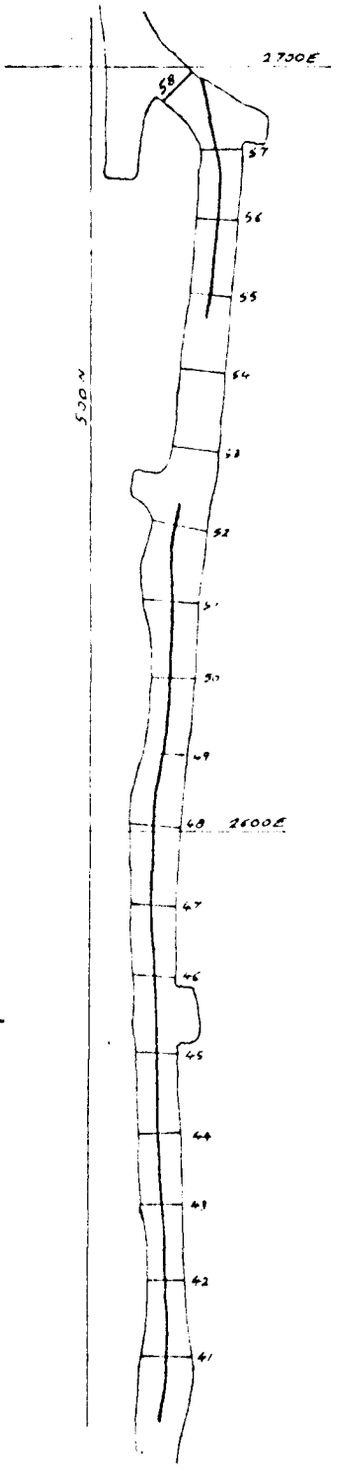
Sample no.	ft W of ref. pt.	length ft.	width ft.	% Pb	% Zn	Barite width	Barite wt %	t.p.v.f.
BLOCK "C", O LEVEL								
40	20	5	11.5	7.4	10.6			4.79
39	30	10	5.5	4.8	4.9			4.58
38	30		wall	3.7	8.2			
37	40	10	4.5	2.6	3.7	6"	16.6	3.75
36	50	10	4.0	6.0	10.0	4"	12.5	3.33
35	60	10	5.0	2.8	7.7	4"	10.0	4.17
34	70	10	10.0	5.1	11.1			8.33
33	70		wall	3.1	13.1			
32	80	10	8.0	1.9	10.7	6"	9.5	6.67
31	90	10	4.5	0.4	6.6	4"	11.1	3.75
30	100	15	5.0	0.8	5.0	6"	15.0	6.25
14*	120	20	4.0	0.1	5.1	3"	9.4	6.67
29	140	15	5.5	0.3	4.3	3"	6.8	6.88
28	150	10	5.5	0.2	1.6	3"	6.8	4.58
27	160	10	5.5	0.7	9.1	3"	6.8	4.58
26	160		wall	0.3	0.7			
25	170	10	6.0	2.6	19.1	3"	6.3	5.00
24	180	10	8.5	1.7	14.0	3"	4.3	7.08
23	180		wall	0.7	3.5			
22	190	10	5.0	0.6	21.0	3"	7.5	4.17
21	200	10	6.0	1.4	16.5	3"	6.3	5.00
20	210	10	7.7	0.3	8.0	15"	24.3	6.42
19	220	10	7.0	1.6	11.2	15"	26.8	5.83
18	230	5	5.5	0.2	3.2	3"	6.7	2.29
				2.02	9.35		6.20	104.12
BLOCK "C", 1 LEVEL & No. 2 STOPE								
4	0	10	7.0	1.6	8.8	3"	5.4	5.83
5	10	10	10.0	0.4	15.4	3"	3.7	8.33
6	20	10	9.5	2.3	5.7	3"	3.9	7.92
10	20	10	6.5	0.1	3.0			5.42
8	30	10	10.0	2.6	5.1	3"	3.8	8.33
7	30		wall	0.1	0.2			
9	25	7.5	6.0	1.6	4.2			3.75
2	37.5	17.5	6.0	0.3	9.7			8.75
140	60	15	5.5	0.8	5.7			6.88
139	70	10	5.5	2.2	6.0			4.58
				1.29	7.54		1.39	59.79
RAISE, O LEVEL TO 1 LEVEL								
14	23(el.)		4.0	0.1	5.1	3"		
15	23		1.0	0.1	1.6	2"		
16	23		4.0	0.5	4.5			
13	43		5.5	0.7	12.2	12"		
12	66		4.7	0.7	6.5			
O LEVEL, SOUTH VEIN								
60	15		5.0	0.7	0.2			
59	25		5.0	1.4	6.2			
O LEVEL, WEST END, NORTH WALL								
17			wall	3.1	0.6			

Sample no.	ft W of ref. pt.	length ft.	width ft.	% Pb	% Zn	Barite width	Barite wt %	t.p.v.f.
BLOCK "C", 1 LEVEL								
138	30	10	6.0	1.2	3.5			5.00
137	40	10	6.0	0.3	0.7			5.00
136	50	10	7.0	0.3	1.4			5.83
135	60	10	4.0	0.4	1.9	8"	25.1	3.33
134	70	10	5.0	0.1	2.2			4.17
133	80	10	7.0	0.2	0.2			5.83
132	90	10	7.5	1.9	3.1			6.25
131	100	10	5.5	1.7	3.9			4.58
130	110	10	4.5	0.4	2.8			3.75
129	120	10	4.7	0.1	0.7			3.92
128	130	10	5.6	0.7	4.0			4.67
127	140	10	5.2	0.4	2.0			4.33
123	150		4.0	0.1	0.1			
124	150		4.0	0.1	0.1			
125	150	5	4.0	0.3	6.0			1.67
SOUTH BRANCH								
114	10	10	6.5	1.4	2.3			5.42
115	20	10	6.5	0.3	1.7			5.42
116	30	10	7.0	0.4	3.2	6"	10.6	5.83
117	40	10	8.2	0.4	1.9			6.83
118	50	10	6.0	0.5	1.8			5.00
120	60	10	6.2	1.5	2.2			5.17
119	70		7.0	0.5	0.2			
122	80		4.7	0.1	0.9			
126	90		10.2	0.1	0.5			
				0.69	2.25		1.05	92.00
No. 1 STOPE, EAST END								
FC1			4.0	0.18	16.9			
-			20.0					
FC2			4.0	0.06	22.6			

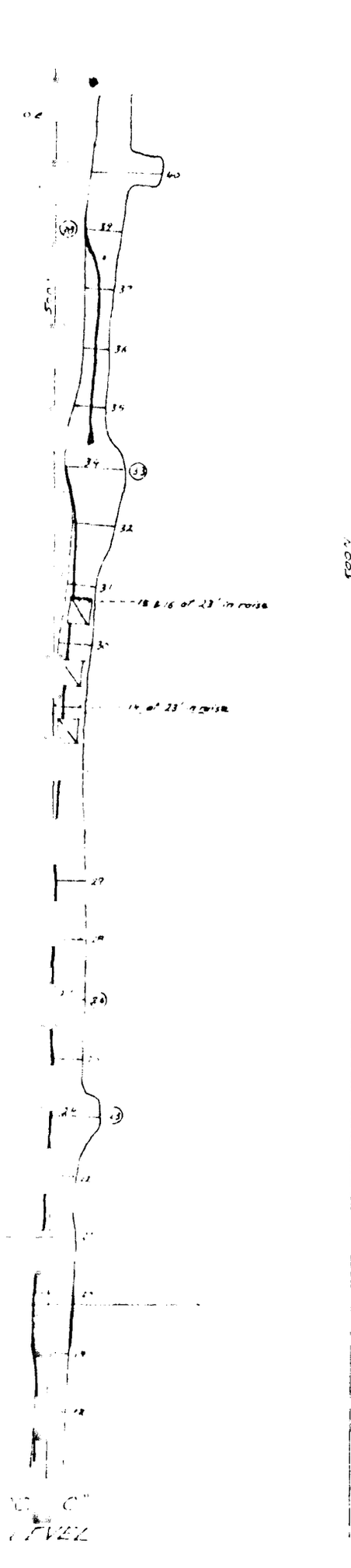


BLOCK "A"
O LEVEL

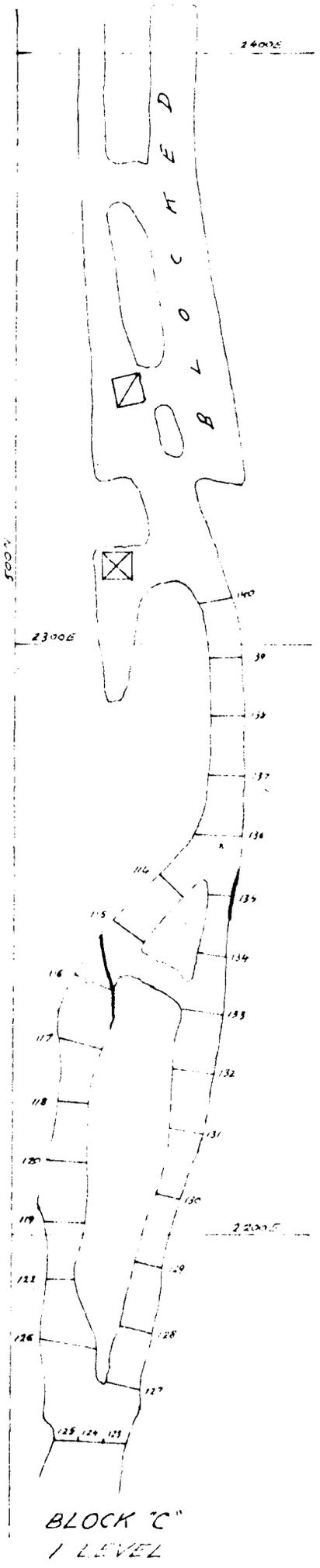
BLOCK "B"
O LEVEL



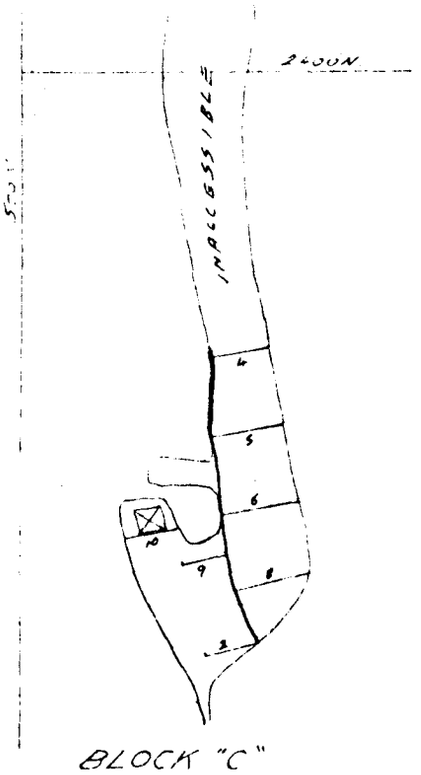
Mine North



"C"
LEVEL



BLOCK "C"
1 LEVEL



BLOCK "C"
No. 2 STOPE
25 ft. above 1 level

LEGEND

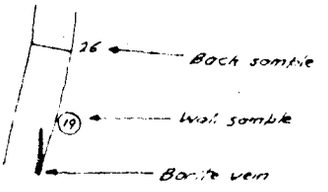


FIG. 10 : FORCE CRAG MINE
SAMPLING PLANS
0 AND 1 LEVELS

SCALE: 1 inch to 25 feet

LIMITED

45 LESMILL ROAD DON MILLS ONTARIO M3B 2T8 445-5755

Certificate of Analysis

NO. 590 PAGE 1 of 1

TO. C.R. Bowdidge,
442 Wellesley St. E.,
TORONTO, Ontario.
M4X 1H7

RECEIVED Oct. 13, 1976 INVOICE NO. 590

SAMPLE(S) OF 12 rocks SUBMITTED TO US SHOW RESULTS AS FOLLOWS:

Sample	%Zn	%Pb
FC- 1	16.9	0.18
2	22.6	0.06
3	0.31	11.7
4	4.32	1.79
5	1.98	0.29
6	7.74	1.55
7	11.8	1.70
8	11.9	1.08
9	8.03	1.67
10	10.8	1.39
11	3.88	0.40
FC-12	7.06	0.89

X-RAY ASSAY LABORATORIES LIMITED

DATE Oct. 15, 1976 CERTIFIED BY A. Hewson

LIMITED

45 LESMILL ROAD DON MILLS ONTARIO M3B 2T8 445-5755

Certificate of Analysis

NO. 612 PAGE 1 of 2

TO. C.R. Bowdidge,
442 Wellesley St. E.,
TORONTO, Ontario.
M4X 1H7

RECEIVED Oct. 15,1976 INVOICE NO. 612

SAMPLE(S) OF 4 pulps on hand SUBMITTED TO US SHOW RESULTS AS FOLLOWS:

Sample	Ag oz./ton
FC-3	1.94
FC-4	0.28
FC-11	Trace

X-RAY ASSAY LABORATORIES LIMITED

DATE Oct. 20, 1976 CERTIFIED BY

LIMITED

45 LESMILL ROAD DON MILLS ONTARIO 445-5755

Certificate of Analysis

NO. 612 Page 2 of 2

TO. C.R. Bowdidge

RECEIVED INVOICE NO.

SAMPLE(S) OF SUBMITTED TO US SHOW RESULTS AS FOLLOWS:

Element	Sens*	Concentration FC-7	Element	Sens*	Concentration FC-7
Antimony	(4)	ND	Manganese	(1)	LM
Arsenic	(4)	ND	Mercury	(4)	ND
Beryllium	(2)	ND	Molybdenum	(3)	FT
Bismuth	(2)	ND	Nickel	(1)	FT
Cadmium	(4)	TL	Silver	(1)	FT
Cerium	(5)	ND	Tantalum	(5)	ND
Columbium	(4)	ND	Thorium	(3)	ND
Chromium	(4)	ND	Tin	(2)	FT
Cobalt	(3)	ND	Titanium	(2)	T
Copper	(1)	T	Tungsten	(4)	ND
Gallium	(2)	FT	Uranium	(3)	ND
Germanium	(1)	FT	Vanadium	(2)	FT
Iron	(2)	LM	Yttrium	(3)	ND
Lead	(2)	L	Zinc	(4)	M
Lithium	(4)	ND	Zirconium	(4)	ND

LEGEND

Key To Symbols

H - 10% plus	L - 0.1-1%
MH - 5-15%	TL - 0.05-0.5%
M - 1-10%	T - 0.01-0.1%
LM - 0.5-5%	FT - 0.01% or less
	ND - Not detected

*Sensitivity (limit of detection)

1-	0.0005-0.001%
2-	0.001-0.005%
3-	0.005- 0.01%
4-	0.01 - 0.05%
5-	0.05 - 0.1%

Note: Better sensitivities can be obtained with special techniques, if and when required.

X-RAY ASSAY LABORATORIES LIMITED

CERTIFIED BY D Vinson

DATE Oct. 20, 1976

APPENDIX II

PRELIMINARY STUDY OF ECONOMICS

This appendix is a preliminary study of the economic aspects of a small-scale mining and milling operation at Force Crag, undertaken with a view to estimating the tonnage and grade of reserves that would be required to support such an operation. The costs used here are based entirely upon second hand information. and have not been substantiated by the writer.

It is assumed that both mining and milling would go on at the rate of 50 tons per shift, one shift per day, 5 days per week, 50 weeks per year. This approach is assumed because, although it has some obvious disadvantages, it would allow for an increase in production rate to 100 or 150 tons per day by the simple expedient of adding second and third shifts.

Mining would be by conventional methods: shrinkage stoping with haulage in 1-ton mine cars by battery locomotive. The existing levels are already set up for this type of operation, and local labour is familiar with the techniques. An underground staff of nine men is assumed.

Power would be supplied by a diesel generator, with air from a diesel compressor. A surface staff of six men to operate the mill, power plant, etc. is assumed.

Operating costs have been estimated by assuming wages of £100 per week per man, and adding an equal amount for material and supplies. A somewhat lower figure was derived by Mr. Gunn using an itemised breakdown of costs, but the high estimate is used here.

It is assumed that a single flotation concentrate of lead and zinc sulphides would be made, for shipment to the Imperial Smelter of Rio Tinto-Zinc Corp. at Avonmouth, and that barite would be concentrated by Wilfley Tables. The 80% recoveries used in the calculations are probably low in the light of the coarse grain size and simple mineralogy.

Prices of £400 per metric ton for zinc and £270 per metric ton for lead are based on current L.M.E. quotes. A figure of £130 per ton of metal to cover freight and smelter charges is used; this may be pessimistic. Detailed smelter schedules have not been obtained. Silver and cadmium would probably be paid by a smelter, possibly adding 5% or more to the net revenue, but this has not been accounted for. A price of £60 per ton for barite was quoted unofficially to the writer, but this is rather higher than the current U.S. price of $60-80 per short ton for ground barite of drilling mud grade in 50 lb. bags, which is equivalent to £42-56 per long ton. A price of £30 per ton, f.o.b. mine, for table concentrates, is assumed.

Mill head grade is taken as the average cited above for Block "C", i.e. 1.75% Pb, 8.68% Zn, 6.68% barite, with no allowance for dilution.

PRE-PRODUCTION COSTS:

Mill		
Feeder & motor	£ 400	
Cone crusher & motor	1,000	
Jaw crusher & motor	1,000	
Screen	400	
Ball mill, 6x8, & motor	10,000	
8 flotation cells*	10,000	
3 tables	3,000	
pipes*	1,000	
launders*	300	
pumps (2 slurry & 2 water)*	1,200	
wiring*	1,000	
Mill equipment total	£29,500	
Repairs to building	5,000	
Installation, labour	20,000	
Mill total	£54,500	£54,500
Other Surface Facilities		
Compressor, 600 c.f.m.	£ 6,000	
Generator, 300 kVA	12,000	
Front-end loader	5,000	
Assay equipment*	6,000	
Workshop equipment & tools(*)	3,000	
Repairs to office	1,000	
Office equipment	1,000	
Repairs to other buildings	2,000	
	£38,000	£38,000
Underground Equipment		
2nd locomotive	£ 2,000	
2nd mucker	500	
Drills*	2,000	
	£ 4,500	£ 4,500
Stope Preparation		
(Estimated)	£10,000	£10,000
		£107,000
Contingencies, 50%		53,500
PRE-PRODUCTION TOTAL		£160,500

OPERATING COSTS

Staff (2 production miners, 2 development miners, 1 timberman, 1 shift boss, 1 u/g labourer, 2 trammers, 1 mechanic, 1 fitter, 1 loader operator, 1 mill superintendent/assayer, 2 mill hands, 1 manager/engineer).

16 men @ £100 p.w. wages	£ 1,600 p.w.
supplies and materials	1,600 p.w.
ESTIMATED OPERATING COST	£ 3,200 p.w.

REVENUE

Estimated weekly revenue:

Lead: 250 tons x 1.75% Pb x 80% recovery = 3.50 tons @ £270/ton	£ 945.00 p.w.		
Zinc: 250 tons x 8.68% Zn x 80% recovery = 17.36 tons @ £400/ton	£ 6,944.00 p.w.		
Gross metal prices	£ 7,889.00 p.w.		
Less smelter charges, 20.86 tons @ £130/ton	2,711.80 p.w.		
Net metal prices	£ 5,177.20 p.w.		
Less royalty at 3.33%	172.57 p.w.		
Net weekly metal revenue	£ 5,004.63	£ 5,004.63 p.w.	
Barite: 250 tons x 6.68% barite x 80% recovery = 13.36 tons @ £30/ton f.o.b.	£ 400.80 p.w.		
Less royalty at £0.12½/ton	£ 1.67 p.w.		
Net weekly barite revenue	£ 399.13	£ 399.13 p.w.	
Net weekly revenue		£ 5,403.76 p.w.	
Less operating costs		£ 3,200.00 p.w.	
Net weekly operating profit		£ 2,203.76 p.w.	

Net annual operating profit	£110,188		
Less depreciation (say £50,000 @ 20% p.a.)	£ 10,000		
Net annual profit (taken as)	£100,188 £100,000	£100,000	
Less taxes @ 50%		£ 50,000	
Annual profit after taxes, before recovery of investment		£ 50,000	($80,000)

APPENDIX III

PROPOSED DEVELOPMENT PROGRAMME

The following tables give details of the proposed diamond drilling programme, and the accompanying plan and longitudinal section show graphically the diamond drilling and the proposed raises, drifts, and cross-cuts.

SHORT DIAMOND DRILL PROGRAMME

	East co-ord.	South ddh ft.	North ddh ft.	
0 LEVEL	1810E	25	25	
	1850E	25	25	(1860E North Branch)
	1900E	25	25	
	1950E	25	25	
	2000E	25	25	
	2050E	25	25	
	2100E	25	25	
	2150E	25	-	
	2200E	25	25	
	2250E	25	25	
	2300E	25	25	
	2350E	25	25	
	2400E	25	25	
	2450E	25	25	
	2500E	25	25	
	2550E	25	25	
	2600E	25	25	
	2650E	25	25	
	2700E	25	25	
	2750E	-	25	
	2800E	-	25	
	2850E	25	25	
	2900E	25	25	
	2950E	25	25	
	3000E	-	25	
	3050E	75	25	
	3100E	65	25	
	3150E	50	25	
	3200E	25	25	
	3250E	-	25	

SHORT DIAMOND DRILL PROGRAMME (CONTD.)

	East co-ord.	South ddh ft.	North ddh ft.	
1 LEVEL	1750E	25	25	
	1800E	-	25	
	1900E	25	25	
	1950E	25	25	
	2000E	25	25	
	2050E	25	25	
	2100E	-	25	
	2150E	25	25	(2160E, south X-cut)
	2200E	25	25	
	2250E	25	25	
	2300E	25	25	
	2400E	-	25	
	2450E	25	25	
	2500E	25	-	
	2550E	25	-	
	2700E	-	25	
	2750E	25	25	
	Total short ddh's, 2215 ft.			

CONTRACT DIAMOND DRILL PROGRAMME (STAGE II)

DDH No.	Target Depth	Target E coord.	Collar Lev.	Collar Co-ordinates	Azim. (Mine)	Incl.	Depth
1	750' OD	1750E	1	1810E, 695N	210°	-57°	285'
2	"	1850E	1	" "	166°	-56°	285'
3	"	1950E	1	" "	139°	-44°	335'
4	650' OD	1750E	1	" "	218°	-70°	405'
5	"	1850E	1	" "	159°	-72°	415'
6	"	1950E	1	" "	132°	-59°	435'
7	750' OD	2050E	0	2170E, 665N	224°	-30°	230'
8	"	2150E	0	2170E, 580N	201°	-63°	180'
9	"	2250E	0	2170E, 665N	147°	-34°	220'
10	"	2350E	0	" "	126°	-24°	300'
11	650' OD	2050E	0	" "	233°	-53°	335'
12	"	2150E	0	" "	190°	-63°	300'
13	"	2250E	0	" "	133°	-57°	310'
14	"	2350E	0	" "	121°	-44°	360'
15	S. Vn.	2750E	0	2770E, 480N	193°	horiz	120'
16	" "	2850E	0	" "	142°	"	150'
17	" "	2950E	0	2950E, 480N	180°	"	125'
					TOTAL		4790'

FORCE CRAG MINES (UK) LIMITED

Introduction	Page	1
1. COMPANY DETAILS		2
2. MINE HISTORY		3
3. RECENT DEVELOPMENT WORK		3
4. FUTURE REQUIREMENTS		3
5. TENURE AND PLANNING PERMISSION		3
6. FINANCIAL FORECAST		4
7. TYPE OF JOINT VENTURE ENVISAGED		5
8. ESTIMATES		5
PRODUCTION INSTALLATION ESTIMATES		6
REVENUE FORECAST FOR FORCE CRAG MINE		8
EFFECT OF CHANGING METAL PRICES ON REVENUE		9
HYPOTHETICAL FLOWSHEET		10
LOCATION MAP		At end

AN OUTLINE OF AN ATTRACTIVE OPPORTUNITY FOR A JOINT VENTURE FOR THE RE-OPENING OF A FORMER LEAD/ZINC/BARYTES MINE NEAR KESWICK, CUMBRIA, WITH PROPOSALS SHOWING THE POSSIBILITY OF ESTABLISHING A USEFUL INVESTMENT IN BRITAIN'S NATURAL RESOURCES IN RETURN FOR A MODEST OUTLAY AND WITH CONSIDERABLE SUPPORT FROM GOVERNMENT GRANTS

DECEMBER 1978.

FORCE CRAG MINES (UK) LIMITED

For the past two years the Company has been carrying out a programme of underground exploration and development for lead/zinc/barytes at the Force Crag Mine, Cumbria, with a view to proving sufficient tonnage of ore to justify reopening the mine as a commercial venture. This work has been supported by the Department of Industry by way of Mineral Exploration Grants. More than £100,000 has been spent on the completed programme of exploration and development.

A feasibility study by the Company's consulting geologist suggests that ore reserves of 50,000 tonnes would be desirable to provide a basis for viable operation at current metal prices. Proven ore reserves to date (December 1978) amount to some 31,000 tonnes, while probable reserves of 12,000 tonnes and possible reserves of 8,500 tonnes bring the total to 51,500 tonnes.

The Company is now desirous of securing a future for its operations by entering into a joint-venture agreement with a suitably substantial partner - who need not necessarily be currently engaged in the mining industry, as the Company has the required expertise available to it.

The sum involved to cover further work underground, the erection of a mill building, the installation of the beneficiation plant, and the provision of further working capital amounts to some £100,000 - £220,000; this would be required in stages over the course of a year to eighteen months. The wide bracket of £100,000 - £220,000 is explained in the following pages, and all the sum would not necessarily be required from the joint-venture partner.

Preliminary discussions with the Department of Industry suggest that substantial grants are likely to be forthcoming from the UK Government under the terms of the Industry Act 1972.

Although the Company is overseas-controlled, the Bank of England has intimated that there would be no objection to the raising of finance from either internal or external sources, subject to the normal two-year rule for overseas loans. Alternative joint-venture arrangements, however, are outlined on later pages which the Company believes may have greater appeal to a prospective partner than the provision of loans or equity capital.

Further details are provided on the following pages, and further information may be obtained in the United Kingdom from:

Mr Gerard Noel, DipCAM, MIPR
68 Grove End Gardens, London NW8 9LN - 01-286 9477

or in Canada from:

Mr Milton Klyman (the Company's Chairman)
M Greene & Associates Limited, 5859 Yonge Street, Suite 100,
Willowdale, Ontario, M2M 3V6 - 223 4140.

1. COMPANY DETAILS

Name	FORCE CRAG MINES (UK) LIMITED
Registered Office	60 King's Walk GLOUCESTER GL1 1LA
Mine Location	Braithwaite KESWICK Cumbria Telephone Braithwaite (059 682) 308
London Office	68 Grove End Gardens LONDON NW8 9LN 01-286 9477
Authorised Capital	£60,000 in 1,200,000 Ordinary Shares of 5p, of which 992,635 have been issued (fully paid)
Holding Company and Other Shareholders	New Force Crag Mines Limited, of Toronto, owns 542,620 shares (54.66 per cent); 450,000 shares are owned by approximately 2,000 small shareholders outside the United Kingdom; the three directors own a total of 15 shares. By a Debenture dated December 7 1976, the Company specifically charged its leasehold property and all its undertaking, property and assets, present and future, to secure a foreign currency borrowing for a maximum of (Canadian) $217,500 from New Force Crag Mines Limited to finance development expenditure and operating costs of the current programme.
Directors	Mr Milton Klyman (Canadian, Chairman) Chartered Accountant; Managing Director, M Greene & Associates Ltd (broker-dealer). Mr George W Hall Mineral Resources Consultant; Director, Elenith Mining Co Ltd. Mr Robert I Gunn BSc, ARCST, MIMM Mine Manager; Mining Engineer; Director, Elenith Mining Co Ltd.
Bankers	National Westminster Bank Limited 21 Eastgate Street GLOUCESTER GL1 1NY
Auditors	Kingscott Dix & Co 60 Kings Walk GLOUCESTER GL1 1LA
Solicitors & Registrars	Farrer & Co (Mr S V Perera) 66 Lincoln's Inn Fields LONDON WC2A 3LH

2. MINE HISTORY

Lead was first discovered at Force Crag in 1831 and some 1,000 tons was probably extracted between then and 1864. The mine was later worked for barytes until 1879, when the mine closed and lay dormant until 1906.

Work continued for the exploitation of combined lead/zinc/barytes until the disastrous year of 1921 when every British mine dependent on zinc closed following the collapse of world metal prices. Subsequent owners and operators worked higher levels of the mine (not covered by the recent exploration programme) for barytes until the 1960s.

The recent exploration programme indicates substantial tonnages of combined lead/zinc/barytes at lower levels of the property below those worked prior to 1921.

3. RECENT DEVELOPMENT WORK

The recently-completed programme of exploration and development has involved both rises from previous workings and the use of core-drilling to put holes into the existing walls of the various levels, to prove up the full width of mineralisation and to search for parallel veins that may have been missed by previous workers.

In addition a new internal shaft has been sunk and a new 30-metre Level driven below the former workings, to explore the likely downward continuations of the ore zone.

4. FUTURE REQUIREMENTS

With the new orebody proven, it is now necessary to renovate or replace the existing derelict mine buildings and to install the crushing and dressing plant required for the production of lead/zinc concentrates and barytes mineral. The Mine Manager believes that the majority of the necessary plant is obtainable second-hand but in good working order, while direct labour would be capable of undertaking most of the actual installation work.

During the past two years the Mine Manager has established contact locally with workers possessing the required skill and adaptability to undertake all foreseeable operations both at surface and underground; it is important that an early agreement should be reached in principle regarding future activity to ensure availability of skilled personnel who may otherwise seek employment elsewhere.

5. TENURE AND PLANNING PERMISSION

The Company has the benefit of a lease covering some 670 acres (270 hectares) surrounding the mine site itself. This mining lease is for 25 years from March 1967, with a dead rent of £50 per annum merging into royalties of 12½p per ton for barytes and 1/30 of the net selling price of silver, lead and zinc ore concentrates.

.../4

An existing planning permission covers underground work, but a further permission would be required for the erection of a mill. Although the mine is situated within a National Park, the Planning Authority appreciates the need for maintaining traditional industries. Relations with the Planning Authority are excellent: the Chief Planning Officer and his minerals officer recently visited the mine to discuss the Company's proposals, and could foresee no problems.

6. FINANCIAL FORECAST

Forecasts and projections are annexed but it must be appreciated that feasibility is dependent upon a number of variables, such as metal prices for lead and zinc, market price of barytes, availability of Government Grants and other assistance. Ore reserves proven contain 2.08% lead metal, 7.23% zinc metal, and 8.13% barytes. Additional ore reserves may result in an improvement on these figures, while an upward movement in metal prices - particularly that of zinc - would radically improve profitability. Lead and zinc prices have been remarkably steady throughout most of 1978 at about £300-£320 per tonne for each metal, with usefully higher levels obtaining in recent weeks (lead up to £450/tonne, zinc £380/tonne). Opinion is widely held that by the time production were to start at Force Crag (say 1980) metal prices may be considerably higher.

On starting production a liability would arise for the repayment of the Government's Mineral Exploration Grants, which by then will amount to some £35,000 plus interest. Terms of repayment are negotiable and could be agreed as a precondition to any joint venture arrangement.

The Company's inquiries indicate that the production of metal concentrates and saleable mineral (barytes) would qualify for assistance under the Industry Act 1972 for manufacturing plants within a Development Area. This could mean grants of at least £24,000 against equipment to be installed in the mill, and possibly a further £16,000 for the buildings and other requirements - say, at least £40,000. Such grants would be non-repayable and would not detract from the amount allowable as "first year" allowances for income tax.

New Force Crag Mines Limited, of Toronto, has indicated that the present debenture arrangements could be modified to defer the Company's liability to repay sums advanced for the exploration programme.

Facilities Available

Discussions have been held with the European Regional Office of a large international bank, and it is considered likely that venture capital could be forthcoming from this source against the security of proven resources underground. It is quite possible, therefore, that a prospective partner acceptable to the bank in question may need to provide only part of the total cost of the mill and equipment.

The Regional Development Grant from the Department of Industry under the Industry Act 1972 of 20% would be worth £24,000 on proposed new machinery. If the bank referred to above were

.../5

to provide only 50% of the required finance, the partner may need to provide as little as £66,500 towards the total maximum estimated expenditure of £213,000, with first year capital allowances of at least £120,000 against tax. In real terms, with the right partner, a mill could be provided for virtually no capital expenditure. Force Crag Mines (UK) limited is not able to take advantage of this arrangement itself because of its inability to take advantage of the tax concessions.

Another overseas bank has intimated that it would welcome a proposition at the appropriate time.

The reduction of the capital required in real terms is illustrated thus:

Total estimated cost of plant with new machinery	**£213,000**
Less 50% supplied by Bank	**106,500**
	106,500
Less Regional Development Grant	**40,000**
Partner to provide	**£66,500**

With first-year allowances of at least £120,000 against tax.

7. TYPE OF JOINT VENTURE ENVISAGED

The type of joint-venture arrangement concluded with any partner will be largely dependent on the partner's long-term financial requirements and general attitude to natural resources. FCM proposes that the most desirable arrangement, incorporating minimum risk for the partner, would be to provide the mill as a turnkey operation, taking advantage, as necessary or prudent, of FCM's existing banking contacts and expertise in the fields of planning, liaison with Government Departments, mill management, local knowledge and supervisory ability. FCM would expect its General Manager to be "seconded" to the partner in order to supervise the erection and renovation of buildings, and the selection and installation of the plant. An agreed proportion of net working profits (as defined and agreed) would initially be allocated to the repayment of investment in the mill, bank finance and DoI Mineral Exploration Grant.

On repayment of the partner's investment etc, as above, options would be exercised (as previously agreed) for the mill to pass to FCM and for the partner to have a stake in the equity of FCM.

8. ESTIMATES

Detailed estimates are provided on the following pages, together with a hypothetical flowsheet for the plant. In order to keep this document to a manageable size figures for smelter revenues and working costs are not analysed in detail, but these will, of course be substantiated to any prospective partner.

PRODUCTION INSTALLATION ESTIMATES

Underground.

Most equipment needed is already on hand but, if available at a suitable price, a second mucker and a second locomotive would be desirable (though not essential). Basic repairs to Nos 0 and 1 Levels are essential, but more elaborate concrete replacements are priced as an extra, as also is the extension of the shaft to No 1 Level. The latter would have to be carried out before long in any case.

	(Extras) £	Essential £
Repairs to No 1 Level	(+3,000)	1,500
Repairs to No 0 Level	(+2,200)	400
Second locomotive	(2,000)	
Second mucker	(1,500)	
15 New tub bodies (1-ton capacity)	(2,500)	
Shaft Raise (120-ft)	(4,200)	
No 1 Shaft Station, etc	(2,500)	

Surface

Mill Plant (Second-hand but see notes)

50-ton bin	1,500	
Feeder	350	
20-ft x 24-in conveyor	800	
20-ft x 12-in jaw crusher	850	
20-ft x 18-in conveyor	800	
6 x 3 Vibrating screen	975	
24-in crushing rolls	1,150	
Vibrating Feeder	350	
20-ft x 18-in conveyor	800	
8-ft x 3-ft screen (two sections)	1,200	
Two jigs	1,500	
5-ft x 4-ft ball mill 1½-in sand pump 65-mesh cyclone	5,500	
Eight flotation cells	10,000	
Two drum filters and vacuum pumps	2,000	
Two concentrate bins and conveyors	2,500	
Return water pump	500	
		30,775
Wiring, etc		2,600
Transport		2,000

Buildings (Materials and own labour)

Repairs to existing building (inc labour)	5,000	
Ancilliary buildings:		
Crusher house	1,500	
Ball Mill House	1,200	
Power House	800	
Amenity Unit	3,500	
		12,000
CARRIED FORWARD		£49,275

PRODUCTION INSTALLATION ESTIMATES (Continued)

BROUGHT FORWARD			£49,275
Installation			
Labour (in addition to foregoing)		12,000	
Plant Hire		2,500	
Foundations		1,000	
Electricians		2,000	
Miscellaneous materials		2,000	
			19,500
Ancilliaries			
Extra compressor		2,500	
Generators (200-kVa)		12,000	
Excavator (JCB 3c Type)		2,500	
Tailings pond:			
Bund excavation	700		
Pump, installation/pump	500	1,200	
Road Improvements		4,500	
Fencing on outcrop		1,000	
			23,700
			92,475
ADD CONTINGENCIES @ 33% APPROX			30,525
			£ 123,000

IMPORTANT NOTE

Dependent on the partnership structure agreed, and the profitability, tax position and special requirements of any prospective partner, it may be preferable to instal new machinery and thus qualify for first-year capital allowances, Regional Development Grant assistance (at 20% of cost), and resulting in a higher break-up value at the conclusion of operations, together with better spares availability during the plant's lifetime. The Mine Manager's inquiries suggest that this would increase the mill plant costs figure by approximately £60,000. Total mill plant cost of £120,000 could be written off immediately and would qualify for a grant of £24,000. The availability of grant does not affect the first-year write-off arrangement for the whole sum.

REVENUE FORECAST FOR FORCE CRAG MINE

Assumptions:

1. Mill throughput: 50 tonnes per day;
2. Five-day week, single shift working, 50-week year;
3. Lead price £400/tonne; zinc producers price $720/tonne, barytes price £40/tonne;
4. Smelting charges as outlined by Commonwealth Smelting (RTZ Group) subject to assay of concentrate. Smelter return calculations available on request;
5. Weekly operating costs of £3,300 include underground labour/materials (mine), surface labour/materials (mill) and an allowance of £200 per week for office and basic administrative costs. Full breakdown available on request.

Metal Revenue (Weekly)

Zinc output: 250 x 7.71% x 92% = 17.73-t of contained zinc.

Lead output: 250 x 2.06% x 92% = 4.74-t of contained lead

Total metal in concentrate = 22.47-t from weekly mill throughput.

Assuming concentrate contains 60% metals, weekly output of concentrate will be 37.45 tonnes.

Smelter's payment would be:

ZINC: $302.4 per tonne of concentrate ($11,325), say	£5,660	
LEAD: £39 per tonne of concentrate	1,460	
SILVER (Ag in Pb)	180	
TOTAL GROSS METAL VALUE	7,300	
LESS smelter's treatment charge of $150/t (say £75/t) on 37.45-t	2,810	
	4,490	
LESS Transport/insurance in transit	400	
	4,090	
LESS royalty at 1/30th (136.33) say	140	
NET METAL REVENUE (Weekly)	3,950	3,950

Barytes revenue (Weekly)

Barytes output: 250 x 7.69 x 85% = 16.34-t (say 16-t) x £40 = £640; less £5/t royalty/transport	560	560
GROSS WEEKLY REVENUE		4,510
LESS Weekly operating costs		3,300
WEEKLY OPERATING PROFIT		£1,210

ANNUAL OPERATING PROFIT (50 weeks) - £60,500.

EFFECT OF CHANGING METAL PRICES ON REVENUE

At the time of writing, December 1, the cash metal price of lead is £430/tonne which would be worth an extra £7,000 on annual operating profit (the foregoing figures being based on £400/t). To indicate the effect of changing metal prices the following figures are provided.

ZINC. The foregoing figures are based on a producers price of $720; Changes in the zinc price would affect annual operating profit:

Producer price ($)	Effect on AOP (£)
700	-7,590
720	-
740	+7,640
760	+15,230
780	+22,820
800	+30,410

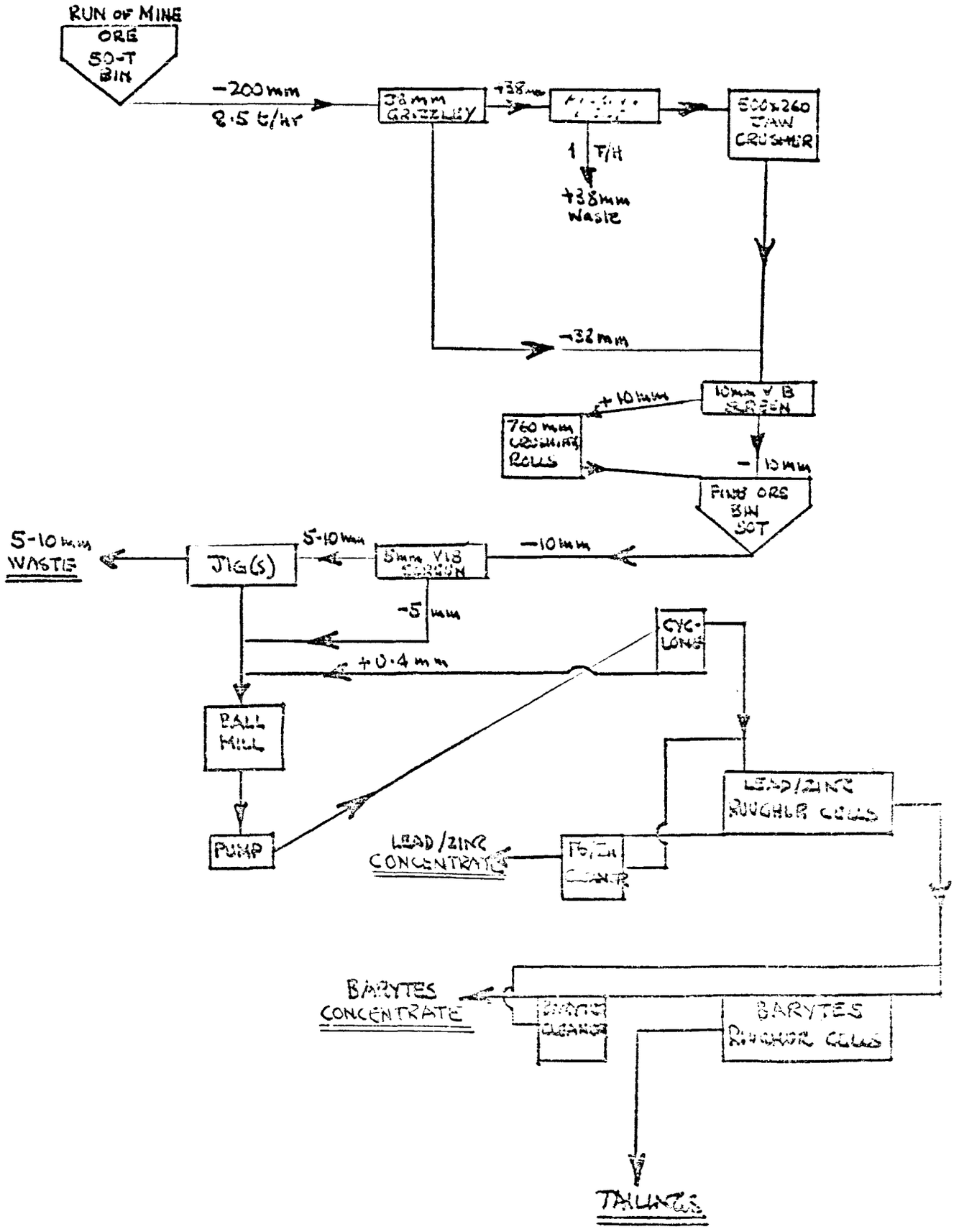
LEAD. Changes in the cash metal price would affect annual operating profit:

Metal price (£)	Effect on AOP (£)
375	-2,710
400	-
425	+6,285
450	+10,875
475	+15,375
500	+19,920

The foregoing calculations allow for increased royalty payments but do not allow for increases in smelting costs which are usually variable in accordance with metal price movements.

LONG-TERM PROSPECTS

It must be emphasised that further exploration and development can be expected to prove orebody continuity both above and below the 30-metre level. The 51,500 tonnes of reserves mentioned earlier is regarded as sufficient to justify the commencement of commercial operations, but traditional mining practice is to continue development while known reserves are being worked. The 51,500 tonnes is sufficient for just over four years throughput, but the likelihood is that operations could continue for a much longer period as fresh reserves were proved. The Company would aim to maintain proven reserves for several years of future milling capacity.


RUN OF MINE
ORE
50-T
BIN
-200mm
8·5 t/hr
38mm
GRIZZLY
+38mm
1 T/H
+38mm
Waste
500x260
JAW
CRUSHER
-32mm
+10mm
10mm V.B
SCREEN
760mm
CRUSHING
ROLLS
-10mm
FINE ORE
BIN
50T
5-10mm
WASTE
JIG(S)
5-10mm
5mm V.B
SCREEN
-10mm
-5mm
+0·4mm
CYC-
LONE
BALL
MILL
PUMP
LEAD/ZINC
ROUGHER CELLS
LEAD/ZINC
CONCENTRATE
BARYTES
CONCENTRATE
BARYTES
ROUGHER CELLS
TAILINGS

[illegible] References

The Stratigraphy and Tectonics of the Skiddaw Slates and the Relationship of the Overlying Borrowdale Volcanic Series in Part of the Lake District. Alexander Simpson. Geological Journal. 1967, Vol. 5, Pt 2, pp. 391-418.

The Sequence and Structure of the Skiddaw Slates in the Keswick Buttermere Area. W.C.C. Rose. Proc. Geol. Ass. 1954-55 Vol. 65, pp. 403-406.

The Lake District Mining Field. T. Eastwood. The Future of Non-Ferrous Mining in Great Britain and Ireland. A Symposium (held 1958). London: The Institution of Mining and Metallurgy. 959.

The Ore Deposits of the Skiddaw District. R.H. Rastall. Proc. Yorkshire. Geol. Soc., 1942, Vol. 24, pp. 328-343.

Memoir of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. 22, 1921, The Lead and Zinc Ores of the Lake District. T. Eastwood.

Mines and Mining in the Lake District. John Postlethwaite. 3rd Edition. Whitehaven, 1913.

The Geology of the English Lake District with Notes on the Minerals. John Postlethwaite. Keswick. 1897.

FORCE CRAG MINES (UK) LIMITED

Quarterly Report - March 1 to May 31 1977

Work on the site actually commenced prior to March 1, but this only involved repairs to buildings and roads, and clearing up underground.

Situation at March 1 1977

Buildings The three-room mine office had been refurbished from a derelict state and provided an office, washroom and messroom, heated by two coal fires. Also refurbished were the compressor house (galvanised on timber), including a workshop with bench, and a loco shed (galvanised on timber), with loco charging unit driven by small diesel engine

Compressors The mine compressor, and Ingersoll-Rand 365-cfm portable had been damaged by theft and vandalism, and parts to repair were on order. A 160-cfm compressor was on hire pending repair of our own.

Roads The mine road from Braithwaite had been improved by cutting back gorse and filling potholes in the dirt surface. The roads to No 1 and No 3 levels had been regraded for use by Land-Rover.

Mine Entrances The entrances to Nos 0 and 1 levels had been cleaned out and new gates and locks fitted. No 3 level entrance had been cleaned out, and a drain overflowing down to No 1 level had been cleared.

Rolling Stock The mine stock of Eimco 12B loader, BEV W217 1½-ton loco, and 24x¾-ton capacity side-tip tubs had been on hire to Swiss Aluminium Ltd, Stanhope, and were returned on January 28. The Eimco wheel treads were very worn and the loco coupling rods missing, but both these features date back to the previous Force Crag period. Otherwise this equipment was in fair order.

Tools and Equipment As most of the original equipment had been damaged or removed, new hand tools had been acquired, and also some workshop equipment, comprising only gas cutting gear and hand tools. The Company's drill sharpener and hand grinder were in good order.

Pending acquisition of new rockdrills, an old Holman machine was married up to an Atlas leg, which improvisation gave erratic service for about three weeks until replaced.

Material Stocks Some timber remained at the mine from the previous work, but otherwise little was at hand. A surface air main from the compressor house to No 0 level, damaged at several points by frost, was salvaged, giving about 600-ft of usable 2-in pipe, and replaced by an underground pipeline. Sufficient rails could be salvaged to equip No 0 tip.

New supplies of timber, drill steels, hoses, explosives, diesel fuel, smithwork and pipe fittings have been arranged.

.../2

Diamond Drill A Boyles Bazooka drill and EWT size drilling equipment was ordered late in December, with delivery quoted as 6-8 weeks, but this did not arrive until the second week in April.

Work Progress At the beginning of March, the staff comprised myself as manager, a foreman, three miners and a general workman.

The latter was still engaged on building work on surface at this stage but subsequently transferred underground and is now a diamond driller. The miners were engaged upon cleaning up and re-timbering falls on No 0 level, installing water and air mains.

OWB Raise As soon as suitable arrangements were completed for temporary storage of explosives at a quarry ten miles distant, on March 14, the first raise was commenced. This was sited on OWB block, No 0 level, a stretch of weak lead/zinc mineralisation with up to 12-in of barytes, occuring below a large zinc stope (No 1 stope) on No 1 level.

The method of raising adopted was the standard incline raise used at South Crofty with a boxhole raise and a separate ladderway raise for the first 24-ft and a 15-ft joining sub-level from which the incline commenced. The incline was positioned to pass over the best values on 0 level and hole near the middle of the No 1 level stope. As the stope drive on 1 level was collapsed, the last part of the raise was turned into the footwall to hole to an adjacent drive. The first 70-ft of the raise showed barytes widths up to 4-ft of excellent quality together with some lead and zinc. The grab samples from ore trammed show only moderate Pb/Zn values. At 75-ft the vein split and the South branch was followed 14-ft until it petered out. A cross-cut was put out tp the South 7-ft in completely barren country rock at this point. The North branch was then followed and this also diminished until the point where the raise had to turn into the footwall to hole. At this point it was only a small stringer.

After the raise holed, a sub-level was commenced where the raise turned and this immediately entered excellent zinc. This was followed for 33-ft and the end still stands with strong zinc and some barytes. The whole raise is to be channel sampled.

Diamond Drilling As mentioned, the drill was very late in arriving and, pending this, the crew refurbished the ventilation into 1 West end, cleaned up 1 level, repaired the ladderway from 0 to 1 level on OWC block and did various other jobs.

When the drill evenually arrived, it was without the hose fittings requested and, after these were obtained, drilling commenced on 1 level as far west as possible, about 80-ft from the breast, there being a bad fall beyond this. Drilling in this area gave no values, as had been expected, and this area may be considered quite barren. This has released a large quantity of ventilation tubing, pipes and rails for use elsewhere and will be sufficient for all future developments planned.

Drilling continued in the area of No 4 stope, 1 level, with holes up to 25-ft north and south at roughly 50-ft intervals eastwards, though the spacing varied to conform to suitable sites and existing cross-cuts. In addition, where a new by-pass drive had replaced the collapsed drive on vein below 4 stope, some declined holes were drilled to intersect the vein below 1 level to give a sampling otherwise impossible because of the collapsed area. It was found at this stage that, while core recovery in country rock is fairly good, in vein material it was very variable, sometimes 3-ft being lost

.../3

completely. Various attempts, including a change of bit type, have failed significantly to improve this, partly because the machine has an ir cylinder feed and accurate feed and rotation control is impossible. Steps are now being taken to use sludge sampling.

By the end of May the drill had reached the east end of 3 stope but two holes under 3 stope have been postponed until a reamer bit for a standpipe for sludge sampling arrives.

The crew have settled down well with the drill, and the driller has worked in this mine for several years previously and can tell what material is being drilled reliably. From his description, the intersections below 4 level should have given good values, but only one good core was recovered out of four.

It has been purposely avoided starting drilling on the more promising areas on 0 level to give the crew time to shake down and to arrive at the best drilling methods, bit type, and core logging and storage method.

Other work It has been necessary to carry out various small jobs ancilliary to the above main activities. These include:-

Repairs to mine compressor
Installation of second compressor
Installation of pump for drilling water
Repairs to treads of Eimco
Repairs to road surface
Cutting stations for diamond drill where drive is too narrow
Modification to air mains
Overhauling 1 west ventilation system

Staff Additions Two more underground labourers have been engaged for salvage work in 1 west. A prt-time employee is assisting with the office work.

At present, I do the fitting work and while operations are on their present scale a fitter is not really necessary.

ASSESSMENT OF RESULTS

Diamond Drill As mentioned, the diamond drilling has not yet reached any of the more promising areas and the rather negative results merely confirm earlier conjectures. The sampling holes below old stopes are quite practicable from a drilling point of view but sludge sampling is necessary.

Development The raise is a curious mixture, and payability of the lower end of this block would depend greatly on the barytes revenue available. Enquiries into markets are in hand. It would be possible to assess this area further by more sub-levels or a second raise, but for the tonnage likely to be found, I do not think this worthwhile. The only really reliable way to assess the ground is to stope it. This would probably be viable in a working mine if there was a rich stope to "sweeten" this sort of material.

One outcome of the work so far is that the mine workforce has developed into a useful team with good equipment.

.../4

WORK CONTINUING

Diamond Drilling The programme of holes on 1 level is well advanced and should be completed in about four weeks, when 0 level can be started. An interesting area will be the ground east of No 2 stope to the south of the 1 level.

Mining The west end of 0 level is being re-driven past some very weak ground which has collapsed, and a raise is to be put up from this drive to No 4 stope on 1 level. The fall in at the end of 0 level has shown some weak lead/zinc mineralisation not apparant when the end was stopped. Upon completion of this raise, another from No 1 level to assess the ground above No 2 stope is planned. It is expected by then that there will be results from boreholes to be followed up by driving.

Other Work Parts, at considerable cost, are on hand to re-furbish the BEV loco with coupling rods, as soon as it can be taken out of service for a few days.

OWB raise is being channel sampled throughout.

1 west end is being stripped of materials.

An explosives store for the mine is shortly to be installed near Braithwaite, planning consent and a ground lease having been obtained.

The surface buildings and workshops are being provided with electric power and a small generator. Underground lighting is shortly to be changed from carbide to electric caplamps.

NOTES

Explosives This has been a tiresome problem, as a result of the regulations arising from the Irish troubles. The police refused to re-licence the existing magazine at the mine on the grounds that its structure did not comply and its siting was too remote. After a long and difficult search, a site was found near Braithwaite, and this then had to be approved by the County Council Crime Prevention Officer, County Council Consumer protection Officer, Allerdale DC Planning Committee, Cumbria CC Planning Committee, Lake District Special Planning Board. A lease has been granted by Lingholm Trust, and a magazine is being supplied by the explosives manufacturers.

In the meantime, storage facilities have been provided by ARC Ltd at Threlkeld Quarry, but it has entailed a 20-mile round trip each day to collect powder. The new magazine should be ready in about two weeks, at considerable saving.

Radon When 1 West was first examined it was found to be impossible to enter far beyond No 4 stope because of blackdamp (CO_2). The ventilation was restored and the area re-entered. The Area Mines Inspector visited to take CO_2 samples, which found none, but also sampled for radon daughters here and elsewhere in the mine. Some of these readings were alarmingly high.

Further measurements carried out by staff from British Steel Corporation's Beckermet Mine showed that the problem was mainly in 1 west end, and that wherever there was ventilation readings were well below the recommended levels. The Inspector has accepted for the time being that No 1 west be salvaged and sealed off, and the raise from 0 west end to No 4 stope be put through to ventilate further west than the present OWC rise circuit.

June 1977

R I Gunn BSc ARCST MIMM

FORCE CRAG MINES (U.K.) LTD.

QUARTERLY REPORT.

September 1977 - November 1977, inclusive.

Progress during Period Development.

At the beginning of September a rise (No. [illegible]) from an old mine stope on No. 2 level was commenced, to prove upward extension of the main ore shoot. In this area there are two old stopes, one on a northern branch being an old barytes stope of 1870 period, and the other on the main part of the vein, worked about 1920. The rise was from the latter, which was only about 35 ft. above the level but showed good zinc values. This stope face had been partly sampled in 1973 with fairly good results. The rise inclines westward and commenced in good ore of greater width than the excavation, so cross cuts were put out at 40 ft. intervals to expose the full width of ore and to check for branches. The first northern cross cut holed into the old barytes stope face, at which point the barytes had pinched right out.

Near the top of the incline, the vein was lost when its width reduced but it was re-located by a cross cut and followed through to No. 2 level. This holing had to be approached cautiously as 2 level was not accessible owing to the portal having run in, and the level had not been entered since 1960. From Mr. W.T. Shaw's examination in that year, it was advised that a large amount of mud could be expected in 2 level and a test hole was put through from 27 ft. below. The rise was then put through and the level was found to be almost full of mud but little water. The pillar under which the rise holed was made accessible for sampling and the stope above 2 level was examined, but because of the mud, such parts of 2 level not already inaccessible because of falls of ground, were not entered. To clear the mud would raise considerable problems and the need to examine or sample the level is not very great.

Some trouble was experienced about this time with heavy rain causing extra water to come down from 3 level through the new rise, and this delayed sampling until November. At present, assay results are still awaited.

On completion of the rise, the development crew transferred to 0 level and commenced crosscutting south of the vein to the point where a winze is to be sunk in the footwall to a new level 50 metres below 0 level. At the end of the period work was starting on cutting the sinking station.

Diamond Drilling.

Drilling the sides of the existing drives on 0 level continued, working westward from the entrance. Results have generally been disappointing as no worthwhile intersections have been found. The fifty foot interval of holes should have been quite adequate to find any ore shoots, and core recovery while not perfect, has been fair. Some holes to the south have been extended beyond the usual 25 ft. to crack the "south vein" but the only intersection showing values was very narrow.

All holes east of the new winze crosscut were completed by the end of October, when drilling was suspended for barytes production. In the original drilling programme, the next hole would have been roughly on the site of the crosscut, and as the crosscut showed, this would have been intersecting a south branch of the vein carrying some zinc. The next holes to the south, working westward, should be of interest and as soon as the barytes commitments are cleared, drilling can resume.

Barytes.

As a result of enquiries for a market for high grade barytes, samples were sent to two parties and both requested bulk samples for trials, one for 100 tons and one for 20 tons.

As the first (OWB) rise put up in the present programme intersected a large lens of barytes, it was decided to attempt to meet the larger order, despite not having any milling plant, and having to use very crude handling methods. So far about 20 tons of clean white barytes have been obtained, but the lens is showing signs of giving out. Wastage is considerable because of iron staining, and hand sorting in the stope is inefficient.

Other work.

Heavy rain and gales have made considerable road and building repairs necessary. Also a revettment supporting the road had to receive attention owing to timbering having rotted.

Work continued on preparation of a detailed surafce survey, and a plan of 0 level dump was prepared from it for a planning application.

The various equipment required for the winze sinking has been accumulated and where necessary overhauled.

A second battery for the locomotive has been obtained, and charging facilities installed.

Appraisal of results.

Development sampling of mineralisation in OWB block was computed for grade and tonnage giving only 1666 tons of 5.31% Zn., 1.86% Pb., but also 14% barytes. Whilst 20 tons of the latter has been extracted, other ore broken for access to this, and discoloured barytes rejected, has been left in the stope and is available for recovery.

Testwork for milling should include examination of barytes concentrates produced by flotation to see that discolouring is removed as the paint market for white barytes offers the best prices. This at present is of the order of £80/Ton - (c.f. £15 - £20/Ton for drilling mud grade). It appears, underground, that iron discolouration tends to wash out of the barytes so that wet grinding and subsequent processes should help to clean it. The present batch for sale is to be dry ground, so this point cannot be tested.

OWB rise proved no reserves.

TWC rise sample results have not yet been received.

Enquiries for a laboratory to test a sample of run of the mine ore were commenced earlier this year but intimation of test work carried out sometime about 1970 was received. Efforts to locate the results of this have so far failed, but it appears that the testwork carried out then would not deal with some of the questions now outstanding, particularly the treatment of water recovered from mill tailings, either for re-use in the mill or discharge into local natural drainage. Negotiations with an ore testing laboratory have therefore been resumed.

FORCE CRAG MINES (U.K.) LTD.

Directors M. Klyman (Canadian – Chairman), R. I. Gunn, G. W. Hall

68 GROVE END GARDENS, LONDON NW8 9LN

01-286 9477

MMEI/AE59

23/1/78

M A Parker Esq
Department of Industry
PTM2B
Millbank Tower
LONDON SW1P 4QU

January 19 1978

Dear Mr Parker

Purely for record purposes I enclose a copy of an internal report covering work done at the Force Crag Mine during the period September/November 1977.

Yours sincerely

Gerard Noel

Received 23/1/78

c.c. IGS, WSA

FORCE CRAG MINE - TONNAGE PROVED UP TO DECEMBER 31 1977

Three blocks have been included in the reserves:

1WC, above No 1 Level (old No 2 stope)
OWC, above No 0 Level
OWB, above No 0 Level

The last is below required grade for lead and zinc, but having a higher than average barytes content, is included.

1WC

From the sampling of No 1 Level (1973), boreholes Nos 21 & 22 (1977), sampling of old No 2 stope (1973 & 1977), grade along No 1 Level from 2265E to 2405E is computed as 1.61% Pb, 7.28% Zn, 8.9% $BaSO_4$, over a width of 8.63-ft, length 140-ft. Sampling of the rise from 2340E, 985-ft OD to 2270E, 1080 OD gives 3.08% Pb, 7.45% Zn, 8.9% $BaSO_4$, average width 11.0-ft over the length of 150-ft

Tonnage is calculated as 16,015 tons (long) allowing for ground removed by old No 2 stope.

This averages 2.51% Pb, 7.38% Zn and 8.9% barytes.

The barytes content of 1WC block has been reduced by an old stope which has removed about 500 tons, which would have increased barytes grade to about 12%.

OWC

Sampling on No 1 Level already quoted gives 1.61% Pb, 7.28% Zn, width 8.63-ft, length 140-ft. Sampling on No 0 Level gives 2.02% Pb, 9.35% Zn and 6.20% barytes (1973). Recalculation of widths on actual exposed full widths basis gives 8.63-ft wide over 230-ft long, 13,305 tons.

OWB

From a previous calculation of tonnage and grade this block contains 1,666 tons of 1.69% Pb, 5.31% Zn; calculations for barytes grade give 16.10%, so this is included in total reserves.

Average for all blocks

	Tons	Pb%	Zn%	Barytes
1WC	16,015	2.51	7.38	8.9
OWC	13,305	1.61	7.28	6.2
OWB	1,666	1.69	5.31	16.1
Average/Total	30,986	2.08	7.23	8.13

.../2

In addition there are probable reserves of equivalent grade material as below:

OWE (below 1W old No 4 stope)	1,000 tons
+ old stope dirt	500 tons
1WB	500 tons

Possible Reserves

2,500 tons of reputed 4% Zn material already broken in 1WB
6,000 tons of good grade material at west end of 1WC block below No 2 Level.

Notes

I consider the barytes grade for the main tonnage to be low, as it is based on measured widths apart from the sampling of 1WC rise, chemically assayed for barium, which gave a higher grade than the rest of the sampling. Measured widths account only for the main leaders of barytes and ignore subsidiary stringers and patches.

Two other areas not mentioned in the above assessment are the recently-drilled predominantly lead area (designated OWD under current classification) which cannot be related to any tonnage at present. Similarly the area near the east end of O (OWA) also does not indicate any ore reserves as such. Though both interesting areas, to do any work on these would be impossible without detracting from the current project.

Original signed and dated

GUNN
uary 24 1978

Sampling figures attached

SAMPLING OF OLD No 1 STOPE & 1WC RISE, No 1 LEVEL

Sample No	Distance from E end of stope	Pb%	Zn%	$BaSO_4$% (from Ba assay)	Width Ft	
26	10-ft	14.0	8.1	None recorded Not sampled	3.5*	
98	20-ft	3.2	8.6	9.56	4.5*	
38	30-ft	0.51	14.8	0.78	4.0*	
43	40-ft	3.2	8.2	1.47	5.8*	
11	45-ft	1.1	1.5	10.29	5.0	
	Distance from start of rise					
17	0-ft	1.4	1.17	6.9	3.7	
21	10-ft	1.4	7.6	13.5	3.8	
22	20-ft	1.7	12.4	25.7	4.0	
45	30-ft	2.6	13.5	9.0	4.0	
15 rise	40-ft	1.6	6.0	22.3	3.0	
47 Xcut	40-ft	2.8	6.5	9.5	12.0	15.(
18	50-ft	0.25	3.9	28.6	4.0	
46	60-ft	2.0	9.4	2.5	3.0	
49	70-ft	2.5	11.1	16.6	5.0	
58 rise	80-ft	0.53	5.0	31.0	4.0	
42 Xcut	80-ft	6.6	4.2	0.5	9.0	15.(
48	90-ft	0.5	4.4	15.1	4.0	
36	100-ft	2.1	19.0	8.8	3.8	
30	120-ft	0.5	21.0	2.5	4.0*	
54	150-ft	2.0	4.2	12.4	7.0*	

In addition to the 1973 sampling of the west end of Old No 1 stope and No 1 Level drives, boreholes 21 and 22 were used, result circulated last year.

* = Full width exposed.

FORCE CRAG MINES (N.Y.) LTD.

Commercial-in-Confid...

Quarterly Report for period

July 1978 - September 1978.

(inc.)

PROGRESS DURING PERIOD.

At the start of the period the new winze was nearly complete, and the sump was finished early in July, enabling crosscutting to the vein to resume. The vein was intersected at 500N 2580E and was found to be of disappointing appearance (see separate description). The drive was commenced westward to pass under OWB and OWC blocks, and by the end of the period had extended 200ft. west, reaching the point below the commencement of OWC block.

All efforts have been concentrated upon pushing this drive on, using a two shift system. Winding and double handling all muck from 30m. level has increased labour needs and costs. Little other work has been possible apart from that directly needed for the 30m. level, such as completing the winze ladderway and equipping 30m. station. Some maintenance on plant, buildings and the road has been necessary.

30m. Drive West.

This commenced on a belt of soft shale dipping 60 deg. N. with a small quartz leader on the hanging wall. After about 50ft. the quartz had developed into a band up to 2ft. wide with small amounts of included country rock, totally barren apart from occasional barytes. Quartz in this quantity is very unusual in Force Crag generally. The vein continues in similar form to 150ft. passing through a number of thin N-S stringers, some containing siderite, barytes and galena.

After 160ft. more barytes, siderite and pyrite showed, with small amounts of galena and a little sphalerite. At 170ft. a strong lens of barytes was encountered, 17ft. long and 21" wide in the floor (but much narrower in the back). A quartz and siderite leader joined the vein from the N.E. at 165ft. and for a short distance after this, zinc and lead mineralisation strengthened, but not in payable amounts. This died out at 190ft. but at 220ft. sphalerite in a zone of siderite stringers appeared on the footwall, actually exposed in October, in the next period.

Because of financial reasons, follow up work on the last find will be limited.

Equipment.

The Company's own pump has performed well, though less water has been encountered lately. The hired hoist has proved good in service and was retained even after the removal of the shaft door made our own hoist available, because performance was better.

The Climax loader was lowered to 30m. level, for which it had to be split into three components.

The diamond drill has been out on hire for the whole period.

The small compressor repairs have been completed but it has not been necessary to use it lately.

The shaft mucker is stored out of use.

Other work.

Apart from routine repairs little has been possible or necessary. The barytes stoped last December was eventually trammed out and despatched in September.

Considerable work was expended on locating and costing equipment for a mill and initial discussions were held with Local Authorities on the subject, in anticipation of better results than actually realised.

Commercial-in-Confidence

Future work.

The future activity at the mine depends mainly on the financial position. It is evident that when the present programme is completed, i.e., driving 30m. west to 250ft., the credit limit will be exhausted. As a result, most hands are to be discharged on October 13th. (only 2 men left now) 17-10-79

Two miners are to be retained for a limited period on some follow-up diamond drilling and clearing up equipment. Some side holes in 30m. west are deemed advisable and also a hole from 30m. station to intersect the vein about 70ft. east of the crosscut, is to be tried. One other hole, if funds etc. permit, to try the OWA zone downward, is to be drilled from a crosscut in the footwall. The location is 365N 3195E declined 45 deg., to intersect about 40ft. below O.

There are some parties expressing interest in the mine, so that all equipment is being retained. As there is some demand, the opportunity to hire some of this out is being taken, which will provide some income at least to pay for the premises to be supervised; it was found at the last shutdown that equipment hired out fared better and deteriorated less than if left on the mine.

Appraisal of results.

It can be taken that OWB block terminates at O level and no further reserves may be shown here.

OWC block obviously does not continue down to 30m. level with the same strength which it shows on O level, but as 30m. does not show some intermittent mineralisation, I would claim it not unreasonable to infer that the ore continues halfway down to 30m. On this basis a block of 10,000 tons approximately of similar grade should be available below O level.

That gives a total of about 40,000 tons, which disregarding tonnage in odd remnants and low return prospects* is well short of the 50,000 ton target.

Such a reserve leaves us with a difficult selection of alternatives, principally as follows:-

1). Abandon the mine. Some £15,000 might be had from the sale of equipment, but if site restoration is necessary this would be swallowed up.
2). Continue exploration in such areas as show promise.
3). A minimum cost mill operation to salvage what can be had from existing reserves.
4). A milling operation with a proportion of profit put to exploration such as in (2).

All apart from (1) require further capital and all that that entails.

(2) is unlikely to be attractive to an investor because of the amount of work done already for relatively meagre returns.

(3) would have to be shown to be profitable, to an investor, and projection of metal prices and costs, even only as far ahead as the limited life of the operation, would be difficult.

At times of high metal price, (3) might evolve into (4) and the life of the operation might be extended. However an investor would be unlikely to go for option (4) in toto, i.e., put in a longer life plant on the assumption that more ore would be found before the current reserve ran out, even though a longer life plant would have a greater break-up value, and some tax and grant advantages.

Force Crag would seem, as it has with several previous owners, again produced a quandary greatly in excess of its size. Myself, I would favour option (3) and hope that opportunity would arise to develope enough to extend the mine's life. Cornwall's longest lived tin mines operate on a two year proved reserve. (? not so).

* Low return in terms of tonnage for effort and expense to evaluate prior to mining.

FORCE CRAG MINES (U.K.) LTD.

Directors: M. Klyman (Canadian — Chairman), R. I. Gunn, G. W. Hall

68 GROVE END GARDENS, LONDON NW8 9LN

01-286 9477

PRESS NOTICE FOR IMMEDIATE RELEASE

FORCE CRAG MINE, CUMBRIA: NEW EXPLORATION PROGRAMME UNDER WAY

Underground exploration work has started, to discover the feasibility of re-opening the Force Crag Mine near Braithwaite, Cumbria. The mine was worked on and off by several operators from the 1840s until 1922 for lead and zinc. Barytes was produced until 1966.

Force Crag Mines (U.K.) Limited, with international finance behind it, is to carry out a programme of exploration, expected to last into next year, to prove the size and value of known ore bodies. Existing ore reserves are estimated to be about 16,000 tons grading 1.75% lead, 8.68% zinc, and 6.68% barytes. These reserves are accessible from the existing workings but the Company intends to locate additional ore bodies to increase reserves sufficiently to justify re-opening the mine on a modest commercial scale.

Should the exploration programme prove successful the Company would propose, subject to the necessary official consents, to start mining and milling at the rate of 50 tons per day. An underground staff of nine, and a surface staff of six to run the mill, is envisaged. Combined lead/zinc concentrate would be obtained by crushing and flotation - to be sold from the mill to a commercial smelter. Barytes would be concentrat on shaking tables.

Force Crag's General Mine Manager, Mr Robert I Gunn, is an experienced mining engineer who has worked extensively on mining projects throughout Britain. Says Gunn: "With greater official encouragement for U.K. mining operations, this countr could become largely self-sufficient in respect of certain bas

metals. Recent increases in world metal prices (lead has more than doubled in the past 18 months) mean that enormous balance-of-payments savings could be effected by mining known domestic deposits."

Notes for Editors

- The current metal price for lead and zinc is now more than £400 per tonne
- Barytes is naturally-occurring barium sulphate, a heavy inert industrial mineral and is the raw material from which almost all other barium compounds are derived. The principal user of barytes is the oil and gas well drilling industry where about 75% of all barytes is used.
- Attachments give historical and other background information.

With compliments:

Gerard Noel
Force Crag Mines (U.K.) Limited
68 Grove End Gardens
LONDON NW8 9LN

01-286 9477

March 4 1977

Background Information on

MINING IN THE LAKE DISTRICT

and the

FORCE CRAG MINE

Mining in the Lake District is known to have commenced as a major industry in the 16th century, and probably continued without interruption until 1966. The era of the greatest activity was the 19th century, with 19 mines in production in 1874. The principal materials sought were lead, copper, zinc, barytes, graphite and tungsten. Although many mines were small by present-day standards, some were of major importance at the time: the Greenside Mine, near Patterdale, which closed in 1962, produced approximately 3m tons of ore containing approximately 8-10 per cent. lead and 1-oz / ton of silver.

The first recorded activity at Force Crag was about 1830, when Messrs. Walton, Dowthwaite & Cowper drove levels 1, 2, and 3. The first reported production was in 1848-50, when 78¼ tons of lead concentrate was produced. From 1858-63 J. Walton & Co. produced 256 tons of lead concentrate.

The mine was reopened for barytes by Straughton & Co. (1867-75) and then by Force Crag Mining Co. (1876-78). During this period 4,497 tons of barytes was extracted. Levels 4 and 5 must have been commenced at this time, but production appears to have been from the original three levels.

The mine was closed from 1880 until 1905, when it was reopened for lead and zinc by Lobb & Co. A mill was erected but the operation was unsuccessful due to the difficulty of separating the zinc ore from the barytes, while lead output alone would not support the operation. Work ceased in 1909 but was resumed in 1912 by the Coledale Mining Syndicate, which erected a flotation plant producing clean concentrate; lack of water power brought about a further closure in 1915.

Braithwaite Mines Ltd. was formed in 1916 to continue the operation, with a gas-engine as power source. Successful production was apparently maintained throughout the remainder of the war and up to 1922, when metals, particularly zinc, became virtually unsaleable.

Total reported production of metals from 1848 to 1913 - the only period for which figures are available - was 415 tons of lead concentrate, and 750 tons of zinc concentrate, with silver running about 30-oz. per ton of pig lead. Most of this came from the Nos. 1,2 and 3 stopes, while the post-1913 production must have come from the Nos. 3 and 4 stopes only.

In 1929, M. Newbold & Partner drove the High Force cross-cut and intersected a wide vein of barytes, but no production resulted and the mine was dormant until 1939, when Tampimex Oil Products Ltd. took it over, put up a new mill (the existing building) and produced, from 1940-47, some 35,000 tons of barytes. In 1948, Laporte Chemicals Ltd. took an interest in the mine but never started production. The period 1960-66 saw McKechnie Brothers Ltd. in operation at Force Crag. There has been little activity at the mine during the past 10 years.

The existing mill building, a solid structure of brick and stone on concrete foundations, needs considerable renovation if it is to be used again. There is a small office building on site which the Company is now rehabilitating.

With compliments

Gerard Noel
Force Crag Mines (U.K.) Limited
68 Grove End Gardens
LONDON NW8 9LN
01-286 9477

March 1977

2000 E

2500 E

3000 E

No. 3

No. 2

1000' O.D.

No. 4 Stope

No. 3 Stope

No. 2 Stope

No. 1 Stope

No. 1

No. 0

500' O.D.

2000 E

2500 E

3000 E

FORCE CRAG MINE

FIG. 12 LONGITUDINAL SECTION
SHOWING PROPOSED DEVELOPMENT

SCALE: 1 inch to 100 feet

= = = = = Proposed raise or drift

⊙ D.D.H. target

[ex- Bowdidge Report- 1976]

2000 E

2500 E

3000 E

I LEVEL

500N

1
2
3
4
5
6

FORCE CRAG MINE

FIG. 11 PLAN SHOWING PROPOSED DIAMOND DRILL PROGRAMME

SCALE: 1 inch to 100 ft.

Proposed X-cut
" contract D.D.H.
" short D.D.H.

0 LEVEL

500N

7
8
9
10
11
12
13
14
15
16
17

MINE

N

2000 E

2500 E

3000 E

Force Crag Mine.

Mining Note Lake Counties by D.T. Shaw

THIS is the only mine in the area to have been worked after the depression, though barytes, not lead or zinc, was obtained. Barytes-working at Force Crag dated back to the 1860s when local men re-opened the lead workings for this mineral, but by 1880 the venture had been given up as uneconomic for price reasons rather than lack of barytes. In 1905-6 Messrs. Lobb & Co., who were working Thornthwaite Mine, reopened the lead workings and erected a then modern dressing plant for the production of lead and zinc concentrates. It was impossible to separate blende and barytes, and as there was not sufficient galena present in the ore to allow the mine to be worked for lead alone, they closed down in 1909 after spending a great deal of money.

In 1912 the Coledale Mining Syndicate was formed and work restarted. This company installed one of the very first Elmore Flotation Plants, which separated clean blende from a mixed blende and barytes concentrate. Lack of water power and other inadequacies brought the mine once more to a stop in 1915. Braithwaite Mines Limited was formed in 1916 with a capital of £15,250, the principal subscribers being Mr. G. F. Wallace and Mr. C. E. Currie. Mr. Wallace acted as manager and proceeded to erect two suction gas engines to overcome the power shortage. A silex-lined ball mill was also installed to grind the coarse mixed concentrates from the jigs to feed the Elmore Plant, and several latest type concentrating tables were also erected. In 1919 an air compressor was set up to supply air to two rock drills. During the 1914-18 war the mine was worked with some vigour for the blende was in great demand by the Ministry of Munitions. The No. 0 Level was begun as a crosscut into the base of the mountain at 100 feet vertically below the No. 1 or Mill Level and by 1921 when the mine closed down it had been driven 350 feet in a NNW direction without finding any sign of the vein.

A fresh company took up the lease of the mines in 1929 and drove the High Force crosscut in search of barytes. This level starts in the steep crags beside Pudding Beck at 1,710 ft. and after driving 520 feet a very fine vein of barytes was cut. Nothing further was done until 1939, when the Tampimex Oil Co. Ltd. took over and erected a ropeway down the mountain to carry the crude barytes to the millsite. Unfortunately in the long interval since 1921 all the former machinery and buildings had been removed and it was necessary to erect a new brick mill building which incorporated some of the original stone walls. A complete crushing and washing plant was installed by Messrs. Davison Ltd., of Hexham, the machines being belt-driven by an 80 h.p. Blackstone diesel engine. Several portable compressors were set up in a shed at High Force Level mouth and during the next seven years some 35,000 tons of high grade barytes was produced.

By 1947 almost all the worthwhile barytes-bearing ground had been removed to a depth of 80 feet below the High Force Level, which was the bottom level off an internal shaft. The 1947 blizzard brought the venture to an end, for by the time the miners were able to get into High Force Level all the shaft workings were full of water and all the pumps and other tackle had been lost. Messrs. LaPorte & Co. Ltd., bought up the lease and plant and drove a long incline from the old No. 3 Level to beneath the 80 ft. Level workings with a view to opening the barytes shoots at greater depth without having to pump or wind the ore up to High Force Level. After completing the incline and putting up a rise from the top of it to the 80 Ft. Level there was a recession in the barytes trade and they decided not to continue. All the plant and machinery was again sold up and removed.

Messrs. McKechnie Brothers Ltd., of Widnes, who were working the Caldbeck Barytes Mines, took up the property in 1960 and drove the No. 3 Level forward to beneath the ore shoots in High Force Level but without finding any workable barytes. Subsequently development and extraction of barytes from workings off the incline was begun and further connections made to High Force Level. The crude barytes ore was scraped down the upper part of the incline to a rise from No. 3 Level where it was drawn out to daylight by a battery-type locomotive in trains of six cars. Here the ore was dumped into a tipper lorry which carried it down the mountainside to the mill. A new plant had been set up in the building, only the shell of which remained, with each machine driven by individual electric motor, and the mill was capable of producing 100 tons of dressed barytes per week. Power for the motors was supplied by a 100 KW Dorman diesel set and there was a 50 KW standby alternator belt driven by a 120 hp. GMC diesel engine. Compressed air for the rock drills, fans and slusher hoist in the mine was from a 600 cu. ft. minute Joy Sullivan rotary compressor which had a Cummins diesel engine.

Development below the 80 Ft. Level was poor as the vein contained large amounts of wet clay with very little barytes; it was very difficult ground to work. In 1965 after clearing through a large fall the west face of High Force Level was seen for the first time and although it was completely barren there was nevertheless a good footwall and it was

thought worthwhile to drive it on at least for a little way to see if there was any sign of further barytes. Presently the vein opened into a brand new shoot of barytes, which was slightly opened up for stoping, in which work up to 5 feet of excellent barytes was revealed. The vein in the face of High Force West level carries about 9 inches of barytes and there is no doubt that further shoots will be discovered if the level is ever advanced. On surface above this ground the rock near the hilltop is black shale in which the vein does not carry any mineral but immediately below this shale the rock is Skiddaw sandstone which is a very favourable host rock in which the barytes has been proved to be workable for at least 300 feet below the shale. Although very varied the general dip of the strata is gently down to the west and there remains some 1,500 feet to drive before the level would come out to surface.

In 1966 Messrs. McKechnie Brothers Ltd. withdrew from mining and gave up the manufacture of barium chemicals. All the plant and machinery was once again sold up by auction and the mine lease given up. A group of Canadian stockbrokers became interested in the possibility of reopening the old lead workings to see if it would be a payable proposition under present-day conditions. A new company called Force Crag Mines Ltd., was formed in Toronto with a share capital of 4,000,000 shares of $1 value.

A new entrance to No. 1 Level has been driven through the loose shale and boulderclay and connected up to the original workings. Most of the old stopes were found to have collapsed and byepass drifts have now been driven past them so that the whole of the old level is open to the western face which was last worked in 1862. This face was found to be off the proper vein which was picked up by extending a crosscut made about 1907. Some driving has been done on the vein and it is thought that the probable downward continuation of an oreshoot seen in No. 3 Level is not far ahead of the present face. The No. 0 Level has been advanced 1800 feet from the entrance and has developed a considerable tonnage of crude ore containing galena, blende and barytes. Although the mine is closed down at present, development work is expected to be resumed shortly with the ultimate object of installing a dressing plant and so bringing the mine into production.

FORCE CRAG

Situated at the head of Coledale, a steep-sided valley 2½ miles SW of Braithwaite (2 miles W of Keswick).
Geol. maps: 1-in O.S. 101 SE; 6-in Cumb. 63 SE.
Recent owners: Tampimex Products 1941-44; Laporte Chemicals 1950.

The somewhat chequered history during the past 100 years is partly attributable to the former difficulties of separating blende and barytes and to their predominance over galena.

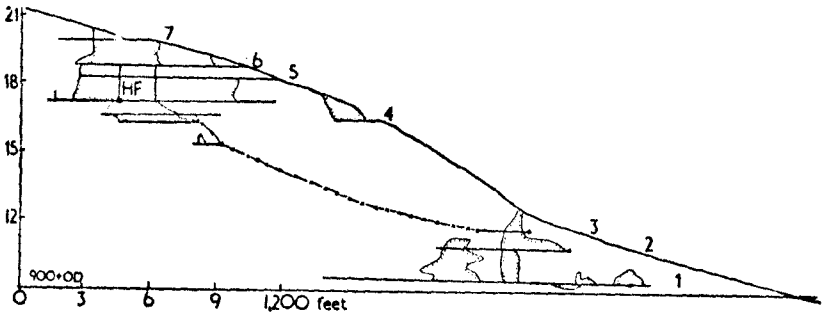


Fig. 4.—Force Crag, showing approximate levels of stoping and position of drive in hanging-wall.

The Force Crag Vein ranges W by S across Coledale to the foot of Crummock Water, a distance of 3 miles. Workings, however, are confined to about 900 yd W of Coledale to Pudding Beck (see Fig. 4). Farther west the vein appears at outcrop as barren quartz; of trials near the western end, at Lanthwaite Gate, little information is available. Believed to continue a mile east of Coledale, it is mostly untried. About 150 to 200 yd N of Force Crag Vein is Long Crag Vein, siliceous at high outcrop but untried elsewhere; crosscuts towards it from Force Crag were abandoned far short of the target.

Force Crag Vein hades north from near vertical to about 40° but is commonly 15-25° with the foot-wall usually better developed than the hanging-wall. The country rock is dark banded Skiddaw Slates and the vein filling is partly slate breccia threaded with irregular veins of quartz. The sole economic mineral about 1200 ft O.D. is barytes. At lower levels barytes is accompanied by blende and galena. Other minerals, in small amounts, are dolomite, psilomelane and pyrite with fluor as a rarity. The order of introduction appears to have been (1) lead-zinc; (2) barytes-dolomite; (3) manganese-pyrite.

The Force Crag Vein varies in width from 1 to 20 ft, but probably averages about 5 ft. At the east end of the No. 1 level, for example, the vein is 15-20 ft wide with good lenses of barytes, and similar widths were encountered in the high levels. In places the vein is split by a barren horse up to 5 yd across and several yards long, as in No. 1 level and on High Force level, though both branches are workable.

Barytes in the upper levels constitutes the principal vein filling. In levels 1 to 3 it occurs chiefly as lenses 2-3 yd long and 6-8 in. thick on the walls as well as in ribs in the middle of the vein. Between these levels galena is seldom in ribs, is frequently scattered but usually in bunches. Blende, on the other hand, is usually scattered. Both lead and zinc tend to occur in NE-SW diagonal bands rather than parallel to the walls.

Galena and blende were almost wholly derived from levels 1 to 3 in Coledale, where blende is about 10 times as common as galena and the

proportion of barytes is about 3 : 1 of metallic ores. These levels are approached by northerly crosscuts ranging from about 120 yd in No. 1 at 941 ft O.D., and about 100 ft above valley floor, to 30 yd in No. 3 at 1173 ft O.D. The lengths of these levels vary somewhat in different records but there is no record of stoping beyond 900 ft W in No. 1, the ground beyond that point being mostly barren; at the western forehead there issues a small hot spring. These workings are approached by a narrow but well-graded road, originally a tram road, from Braithwaite; the higher workings are reached by extremely rough track and an aerial ropeway.

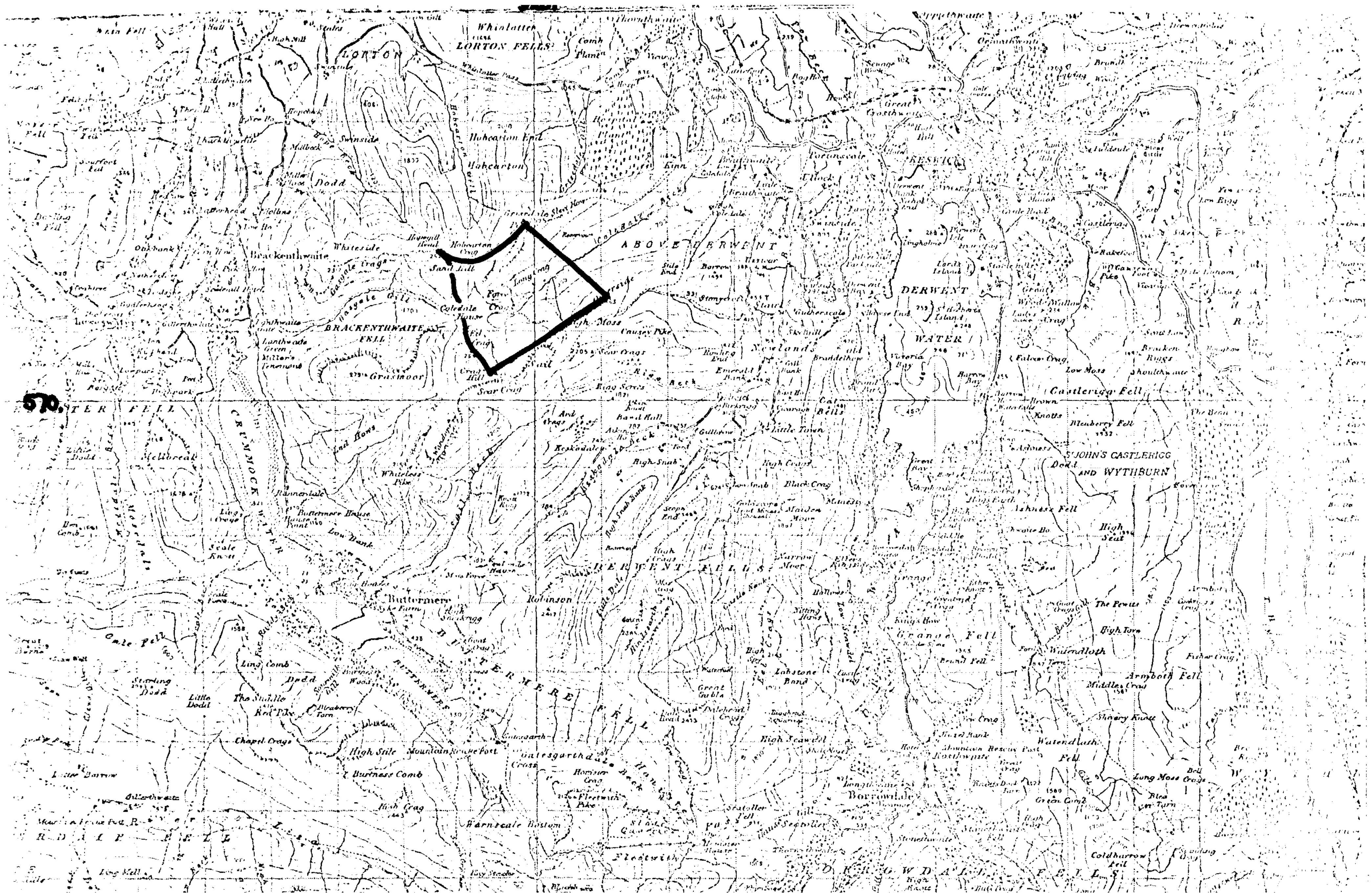
High Force, the principal upper level, is entered by a 500-ft crosscut at 1710 ft from the High Force crags, made about 1929. Above it the ground is largely stoped to surface at about 2000 ft; below it there are sub-levels at 50 and 80 ft, and a short one, the '1100', still lower. It will be noted from Fig. 4 that these high workings, mainly by Tampimex and which yielded about 35 000 tons of dressed barytes, are connected by inclined drive of recent date to No. 3 level. This incline, roughly parallel to the vein, is in the hanging-wall. From it only one crosscut, of 27 ft, was made about 250 ft below High Force level to the vein, which there carried but a 6-in string of barytes. One trial, however, in a vertical height of some 500 ft between known orebodies seems hardly sufficient to condemn a vein in spite of some downward deterioration from High Force, for the stopes between 1 and 2 levels showed 12-30 in. of barytes on the hanging-wall of a vein 8-10 ft wide, which there, of course, carries blende and galena in addition.

Deterioration westwards in these low levels has already been remarked; there is deterioration westwards too, between No. 7 or Pudding Beck and High Force levels, chiefly due to silicification which sets in about the same vertical position. Even so, on the assumption of an orebody vertically below the high workings, there would appear to be good chances of a deposit some 800 ft square within 300-400 ft of No. 1 level forehead, in the upper half of which one would expect barytes to predominate while the lower half would yield galena, blende and barytes. How far west the silicified zone extends is unknown but the presence of lead at Lanthwaite Gate warrants some trial of the intervening ground by inclined borings beginning a few hundred feet west of the highest Force Crag workings.

The continuation eastward across Coledale of the Force Crag Vein is also worthy of trial though in much of that region only 100-200 ft of backs would be available, for that side of the valley is less steep than the other.

Published outputs relating to odd years worked between 1848 and 1913 amount to only 415 tons of galena and 750 tons of blende; the latter figure is at variance with the record of blende being 10 times more abundant than galena. Silver amounted to 30 oz per ton of pig lead.

In his report to Ministry of Munitions Cunningham (1917/MS) estimated that Force Crag (from lower levels) could produce 20-30 tons of blende concentrate a week averaging 42 per cent zinc, and stated that G. F. Wallace, of Force Crag, estimated a reserve of 40 000



LORTON FELLS
Whinlatter
LORTON
Thornthwaite
Hobcarton End
Hobcarton
Dodd
Whiteside
Brackenthwaite
Hobcarton Crag
Sand Hill
Coledale Hause
Long Crag
Force Crag
Grisedale Pike
Hospital Plant
Portinscale
Braithwaite
KESWICK
Great Crosthwaite
Castlerigg
ABOVE DERWENT
Swinside
Stair
Stoneycroft
Barrow
Causey Pike
High Moss
Scar Crags
Sail
BRACKENTHWAITE FELL
Grasmoor
Crag Hill
Rigg Beck
Newlands
DERWENT WATER
Derwent Isle
St Herbert's Island
Lords Island
Victoria Bay
Falcon Crag
Castlerigg Fell
Low Moss
Shoulthwaite
Cat Bells
Little Town
Ard Crags
Keskadale
High Snab
Blenberry Fell
ST JOHN'S CASTLERIGG AND WYTHBURN
Ashness Fell
High Seat
570.
CRUMMOCK WATER
Mellbreak
Rannerdale
Buttermere Hause
Low Bank
Whiteless Pike
Maiden Moor
Black Crag
High Crag
Scope End
DERWENT FELLS
Narrow Moor
Robinson
Buttermere
High Snockrigg
Grange
Grange Fell
Kings How
Watendlath
Armboth Fell
High Tove
The Fewtis
Great Gable
Dale Head
High Scawdel
Hindscarth
BUTTERMERE
Gatesgarthdale Beck
Honister Crag
Fleetwith Pike
High Stile
Red Pike
Chapel Crags
Starling Dodd
Little Dodd
Floutern Tarn
Burtness Comb
High Crag
Mountain Rescue Post
Borrowdale
Rosthwaite
Seatoller
Stonethwaite
Watendlath Fell
Middle Crag
Blea Tarn
Long Moss Crags
Coldbarrow Fell
Warnscale Bottom
Fleetwith
Little Barrow
Gillerthwaite

DETAILS OF THE EXPLORATION PROJECT

4. (a) Name by which the project is known to the applicant.

FORCE CRAG MINE

(b) Details of site or address; please include three copies of a map or overlays (which should be to the scale of 4 miles to the inch) indicating the boundaries of the area to be explored and giving National Grid References. Maps should be signed for identification purposes by a director of the company.

SITE IS APPROXIMATELY THREE MILES SOUTH-WEST OF BRAITHWAITE, CUMBRIA.
NGR: NY 202 217.

THREE COPIES OF MAP SUBMITTED HEREWITH

(c) Minerals sought.

LEAD, ZINC, BARYTES

(d) Provide three copies of a separate statement, with maps or overlays, and plans as appropriate, of the relevant geology of the area, showing existing workings, if any, and identifying the specific targets (eg mineralised zones, including lodes, and geophysical and geochemical anomalies etc).

THREE COPIES OF STATEMENT SUBMITTED HEREWITH AS "APPENDIX I" TOGETHER WITH THREE COPIES OF 1" to 100-ft PLAN OF EXISTING WORKINGS AND THREE COPIES OF 25-in to 1-mile SURFACE PLAN.

DETAILS OF WORK PROGRAMME

7. (a) Describe the work programme for which assistance is being sought.

It is recommended that a two-stage programme of exploration and development be initiated. Stage I should consist of: a programme of diamond drilling of short, horizontal holes into the walls of the drifts on 0 and 1 levels to test the full width of known shoots and to explore for parallel shoots; an I.P. survey to test for the possible eastward extension of the zone; a soil geochemical survey to test an area of interest in the eastern corner of the property; and development work to substantiate known reserves.

Stage II would be contingent upon satisfactory results from Stage I (above) and would be subject to a separate application.

The following is a summary of the report dated October 25 1976 by C R Bowdidge, MA PhD FGAC, whose full report is on the files of the Ontario Securities Commission, and of which a copy will be supplied to the Department of Industry upon request.

The property consists of an area of approximately 670 acres, including the Force Crag Mine, a former producer of lead/zinc/silver and barite.

The property is underlain by slates, shales and sandstones of the Ordovician Skiddaw Slate Series, which have been subject to multiple deformation during the Caledonian Orogeny. The mineralized zones are located in a fault-like structure which is provisionally interpreted as a dislocation between two structural domains.

The Force Crag Mine is known to have produced lead and zinc intermittently from the 1840s to 1922. The closure of the lead/zinc operation in 1922 was reportedly the result of a general slump in metal markets.

The mineralization consists of clots and strings of sphalerite and galena in a breccia-like zone. It occurs as shoots up to 22-ft wide distributed along the structure over a length of at least 1,000-ft. In the upper mine levels, not relevant to this application, barite occurs alone, as veins up to 5-ft or more wide.

Based on sampling data supplied by the Company, a probable reserve was calculated as: 16,391 tons averaging 1.75% lead, 8.68% zinc and 6.68% barite. Additional tonnages of lower grade material are available.

It is concluded that there are good possibilities for developing further reserves by (a) testing the full width of known shoots, (b) exploring for possible parallel shoots, (c) extending the zone at depth, and (d) exploring for a possible eastward extension of the zone across the valley where a previous geochemical survey has indicated possible mineralization.

January 1977

REPORT ON
FORCE CRAG MINES LIMITED

Cumberland, England

Toronto, Ontario
July 15, 1971

t, P. Eng

TABLE OF CONTENTS.

Summary	i
Introduction	1
Property	2
Location and Access	2.
Facilities	2
History	3
Geology	3
Possible Economics	5
Summary and Conclusion	5
Recommendations	6
Estimated Costs	7
Acknowledgements	8
Certificate	9
Longitudinal Section	

SUMMARY.

Force Crag Mines Limited holds a property in northwestern England, previously developed by eight adits, from which barite and zinc-lead have been mined.

The present company opened a ninth adit, the "O" Level, and explored along the principal structure a length of about 1,470 feet, of which 510 feet showed zinc-lead mineralization estimated by incomplete muck sampling to grade 2.33% lead and 4.0% zinc.

There is estimated to be 48,500 tons of material of this grade available above the "O" Level, including 2,000 tons on the dump, and material already broken underground.

Based on records from previous milling operations, and a tentative smelter schedule, net smelter returns are estimated at £5.4 per ton of ore, including revenue from barite. Operating costs have been estimated at £3.82 per ton, including royalties, but not including depreciation, interest, or taxes. It is estimated that little or no return could be expected on capital, unless the grade is higher than estimated, or more mineralized material is developed.

It is concluded the Force Crag structure warrants further exploration and two programs are recommended to explore the strike extensions, one a program of drifting to the west, and one a program of surface geochemistry to the east. These are estimated to cost $15,000. If warranted by the results of this work, a follow-up program estimated to cost $20,000 is recommended.

INTRODUCTION.

Force Crag Mines Limited, by agreements with the owners of the Leconfield Estate, holds a property in the Lake District of northwestern England.

Mining, by means of adits, has been carried out intermittently for over 100 years. Both barite and zinc-lead have been mined.

The present company has been attempting to develop more zinc-lead ore in the lower levels of the mine and has opened a new level, the "O" Level.

The purpose of this report is to provide a review of the geology and development of the zinc-lead occurrences, and to make recommendations for the further exploration of these or similar occurrences.

PROPERTY:

The property is held under two agreements with the owners of the Leconfield Estate. The first is a prospecting licence valid for a period of five years and the second is a mining lease for 99 years which will come into effect at any time within the five year period, at the company's discretion.

The property is rather more than a square mile in size, centred on Force Crag 4 1/2 miles west-southwest of the town of Keswick. The boundaries are:

SW:	From the summit of Crag Hill via the parish boundary to the summit of Sand Hill (by way of Eel Crag and Coledale Hause)
NW:	From the summit of Sand Hill via the parish boundary to the summit of Grisedale Pike (passing the top of Hobcarton Crag)
NE:	From the summit of Grisedale Pike in a straight line to the summit of Outerside.
SE:	From the summit of Outerside in a straight line to the summit of Crag Hill.

The area is within the Lake District National Park, Government planning permission for mining operations will continue in force from previous operations.

LOCATION AND ACCESS:

The nearest town is Keswick, (population 4,500) 100 miles north of Manchester and Liverpool. From Keswick one goes west, two miles by paved highway, to the village of Braithwaite, where the paved Whinlatter Pass Road is taken for 1/4 mile. From here, a gravel road follows the north bank of Coledale Beck for two miles to the mine.

FACILITIES.

The company has on hand sufficient equipment to continue limited underground development.

Only minor capital expenditures would be required for more extensive development.

A change house is on the property. A substantial brick and stone building needing minor repairs is available.

HISTORY.

The Force Crag Mine has had a somewhat checkered history during the past 100 years, partly attributable to former difficulties of separating zinc blende and barite, and to their dominance over galena.

Galena and blende were almost wholly derived from levels 1 to 3..

The mine was previously developed by eleven levels developed through eight adits in the hillside. The sulphide bodies and barite bodies were mined by stoping from the levels. Mining was carried out during the period between 1848 and 1923. Production and grade figures are not accurately known.

Tampimex, Laporte Chemicals, and McKechnie Brothers, the lessees over the last 25 years are all primarily concerned with the treatment of industrial materials (in this case lithopane from barite) rather than mining Eastwood records that the last metal production was in 1923 when the mine closed mainly on account of poor demand for zinc blende.

The present company reopened the No. 1 Level. The most recent work wa to extend a crosscut southward, from a point near the drift face, to the principal structure, and drift along it a short distance westward.

A new level, the "O" Level, has also been opened, as an adit, 100 feet low in elevation than the No. 1 Level. This level has been driven westward about 1750 feet, most of which has been along the main structure. This is the lowest elevation it is practical to explore by using adits since the structure below this level strikes into the gently sloping valley floor.

One raise has been driven from the "O" Level to an underhand stope on the No. 1 Level.

An attempt was made to explore the zone, near the elevation of the "O" Level, by diamond drilling. Two holes were drilled from the No. 1 Level and two from surface. Drilling was unsatisfactory,

GEOLOGY.

The country rocks at the Force Crag Mine are slates, sandstones, and sha of the Skiddaw series of the Lower Ordovician.

The Force Crag structure, a fault, cuts through these. It strikes approximately N. 85°W. and dips north from near vertical to about 50°, but is commonly 65° to 75°. Where there is mineralized material, it varies in width from 1 to 20 feet, but probably averages about 5 feet. The structure has been worked over a length of rather more than a half mile,

but considered to cross the full mile width of the property and may extend a total length of four miles.

According to company plans, along its upper westward part, the structure cuts through sandstones. A large part of this section was mined for barite The structure passes westward into black shales which appear to have been unproductive. Along the lower eastward section, the structure cuts slates and was mined for zinc-lead. It is in this slate horizon, and below the zinc-lead stoping, that most of the present company's work has been done. Between the sandstones and the slates is a "transition zone", of thinner alternating relatively incompetent shale and slate beds, which to date has seen almost no stoping, but in which there is reported to be at least one occurrence of lead-zinc material. The trace of the boundaries of these sedimentary horizons on the Force Crag fault plane is shown on company plans to vary from about 20^{o} to 50^{o} to the west. The position of these contacts, thus presented, is not claimed to be exact, but is accepted as a good generalization.

Where examined on the "O" Level and the No. 1 Level, the mineralized material ranged from tiny blobs of sphalerite and galena to massive sections of these minerals, usually with many included fragments of slate. The metallic mineralization was usually accompanied by a vein of barite which is visually estimated to make up about 10% of the total volume of the mineralized sections. Wider sections of mineralization sometimes include a horse of waste.

Before drifting was resumed early in May at the west end of the No. 1 Level, Mr. W. T. Shaw, the mine manager, reported about 1, 530 feet of the structure on the No. 1 Level had been explored by drifting, of which 470 feet had been mineralized. The longitudinal section of the mine, one of the company plans, shows a slightly greater length has been stoped overhand. It is understood that the No. 1 Level has since been carried to the west a short distance along the structure with no good mineralization having been exposed. It is reported that the face of the No. 1 Level is now about 75 feet from the projected position of a mineralized section on the No. 3 Level, 200 feet above.

On the "O" Level, Mr. Shaw reported about 1, 470 feet of the structure has been explored and of this length, 510 feet had mineralization similar to the stoped sections on the No. 1 Level.

The pattern of the mineralized sections is somewhat erratic. They may be as short as 90 feet, and even a good section may include a length of weak mineralization.

Average grade of 2.33% lead and 4.0% zinc has been estimated for the mineralized sections. This is based on muck samples taken on the "O" Level and is an estimate of the grade expected to be obtainable by stoping. The average of the muck samples actually taken on the "O" Level was 2.56% lead and 6.52% zinc. Some high assays were removed before averaging. Samples were not taken in the less mineralized sections, even though some of these would have to be included in material being stoped. For this reason management reduced the average to 2.33% lead and 4.0% zinc. Visually this appears to be approximately correct, but since complete assay plans are not available there must be some doubt.

Chip samples, taken from the back of the drift along one mineralized section, gave a higher result, however.

Mr. Shaw has estimated the material grading 2.33% lead and 4.0% zinc available for mining above the "O" Level at 48,500 tons, including 2,000 tons on the dump and material already broken underground.

POSSIBLE ECONOMICS.

Based on records from previous milling operations, it has been estimated that recoveries of 90% of the lead and 90% of the zinc could be effected, with concentrates averaging 70% lead and 60% zinc. It is expected that 25 oz. of silver would be recovered with each ton of lead concentrate. It is also expected that barite valued at £1.00 per ton of ore could be recovered

Based on a tentative smelter schedule received from Rio Tinto Zinc Corp. in 1967, net smelter returns are estimated at about £5.4 per ton of ore, assuming the grade of the mineralized material to be correct. Operating costs have been estimated at £3.82 per ton, including royalties, but not including depreciation, interest, or taxes.

SUMMARY AND CONCLUSIONS.

Underground development by Force Crag Mines Limited, has exposed lengths of zinc-lead mineralization on a new adit level, the "O" Level, totalling 510 feet. The grade of this material is estimated to be 2.33% lead and 4.0% zinc, although complete assay plans are not available.

The company estimates material of this grade, available for mining above the "O" Level, to be 48,500 tons, including broken muck underground and on the dump.

It is estimated an operating profit could be won from mining and milling this material, but a complete up-to-date feasibility study has not been done.

It is estimated that little or no return could be expected on capital which would have to be supplied to bring the mine into production, unless the grade is higher than estimated, or more mineralized material is developed.

The face of the No. 1 Level is now some 75 feet or so from the projected position of a mineralized section on the No. 3 level.

The host rocks beyond this section, for some distance to the west, are believed to be incompetent, beyond which the competent sandstone horizon is located.

The Force Crag structure strikes eastward into unexplored ground, the elevation of which is lower than the "O" Level, but gently sloping, so that it can not be explored further by adits. There is about 2,000 feet of strike length from the portal of the "O" Level to the east boundary of the property.

RECOMMENDATIONS.

It is recommended that exploration of the Force Crag Mine be continued in two different phases. Phase A is to consist of two different programs and Phase B is to follow up any encouraging results obtained in Phase A.

Phase A:

Program I is recommended to consist of an extension of the No. 1 Level westward to explore for and develop the mineralized section projected to be 75 feet or so west of the current face.

It is recommended any mineralized sections found in the drifting be carefully sampled, using the muck sampling method previously employed.

As soon as the projected position of the mineralized section has been passed by the drifting, a reassessment of the entire underground program should be made. This should include the sampling of the "O" Level dump, as a check on the estimated grade.

Program II is recommended to consist of a geochemical survey of the 2,000 feet of ground between the "O" Level portal and the eastern boundary of the property.

Phase B:

Depending on the results obtained in Phase A, follow-up work on one of the Programs is recommended.

For Program I, this would consist of additional drifting.

REPORT ON
FORCE CRAG MINES LIMITED

Cumberland England

Toronto, Ontario
July 15, 1971.

TABLE OF CONTENTS.

Summary

Introduction

Property

Location and Access

Facilities

History

Geology

Possible Economics

Summary and Conclusion

Recommendations

Estimated Costs

Acknowledgements

Certificate

Longitudinal Section

SUMMARY.

Force Crag Mines Limited holds a property in northwestern England previously developed by eight adits, from which barite and zinc-lead have been mined.

The present company opened a ninth adit, the "O" Level, and explored along the principal structure a length of about 1,470 feet, of which 510 feet showed zinc-lead mineralization estimated by incomplete muck sampling to grade 2.33% lead and 4.0% zinc.

There is estimated to be 48,500 tons of material of this grade available above the "O" Level, including 2,000 tons on the dump, and material already broken underground.

Based on records from previous milling operations, and a tentative smelter schedule, net smelter returns are estimated at £5.4 per ton of ore, including revenue from barite. Operating costs have been estimated at £3.82 per ton, including royalties, but not including depreciation, interest, or taxes. It is estimated that little or no return could be expected on capital, unless the grade is higher than estimated, or more mineralized material is developed.

It is concluded the Force Crag structure warrants further exploration and two programs are recommended to explore the strike extensions, one a program of drifting to the west, and one a program of surface geochemistry to the east. These are estimated to cost $15,000. If warranted by the results of this work, a follow-up program estimated to cost $20,000 is recommended.

INTRODUCTION.

Force Crag Mines Limited, by agreements with the owners of the Leconfield Estate, holds a property in the Lake District of northwestern England.

Mining, by means of adits, has been carried out intermittently for over 100 years. Both barite and zinc-lead have been mined.

The present company has been attempting to develop more zinc-lead ore in the lower levels of the mine and has opened a new level, the "O" Level.

The purpose of this report is to provide a review of the geology and development of the zinc-lead occurrences, and to make recommendations for the further exploration of these or similar occurrences.

PROPERTY:

The property is held under two agreements with the owners of the Leconfield Estate. The first is a prospecting licence valid for a period of five years and the second is a mining lease for 99 years which will come into effect at any time within the five year period, at the company's discretion.

The property is rather more than a square mile in size, centred on Force Crag 4 1/2 miles west-southwest of the town of Keswick. The boundaries are:

SW:	From the summit of Crag Hill via the parish boundary to the summit of Sand Hill (by way of Eel Crag and Coledale Hause)
NW:	From the summit of Sand Hill via the parish boundary to the summit of Grisedale Pike (passing the top of Hobcarton Crag)
NE:	From the summit of Grisedale Pike in a straight line to the summit of Outerside.
SE:	From the summit of Outerside in a straight line to the summit of Crag Hill.

The area is within the Lake District National Park, Government planning permission for mining operations will continue in force from previous operations.

LOCATION AND ACCESS:

The nearest town is Keswick, (population 4,500) 100 miles north of Manchester and Liverpool. From Keswick one goes west, two miles by paved highway, to the village of Braithwaite, where the paved Whinlatter Pass Road is taken for 1/4 mile. From here, a gravel road follows the north bank of Coledale Beck for two miles to the mine.

FACILITIES.

The company has on hand sufficient equipment to continue limited underground development.

Only minor capital expenditures would be required for more extensive development.

A change house is on the property. A substantial brick and stone building needing minor repairs is available.

HISTORY.

The Force Crag Mine has had a somewhat checkered history during the past 100 years, partly attributable to former difficulties of separating zinc blende and barite, and to their dominance over galena.

Galena and blende were almost wholly derived from levels 1 to 3

The mine was previously developed by eleven levels developed through eight adits in the hillside. The sulphide bodies and barite bodies were mined by stoping from the levels. Mining was carried out during the period between 1848 and 1923. Production and grade figures are not accurately known.

Tampimex, Laporte Chemicals, and McKechnie Brothers, the lessees over the last 25 years are all primarily concerned with the treatment of industrial materials (in this case lithopane from barite) rather than mining. Eastwood records that the last metal production was in 1923 when the mine closed mainly on account of poor demand for zinc blende.

The present company reopened the No. 1 Level. The most recent work was to extend a crosscut southward, from a point near the drift face, to the principal structure, and drift along it a short distance westward.

A new level, the "O" Level, has also been opened, as an adit, 100 feet lower in elevation than the No. 1 Level. This level has been driven westward about 1750 feet, most of which has been along the main structure. This is the lowest elevation it is practical to explore by using adits since the structure below this level strikes into the gently sloping valley floor.

One raise has been driven from the "O" Level to an underhand stope on the No. 1 Level.

An attempt was made to explore the zone, near the elevation of the "O" Level, by diamond drilling. Two holes were drilled from the No. 1 Level and two from surface. Drilling was unsatisfactory.

GEOLOGY.

The country rocks at the Force Crag Mine are slates, sandstones, and shales of the Skiddaw series of the Lower Ordovician.

The Force Crag structure, a fault, cuts through these. It strikes approximately N. 85°W. and dips north from near vertical to about 50°, but is commonly 65° to 75°. Where there is mineralized material, it varies in width from 1 to 20 feet, but probably averages about 5 feet. The structure has been worked over a length of rather more than a half mile,

but considered to cross the full mile width of the property and may extend a total length of four miles.

According to company plans, along its upper westward part, the structure cuts through sandstones. A large part of this section was mined for barite The structure passes westward into black shales which appear to have been unproductive. Along the lower eastward section, the structure cuts slates and was mined for zinc-lead. It is in this slate horizon, and below the zinc-lead stoping, that most of the present company's work has been done. Between the sandstones and the slates is a "transition zone", of thinner alternating relatively incompetent shale and slate beds, which to date has seen almost no stoping, but in which there is reported to be at least one occurrence of lead-zinc material. The trace of the boundaries of these sedimentary horizons on the Force Crag fault plane is shown on company plans to vary from about 20^{o} to 50^{o} to the west. The position of these contacts, thus presented, is not claimed to be exact, but is accepted as a good generalization.

Where examined on the "O" Level and the No. 1 Level, the mineralized material ranged from tiny blobs of sphalerite and galena to massive sections of these minerals, usually with many included fragments of slate. The metallic mineralization was usually accompanied by a vein of barite which is visually estimated to make up about 10% of the total volume of the mineralized sections. Wider sections of mineralization sometimes include a horse of waste.

Before drifting was resumed early in May at the west end of the No. 1 Level, Mr. W. T. Shaw, the mine manager, reported about 1, 530 feet of the structure on the No. 1 Level had been explored by drifting, of which 470 feet had been mineralized. The longitudinal section of the mine, one of the company plans, shows a slightly greater length has been stoped overhand. It is understood that the No. 1 Level has since been carried to the west a short distance along the structure with no good mineralization having been exposed. It is reported that the face of the No. 1 Level is now about 75 feet from the projected position of a mineralized section on the No. 3 Level, 200 feet above.

On the "O" Level, Mr. Shaw reported about 1, 470 feet of the structure has been explored and of this length, 510 feet had mineralization similar to the stoped sections on the No. 1 Level.

The pattern of the mineralized sections is somewhat erratic. They may be as short as 90 feet, and even a good section may include a length of weak mineralization.

An average grade of 2.33% lead and 4.0% zinc has been estimated for the mineralized sections. This is based on muck samples taken on the "O" Level and is an estimate of the grade expected to be obtainable by stoping. The average of the muck samples actually taken on the "O" Level was 2.56% lead and 6.52% zinc. Some high assays were removed before averaging. Samples were not taken in the less mineralized sections, even though some of these would have to be included in material being stoped. For this reason management reduced the average to 2.33% lead and 4.0% zinc. Visually this appears to be approximately correct, but since complete assay plans are not available there must be some doubt.

Chip samples, taken from the back of the drift along one mineralized section, gave a higher result, however.

Mr. Shaw has estimated the material grading 2.33% lead and 4.0% zinc available for mining above the "O" Level at 48,500 tons, including 2,000 tons on the dump and material already broken underground.

POSSIBLE ECONOMICS.

Based on records from previous milling operations, it has been estimated that recoveries of 90% of the lead and 90% of the zinc could be effected, with concentrates averaging 70% lead and 60% zinc. It is expected that 25 oz. of silver would be recovered with each ton of lead concentrate. It is also expected that barite valued at £1.00 per ton of ore could be recovered

Based on a tentative smelter schedule received from Rio Tinto Zinc Corp., in 1967, net smelter returns are estimated at about £5.4 per ton of ore, assuming the grade of the mineralized material to be correct. Operating costs have been estimated at £3.82 per ton, including royalties, but not including depreciation, interest, or taxes.

SUMMARY AND CONCLUSIONS.

Underground development by Force Crag Mines Limited, has exposed lengths of zinc-lead mineralization on a new adit level, the "O" Level, totalling 510 feet. The grade of this material is estimated to be 2.33% lead and 4.0% zinc, although complete assay plans are not available.

The company estimates material of this grade, available for mining above the "O" Level, to be 48,500 tons, including broken muck underground and on the dump.

It is estimated an operating profit could be won from mining and milling this material, but a complete up-to-date feasibility study has not been done.

It is estimated that little or no return could be expected on capital which would have to be supplied to bring the mine into production, unless the grade is higher than estimated, or more mineralized material is developed.

The face of the No. 1 Level is now some 75 feet or so from the projected position of a mineralized section on the No. 3 level.

The host rocks beyond this section, for some distance to the west, are believed to be incompetent, beyond which the compentent sandstone horizon is located.

The Force Crag structure strikes eastward into unexplored ground, the elevation of which is lower than the "O" Level, but gently sloping, so that it can not be explored further by adits. There is about 2,000 feet of strike length from the portal of the "O" Level to the east boundary of the property.

RECOMMENDATIONS

It is recommended that exploration of the Force Crag Mine be continued in two different phases. Phase A is to consist of two different programs and Phase B is to follow up any encouraging results obtained in Phase A.

Phase A:

Program I is recommended to consist of an extension of the No. 1 Level westward to explore for and develop the mineralized section projected to be 75 feet or so west of the current face.

It is recommended any mineralized sections found in the drifting be carefully sampled, using the muck sampling method previously employed.

As soon as the projected position of the mineralized section has been passed by the drifting, a reassessment of the entire underground program should be made. This should include the sampling of the "O" Level dump, as a check on the estimated grade.

Program II is recommended to consist of a geochemical survey of the 2,000 feet of ground between the "O" Level portal and the eastern boundary of the property.

Phase B:

Depending on the results obtained in Phase A, follow-up work on one of the Programs is recommended.

For Program I, this would consist of additional drifting.

ACKNOWLEDGEMENTS:

Report on Force Crag Mines Limited Zinc-Lead-Barytes Property Cumberland, England, February 10, 1967 by D. W. Sullivan, P. Eng.

Company Plans of Mine Workings.

Company Report dated March 11, 1971 in Company files.

Personal correspondence with Mr. W. T. Shaw, mine manag

DEPARTMENT OF INDUSTRY
MEPT 1B
Millbank Tower Millbank London SW1P 4QU
Telex 915879 Telegrams Advantage London SW1
Telephone Direct Line 01-211 3704
Switchboard 01-211 3000

Dr. E. H. Francis

Dr G R Chapman
Mineral Intelligence Unit
Institute of Geological Sciences
Exhibition Road
LONDON
SW7 2DE

Your reference —
Our reference MMEI/AE.59
Date 10 FEBRUARY, 1977

Dear Dr Chapman

FINANCIAL ASSISTANCE FOR MINERAL EXPLORATION

I attach a copy of a submission with associated maps and papers from FORCE CRAG MINES (UK) LTD. for consideration of the FORCE CRAG MINE project.
I would be grateful if you would examine the submission and advise:

(i) Whether the applicants have appropriate expertise and/or experience to undertake the programme or have access to it.

(ii) Whether there is any reason why the project should not be supported.

(iii) Whether the proposed work programme is sensible in the light of available information.

(iv) If, in your view, there appear to be any abnormal features in the submission which we should take into account in reaching a decision.

If the information provided is not adequate you should approach the applicant direct but we would be grateful if you would keep us informed if anything significant arises from your discussions.

Yours sincerely

M Parker

FORCE CRAG MINES (U.K.) LTD.

Directors: M. Klemm (Canadian — Chairman), R. L. Glenn, G. W. Hall

25 BARTON STREET, GLOUCESTER GL1 1PN

Telephone: 0452 23196

Department of Industry
MEPT Division
Millbank Tower
Millbank
LONDON
SW1P 4QU

February 1 1977

Dear Sirs

In connection with the attached application under the Mineral Exploration and Investment Grants Act 1972:

(i) We wish the proposed exploration programme outlined in this application to be considered for financial assistance under the Mineral Exploration and Investment Grants Act 1972. To the best of our knowledge and belief the information given in the application is correct.

(ii) We understand that before any monies are advanced by the Department we will be required to give undertakings in writing regarding the terms and conditions governing the scheme.

(iii) We agree that the information given in this application may be made available in confidence to the Institute of Geological Sciences.

(iv) We agree that the information given in sub-paragraphs 4(b) and 7(a) and (b) may be made available in confidence to the Nature Conservancy Council.

Yours faithfully
FORCE CRAG MINES (U.K.) LIMITED

George W Hall

George W Hall
Director

MINERAL EXPLORATION AND INVESTMENT GRANTS ACT 1972

DETAILS OF APPLICANT(S)

1. (a) Name, address and telephone number of the Applicant.

FORCE CRAG MINES (U.K.) LIMITED
25 BARTON STREET
GLOUCESTER
GL1 1PN

GLOUCESTER (0452) 23196

(b) Address of Registered Office.

60 KING'S WALK
GLOUCESTER
GL1 1LA

(c) Name, address and telephone number of the person to be contacted for any further information required, and of a deputy.

Mr GERARD NOEL
FORCE CRAG MINES (U.K.) LIMITED
68 GROVE END GARDENS
LONDON NW8 9LN

01-286 9477

(d) Name and address of a U.K. bank from which a reference can be obtained.

NATIONAL WESTMINSTER BANK LIMITED
21 EASTGATE STREET
GLOUCESTER

2. Who will be carrying out the proposed exploration (if not the applicant)?

THE APPLICANT, BUT SOME DIAMOND DRILLING MAY BE SUBCONTRACTED

THE GEOCHEMICAL SURVEY WILL BE SUBCONTRACTED

FINANCIAL INFORMATION

3. Provide:

(a) a copy of the charter, memorandum and articles of association or other constitutional document relating to the applicant;

COPY OF THE MEMORANDUM AND REVISED ARTICLES OF ASSOCIATION (Adopted by Special Resolution passed April 29 1976) SUBMITTED HEREWITH.

(b) a copy of the applicant's latest audited accounts and the latest directors' report;

ACCOUNTS TO DECEMBER 31 1975 SUBMITTED HEREWITH; ACCOUNTS TO DECEMBER 31 1976 AVAILABLE SHORTLY.

(c) in addition, if the applicant is a subsidiary company, a copy of the latest audited accounts of its ultimate parent company and of the group of which it forms part.

FORCE CRAG MINES (U.K.) LIMITED IS A 54.66%-OWNED SUBSIDIARY OF NEW FORCE CRAG MINES LIMITED, SUITE 1323, YONGE STREET, TORONTO, ONTARIO, CANADA.

A COPY OF A PROSPECTUS DATED DECEMBER 7 1976 IN RESPECT OF AN OFFER OF SHARES IN NEW FORCE CRAG MINES LIMITED IS SUBMITTED. THIS CONTAINS THE RELEVANT INFORMATION.

State:

(d) whether the company or business or any directors or partners are associated with any other business. If so, further particulars may be required;

DIRECTORS:

MILTON KLYMAN
NEW FORCE CRAG MINES LIMITED
PRESIDENT AND DIRECTOR
M GREENE & ASSOCIATES LIMITED
SECRETARY/TREASURER

GEORGE WILLIAM HALL
MINERAL RESOURCES CONSULTANT
DIRECTOR - ELENITH MINING CO LTD
- GEOCHEMICAL RE-MINING LTD

ROBERT INGHRAM GUNN
MINING ENGINEER (Self-employed)
DIRECTOR - ELENITH MINING CO LTD

(e) whether the applicant company's stock or shares or those of an associated company are quoted on a recognised stock exchange, and if so, give the name of the exchange.

NO.

DETAILS OF THE EXPLORATION PROJECT

4. (a) Name by which the project is known to the applicant.

FORCE CRAG MINE

(b) Details of site or address; please include three copies of a map or overlays (which should be to the scale of 4 miles to the inch) indicating the boundaries of the area to be explored and giving National Grid References. Maps should be signed for identification purposes by a director of the company.

SITE IS APPROXIMATELY THREE MILES SOUTH-WEST OF BRAITHWAITE, CUMBRIA.
NGR: NY 202 217

THREE COPIES OF MAP SUBMITTED HEREWITH

(c) Minerals sought.

LEAD, ZINC, BARYTES

(d) Provide three copies of a separate statement, with maps or overlays, and plans as appropriate, of the relevant geology of the area, showing existing workings, if any, and identifying the specific targets (eg mineralised zones, including lodes, and geophysical and geochemical anomalies etc).

THREE COPIES OF STATEMENT SUBMITTED HEREWITH AS "APPENDIX I" TOGETHER WITH THREE COPIES OF 1" to 100-ft PLAN OF EXISTING WORKINGS AND THREE COPIES OF 25-in to 1-mile SURFACE PLAN.

5. (a) Who owns the mineral rights?

THE APPLICANT'S PARENT COMPANY (NEW FORCE CRAG MINES LIMITED) BY VIRTUE OF A LEASE FROM THE EGREMONT ESTATE DATED JUNE 14 1967.

(b) What terms have been arranged to obtain access for exploration purposes?

THE LEASE PROVIDES FOR ACCESS OVER THE ROAD FROM BRAITHWAITE

(c) What terms (if any) have been agreed for working the minerals?

THE LEASE PROVIDES FOR THE WORKING OF ANY MINERALS DISCOVERED, ON NORMAL ROYALTY TERMS.

6. What arrangements are being made for planning permission?

AN EXISTING PERMISSION IS IN FORCE; NO FURTHER PERMISSION IS REQUIRED AT THIS STAGE - SEE LETTER DATED APRIL 11 1975 FROM CHIEF PLANNING OFFICER "APPENDIX II"

DETAILS OF WORK PROGRAMME

7. (a) Describe the work programme for which assistance is being sought.

It is recommended that a two-stage programme of exploration and development be initiated. Stage I should consist of: a programme of diamond drilling of short, horizontal holes into the walls of the drifts on 0 and 1 levels to test the full width of known shoots and to explore for parallel shoots; an I.P. survey to test for the possible eastward extension of the zone; a soil geochemical survey to test an area of interest in the eastern corner of the property; and development work to substantiate known reserves.

Stage II would be contingent upon satisfactory results from Stage I (above) and would be subject to a separate application.

(b) State proposed starting date and target date for completion of the work programme.

STARTING DATE - FEBRUARY 1 1977
FINISHING DATE - OCTOBER 31 1977 (Stage I)
- JULY 31 1978 (Stage II)

(c) Provide three copies of a separate statement giving a breakdown of the estimated cost of the work programme for which assistance is now being sought, together with information on how these estimates have been compiled.

THREE COPIES OF STATEMENT SUBMITTED HEREWITH AS "APPENDIX III".

THE ESTIMATED COSTS ARE BASED ON VERBAL QUOTES FROM BOYLES BROTHERS LTD FOR DIAMOND DRILLING; FROM HUNTING SURVEYS FOR THE I.P. SURVEY; OTHER COSTS ARE BASED ON DIRECTORS' ESTIMATES IN THE LIGHT OF CURRENT CONDITIONS AND INDUSTRY PRACTICES.

(d) State total amount of financial assistance which you are seeking from the Department of Industry in respect of the work programme described.

£20,733 - ie 35% of £59,238 (Appendix III).

8. How is it proposed to finance the balance of the cost of the exploration project?

BY FUNDS ALREADY HELD BY PARENT COMPANY AND TO BE LENT TO THE APPLICANT IN THE NORMAL WAY OF BUSINESS.

NO FUNDS, OTHER THAN THOSE TO WHICH THIS APPLICATION RELATES, WILL BE FORTHCOMING FROM PUBLIC SOURCES.

The following is a summary of the report dated October 25 1976 by C R Bowdidge, MA PhD FGAC, whose full report is on the files of the Ontario Securities Commission, and of which a copy will be supplied to the Department of Industry upon request.

The property consists of an area of approximately 670 acres, including the Force Crag Mine, a former producer of lead/zinc/silver and barite.

The property is underlain by slates, shales and sandstones of the Ordovician Skiddaw Slate Series, which have been subject to multiple deformation during the Caledonian Orogeny. The mineralized zones are located in a fault-like structure which is provisionally interpreted as a dislocation between two structural domains.

The Force Crag Mine is known to have produced lead and zinc intermittently from the 1840s to 1922. The closure of the lead/zinc operation in 1922 was reportedly the result of a general slump in metal markets.

The mineralization consists of clots and strings of sphalerite and galena in a breccia-like zone. It occurs as shoots up to 22-ft wide distributed along the structure over a length of at least 1,000-ft. In the upper mine levels, not relevant to this application, barite occurs alone, as veins up to 5-ft or more wide.

Based on sampling data supplied by the Company, a probable reserve was calculated as: 16,391 tons averaging 1.75% lead, 8.68% zinc and 6.68% barite. Additional tonnages of lower grade material are available.

It is concluded that there are good possibilities for developing further reserves by (a) testing the full width of known shoots, (b) exploring for possible parallel shoots, (c) extending the zone at depth, and (d) exploring for a possible eastward extension of the zone across the valley where a previous geochemical survey has indicated possible mineralization.

January 1977

FORCE CRAG MINES (U.K.) LIMITED APPENDIX II

LAKE DISTRICT NATIONAL PARK

K. G. HADDLETON, C.B.E., D.L., M.A., LL.B.
National Park Officer
Chief Officer of the
Special Planning Board

R. B. BAYNES, M.A., M.R.T.P.I.
Chief Planning Officer

NATIONAL PARK OFFICE
COUNTY HALL, KENDAL LA9 4RQ
TELEPHONE: (0539) 21000
Ext. 261

Our ref CA53
608/RBB/MRM

11 April 1975

Dear Sir,

Force Crag Mine, Coledale, Braithwaite

The Director of Planning for Cumbria has forwarded to me your enquiry about Force Crag Mine which is within the Lake District National Park.

In June 1949 permission was granted for the continued working of minerals at Force Crag Mine subject to no additional adits being driven. I believe that Barytes continued to be worked at Force Crag until 1947 since when exploratory work for minerals has continued. On this basis there continues to be a valid planning permission for the working of minerals.

If your proposals are of a minor nature, they may well be covered by the existing planning permission. If a new adit is to be formed or if additional buildings, tips or ancillary works are required, then a further permission should be obtained. For this purpose a planning application should be submitted in the first instance, to the Allerdale District Council, Town Hall, Cockermouth.

Yours faithfully,

R B Baynes

Chief Planning Officer

Mr. G. Noel,
Public Affairs Adviser,
Force Crag Mines (UK) Ltd.,
Thistlemoor,
Northwood Green,
Westbury on Severn,
Glos, GL14 1ND

FORCE CRAG MINES (U.K.) LIMITED — APPENDIX III

Geochemical, geophysical and other surveys directly related to specified areas.			
I.P Survey: Mobilization	600		
6 days @ £200/day	1,200		
2 days standby @ £150/day	300		
Supervision	600		
	2,700		
Geochemical Survey	300		
	3,000	3,000	3,000
Trenching, test holes and borings.			
NONE			
Exploratory shafts and undergound exploration			
Short diamond drilling programme 2,215-ft + 40% = 3,100-ft @ £2/ft	6,200	6,200	
Raising from 1 to 2 level			
Raising 170-ft @ £25/ft	4,250		
Sub-level drift 150-ft @ £30/ft	4,500		
X-cuts and slashes	1,000	9,750	
Raising from 0 to 1 level			
Below No 4 stope, 120-ft @ £25/ft	3,000		
Below No 3 stope, 90-ft @ £25/ft	2,250		
At W end block "C", 90-ft @ £25/ft	2,250		
Below No 1 stope, 120-ft @ £25/ft	3,000		
X-cuts and slashes	1,000	11,500	
Driving extension to No 0 or 1 level 250-ft @ £30/ft	7,500	7,500	34,950
Collecting and Assaying of samples, including bulk samples.			
Assays, both geochemical and core	3,100	3,100	3,100
		Carried forward	£41,050

Brought forward		41,050
Mineral processing and metal extraction assessments, including pilot plant operations.		
Material to be submitted to Mineral Processing Divison, Warren Spring Laboroatory. Details of expenditure to follow, but say		2,000
Direct costs of fuel, materials and labour; fees paid to contractors for carrying out qualifying work; hire of plant and machinery.		
Supervision costs	4,500	
Hire of drill (Bazooka)	1,875	
Hire of Land-Rover (39 weeks @ £7)	273	
Running costs of Land-Rover	390	
	2,938	2,938
Temporary buildings and ancilliary works likely to be of no value at the end of the exploration phase.		
Rehabilitation of abandoned buildings to provide security for plant and equipment	1,500	1,500
Other costs attributable to the project and which would not otherwise have occurred, eg fair wear and tear on plant and machinery; cost of feasability studies leading to a decision whether or not to develop a productive mine.		
Wear and tear: Compressor	1,200	
Locomotive	500	
Eimco loader	600	
Wagons (20)	300	
Rock drills (2)	500	
	3,100	3,100
Carried forward ..		50,588

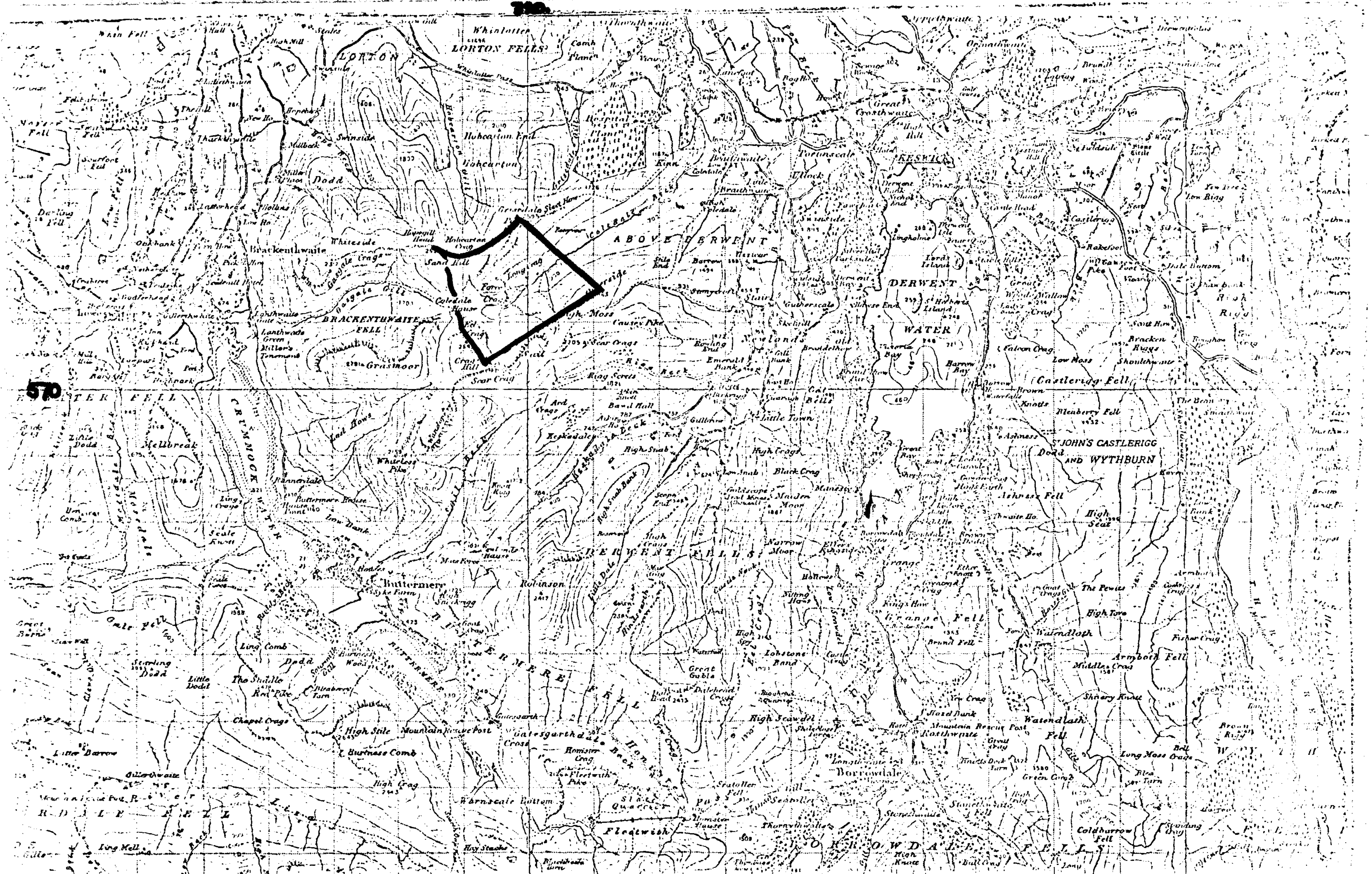
Brought forward		50,588
The rehabilitation of old workings or installations to the extent that this is necessary for the conduct of the exploration programme.		
Rehabilitation of 0 and 1 levels	4,000	
Rehabilitation of 3 level	1,000	
	5,000	5,000
Qualifying overhead related to approved expenditure.		
Accommodation subsidy for employees' relocation	650	
Insurance, say	3,000	
	3,650	3,650
		£59,238

For and on behalf of
FORCE CRAG MINES (U.K.) LIMITED

George W Hall

George W Hall
Director

JANUARY 1977


LORTON FELLS
Whinlatter
KESWICK
Portinscale
Great Crosthwaite
ABOVE DERWENT
DERWENT WATER
Newlands
Cat Bells
Causey Pike
Grasmoor
BRACKENTHWAITE FELL
Brackenthwaite
Whiteside
Coledale House
Sand Hill
Hobcarton
Swinside
Dodd
Castlerigg
Castlerigg Fell
ST JOHN'S CASTLERIGG AND WYTHBURN
CRUMMOCK WATER
Mellbreak
Buttermere
Robinson
Whiteless Pike
DERWENT FELLS
BUTTERMERE
Grange Fell
Watendlath
Armboth Fell
High Seat
High Stile
Red Pike
Borrowdale
Fleetwith
Dale Head
High Spy
Maiden Moor
High Crags
570

CERTIFICATE.

I, T. Walter Dent of the City of Toronto, in the Province of Ontario,

hereby certify:

1. That I am a consulting geologist with offices at 209-185 Bay Street, Toronto, Ontario, and am employed by G. H. D. Consultants Limited.

2. That I am a graduate of Queen's University, Kingston, Ontario (1945) in mineralogy and geology, and have practiced my profession continuously since graduation

3. That I am a member of the Association of Professional Engineers of the Province of Ontario.

4. That my report on the property of Force Crag Mines Limited in the County of Cumberland, England is based on reports in company files, correspondence and discussions with Mr. W. T. Shaw, A. I. M. M. mine manager, Company mine plans, and a personal visit to the property on April 27 and April 28, 1971.

5. That I have no direct or indirect interest, nor do I expect to receive any direct or indirect interest, in the property described herein, nor any shares in any affiliate of that Company.

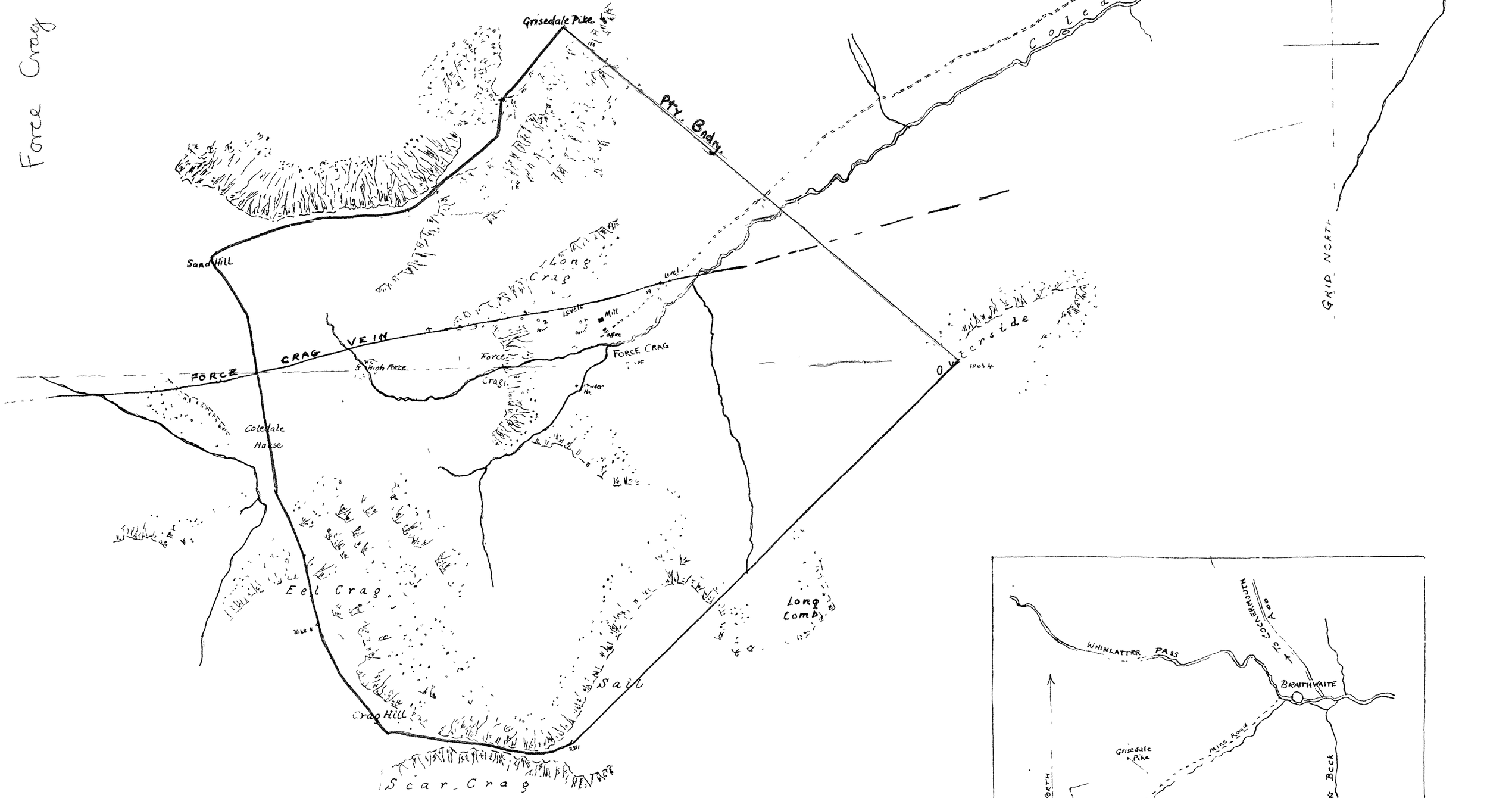
DATED at Toronto, this 15th day of July, 1971.

T. W. Dent, P. Eng.
Association of Professional
Engineers of Ontario.


LONGITUDINAL SECTION
FACING NORTH
FORCE CRAG MINE
LAKELAND MINING DISTRICT - ENGLAND
0 100 200 300 400
FEET
BARYTES STOPES
LEAD-ZINC STOPES
BLACK SHALES
SANDSTONES
TRANSITION ZONE
No.7
No.6
No.5
No.4
No.3
No.2
No.1
HIGH FORCE LEVEL
SHAFT
50
80' LEVEL
1100
900
650
Pb Zn
ORE PASS
SERVICE RISE
LAPORTE INCLINE
Shale filled vein
Milkhouse
"Shale" filling vein
Water + CO2
Some Ba
Pb Zn
No 4 STOPE
NO3 STOPE
No 2 STOPE
Spring with 150 gpm
XCUT N
RISE
XCUT N
'O' level Elev 2
O Level
840
Boulder Clay
Boulder Clay

FORCE CRAG MINES LTD.

Force Crag Mine



SCALE. 6" - 1 MILE.

LOCATION MAP.

Scale 1" - 1 MILE.

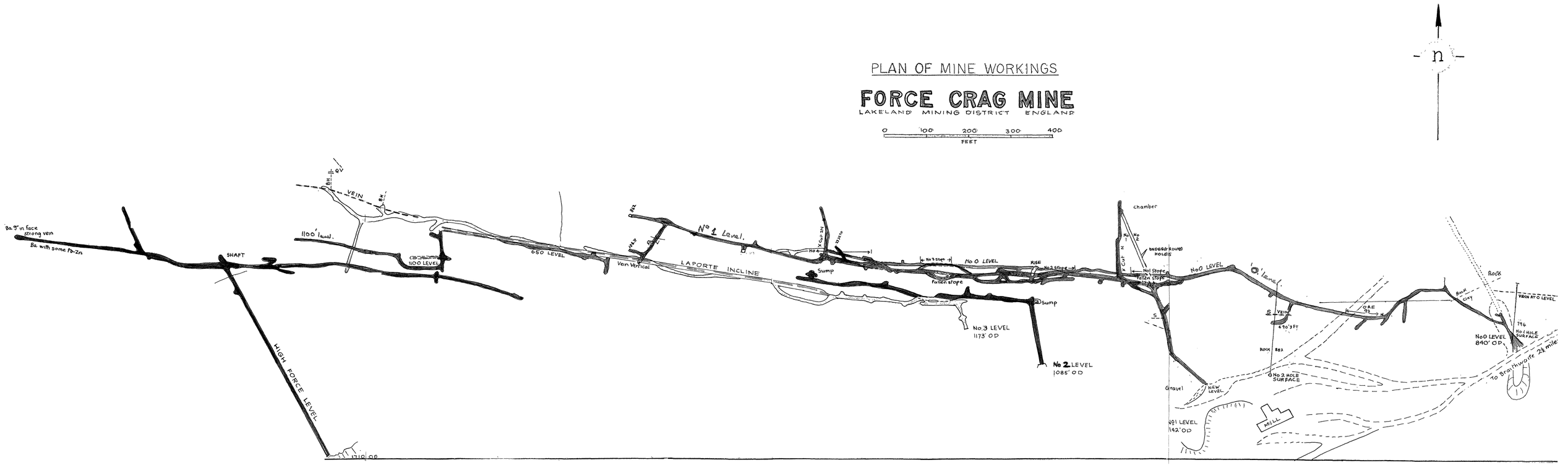
PLAN OF MINE WORKINGS

FORCE CRAG MINE

LAKELAND MINING DISTRICT ENGLAND

0 100 200 300 400
FEET

n



FORCE CRAG MINE

1 IN. TO 100FT.

N

No. 7

No. 6

No. 5

No. 4

No. 3

No. 2

No. 1

No. 0

Force Crag Mine

Old Ropeway

"O" Level

Ore Dump

Road

Stream

Fault ?

East Boundary

Cobalt V.

South Boundary

F.W.

N

$\frac{320}{700}$ Pb / Zn in ppm.

Note Pb >220 plotted only
Zn >240 " "

FORCE CRAG MINES LIMITED
Geochemical Plan.
25 inches = 1 mile.
March 1972 Drawn by; W.D.

FORCE CRAG MINE
SCALE: 1 IN. TO 100 FT.
N
No. 7
No. 6
No. 5
No
No. 3
No. 2
No. 1 (MILL LEVEL)
No. 0
LAPORTE INCLINE
MILKHOUSE RISE
BOULDER CLAY
No. 6
No. 5
No. 4
No. 3
No. 2
No. 1
No. 0
Force Crag
OLD ROPEWAY (CONSTRUCTED BY TAMPIMEX OIL CO. LTD. 1939)
PONDS

FORCE CRAG MINE

SCALE: 1 IN. TO 100 FT.