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THE MOUNT BRUSSILOF MAGNESITE PROJECT, BRITISH COLUMBIA

A PRELIMINARY GEOLOGICAL FIELD INVESTIGATION

BY

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(2) History of Geological Investigation and Exploration

In 1966, G.B. Leech of the Geological Survey of Canada published a two-page summary which dealt with two reconnaissance field traverses routed over the west flank of Mount Brussilof and he also listed X-ray diffractometer analyses of grab samples taken at 100 foot vertical intervals. Indications at that stage suggested the presence of major quantities of generally high-grade magnesitic rock.

It is believed that,on the basis of the above information, New Jersey Zinc initiated a very substantial claim-staking program. However, this company subsequently allowed most of the claims to lapse, retaining only six contiguous claims in an area where a diamond drill core program had been carried out. Negotiations are presently underway between Orhan Baykal, P. Geol., of Baykal Minerals Ltd., to acquire the basic geological and chemical data derived from the diamond-drill program.

Thirty six claims were staked by Messrs. P. Roy Swainson and John M. Kruszewski of Calgary, in the summer of 1968, which covered the more accessible magnesite beds on the lower western slopes of Mount Brussilof, and overlapped the six New Jersey Zinc claims in the northwest part of the region.

Imperial Oil Enterprises Ltd. took an interest in the property, a staff geologist visited Mount Brussilof briefly in October 1968 and was satisfied with the tonnage and grade poss-ibilites as indicated at that time. Subsequent investigations by Imperial Oil into the marketing situation for magnesite apparently did not yield sufficient encouragement and further interest in developing the property was terminated.

Meanwhile, information and enquiries of a European source indicated good market possibilities for magnesite products and led to an option agreement between Baykal Minerals Ltd. and the vendors (P.Roy Swainson and John M. Kruszewski) in May,1969.

During the September field program an increasing appreciation of the potential magnitude of the magnesite deposits gradually developed and additional claims were acquired adjacent to the initial 36-claim block. To October 29, 1969, a total of some 278 claims had been staked by members of the field crew working on the magnesite project on behalf of Baykal Minerals Ltd. An outline of the claims boundary is shown on Figure I, which covers an area on the order of 20 square miles. The only conflicting land situation within this area concerns the 6 pre-existing claims, owned by New Jersey Zinc, which are located towards the northern margin of the current centre of exploration activity. The record numbers of the recently recorded mineral claims are not available at the time of writing.

The known magnesite occurrences are considered to be well protected; the likeliest regional extensions, as determined by inspection from the air, have been covered; and the waters of two rivers, the Mitchell and Cross Rivers, are included within the boundaries of the staked ground. Local access to the property from the west via the valleys of the Cross and Mitchell Rivers would appear to be adequately assured by the existing property boundaries.

(3) Location, Access and Terrain

The location of the Mount Brussilof magnesite project area is shown on Figure 2 , relative to road, rail, town and surface-water features. The west flank of Mount Brussilof is situated at 115° 38'

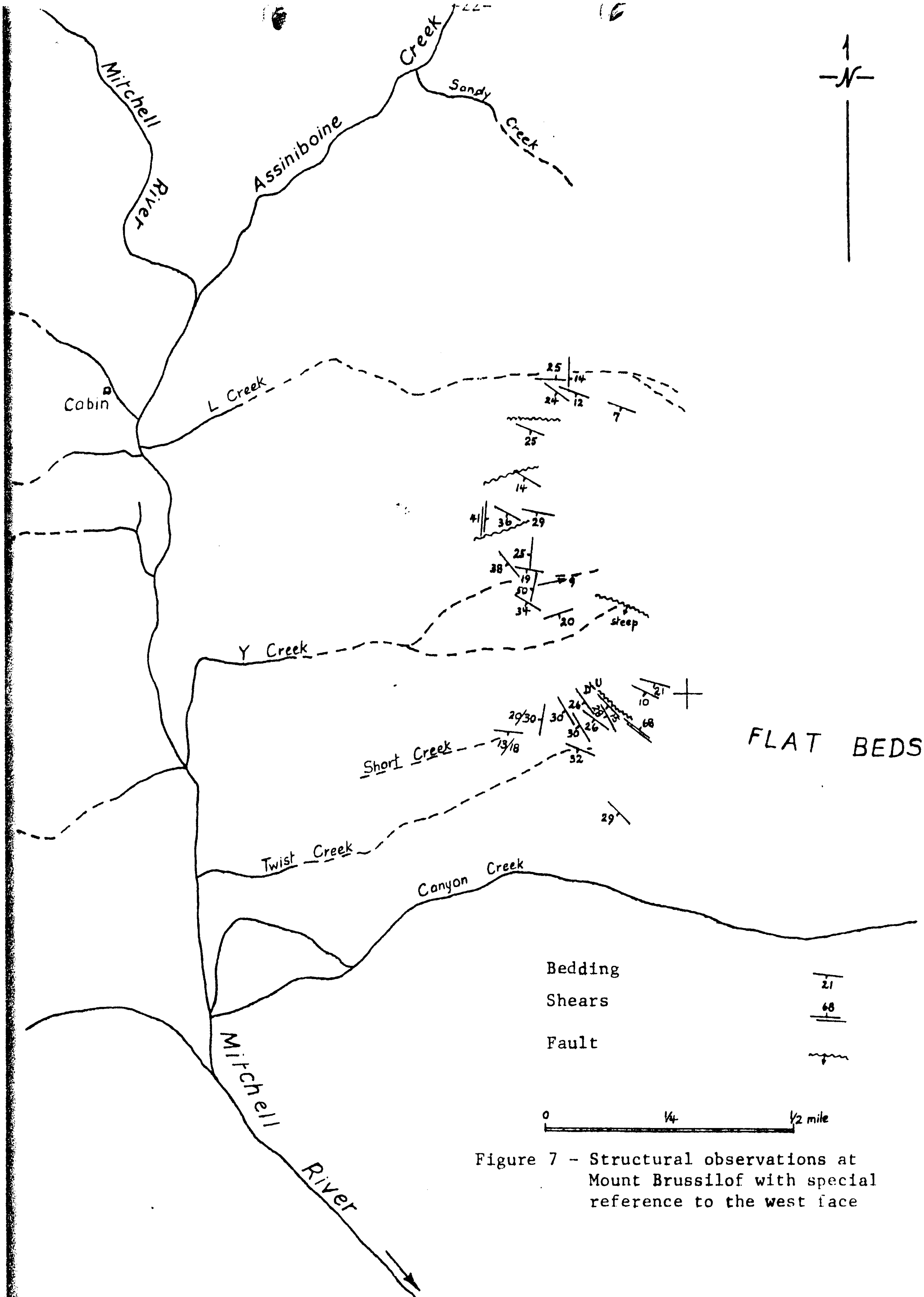


Figure 7 - Structural observations at
Mount Brussilof with special
reference to the west face

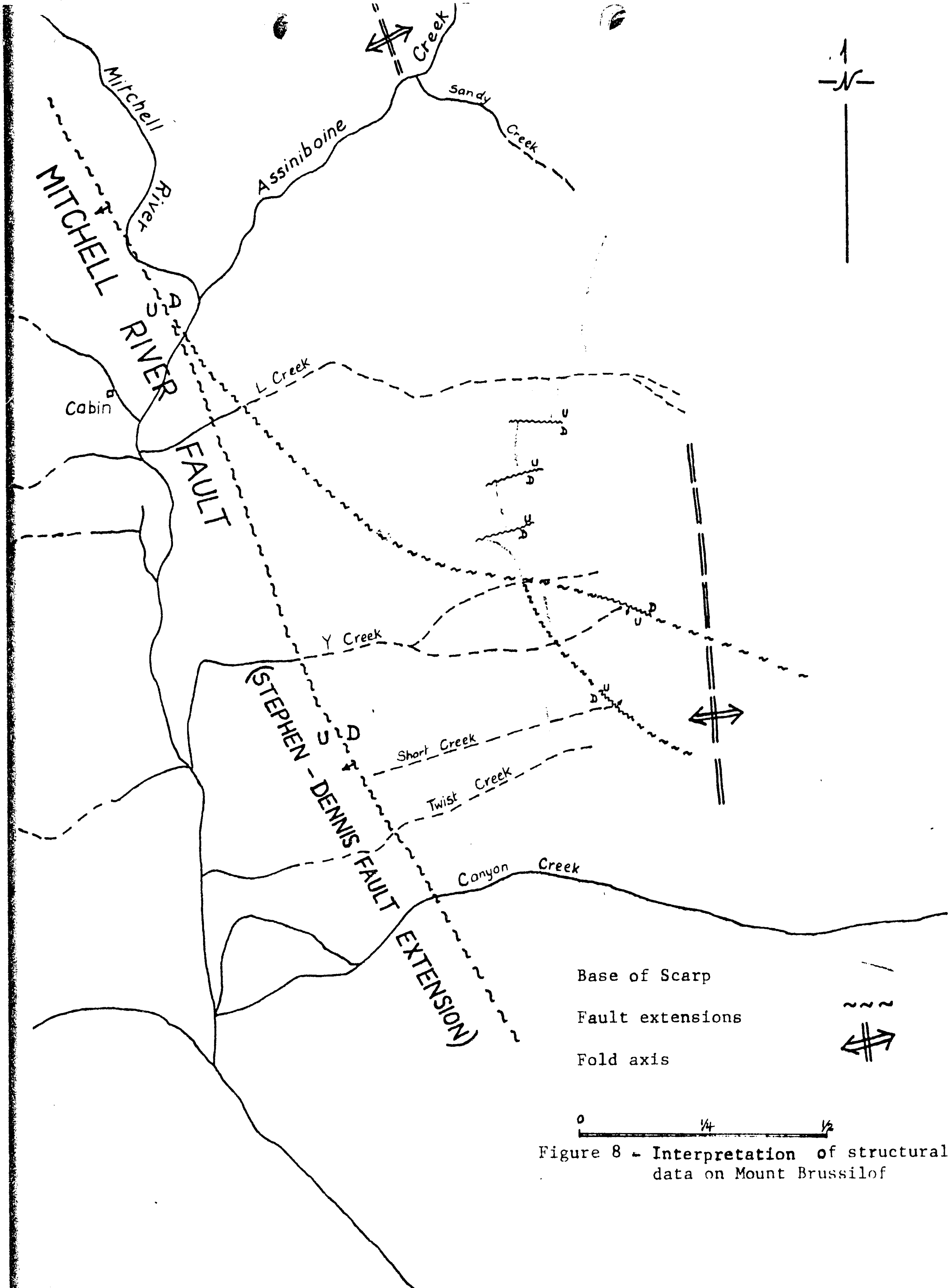


Figure 8 - **Interpretation** of structural data on Mount Brussilof

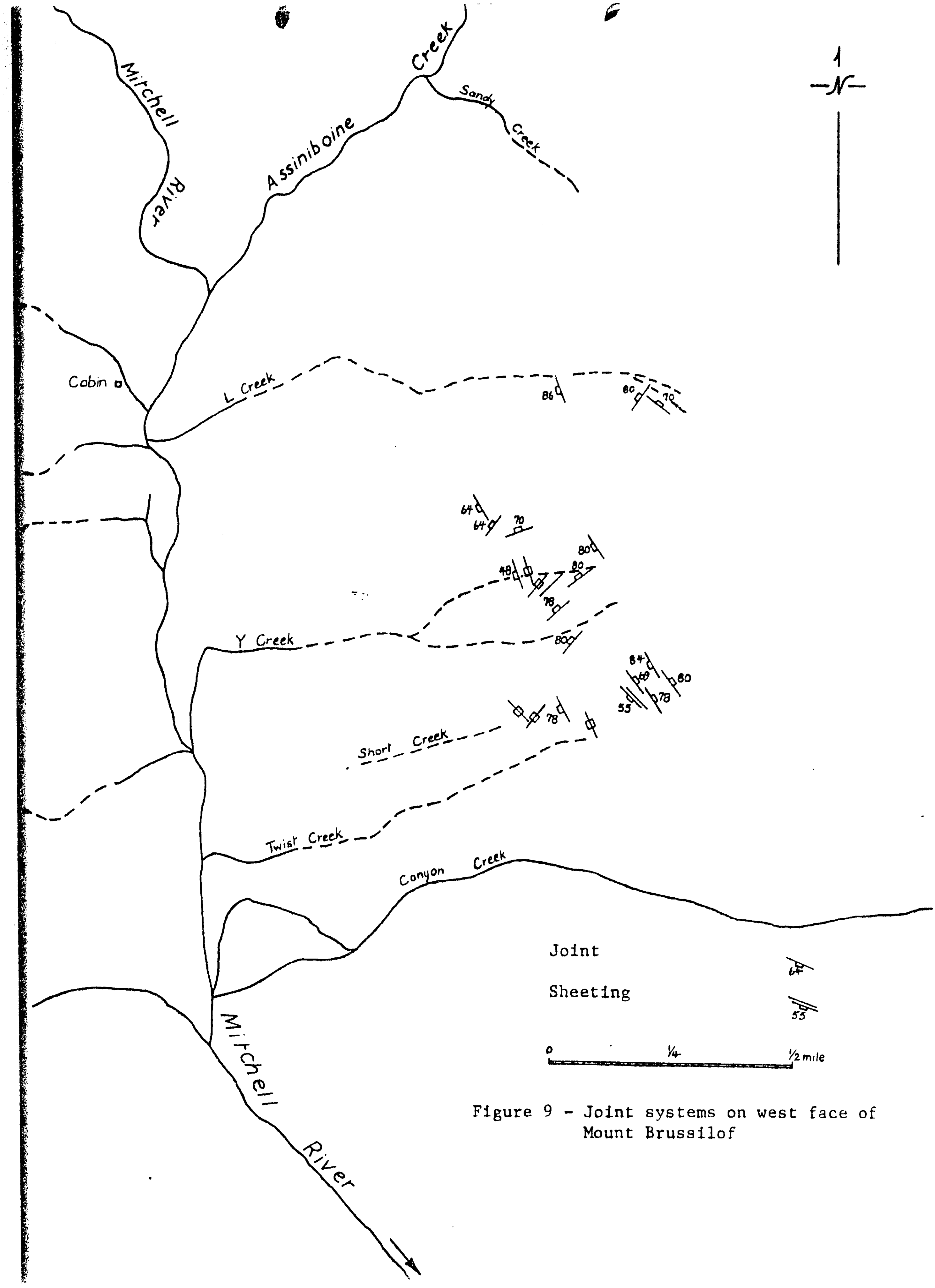


Figure 9 - Joint systems on west face of Mount Brussilof

D. MAGNESITE OCCURRENCE

Three types of commercial magnesite deposits are recognized in the world:

(i) veins, filling fractures or fault zones typically within ultrabasic rocks;

(ii) sedimentary beds; and

(iii) replacement of either dolomite or limestone.

The magnesite deposits of Mount Brussilof are included in either of the latter two categories. Structural and stratigraphic correlations of the magnesitic beds have been made on the basis of MgO chemical analyses and field observations and are indicated for the total area studied (figure 10) and for the small area between sample sections J and K (figure 11). This interpretation of the geology on the west fact of Mount Brussilof plus the near-distance observations from the helicopter and the ground observations of the third dimension (i.e. easterly direction) in the erosional cuts of L Creek and Canyon Creek, point to the high-grade magnesite deposits occurring as a series of extensive flat, bedded, lense-shaped masses, which may be multi-layered within fairly well-defined stratigraphic zones. For example, in the J-K zone, virtually pure magnesite occurs interbedded with dolomitic magnesite, magnesitic dolomite,and smaller amounts of dolomite. The individual high-grade magnesite bodies are visualized to be tabular lenses from 10 to 50 feet in thickness with lateral extensions of 1000 feet or more, lying conformably in stratigraphically controlled zones which themselves have continuity over several miles.

At this point, it is of interest to note that the largest deposits in the United States, near Chewelah, Wash., are described

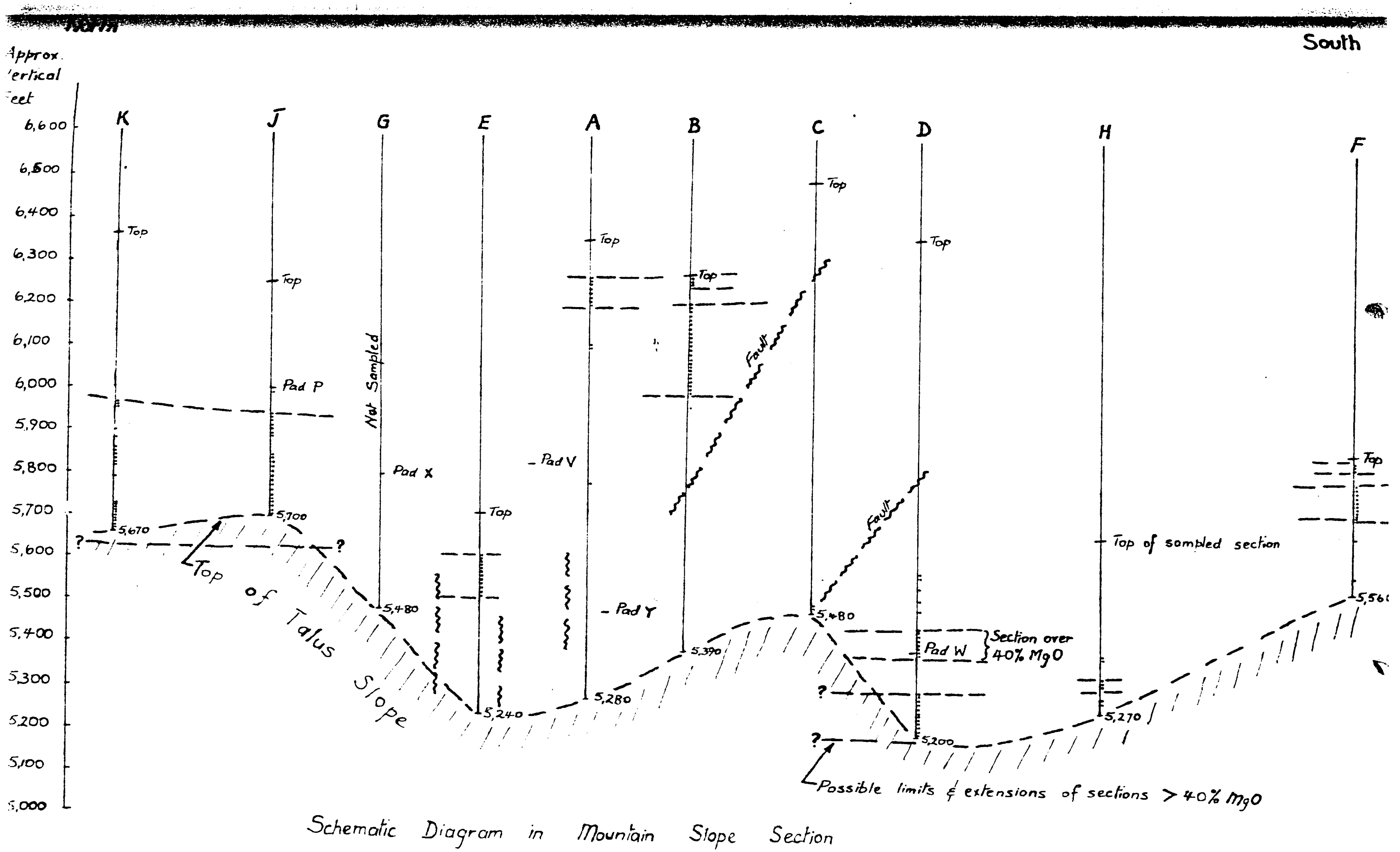
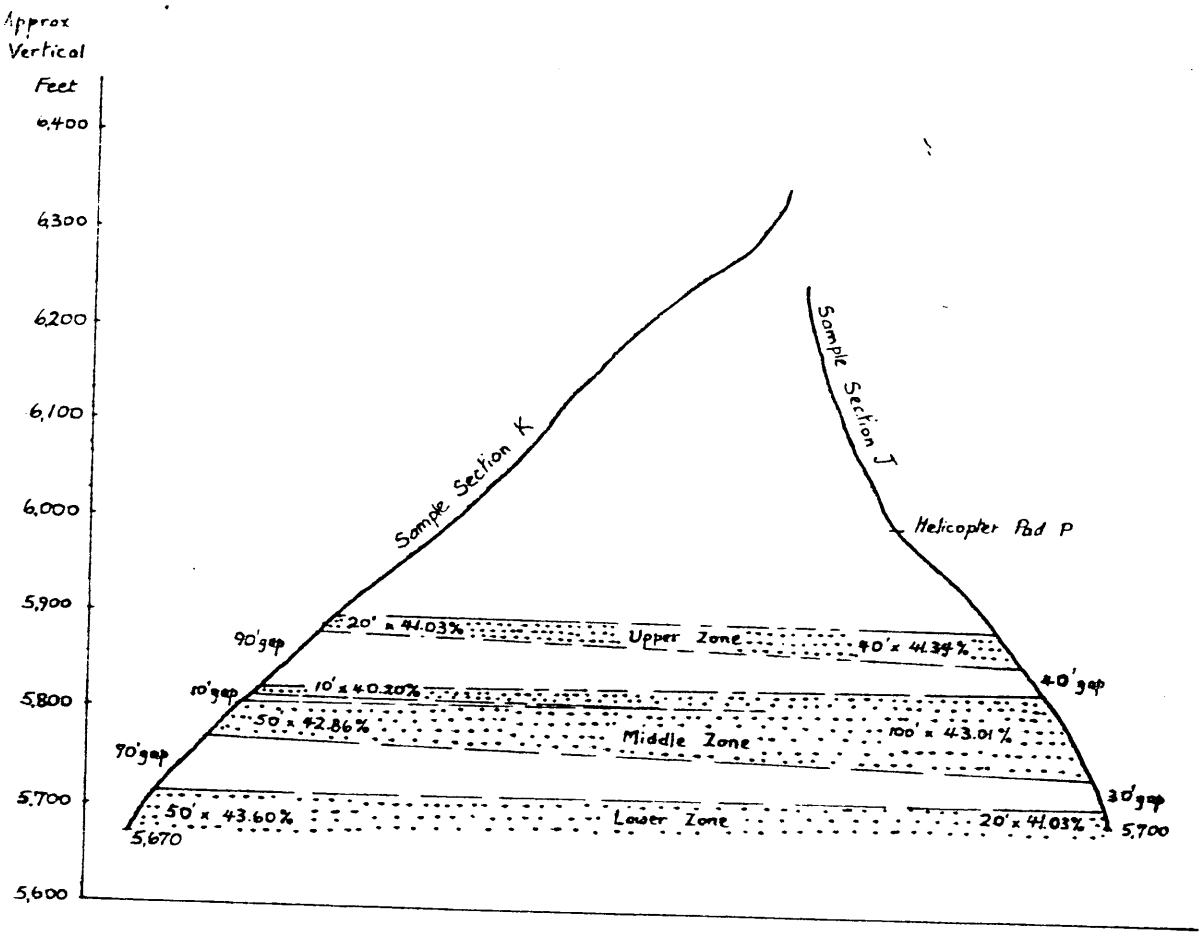
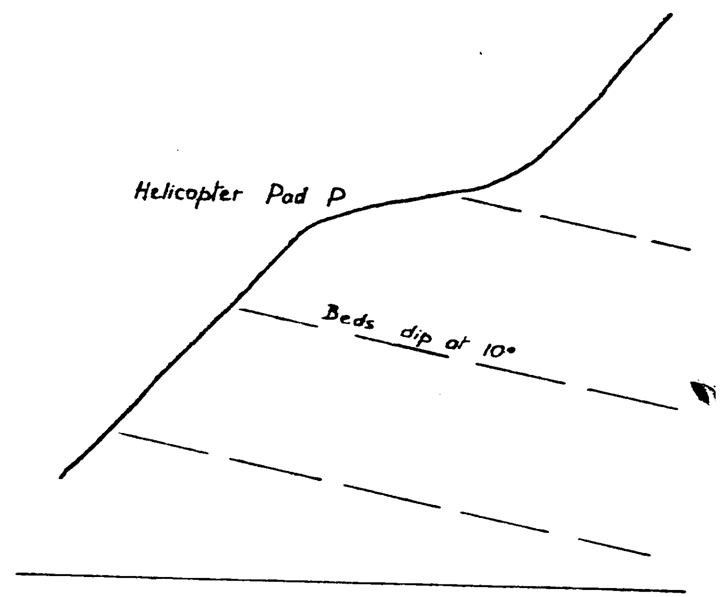


Figure 10 - Schematic slope section of sampled sections on west face of Mount Brussilof



Schematic Section in Mountain Slope at J-K Location



Schematic Vertical Cross Section Through J Approx.

Approximate scale for horizontal and slope distances: 1 inch = 200 feet

Figure 11 - Detail of J-K magnesite body in slope section

as replacements within Carboniferous dolomite and are "huge, bedded lenses up to 1,000 feet long and 300 feet thick". Whereas"the largest deposits in the world are worked in Manchuria over a 9-mile belt" and occur as replacements in metamorphosed Cambrian dolomite.

Individual magnesite bodies at Mount Brussilof are known to be laterally continuous over considerable distances because the base of the magnesite zone, though disrupted vertically by fault movement, has been walked out in the G-E-A-B area, and again in the area at the base of D. Lateral continuity in the case of G-E-A is particularly readily visualized because of the continuity of the associated scarp landform. Further south, for example, at the base of sample section D, tracing the lateral extensions is hindered by the interference of talus accumulations. The northward extension of the lower magnesite beds exposed at D across the valley of Short Creek lacks surface expression because it is masked by about 10 feet of loose overburden. A random composite chip sample taken over a vertical distance of 100 feet in the north valley wall of Short Creek (Table 4, JG-69-104-2) however, confirms the continuity of this particular bed.

There is a persistent general problem, however, in that towards the south end of the west face of Mount Brussilof, where the strata gradually become lower in elevation, the high-grade magnesite beds become masked by talus and vegetation on the lower slopes and thereby fail to develop the cliff-forming topographic landform which would normally provide the first clue for exploration purposes.

In addition to dolomite and calcite, extremely small amounts of non-carbonate impurities which can be anticipated, include vein quartz and pyrite. The distribution of vein quartz appears to be

TABLE 4

ROCK SAMPLES ANALYSED WHICH ARE NOT PART OF SYSTEMATICALLY SAMPLED SECTIONS

Sample Number	Location	Sample Description	MgO%
JG-69-104-1	North valley wall, Short Creek; from 4,990 to 5,180 feet	Almost continuous outcrop throughout section sampled; composite sample of random chips; total sample 2 lbs.	31.09
JG-69-104-2	North valley wall, Short Creek; from 5,180 to 5,280 feet; (top at W pad)	Almost continuous outcrop throughout section sampled; composite sample of random chips; total sample 3 lbs; magnesitic rock continues above W pad.	41.45
JG-69-104-3 -4 -5	Sample section B; at elevation of composite samples 4 and 5	Composite of selected samples to test possible movement along prominent fractures within dolomite and magnesian-dolomite.	19.48 21.55 23.63
JG-69-108-1	Above and in alignment with Short Creek, at elevation 5,810 feet	Selected samples of light-grey, coarse-grained dolomite from 2 to 5 foot diameter blocks.	20.72
JG-69-108-2	Above and in alignment with Short Creek, at elevation 5,810 feet	Composite of selected samples of white, very coarse-grained dolomite located between blocks sampled in JG-69-108-1.	21.55
JG-69-111-2	Base of sample section G	Selected sample of snow-white, compact, fine-grained, massive carbonate rock	21.97

controlled by fault action and therefore is restricted geographically, as such areas could be readily isolated if necessary in the course of a mining operation. Just above the fault-scarp at the upper terminus of Short Creek, an area of 100 x 50 feet contained 3 discontinuous milk quartz veins ranging from 1/4 to 3 inches thick and representing less than one per cent of the total volume of the rock in this area.

The distribution of pyrite is much more general than that of vein quartz, being present in all members of the carbonate rock series, from dolomite to magnesite, (see explanation to Table 13, for members of series). Pyrite typically occurs as disseminated fine-grained crystals, but is also seen uncommonly as discontinuous seams or layers, as illustrated in plate 8. The situation of a pyrite seam between very coarse-grained dolomite and magnesite, as in plate 8, would suggest that a reaction relationship exists between these three mineral phases and may point to the origin of this pyrite. Only in rare places, and for small selected rock volumes on the order of hand specimen sizes, does the amount of pyrite exceed one per cent of the rock volume. Some pyrite grains may have developed an iron oxide surface.

The stratigraphic correlations made in the local area of the J-K sampled sections based on chemical analyses are indicated in Figure 11; they appear to generally conform to the attitude of the enclosing strata, and therefore this simple interpretation appears to be the most reasonable. The geologic implication of this interpretation is that the high-grade magnesitic rock beds have a considerable lateral extent (over 1,000 feet) as compared to their thickness (20 to 50 feet). From present knowledge of the geology of the Mount Brussilof area, there is no reason to suggest that the nature or geometry of the magnesitic beds should change in the general region under study.

Scattered ground observations have shown that the zones of high-grade magnesite beds extend over a strike distance of three miles in a north-northwest direction along the valleys of the Mitchell and Cross Rivers. Preliminary supporting data indicate that the total strike length of the zones could be extended to possibly six miles in total.

The structure which has been observed and is to be expected in the west face of Mount Brussilof has been dealt with and illustrated under "General Geology", most of which applies to the magnesite zones.

The evidence for the origin of the magnesite beds of Mount Brussilof is inconclusive at the moment. Two modes of origin may be considered:

(i) primary sedimentation, or

(ii) metasomatic replacement of dolomite.

In either case, it is evident that late recrystallization has played a modifying role during a mild metamorphism insofar as:

- dolomite has recrystallized to a typically coarse-grained rock and has locally formed crystals up to six inches in diameter; and
- pyrite has been locally formed at the interface between magnesite and coarse-grained dolomite.

In the latter case it would appear that the breakdown of magnesite under metamorphic conditions has resulted in the formation of pyrite and dolomite. The total reaction might be summarized as follows:

$$\underset{\text{Limestone}}{CaCO_3} + \underset{\text{Magnesite}}{MgCO_3.(FeCO_3)} + \underset{\text{Sulfur}}{S} \longrightarrow \underset{\text{Pyrite}}{FeS_2} + \underset{\text{Dolomite}}{CaCO_3.MgCO_3} + \underset{\text{Carbon Dioxide}}{CO_2}$$

E. ECONOMIC GEOLOGY

(i) Tonnage and Grade Estimates

Since the magnesite is a bedded deposit, interlayered with beds of dolomite, magnesitic dolomite, and dolomitic magnesite, chemical analyses of representative chip samples of the carbonate rocks range from 19 to about 47 per cent MgO. Magnesite beds have been sampled across strike (upslope) in a series of nine sections on the west face of Mount Brussilof (figure 4). All but one of these sampled sections show aggregate slope lengths of 30 to 100 and even over 200 feet typically containing 41 to 45 per cent MgO. Details of these analysed sampled sections are listed in Table 13 . MgO grades of some analysed sections can be raised above the indicated range of 41 to 45 per cent by greater selectivity.

Tonnage estimates of magnesitic rock are made on three scales of observations:-

a. Specific bodies of magnesite outlined on Mount Brussilof;

b. The particular area sampled in detailed sections on the west face of Mount Brussilof; and

c. The general region around Mount Brussilof included within the claims boundary.

a. (i) The J-K Magnesite Body

This particular magnesite occurrence has been singled out for mention because of a number of favourable factors which make it amendable to analysis in order to establish a significant tonnage of good grade material.

- The indicated grades of MgO content are very good, Table 13, Figure 11), as established by the two sampled sections J and K;

- The rock is virtually completely exposed on the west face of Mount Brussilof, and the magnesite beds can be seen to be continuous in outcrop, (Plates 1A,2, 3 and 4);

- The bedded structure of the deposit is structurally simple, as can be seen from the expression of strike illustrated on Plates 1A, 2 and 4, and the gentle dip is seen on Plate 3. This structural situation is also depicted in Figure 11;

- The outcrop section appears to be relatively homogeneous as dark-grey dolomite beds cannot be detected on Plates 1A, 2, 3 or 4;

- The steep rock slopes of 45 to 47 degrees on the face of the rock section sampled and the wide bench above the magnesite beds (at helicopter pad P) would provide favourable conditions for a surface mining operation.

Figure 11 depicts three good-grade magnesite zones - lower middle and upper - along with their slope distances and average grades. Using arithmetic averages for both section thicknesses and MgO analyses, these zones appear to represent the following:-

Upper Zone	25 feet with an average grade of 41.18% MgO
Middle Zone	75 feet with an average grade of 42.96% MgO
Lower Zone	50 feet with an average grade of 42.31% MgO

giving an accumulated thickness of 150 feet with a weighted average of 42.44% MgO.

In calculating the "visible" tonnages within the J-K magnesite body, the following dimensions and factors have been used:-

strike length	=	1,800 feet; the distance from L Creek to Sandy Creek (J to K at base is 1,200 feet); variable estimate could probably be readily extended, especially towards south at sample section G;

dip distance = 400 feet; approximate depth (i.e. distance in down dip direction) of erosional incision at L Creek; variable estimate, could be readily extended in dip (easterly) direction by diamond drill information;

slope distance = 150 feet; fixed estimate, accumulated thickness of the three measured magnesite zones; the true stratigraphic thickness of these beds which dip at 10 degrees into the mountain is 122 feet[1] (i.e. minus 20% of the slope distance approximately) (Figure 11 , cross-section);

Volume: weight ratio of magnesite= 12 cubic feet magnesite contains 1 ton (2000 pounds) of rock; based on a specific gravity of magnesite = 3.0 and a rock porosity of 5 per cent.

Tonnage in J-K body = $\frac{1,800 \times 124 \times 400}{12}$ = 7,440,000 short tons (average grade=42.44%MgO)

If part of the middle zone was selected (from within K (iii) and J (ii), Table 1), then the following tonnage estimate becomes possible:-

Tonnage selected from middle zone of J-K body $\frac{1,800 \times 36 \times 400}{12}$ = 2,160,000 short tons (average grade=44.55% MgO)

a. (ii) Sample Section B

Tonnage estimates of the indicated zones (B(ii) and B(iii), (Table 5) follow, based on similar assumptions made above, but for a strike length of 1,000 feet (variable estimate) and a down-dip distance of 300 feet (variable estimate) in each case.

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[1] Since chip sampling was carried out in 10-foot slope sections it is reasonable to expect that a more detailed breakdown of the sampled beds would effectively add to the indicated thickness of the good to high-grade magnesite. It will be assumed that on the average an additional 5 feet (2-1/2 feet at both top and bottom) of good to high-grade magnesite exists in the adjacent beds.

TABLE 5

SELECTION OF MgO GRADES FROM CHIP SAMPLES TAKEN ALONG SAMPLED SECTIONS ON THE WEST FACE OF MOUNT BRUSSILOF

Sample Section		Range of MgO Grade	Average MgO Grade	Slope Distance-Chip Sample	
				Individ.Portions	Aggregate
K	(i)	41.86 - 45.18	43.60	50+* feet	
	(ii)	43.52	43.52	10	
	(iii)	44.35	44.35	30	
	(iv)	40.62 - 41.45	41.03	20	
	(v)**	37.72 - 44.35	42.86	50	120+
J	(i)	39.38 - 42.69	41.03	20+	
	(ii)	41.45 - 45.59	43.01	100	
	(iii)	39.79 - 41.86	41.34	40	160+
E	(i)	41.45	41.45	20	
	(ii)	43.93	43.93	20	
	(iii)	43.93	43.93	10	50
A	(i)	40.20 - 44.35	43.24	60	60
B	(i)	42.28 - 43.11	42.70	20	
	(ii)	44.76 - 45.59	45.18	30	
	(iii)	46.01 - 46.84	46.42	20	
	(iv)	43.52 - 43.93	43.72	20+	
	(v)***	32.74 - 46.84	41.88	190	190+
D	(i)	40.62 - 41.86	41.31	40	
	(ii)	39.38 - 42.69	41.45	30	
	(iii)	40.20 - 43.23	42.18	30	
	(iv)	46.01	46.01	10	110
H	(i)	43.11 - 45.15	44.13	20	
	(ii)	41.03	41.03	10	30
F	(i)	40.62 - 42.69	41.65	20	
	(ii)	40.20 - 41.45	40.76	30	
	(iii)	40.20 - 43.11	41.19	40+	90+

* Plus sign (+) indicates top or bottom of section sampled is either obscured or not sampled.

** Includes the combined sections (ii) and (iii) plus the intervening 10 foot gap.

*** Includes the combined sections (i), (ii) and (iii) plus the intervening gaps of 10 and 60 feet, and 30 feet on the bottom of the section.

Tonnage in B(ii) = $\frac{1,000 \times 28 \times 300}{12}$ = 700,000 short tons (average grade= 45.18% Mgo)

Tonnage in B(iii) = $\frac{1,000 \times 20 \times 300}{12}$ = 500,000 short tons (average grade= 46.42% MgO)

b. West Face of Mount Brussilof

From a consideration of the geology of the sections sampled the field data obtained from a one-mile-long area examined in some detail on the west face of Mount Brussilof (presented in schematic form in Figure 10), it is felt that the "visible" indicated tonnage of good to high-grade magnesite rock could be expected to be as follows, assuming an aggregate magnesite thickness of 90 feet, a strike length of 5,200 feet, and a dip length of 400 feet - all variable estimates:

Indicated tonnage of total sampled area on west face of Mount Brussilof

= $\frac{5,200 \times 90 \times 400}{12}$ = 15,600,000 short tons

c. General Region Within Claims Boundary

It may be of some interst to speculate on the order-of-magnitude tonnages of magnesite rock which may lie within the boundaries of the claims area. Sightings from the helicopter, staking activity, prospectors' ground exploration, the geological-sampling field program, the topographic expression of thick magnesite beds, and the consideration of sedimentary-stratigraphic principles, all together provide the basis for assuming a possible lateral extent of the magnesite beds beneath an area of about 20 square miles. The potential tonnage of good-grade magnesite assuming a thickness of 30 feet, over an area of 20 square miles indicates:-

- magnesite bodies tend to occur as flat, laterally extensive lenses, over 1,000 feet long and up to 50 feet thick; these lenses are either flat or gently folded, with minor offsets along a few transverse faults; the lenses occur in parallel, overlapping in multi-layered zones;

- the magnesite bodies are of such size, shape, continuity and attitude, that they should be relatively easily evaluated as to their average grade, internal variations and tonnage;

- the mining of magnesitic rock would be by surface methods initially, and the geologic and terrain conditions should aid in a relatively simple operation;

- the geographic location is such that access to the site of the deposits and the availability of essential services and facilities for a mining-milling operation, do not appear to present any unusual difficulties.

G. CONCLUSIONS

The conclusions seem to be largely obvious and fairly decisive:-

- the known magnesite occurrences and their extensions are adequately protected by 278 mineral claims.

- the magnesitic rock is interbedded with dolomite and occurs as bedded, cream-colored crystalline magnesite, which may be of either replacement or sedimentary origin;

- the indicated grades of magnesitic rock are within the currently commercial range;

- an upward revision of the MgO grades reported to date may be anticipated pending further check analyses and comparison with analytical procedures used so far;

- any slight bias introduced in the attempted representative chip sampling program would tend to dilute the concentration of magnesite in the samples collected and therefore would lead to the reporting of conservative MgO values;

- more than adequate "visible" tonnages of commercial grade magnesite have been indicated in the course of systematic chip sampling along a strike length of one mile confined to one of two parallel major zones of magnesitic rock in the west face of Mount Brussilof.

- tonnages and grades of magnesitic rock in the J-K body indicate over 3 million short tons of 42.96% MgO, or over 6 million short tons of 42.44% MgO. The one-mile-long zone which has been chip sampled in nine sections, indicates about 15 million short tons of magnesitic rock of comparable grade, whereas the potential tonnage for the region as a whole could well be on the order of one billion (American) short tons;

would give a much enlarged picture of the ore and should add substantially to the tonnage potential. At an average overall cost of $15.00 per foot, total cost of this operation would be $63,000.00 to $79,000.00

Respectively submitted,

Eugene Stary, P. Eng.

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