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1971 EXPLORATION OF PROPERTIES IN THE CLARK RANGE SOUTHWESTERN ALBERTA & SOUTHEASTERN B. C.

BY G.A. VAN DYCK SEPT. 1971

ALCOR MINERALS LTD.

1971 EXPLORATION OF PROPERTIES
IN THE
CLARK RANGE
SOUTHWESTERN ALBERTA AND SOUTHEASTERN BRITISH COLUMBIA

Geographic Coordinates
49° 15' N
114° 15' W
NTS Sheet 82G/SE

by

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September 20, 1971

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INTRODUCTION

Field work on the properties of Alcor Minerals Ltd. in the Clark Range of southwestern Alberta and southeastern British Columbia began on June 2, 1971, and was completed on August 4, 1971. Mineral occurrences and geochemical anomalies noted in the Gateway Formation of the Late Precambrian Purcell Series during the 1970 exploration and the similarity of these occurrences with descriptions of sedimentary copper deposits mentioned in the geologic literature favored stratigraphic work in the Gateway Formation. Thus the 1971 field work consisted mainly of detailed stratigraphy of the Gateway Formation, with less detail on other nearby formations: Sheppard and Roosville. It included some geochemical prospecting and geological examination of some showings and geochemical anomalies outlined in the 1970 exploration. The geological work was conducted by two geologists and two university undergraduates as assistants. The program was designed to evaluate the Clark Range property of Alcor Minerals Ltd. with particular emphasis on the possibility of sedimentary copper in the Gateway Formation.

The base camp was at Beaver Mines. Overnight camps required in the less accessible localities were back-packed in by the crews. Two rented trucks, a 4x4 equipped with a winch and a ¾-ton pick-up, provided transportation.

This report describes the evaluation of the Alcor property in the Clark Range, based on the exploration undertaken in 1971. It has been supplemented in a few places by reports from Cominco Ltd. and notes of traverses conducted in 1970. The sections on Geographic Setting and Regional Geology have been kept brief. More detailed information on these is available in published reports in the list of references and on maps available from the Alberta Department of Lands and Forests.

SUMMARY

The properties of Alcor Minerals Ltd. in southwestern Alberta consist of four wholly-owned Exploration Permits totalling 48,159 acres, three partly-owned Exploration Permits totalling 35,965 acres, two quarter section claims or parts thereof, and selected leases in Townships 3 and 4, Range 3, West of the 5th Meridian totalling eight sections. The property in British Columbia consists of 23 mineral claims. These properties lie within and adjacent to the Clark Range which extends in a northwesterly direction for about 40 miles in Alberta and British Columbia and is about 20 miles wide. It contains mountains rising to elevations greater than 8,000 feet. Access is via provincial highways and gravelled roads, with railways not more than 30 miles away from any part of the properties. Exploration in the area has been conducted by Kennco Explorations Limited, Cominco Ltd., Falconbridge Nickel Mines Ltd., and by smaller companies and prospectors.

The rocks in the area are Late Precambrian strata of the Purcell Series which form part of the Lewis Thrust Sheet. They consist of limestones, dolomites, argillites, siltstones, sandstones, quartzites, and andesitic lava flows, and are cut by basic dykes and sills. These Precambrian rocks have been superimposed on younger Paleozoic and Mesozoic strata by the Lewis Thrust.

Detailed stratigraphy of the Gateway Formation involved measuring and describing 12 complete sections and 5 partial sections, and sampling of copper-bearing units. The Gateway Formation averages 1500 feet thick with a lower red-bed member comprising about two-thirds and an upper buff-weathering member the remaining one-third. What is apparently syngenetic chalcocite is restricted essentially to the dolomitic units, the better occurrences being in the lower member. They range from 0.01 per cent to 2.3 per cent copper across thicknesses ranging from 1" to 60"; they are disappointingly low. Six additional sections were measured and described across the Sheppard and

Roosville Formations where exposures are favorable. Generally, chalcopyrite and bornite are finely scattered along porous zones, joints, and fractures in parts of these formations, but grades are too low to be economic.

Geochemical prospecting involved the collection of soil samples close to two measured stratigraphic sections in which the copper-bearing beds had been located. Samples of the humus layer collected at intervals of 50 feet up the slope indicated the positions of copper-bearing beds.

Lead-zinc mineralization in the Sheppard Formation at the North Kootenay Pass is present in a zone, 8 feet thick, of dolomite and black siltstone approximately 80 feet above the Purcell-Sheppard contact. Surface chip samples show concentrations of lead, zinc, and copper far below what is considered economic.

Examination of occurrences 19 and 20 noted in 1970 revealed these to be too low grade and not extensive enough to be important. Examinations of geochemical anomalies noted in 1970 resulted in the finding of previously unnoted mineral occurrences, which may be important.

RECOMMENDATIONS

1. Continue stratigraphic studies of the Gateway Formation to the southwest in the Clark Range and in other ranges to the southwest and west.

2. Drill stratigraphic test holes through the Gateway Formation in easily accessible places along the valley of the South Castle River between Scarpe and Font Creeks.

3. Retain sufficient property to adequately protect any discoveries made as a result of this drilling.

4. Drop all other property except the Whistler and Grizzly Showings, and the geochemical anomaly northeast of Victoria Peak.

5. Parts of the Siyeh Formation should receive limited stratigraphic study.

PROPERTY

The property in Alberta consists of four wholly-owned Quartz Mineral Exploration Permits totalling 48,159 acres, three partly-owned Quartz Mineral Exploration Permits totalling 35,965 acres, two quarter section claims or parts thereof, and leases on eight sections.

Quartz Mineral Exploration Permit No.	Acres	Date of Permit
	Wholly-Owned	
66	9,440	3-10-68
67	19,840	3-10-68
68	9,279	3-10-68
147	9,600	5- 2-70
	30% Undivided Interest with Option	
70	19,652	7-11-68
71	6,454	7-11-68
	Optioned	
140	9,859	4- 7-69

Claim	Record Number	Record Date
	Quarter Section Claims	
SW26-3-1W5 (part)	872	24- 3-70
NW27-3-1W5	883	28- 4-70

Leased Land

Sections 15, 22, 27, and the east halves of Sections 16, 21, 28, and 34
Tp. 3, R.3 W5

Sections 21 and 26, east half of Section 16, and south half of Section 35
Tp. 4, R.3 W5

The property in British Columbia consists of twenty-three mineral claims as listed below. These and claims previously held are referred to as the Flathead properties. None of the claims has been surveyed and none of the claim posts has been checked in the field. Nevertheless they are believed to have been located in accord with the Mineral Act of British Columbia.

Claims	Record Number	Record Date	Expiry Date
Commerce Peak - Sage Creek			
Top 22 to 30	11229 to 11237	17-6-68	17-6-77
Aka 2 and 6	12771 and 12775	27-8-68	27-8-77
La Coulotte Ridge			
Stang 33 to 40	11486 to 11493	11-7-68	11-7-74
Paul 5 and 6	11498 and 11499	11-7-68	11-7-74
Paul 19 and 20	11512 and 11513	11-7-68	11-7-74

GEOGRAPHIC SETTING

The properties lie within the Clark Range of southwestern Alberta and adjacent southeastern British Columbia, north and northwest of Waterton Lakes National Park. The Clark Range forms part of the southern Canadian Rocky Mountains and straddles the Alberta-British Columbia border for about 40 miles extending northwesterly from the 49th Parallel. It contains many rugged mountains, some rising to elevations greater than 8000 feet; the elevation of the lower valleys is about 4500 feet.

Parts of the periphery of the Clark Range can be reached by Alberta and British Columbia Highway 3, by Alberta Highways 5 and 6, and by the southern transmountain line of the Canadian Pacific Railway and some of its branch lines in Alberta. Supplies and accommodation can be obtained in Pincher Creek or Waterton Park, Alberta, or Fernie, British Columbia. Within the area are a number of all-weather Forestry, gas-well service, and other gravel roads. In addition, dry-weather and 4-wheel drive roads, and numerous trails provide access to many of the larger valleys and some of the mountain passes and ridges. Some of the mountain tops are suitable for landing helicopters, but strong winds can seriously hinder their use.

Most of the valleys contain streams or rivers of various sizes, the largest being the Flathead and Castle Rivers; hence ample water is available except on some of the higher mountains.

Most of the lower parts of the mountain slopes are heavily timbered with spruce and lodgepole pine. Some parts are being exploited by lumber companies. Parts of the area were burned over many years ago with the resulting deadfall and second growth making travel on foot very slow in some areas.

Conventional prospecting, surface geological work, and geochemical field work are possible without serious hindrance from snow and ice during June, July, and August in the Clark Range. Some interrupted work can be expected by snow in September, but delays may be only short through much of September and October as was experienced during the 1970 field season. One cannot count on conducting field work in May. July and August are frequently so hot and dry that the forests are closed because of fire hazard in parts of August and September. Such closures generally apply only to recreational use.

Shell Canada Limited operates a large gas processing plant 12 miles southwest of Pincher Creek. Coal was produced until the 1920's from large deposits near Corbin which is west of the Flathead Range, the range immediately north of the Clark Range.

PREVIOUS EXPLORATION

Recent exploration for metallic minerals in the Clark Range began about 1963. Companies active in this work have included Kennco Exploration Ltd., Akamina Minerals Limited, Cominco Ltd., and Falconbridge Nickel

Mines Ltd. This exploration has been summarized by Halferdahl (1971).

In 1970 L. B. Halferdahl & Associates Ltd. explored Alcor's properties in Alberta and one of the Flathead properties. The program consisted of conventional prospecting and noting geological structures; a geochemical survey; and detailed work including mapping, trenching, and drilling of the Spionkop Showing.

Also in 1970 Geowest Services Ltd. carried out exploration of Alcor's Flathead properties which consisted of conventional and geochemical prospecting, and evaluation of some of the showings.

REGIONAL GEOLOGY

The general features of the geology of the Clark Range are well known through mapping by officers of the Geological Survey of Canada and by drilling and other geological investigations by individual companies. In the Clark Range, a block of Late Precambrian dominantly sedimentary rocks known as the Purcell Series forms part of the Lewis Thrust Sheet, a major structure of the Rocky Mountains in the southern part of Canada and the northern part of the United States. The Lewis Thrust carried the Precambrian rocks and some of the overlying Paleozoic rocks now constituting the Clark Range eastward from the vicinity of Cranbrook, superimposing them on younger Paleozoic and Mesozoic strata. The maximum stratigraphic separation is 25,000 feet to 30,000 feet, and the maximum thickness of the sheet is 20,000 feet. Other thrust faults are known particularly close to the Lewis Thrust.

The Flathead Fault is a major southwest-dipping normal fault along the west side of the Clark Range in the Flathead Valley; it extends for 50 miles or more both north and south of the Clark Range. It has dropped the strata of the Lewis Thrust Sheet at least 20,000 feet on its west side.

The Lewis Thrust Sheet in the Clark Range forms a broad synclinorium extending from the Akamina syncline in the southeast near Cameron Lake to a series of smaller synclines and anticlines in the northwest near Mount McCarty. In addition to the structures mentioned above, many smaller folds and faults are present.

Rocks of the Purcell Series have been divided into several formations; from bottom to top as designated by officers of the Geological Survey of Canada they are Waterton, Altyn, Appekunny, Grinnell, Siyeh, Purcell, Sheppard, Gateway, Phillips, and Roosville. If the minimum and maximum thicknesses measured for each formation are totalled, the thickness of the Purcell Series ranges from about 10,000 feet to more than 21,000 feet. The rocks include limestones, dolomites, argillites, siltstones, sandstones, quartzites, and andesitic lava flows. Most are cut by basic dykes and sills which are generally considered to be related to the Moyie intrusions of the Cranbrook area to the west.

Some of these intrustions, particularly the dark green sills, contain low grade copper mineralization with local higher grade pockets, but such mineralization is present mostly in the fine-grained margins, while very close by are dark basic intrusives essentially barren of copper minerals. While not conclusive, this suggests that there may be two periods of intrusion of basic rocks with the mineralization taking place between them. Douglas (1952) noted the presence of dark green basic sills which locally contain stellate aggregates of feldspar up to 2 inches or more in size. Some of these rocks contain ellipsoidal structures resembling pillows, as well as vesicular tops, features which suggest that some may be lava flows.

Other much younger porphyritic trachytes or syenites have been noted by Price (1962). One of these is shown along La Coulotte Ridge on his map. Sill-like bodies, apparently petrographically similar, were encountered during this project as shown in later sections.

STRATIGRAPHY

Sheppard Formation

The Sheppard Formation is underlain by the Purcell Formation and is overlain by the Gateway Formation. Two complete sections and one partial section through the Sheppard Formation were measured along the east margin of the Clark Range; measured total thicknesses ranged from 335 feet on Yarrow Creek, about 550 feet on North Drywood Creek to 1000 feet on Victoria Peak. Limited coverage, however, did not allow a regional analysis of the Sheppard. Price (1961) quotes the Sheppard Formation as thinning from a maximum thickness of 900 feet at Wall Lake in south-central Clark Range to approximately 500 feet at Bauerman Creek; to 580 feet at South Drywood Creek; to 470 feet at Pincher Ridge, and 160 feet at North Kootenay Pass.

In the Clark Range the Sheppard Formation comprises light colored dolomite, light yellow and grey and dark red sandstone and siltstone, light green dolomitic sandstone, dolomitic argillite and argillite. Relatively thin diorite sills are present locally. Where measured, there are two distinct subdivisions. The lower part consists of light greenish buff and greenish grey fine-crystalline dolomite and dolomitic argillite interbedded with silty and sandy dolomite, coarse-grained dolomitic quartz sandstone, and light green argillite. The upper part of the Sheppard contains red to purple siltstone, fine-grained sandstone, and quartzites. They are interbedded with light grey to buff fine-crystalline dolomite and dolomitic argillite. Light grey to buff weathering stromatolitic and oolitic(?) dolomite beds form the uppermost part of the formation. Ripple marks, mud cracks, and intraformational conglomerates are scarce. At the Sheppard-Gateway contact the buff dolomites grade into red siltstones in a few tens of feet.

TABLE 1: MEASURED SECTIONS IN THE CLARK RANGE

Section No.	Location	Thickness (Measured)	
GATEWAY FORMATION			
1	Commerce Pass	1740'	
2	Pincher Ridge	1440'	
3	Sage Mountain	1100' *	
4	Victoria Peak	1200'	
6	North Kootenay Pass	1170'	
7	Gladstone Mountain	1300'	
8	Lys Ridge	1490'	
9	Lys Ridge	1700'	
10	Lys Ridge	1300'	
11	Barnaby Ridge	1530'	
12	Loaf Mountain	1630'	
13	Rainy Ridge	1620' *	
14	Prairie Bluff Mountain	1030' *	
15	Sunkist Mountain	1200' * (faulted?)	
16	Bovin Lake	1350'	
17	Wall Lake	865' *	
SHEPPARD FORMATION			
2	Pincher Ridge	515' *	
4	Victoria Peak	1000'	
5	Yarrow Creek	320'	
ROOSVILLE FORMATION			
26	Victoria Ridge	910'	
28(a)	Jutland Mountain	726')	1829'
28(b)	Jutland Mountain	1103')	

* Complete section not measured.

Gateway Formation

The Gateway Formation lies above the Sheppard Formation and below the Phillips Formation. As used in this report, the Gateway Formation is equivalent to Members A and B of the Kintla Formation.

The detailed stratigraphic examination of the Gateway Formation to determine the possibility of a sedimentary-type copper deposit included the measuring of 12 complete stratigraphic sections and 5 partial sections. Fifteen of the measured sections are on the Alberta side of the Clark Range and two are on the British Columbia side: Sunkist Mountain (Section 15) and Wall Lake (Section 17). Section locations were selected to provide a regional picture of lithologic and mineralization trends within the Gateway Formation in the Clark Range, but were restricted to suitable exposures in some places.

On the basis of color and lithology, the Gateway Formation in the Clark Range can be divided into two distinct members. The lower member consists of dark red and purplish red argillaceous and micaceous siltstone and argillite. Grey siltstone interbeds within the red rocks produce a marked striped appearance over certain intervals of outcrops. Abundant casts of cubic salt crystals are characteristic of the lower member. Mud cracks, ripple marks, small scale cross-bedding, and intraformational conglomerates consisting of red argillite chips in a siltstone matrix are abundant locally. Specular hematite is common in small irregular depressions along bedding planes. Red argillaceous partings along bedding produce the common red to reddish purple color of outcrops; the siltier bedding is browner. These characteristics of the Gateway Formation are particularly distinct on the west margin of the area.

Within these red beds are several resistant light colored bands of buff-to-green-weathering silty to argillaceous dolomite. In most sections measured, three such dolomitic units were noted varying in thickness from two feet to twelve feet, but commonly about 3 feet. The lower two dolomitic units are mostly within fifteen to thirty feet stratigraphically of each other and are separated by 10 to 20 feet of purplish red argillaceous siltstone. These two lower dolomitic units are commonly between three and five hundred feet stratigraphically above the Sheppard-Gateway contact. The third dolomitic unit of the Lower Gateway Member is one hundred and fifty to two hundred feet stratigraphically above the second. Locally additional dolomitic units are present as in Section 13 on Rainy Ridge, but these do not appear to have the consistent and widespread areal extent characteristic of those previously mentioned. The extent and correlation of these units is illustrated in Figure 3.

The red and grey siltstones and argillites of the lower member grade upward into the green micaceous argillite, dolomitic argillite, and dolomitic siltstones of the upper member. The transition between these two members may extend for several hundred feet stratigraphically as on Commerce Pass or it may be rather abrupt as near Bovin Lake. The color change from red to green characteristically serves to distinguish the two members.

The upper member of the Gateway Formation consists of green and greenish grey micaceous argillite, dolomitic argillite, dolomitic siltstone, and fine-grained dolomite. Ripple marks are common; mud cracks and salt casts are present locally, as are purple argillaceous partings, particularly near the top. The proportion of sand increases toward the top and marks the transition into the overlying Phillips Formation. Associated with the transition to the Phillips is a color change from grey-green to red. For the purposes of this work, the Gateway-Phillips contact was considered to be marked by the change in grain size (silt-sand) marking a change in the depositional energy environment. A 4-foot bed of green argillite commonly marked the boundary. It is overlain by coarse cream-colored sandstones, thickly bedded and resistant.

Sections measured along the north end of the Clark Range: Gladstone Mountain, Victoria Peak, and North Kootenay Pass show a thickness of 1200 to 1300 feet; those on Lys Ridge and Commerce Pass show a maximum thickness of 1700 feet. The measured thickness of the Gateway Formation on Sunkist Mountain is 1200 feet, while Price (1961) gives a thickness of 2250 feet in the same area. This discrepancy could be due to faulting on Sunkist Mountain. Price's measurements also show thickness increasing to the southwest with this change in both the upper and lower members.

Both the Upper and Lower Gateway are cut by sills and dykes of chloritized diorite. These vary in thickness from 2 to 20 feet and are ubiquitous.

Between Commerce Pass and Rainy Ridge, the Gateway is cut by trachytic sill-like bodies varying in thickness from 220 feet to 4 feet and of variable extent. The thickest body is on Commerce Pass.

Roosville Formation

The Roosville Formation overlies the Phillips Formation and is unconformably overlain by the Paleozoic Flathead Formation, making it the youngest formation of the Purcell Series in the Clark Range. Measurements were made at two places: Victoria Ridge with 910 feet in the lower part, and Jutland Mountain with 1800 feet in a complete composite section. At its lower contact the red siltstones and sandstones of the Phillips Formation grade into green argillites and greenish grey dolomitic argillite. The Roosville Formation consists of green and greenish grey argillite, dolomitic argillite, siltstone, and sandstone. Micaceous partings are common in the siltstone and sandstone, and mud cracks and oscillation ripple marks are present throughout. In the lower part of the formation, stromatolitic dolomites and siliceous oolitic (?) beds are of local extent. The Roosville Formation resembles the Appekunny Formation and the upper member of the Gateway Formation. The upper contact of the Roosville is a regional unconformity with the overlying beds consisting of a clear white quartz sandstone of the Flathead Formation, which grades upward into a green shale unit. Like the Sheppard and Gateway, the Roosville is cut by diorite sills and dykes varying in thickness from a few feet to tens of feet.

TABLE 2: COPPER IN GATEWAY AND ROOSVILLE FORMATIONS

		Range	Average	Standard Deviation	Number of Sections
Carbonate Units in Lower Gateway					
1.	Per Cent Cu	0.1 - 0.32	0.21	0.15	10
	Thickness	9" - 36"	22½"	13½"	
2.	Per Cent Cu	0.01 - 0.41	0.18	0.12	15
	Thickness	2" - 60"	25"	17½"	
3.	Per Cent Cu	0.16 - 2.3	0.82 *	1.0	11
	Thickness	3" - 12"	7"	3¾"	
4.	Per Cent Cu	Only traces noted			8
	Thickness				
Upper Gateway					
	Per Cent Cu	0.01 - 0.18	0.1	0.06	5
	Thickness	1" - 18"	8¾"	7"	
Roosville					
	Per Cent Cu	.01 - .11	.04	.04	
	Thickness	½" - 24"	16"	9¾"	

* Affected by one higher assay.

MINERALIZATION

Sheppard Formation

Within the Sheppard Formation copper is present primarily as small scattered specks of chalcopyrite in vugs and along joint surfaces within silty dolomites. On Pincher Ridge sparse chalcopyrite was found in a siliceous dolomite immediately under a diorite sill. This mineralized zone is 7 feet thick with average copper content of 0.02 per cent. On Victoria Peak (Section 20) chalcopyrite is present in thin sandy lenses and in calcareous nodules, which assayed 0.22 per cent copper.

Gateway Formation - Lower Member

In the red-bed succession of the lower member, the mineralization is essentially restricted to the carbonate beds previously described. The main indicator of mineralization is malachite stain along joint surfaces. The thickness of the mineralized intervals varies from a fraction of an inch to several feet. Assay results showed a range in copper content of 0.01 to 2.3 per cent. The highest assay of 2.3 per cent appears to be due to secondary mineralization in a sandy porous lens in the third carbonate bed in the section measured on Sage Mountain. The average copper content for the mineralized dolomitic units is 0.26 per cent and the average thickness is 18 inches.

The source of this mineralization appears to be due to the primary precipiration of chalcocite contemporaneous with the carbonate sedimentation. The chalcocite, however, is so fine-grained and finely disseminated that much of it cannot be seen even when magnified 50 times. One sample collected during the 1970 field season from a carbonate bed in the Lower Gateway near Grizzly Creek showed chalcocite grains ranging from 5 to 50 microns in very fine-grained dolomite. Their abundance varies from layer to layer, but does not appear to be related to fractures. Minor secondary bornite and chalcopyrite were noted locally in the dolomitic units.

Gateway Formation - Upper Member

Copper mineralization in the upper member of the Gateway Formation is essentially restricted to the dolomitic intervals, the lithology ranging from silty dolomites to dolomitic argillites. All are fine-grained, weathering greenish brown, with fresh surfaces light green. The main indicator of mineralization is malachite stain which is associated with abundant manganese (?) dendrites. Disseminated chalcopyrite is present locally in silty dolomite beds, but its very fine-grain size and sparse distribution make recognition difficult.

The most abundant copper mineralization in the upper member was noted on Commerce Pass (Section 1) and Barnaby Ridge (Section 11) where two mineralized horizons were found in each section. In the Upper Gateway assay results range from 0.01 to 0.18 per cent copper, and the average copper content for the mineralized units of the Upper Gateway is 0.1 per cent copper with an average thickness of $8\frac{3}{4}$ inches.

No copper mineralization was noted in the transition zone between the lower and upper members.

Roosville Formation

Copper mineralization in the examined sections of the Roosville Formation consists of disseminated chalcopyrite, bornite, and malachite stain locally in the dolomites, green dolomitic argillites, and siliceous oolitic beds.

In buff-weathering, fine-grained, dense dolomite, pods of chalcopyrite, 4 mm x 2 mm, are parallel to bedding. Malachite stain is present along bedding planes and joint surfaces associated with abundant manganese (?) dendrites. Green dolomitic argillites adjacent to the mineralized dense dolomite also contain chalcopyrite and malachite parallel to bedding. The oolitic beds contain small pods of chalcopyrite and bornite, finely disseminated across thin intervals.

Minor malachite staining was noted along a sill margin in baked green argillite with some very finely disseminated chalcopyrite and pyrite in the adjacent diorite sill.

Sage Mountain

A total of 84 samples were collected on Sage Mountain almost parallel to Section 3 and about 150 feet south of it. They were collected at intervals of 50 feet up the slope across the strata. There Sage Mountain has an average slope of about 30° and is covered with trees and underbrush. At sample locations each recognizable soil horizon was sampled in pits 18 to 30 inches deep:

1. LF — Humus and organic material, mostly needles, moss and partially decomposed organic material, dark brown to black. Thickness: ½ to 2 inches.

2. Ae — Pinkish grey, ash-like layer, silty, few rock fragments, loose, locally sticky, some carbon. Thickness: 2 to 5 inches.

3. Bf — Pinkish brown to moderate red, sticky to not sticky, clay, silty, abundant to few rock fragments, loose. Thickness: 2 to 23 inches.

4. B — Rusty orange brown, clay, silty, coarse sand and rock fragments locally abundant. Thickness: 5 to 16 inches.

5. B — Light brown, clay, silty, crumbly, loose, abundant rock chips, sticky. Thickness: 5 to 21 inches.

6. Bc — Creamy light brown clay, silty, loose, very abundant rock fragments. Thickness: 5 to 7 inches.

7. Various layers which do not fit normal sequence.

Although specific samples of the soil horizons vary slightly from the general description, each can be easily recognized as being one of the seven described above. The 80-mesh fraction of each sample was analyzed for copper and zinc; first after complete digestion and second after cold extraction. Mercury, silver, molybdenum, and lead were determined after complete digestion only. The results of the analyses are given in Appendix 2 and some are shown in Figures 4 and 5.

In Figure 4 the copper concentrations in the totally digested samples and the mineralized beds are plotted. The lower and second mineralized beds are indicated by higher copper concentrations in samples immediately below the bed, particularly in the layer of humus and organic material. The highest mineralized bed in Section 3 pinches out before it reaches the sampled area.

The humus layer generally has the highest copper concentrations of any of the layers sampled except for the lowest layer at the second mineralized bed where the mineralized bed was actually encountered in the pit. There most of the sediment above the bedrock is derived from the bedrock upslope from the mineralized zone. The second sample above the lower mineralized bed has a higher than average copper concentration; it may be due to contamination or to a mineralized zone that either does not extend to the measured section or was missed. These results indicate that sampling the humus layer at intervals of 50 feet and analyzing for copper is capable of locating copper-bearing beds of the thickness and grade encountered during the stratigraphic work in the environment of the Clark Range. Higher grades or thicker sections would probably be located more easily.

Lead appears to be concentrated in the humus; zinc, silver, molybdenum, and mercury do not appear to be preferentially concentrated in any particular horizon. Copper does not appear to be related to any of the other elements analyzed.

The results of the analyses after cold extraction do not show either of the two mineralized beds except for the sample right in the mineralized bed. Zinc appears to be preferentially concentrated in the humus layer.

Pincher Ridge

As a result of the work on Sage Mountain, only samples of humus were collected on Pincher Ridge. Twenty samples were collected at intervals of 50 feet measured up the slope, about 100 feet west of Section 2. There the mountainside slopes about 28° and is sparsely covered with trees and underbrush. The samples were analyzed for copper after complete digestion. The results are shown in Figure 5. The sampled interval crossed only one mineralized zone, but a second is present about 100 feet above the top of the interval. There sampling was restricted by the lack of humus.

The copper concentrations in the humus on Pincher Ridge are generally higher than those on Sage Mountain, and have a much smaller range. The smaller range in copper content in the samples from Pincher Ridge may be due to a less stable slope caused by less vegetation cover and microclimatic differences. Such a slope would allow the weathered bedrock to mix more thoroughly with the sampled material, thereby making it more uniform in composition. At any rate the concentration of copper in the humus increases only about 50 per cent above the background for about 200 feet downslope from the mineralized bed. The higher copper concentration in the sample farthest up the mountainside probably results from the second copper-bearing bed. The high copper concentration in the sample about 125 feet above the lower copper-bearing bed cannot, at present, be adequately explained.

EXAMINATION OF SHOWINGS AND GEOCHEMICAL ANOMALIES

Drywood Mountain

Occurrence 20 from Alcor's 1970 program at an elevation of 6750 feet on the northeast spur of Drywood Mountain is about 50 feet stratigraphically above the Appekunny-Grinnell contact. The mineralization is restricted to a 2-inch quartzite bed at the top of a 1-foot unit of interbedded quartzite and argillite. The quartzite beds are irregular and lenticular.

Malachite stains joint planes in the upper 2-inch bed, which contains small grains of chalcocite. Bornite is present in stringers 1 mm thick and in cavity fillings. Slickensides in the quartzite are locally coated with malachite.

The 2-inch copper-bearing bed extends along strike for several thousand feet with little change in the nature or extent of mineralization. Two chip samples averaged 0.24 per cent copper across 2 inches.

Occurrence 19 was located at an elevation of 6400 feet on the southeast spur of Drywood Mountain approximately 10 feet below the Siyeh-Grinnell contact. Malachite stains the fracture surfaces of a white medium-grained quartzite which is sheared due to a nearby low angle thrust fault. Beds range from four inches to one foot with sparse layers of green argillite chips. To the south the unit becomes browner where knots of bornite up to ½-inch in size with halos of malachite are irregularly dispersed through it. The mineralized zone was traced along strike approximately 500 feet to the south. Sampling indicates an average grade of 0.04 per cent copper across three feet.

Sheppard Formation in North Kootenay Pass

The Sheppard Formation in the North Kootenay Pass was examined to check the sphalerite and galena noted by Cominco in 1970. The main concentration of sphalerite and galena is in the lower two feet of a black siltstone and the upper six feet of an underlying grey dolomite about 80 feet above the Purcell-Sheppard contact. Chip samples from immediately north of Mt. Hollebeke, along the Continental Divide, and north of the North Kootenay road gave the results below.

	Continental Divide			North Kootenay Pass		
	Pb	Zn	Cu	Pb	Zn	Cu
Siltstone - Lower 2 feet	0.07	0.01	0.03	0.02	0.01	0.01
Dolomite - Upper 3 feet	0.17	0.13	0.04	0.02	0.01	0.01
Dolomite - Lower 3 feet	0.16	0.24	0.03	0.02	0.02	0.02

The grade across eight feet average 0.08 per cent lead, 0.07 per cent zinc, and 0.02 per cent copper. The sphalerite and galena are very fine-grained and difficult to discern; they are most noticeable along the margins of blocks and chips of dolomite in 3-inch to 4-inch beds of intraformational conglomerate within the grey dolomite unit.

Northeast of Victoria Peak

Anomalous concentrations of copper, lead, and zinc were found in the waters of creeks draining south from the ridge between Prairie Bluff and Victoria Peak during Alcor's 1970 program.

No obvious source for the anomalous lead and zinc was observed. The Sheppard Formation underlies much of the upper reaches of the drainage basin giving the anomalies,and lead-zinc mineralization similar to that seen in the North Kootenay Pass could be the possible cause for the anomalous concentrations. Between the two creeks, moderate amounts of chalcopyrite are disseminated in a medium-grained, dirty looking sandstone bed about one foot thick in the Sheppard Formation, 63½ feet above the top of the Purcell Lava. It strikes 140° and dips 23° southwest. It was traced about 200 feet. A short distance stratigraphically above or below the chalcopyrite-bearing sandstone, sparse chalcopyrite is disseminated through at least one foot of grey fine-grained dolomite.

The anomalous copper concentrations in the creek draining south from the northeast ridge of Victoria Peak may be due to chalcopyrite in white quartzites along the Appekunny-Grinnell contact. This creek flows roughly parallel to the contact where a sample of continuous chips assayed 0.22 per cent copper across 10 inches.

CONCLUSIONS

The Gateway Formation has an average thickness of 1500 feet in the Clark Range of southwestern Alberta and thickens to the southwest. Two members are recognized; a lower red siltstone succession which accounts for approximately two-thirds of the total thickness, and an upper green grey argillaceous, dolomitic to silty succession which becomes sandier at the top where it grades into the Phillips Formation.

Detailed stratigraphy of the Gateway Formation shows that copper mineralization is mainly in the dolomitic units; some mineralized units can be traced for many miles throughout the Clark Range. In the red-bed succession of the lower member, copper minerals are restricted to the buff-weathering, dense dolomite and silty dolomite units. They appear to be syngenetic with precipitation of chalcocite probably contemporaneous with the carbonates. Their very fine-grained and finely disseminated nature makes positive identification difficult. Copper in the dolomitic units of the lower member averages 0.26 per cent across 18 inches - uneconomic under present conditions.

Copper mineralization in the upper member of the Gateway Formation is also essentially restricted to the dolomitic units with the lithology ranging from silty dolomite to dolomite to dolomitic argillite. Chalcopyrite sparsely distributed in very fine grains is present in a few places. Otherwise copper mineralization appears similar to that in the lower member, but in thinner units. The average copper content is 0.1 per cent across an average thickness of 8¾ inches. In spite of the low grade of the thin copper-bearing beds found and because of the fine-grained nature of the copper minerals and the difficulty of detecting them where malachite staining is absent, a drill hole or two to better test the Gateway Formation appears warranted. Such holes could be drilled where access is easy in the valley of the South Castle River between Scarpe and Font Creeks.

Lead-zinc mineralization in the Sheppard Formation of the North Kootenay Pass is mainly restricted to an 8-foot zone: the lower 2 feet of a black siltstone and the upper 6 feet of the underlying grey dolomite. The grades across this zone are very low.

Examination of one geochemical anomaly noted in 1970 led to the finding of a 10-inch copper-bearing zone along the Appekunny-Grinnell contact on the northeast ridge of Victoria Peak, and a chalcopyrite-bearing sandstone bed one foot thick in the Sheppard Formation some 60 feet above its base. No obvious source for the anomalous lead-zinc concentrations was found, but it may be due to lead-zinc mineralization in the Sheppard Formation similar to that in the North Kootenay Pass.

The geochemical prospecting conducted on Sage Mountain and Pincher Ridge indicated that samples of the humus layer collected at 50 feet invervals up the slope can detect the copper-bearing beds of the Gateway Formation in the Clark Range. It is expected to be useful where overburden obscures the bedrock.

Respectfully submitted,

[redacted]

Gene A. Van Dyck, B.Sc.

PROFESSIONAL GEOLOGIST ALBERTA
L. B. HALFERDAHL

L. B. Halferdahl, Ph.D., P. Geol.

Edmonton, Alberta
September 20, 1971

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CERTIFICATE

I, Laurence B. Halferdahl, with business and residence addresses in Edmonton, Alberta, do hereby certify that

1. I am a licensed Professional Geologist in the Province of Alberta and a licensed Professional Engineer in the Province of British Columbia.

2. I am a graduate of Queen's University, Kingston, Ontario (B.Sc. in 1952 and M.Sc. in 1954 in Geological Sciences in the Faculty of Applied Science) and of The Johns Hopkins University, Baltimore, Maryland (Ph.D. in 1959 in the Department of Geology).

3. From 1957 to 1969 I was on the staff of the Research Council of Alberta as a mineralogist and geologist where I was in charge of the mineralogy laboratory and conducted various field and laboratory investigations.

4. Since 1969 I have been a consulting geological engineer conducting and directing property examinations and evaluations, and exploration programs for metallic minerals, industrial minerals, and coal.

5. The data in this report by G.A. Van Dyck were obtained from published and unpublished reports, and his own and A. Kahil's examination of the properties from June 2 to August 4, 1971. Their work was under my general supervision.

Respectfully submitted,

[redacted]

Edmonton, Alberta
September 20, 1971

L. B. Halferdahl, Ph.D., P. Geol.

APPENDIX 1: COLUMNAR SECTIONS IN CLARK RANGE

- Argillite
- Siltstone
- Sandstone
- Dolomite
- Quartzite
- Dolomitic siltstone
- Argillaceous dolomite
- Silty dolomite
- Dolomitic argillite
- Covered interval
- Diorite
- Trachyte

Width of column indicates relative resistance to weathering.

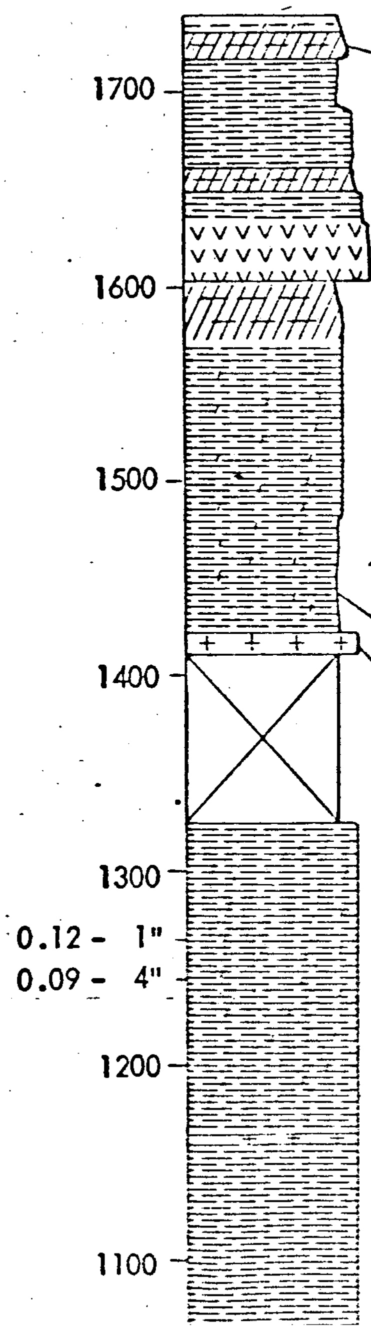
Assay results: % Cu - sample length .... 0.41 - 2"

SECTION 1 - COMMERCE PASS

A1

PHILLIPS FORMATION

UPPER GATEWAY FORMATION



Green-weathering argillite (3') grading down into brown-weathering dolomitic siltstones; siltstones are light brown on fresh surfaces, argillites are green; beds $\frac{1}{4}$" to $\frac{1}{2}$".

Green-grey-weathering interbedded siltstone and argillite units alternating over 6" to 2' intervals.

Green-weathering siltstones; beds $\frac{1}{4}$" to 2"; green argillite partings along bedding; ripple marks; 31' above base is 18" bed of chippy siltstone with purple argillite partings.

Brown-weathering dolomitic siltstone; beds $\frac{1}{2}$" to 4"; argillite partings cause ribbed appearance.

Green-weathering siltstone and dolomitic siltstone; green on fresh surfaces; beds $\frac{1}{4}$" to 1"; thin green argillite partings.

Porphyritic trachyte sill; weathers light pinkish grey.

Brown-weathering silty dolomite to fine grained sandstone; beds 1/8" to 8"; a few green silty argillite beds up to 6"; beds thin to 1/16" to 1" near top and are more argilloceous.

Green-weathering dolomitic siltstone and silty dolomite; beds 1" to 4"; green argillite partings; salt casts; finely laminated and rippled; purple argillite partings between 68.5' to 82' from bottom of unit.

Green-to-brown-weathering dolomitic siltstones; dark grey green on fresh surfaces; beds $\frac{1}{4}$" to 1" with light pink bands parallel to bedding; argillite partings along bedding partly eroded producing a ribbed appearance.

Diorite sill; dark grey, fine to medium-grained.

Covered interval with green-weathering argillaceous siltstone in float; bedding looks to be $\frac{1}{2}$" to 1".

Green-weathering siltstones; green-grey on fresh surfaces; beds 1" to 4"; a few bands up to 6" with purple argillite partings along bedding and a few silty dolomite beds 2" to 6".

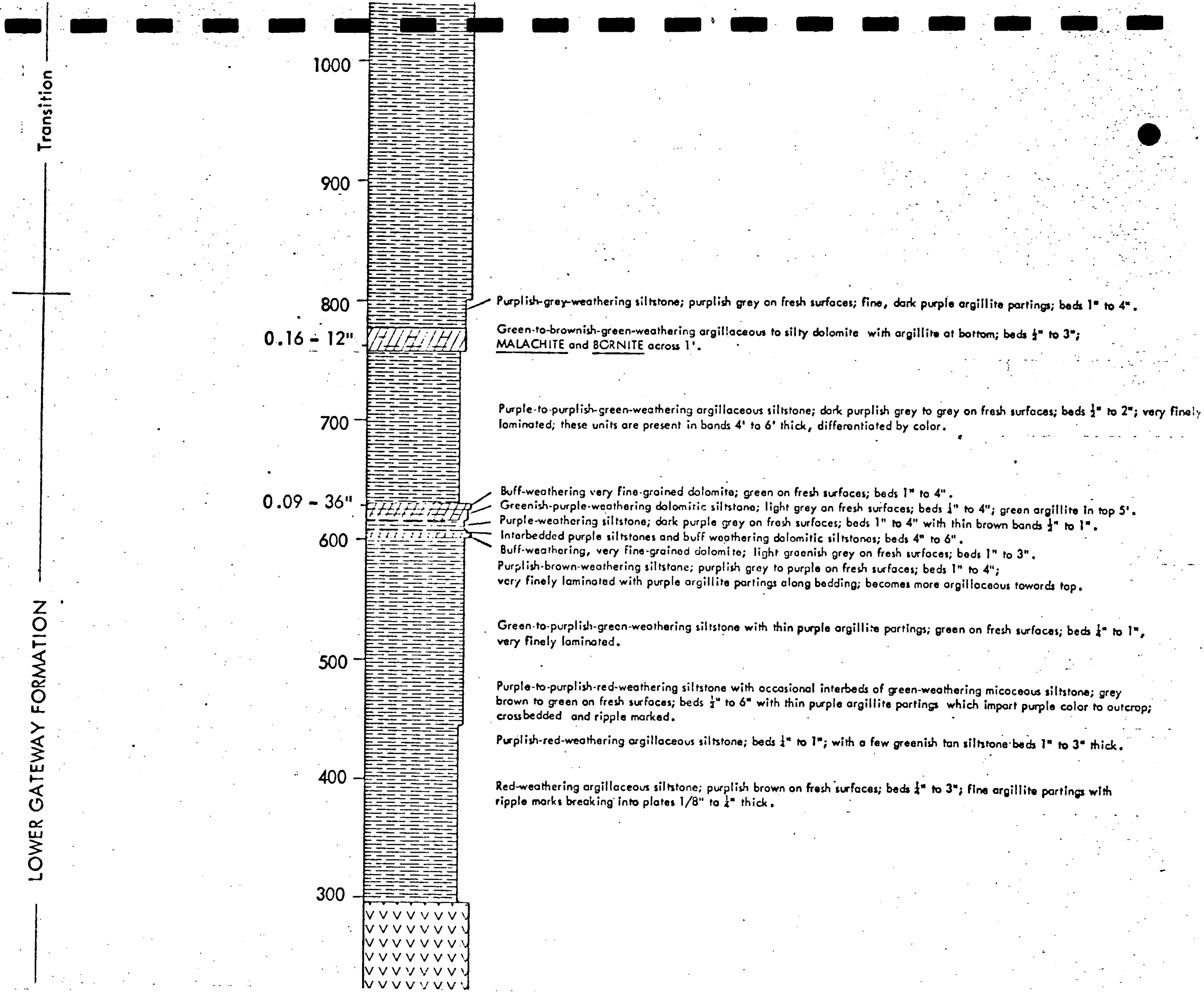
MALACHITE and CHALCOPYRITE along 1" shear zone in silty dolomite.

MALACHITE and BORNITE in 4" of silty dolomite, parallel to bedding.

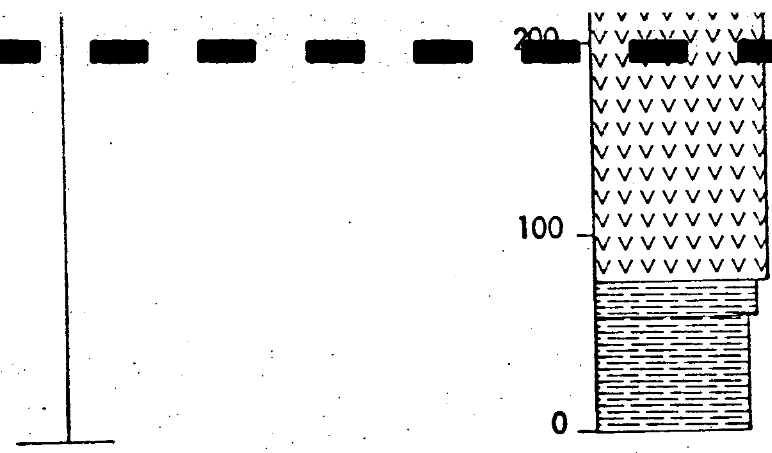
Diorite sill; dark grey to black, fine-grained.

Greyish-green-weathering siltstone; green on fresh surfaces; beds 1" to 4"; fine brown bands parallel bedding; locally dolomitic.

Interbedded purplish grey and greenish grey siltstones; beds 1" to 4"; purple color due to argillite partings along bedding; alternating color units 5' to 10' thick with green units more abundant at bottom.



Transition
LOWER GATEWAY FORMATION
1000
900
800
0.16 - 12"
700
0.09 - 36"
600
500
400
300
Purplish-grey-weathering siltstone; purplish grey on fresh surfaces; fine, dark purple argillite partings; beds 1" to 4".
Green-to-brownish-green-weathering argillaceous to silty dolomite with argillite at bottom; beds ½" to 3"; MALACHITE and BORNITE across 1'.
Purple-to-purplish-green-weathering argillaceous siltstone; dark purplish grey to grey on fresh surfaces; beds ½" to 2"; very finely laminated; these units are present in bands 4' to 6' thick, differentiated by color.
Buff-weathering very fine-grained dolomite; green on fresh surfaces; beds 1" to 4".
Greenish-purple-weathering dolomitic siltstone; light grey on fresh surfaces; beds ¼" to 4"; green argillite in top 5'.
Purple-weathering siltstone; dark purple grey on fresh surfaces; beds 1" to 4" with thin brown bands ½" to 1".
Interbedded purple siltstones and buff weathering dolomitic siltstones; beds 4" to 6".
Buff-weathering, very fine-grained dolomite; light greenish grey on fresh surfaces; beds 1" to 3".
Purplish-brown-weathering siltstone; purplish grey to purple on fresh surfaces; beds 1" to 4"; very finely laminated with purple argillite partings along bedding; becomes more argillaceous towards top.
Green-to-purplish-green-weathering siltstone with thin purple argillite partings; green on fresh surfaces; beds ¼" to 1", very finely laminated.
Purple-to-purplish-red-weathering siltstone with occasional interbeds of green-weathering micaceous siltstone; grey brown to green on fresh surfaces; beds ½" to 6" with thin purple argillite partings which impart purple color to outcrop; crossbedded and ripple marked.
Purplish-red-weathering argillaceous siltstone; beds ¼" to 1"; with a few greenish tan siltstone beds 1" to 3" thick.
Red-weathering argillaceous siltstone; purplish brown on fresh surfaces; beds ¼" to 3"; fine argillite partings with ripple marks breaking into plates 1/8" to ¼" thick.



Porp[redacted] trach[redacted]; m[redacted]and de[redacted]rey o[redacted] surfa[redacted]

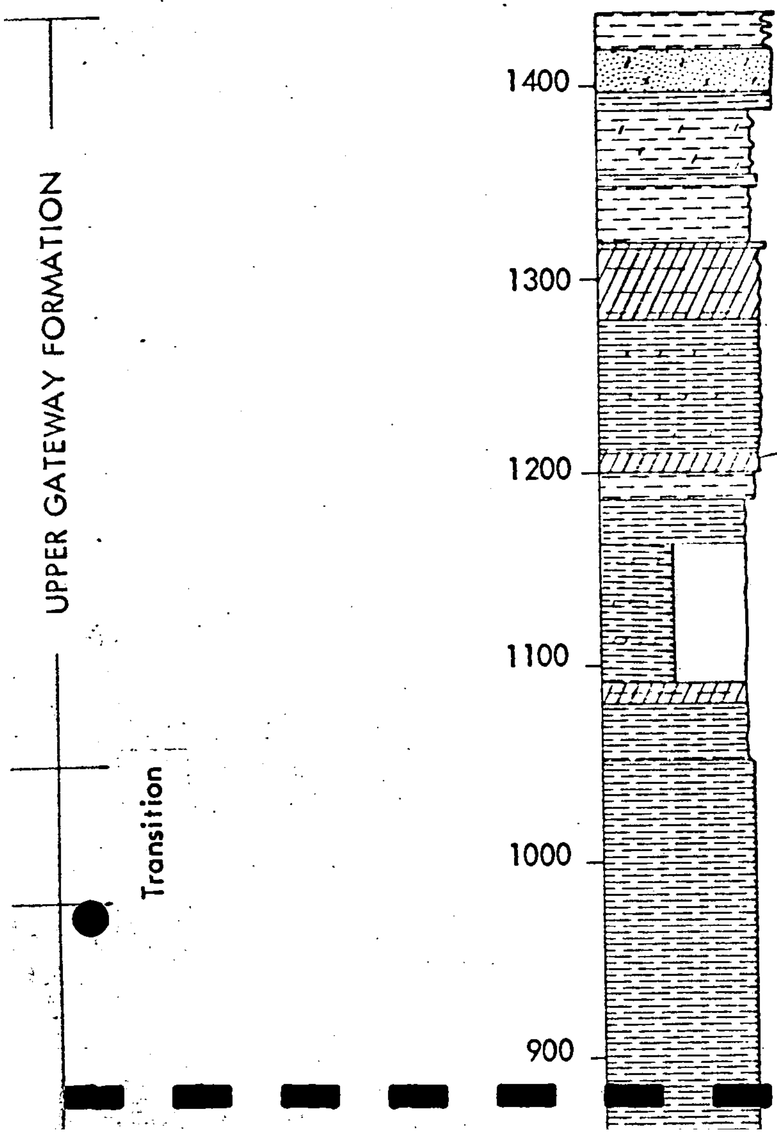
Greenish-grey-weathering siltstone with purplish red argillaceous siltstone interbeds ¼" to 1" thick; grey on fresh surfaces; beds 1" to 2"; crossbedded.

Purplish-red-weathering argillaceous siltstones; finely laminated with greenish grey bands; purplish red on fresh surfaces; beds ¼" to 3".

SHEPPARD FORMATION

SECTION 2 - PINCHER RIDGE

PHILLIPS FORMATION



Green argillite with more resistant siltier beds, 3" to 4" thick, more abundant at top.

Brown-weathering dolomitic sandstone grading to siltstone; beds 2" to 6".

Green-weathering siltstone with thin argillaceous partings; beds 6" to 1'.

Interbedded green-weathering siltstones and argillites with a few 4" beds of brown weathering sandy dolomite.

Purplish-red-weathering, very finely laminated argillaceous siltstone.

Green-weathering, very finely laminated argillite with a few more resistant siltstone beds 1" to 4" thick.

Rusty-brown-weathering finely laminated, silty dolomite with beds ¼" to 1" thick; salt casts; ripple marks.

Brownish-green-weathering, very fine-grained dolomite grading to argillaceous dolomite; beds ½" to 2"; more argillaceous at top.

Green-weathering argillaceous siltstone with interbeds of silty dolomite, 1" to 4" thick.

Brown-weathering, sandy dolomite in very thin beds.

Greenish-brown-weathering silty dolomite in very thin beds.

Brownish-green-weathering argillite grading to argillaceous siltstone; finely laminated.

Interbedded purplish red siltstones, green argillaceous siltstones and a few sandy dolomite beds 2" to 4" thick; argillites and siltstones are finely laminated and alternate in units 2' thick.

Interbedded sequence of green-weathering siltstones; argillaceous dolomite in beds ¼" to 1".

Green-brown-weathering very fine-grained argillite grading to silty dolomite; beds ¼" to 2".

Green-weathering argillites and siltstones, with a few 4" beds of brown-green weathering silty dolomite; finely laminated; beds ¼" to 2".

Interbedded red-and-greyish-green-weathering siltstones and argillaceous siltstones alternating in units 2' thick.

Red-weathering siltstone; beds 4" to 1'; finely laminated.

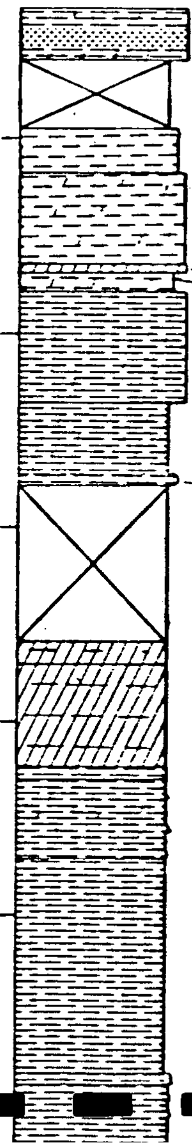
SECTION 8 – LYS RIDGE

AS

PHILLIPS FORMATION

UPPER GATEWAY FORMATION

Transition



Interbedded green-to-buff-weathering siltstone, quartzite and argillite; locally dolomitic beds 1" to 4".

Covered.

Green-to-purplish-green-weathering argillites and argillaceous siltstone with a few 6" to 1' beds of dolomite; beds ¼" to 6".

Green-to-buff-weathering argillaceous dolomite grading to dolomitic siltstone; beds ½" to 2".

Buff-weathering silty dolomite; beds 1".

Buff-weathering dolomitic argillite grading to silty argillite; 1/8" beds.

Greenish-buff-weathering interbedded silty dolomite and thin platy argillite; beds in silty dolomite 1" to 3"; argillite units up to 18" thick.

Green-weathering silty dolomitic argillite; beds ½" to 1".

Purplish-green-weathering argillaceous siltstone; beds 1" to 4".

Mostly covered; a few outcrops of greyish-buff-weathering argillaceous dolomite to silty dolomite; scree mostly greenish buff silty argillite.

Brown-weathering argillaceous to silty dolomite; beds 1" to 6"; becomes less dolomitic at top.

Purple-weathering finely laminated argillaceous siltstone; beds ½" to 2".

Greenish-buff-weathering argillaceous siltstone grading to silty argillite; with a few 2" to 4" beds of very fine-grained buff-weathering dolomite; dolomite is green on fresh surfaces.

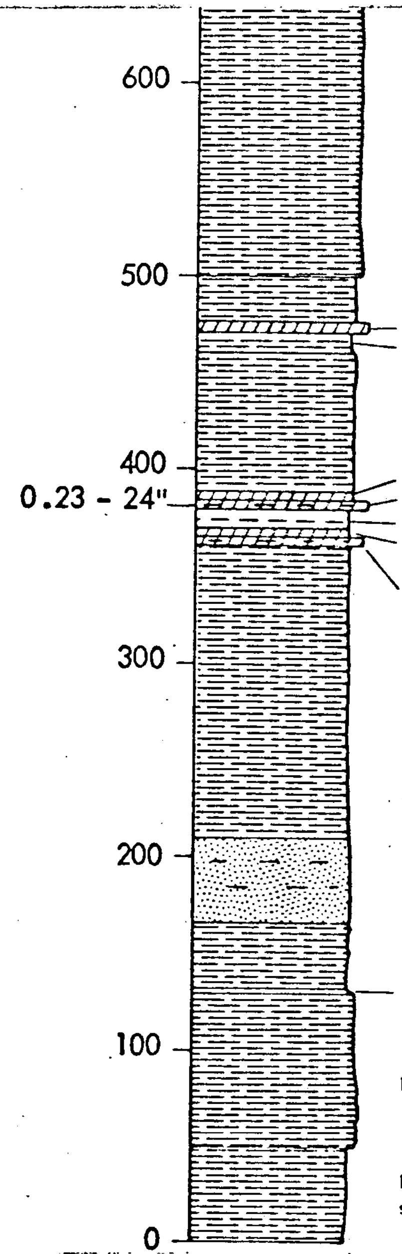
Purplish-grey-to-greenish-purple-weathering argillaceous siltstone; beds 1" to 4".

Purplish-red-weathering finely laminated siltstone; beds 1" to 4".

Purplish-red-weathering finely laminated siltstone grading to argillaceous siltstone; beds ½" to 4".

Green-weathering argillaceous siltstone with purplish red laminae.

Red-weathering finely laminated siltstone; beds 4" to 1'; lighter bleached banding parallel bedding



Purplish-red-to-reddish-brown-weathering siltstone; purplish brown on fresh surfaces; beds 1" to 6"; fine red laminations; contains few 2" to 10" brown-grey-weathering silty dolomite beds; two resistant 8" to 10" dolomitic beds at top of unit.

Red-weathering argillaceous siltstone; purple red on fresh surfaces; beds $\frac{1}{2}$" to 2".

Greenish-grey-weathering argillaceous to silty dolomite; beds $\frac{1}{4}$" to 1".

Red-weathering silty argillite; purplish red on fresh surfaces; beds $\frac{1}{4}$" to $\frac{1}{2}$".

Red-weathering argillaceous siltstone; purplish red on fresh surfaces; beds $\frac{1}{4}$" to 1"; containing a few dolomitic beds up to 8" and discontinuous $\frac{1}{2}$" to 1" bleached strips.

Green-weathering purple dolomitic argillite grading down into dolomitic siltstone; beds $\frac{1}{4}$" to $\frac{1}{2}$".

Buff-weathering dolomite; beds $\frac{1}{4}$" to 3"; scattered MALACHITE and BORNITE across 2'.

Light-green-weathering argillaceous siltstone and argillite; beds $\frac{1}{4}$" to 1"; purple mottling near base.

Purple-weathering silty dolomite; beds $\frac{1}{4}$" to $\frac{1}{2}$"; purple argillite partings; contains 2' dark greenish grey siltstone bed at top.

Buff-weathering very fine-grained dolomite; green grey on fresh surfaces; beds $\frac{1}{4}$" to $\frac{1}{2}$"; abundant chlorite.

Reddish-brown-weathering argillaceous siltstone with interbeds of silty argillite; purplish red on fresh surfaces; beds in siltstone $\frac{1}{2}$" to 3"; fine red laminae show crossbedding; slump structures and flame structures present; contains a few brown sandy beds.

Brownish-red-weathering argillaceous, limey, fine grained sandstone; purplish brown on fresh surfaces; beds 1" to 2"; 1/16" to $\frac{1}{2}$" interbeds of red silty argillite.

Red-weathering argillaceous siltstone; purplish red on fresh surfaces; beds $\frac{1}{2}$" to 2"; contains a few 1' beds of brownish red argillaceous sandstone.

Red to grey banded argillites and siltstones; siltstones purplish grey on fresh surfaces; siltstone beds 1" to 3"; argillite beds 1/16" to $\frac{1}{2}$"; finely laminated.

Red-weathering siltstone; purplish red on fresh surfaces; beds $\frac{1}{4}$" to 2"; with $\frac{1}{2}$" to 4" brown to grey resistant sandy beds.

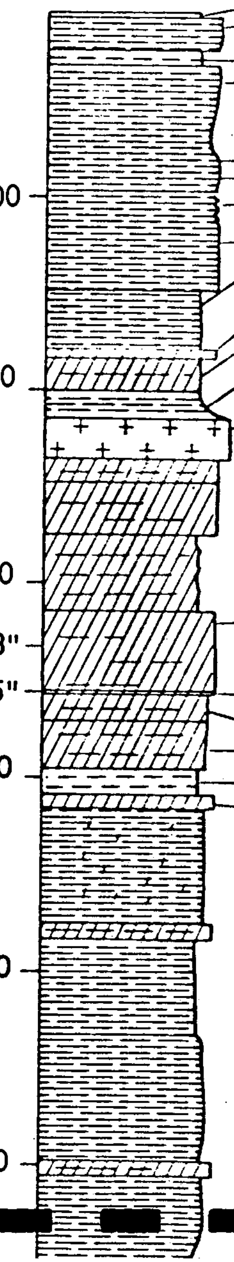
Red-weathering argillaceous siltstone; purple grey on fresh surfaces; beds $\frac{1}{4}$" to 2"; thin argillite partings along bedding; salt casts, ripple marks and specular hematite abundant.

SHEPPARD FORMATION

SECTION 7 – GLADSTONE MOUNTAIN

A7

PHILLIPS FORMATION



Green-weathering argillite; green on fresh surfaces; beds 1/8" to ¼".

Green-weathering interbedded siltstone and argillite units 6" to 8" thick; purple argillite partings.

Green-weathering argillite; with scattered siltstone beds 1" to 3".

Greenish-brown-weathering interbedded siltstone and argillite.

Green-weathering siltstone; green on fresh surfaces; beds 1" to 6".

Brown-weathering interbedded siltstone and argillite; alternating units 1" to 2" thick.

Green-weathering interbedded siltstone and argillite; alternating units 6" to 2' thick.

Green-weathering siltstone; beds ¼" to 2" purple argillite partings; crossbedded.

Brown-weathering interbedded dolomitic siltstone and green argillite in units 1" to 4"; siltstone beds 1" to 3"; argillite beds 1/8" to ¼".

Light-green-weathering dolomitic siltstone; beds ¼" to 1"; with 3" to 8" brown dolomite beds.

Brown-weathering silty dolomite; green on fresh surfaces; beds ½" to 2".

Light-green-weathering baked siltstone; beds 3" to 4" grading up into dolomitic siltstone; beds ¼" to 1" at top.

Diabase sill; dark rusty grey.

Green-weathering dolomitic siltstone; green on fresh surfaces; beds 1" to 6"; salt casts on bedding planes.

Light-brown-weathering silty dolomite; green on fresh surfaces; beds ¼" to 2"; with cream colored splotches.

Greenish-grey-weathering dolomitic siltstone; greenish grey to purplish grey on fresh surfaces; beds 1/8" to 1" with purple argillaceous material along bedding planes giving unit a purple color; interbeds of brown to green brown silty dolomite 8" to 2'; which are more resistant.

Green-to-greenish-brown-weathering silty dolomite; green on fresh surfaces; beds ¼" to 4"; 3" mineralized bed with small grains of BORNITE and CHALCOPYRITE.

Green-weathering dolomite; green on fresh surfaces; beds ½" to ¼"; CHALCOPYRITE and BORNITE along bedding across 15".

Brown-to-greenish-brown-weathering silty dolomite; beds ½" to 1".

Greenish-grey-weathering dolomitic siltstone; beds 1/8" to 1"; thin purple argillite partings along bedding.

Purplish-red-weathering silty argillite; beds 1/8" to 1".

Greenish brown silty dolomite; light grey green on fresh surfaces; beds ¼" to 1"; argillaceous at top.

Purplish red argillaceous siltstone and interbedded grey green dolomitic siltstone; beds in argillaceous siltstone 1/8" to 1"; beds in dolomitic siltstone ½" to 1"; dolomitic siltstone units up to 8" thick; argillaceous siltstone units 1' to 2' thick.

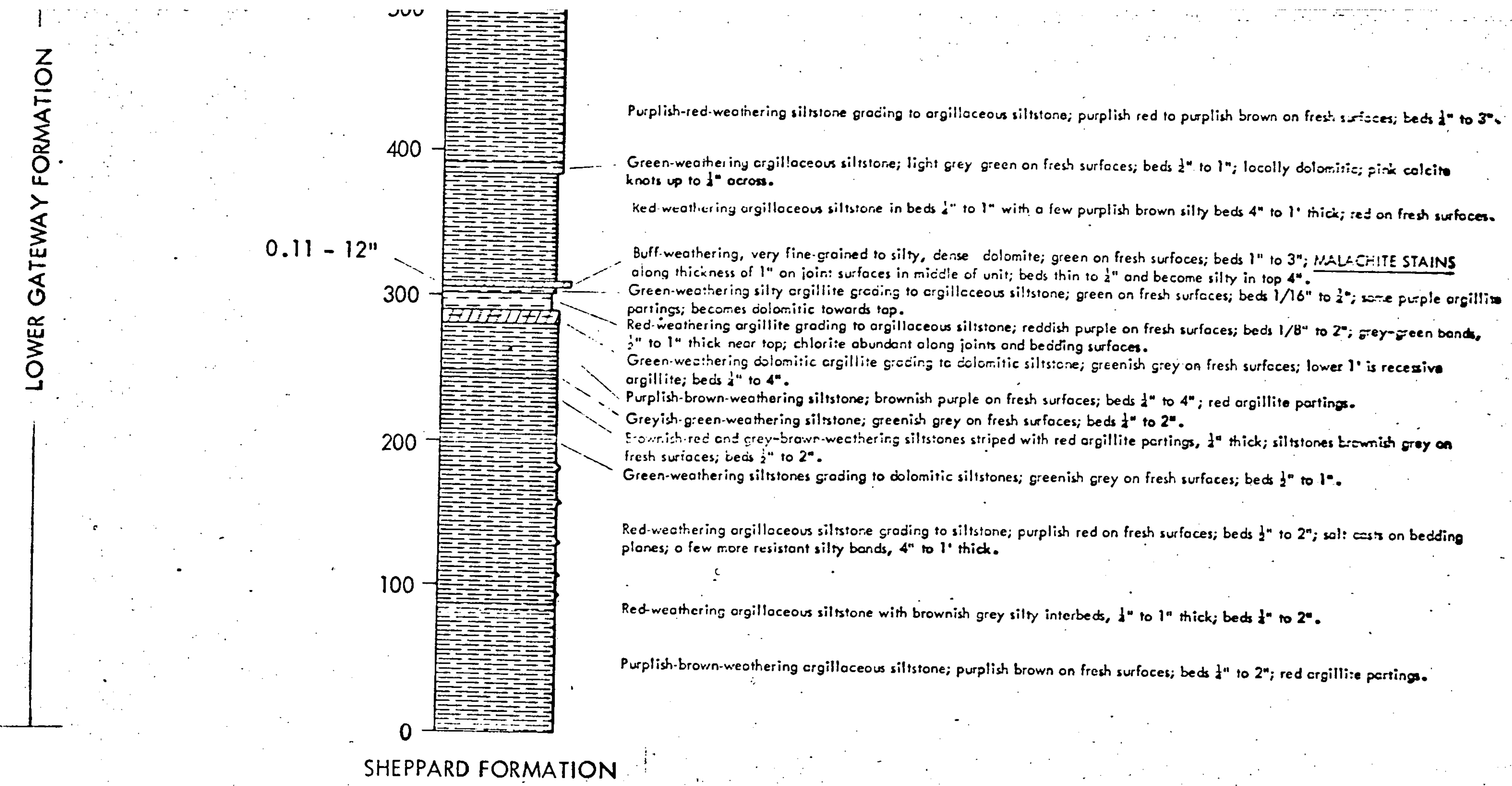
Grey-green-weathering dolomitic siltstone; greenish grey on fresh surfaces; beds ¼" to 2"; thin argillaceous partings.

Red-weathering argillaceous siltstone; purple red on fresh surfaces; beds ½" to 2".

Purplish-red-to-purplish-brown-weathering argillaceous siltstone; purplish grey on fresh surfaces; beds 1" to 4"; finely laminated; red argillaceous partings; salt casts and bleaching along bedding.

Buff-weathering very fine-grained, micaceous, silty dolomite; beds 2" to 6".

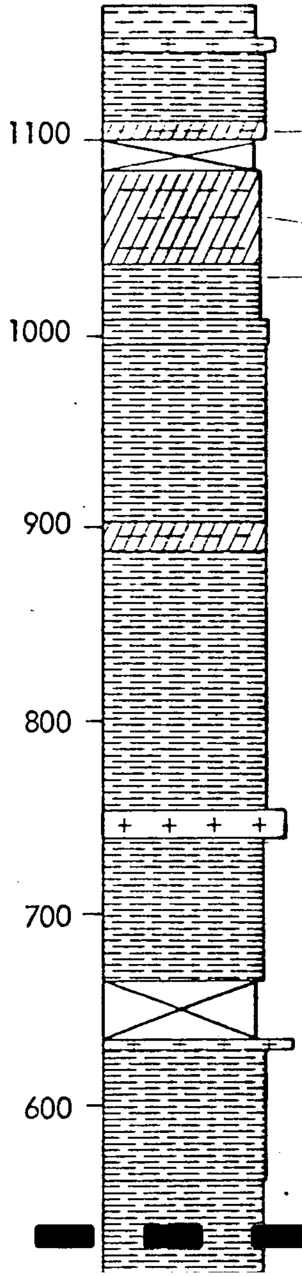
Purplish[redacted]eathe[redacted]nterbe[redacted]ltsto[redacted]rgill[redacted] silts[redacted]h gre[redacted]brown[redacted]itic b[redacted] to 1".[redacted] thick.


LOWER GATEWAY FORMATION
500
400
300
200
100
0
0.11 - 12"
SHEPPARD FORMATION
Purplish-red-weathering siltstone grading to argillaceous siltstone; purplish red to purplish brown on fresh surfaces; beds ¼" to 3".
Green-weathering argillaceous siltstone; light grey green on fresh surfaces; beds ½" to 1"; locally dolomitic; pink calcite knots up to ¼" across.
Red-weathering argillaceous siltstone in beds ¼" to 1" with a few purplish brown silty beds 4" to 1' thick; red on fresh surfaces.
Buff-weathering, very fine-grained to silty, dense dolomite; green on fresh surfaces; beds 1" to 3"; MALACHITE STAINS along thickness of 1" on joint surfaces in middle of unit; beds thin to ½" and become silty in top 4".
Green-weathering silty argillite grading to argillaceous siltstone; green on fresh surfaces; beds 1/16" to ½"; some purple argillite partings; becomes dolomitic towards top.
Red-weathering argillite grading to argillaceous siltstone; reddish purple on fresh surfaces; beds 1/8" to 2"; grey-green bands, ½" to 1" thick near top; chlorite abundant along joints and bedding surfaces.
Green-weathering dolomitic argillite grading to dolomitic siltstone; greenish grey on fresh surfaces; lower 1' is recessive argillite; beds ¼" to 4".
Purplish-brown-weathering siltstone; brownish purple on fresh surfaces; beds ¼" to 4"; red argillite partings.
Greyish-green-weathering siltstone; greenish grey on fresh surfaces; beds ¼" to 2".
Brownish-red and grey-brown-weathering siltstones striped with red argillite partings, ¼" thick; siltstones brownish grey on fresh surfaces; beds ½" to 2".
Green-weathering siltstones grading to dolomitic siltstones; greenish grey on fresh surfaces; beds ½" to 1".
Red-weathering argillaceous siltstone grading to siltstone; purplish red on fresh surfaces; beds ½" to 2"; salt casts on bedding planes; a few more resistant silty bands, 4" to 1' thick.
Red-weathering argillaceous siltstone with brownish grey silty interbeds, ¼" to 1" thick; beds ¼" to 2".
Purplish-brown-weathering argillaceous siltstone; purplish brown on fresh surfaces; beds ¼" to 2"; red argillite partings.

SECTION 6 – NORTH KOOTENAY PASS

PHILLIPS FORMATION

UPPER GATEWAY FORMATION



Rusty green baked argillite; green on fresh surfaces; grades upward into green argillite; very thinly bedded.
Rusty black diorite sill.
Green-weathering siltstone; dark green on fresh surfaces; beds ½" to 4"; green argillite partings; sandier at top.
Interbedded green siltstones, brown dolomitic siltstones, and brownish green argillites; beds ¼" to 3" in siltstones.
Covered; green argillite scree.

Brownish-green to green-weathering dolomitic siltstone; light grey green on fresh surfaces; beds ¼" to 2"; thin brown banding along bedding; grades to dolomite in lowest 10'.
Greenish-grey-weathering siltstones; grey on fresh surfaces; beds ¼" to 2" with thin purple argillite partings.

Green-weathering siltstones and argillaceous siltstones; green on fresh surfaces; beds ½" to 4"; at 998.5' small blobs and knots of CHALCOPYRITE along rusty laminae in a 1" bed of grey siltstone which weathers brown.

Unit weathers more brown from 985' to 1000'.

Brownish-green weathering silty dolomite grading to dolomitic siltstone; light green on fresh surfaces; beds 1" to 4".
Green-weathering argillaceous siltstone; dark green on fresh surfaces; very finely laminated with beds 1" to 7"; crossbedded; green and brown alternating in ½" to 2" intervals to produce a striped pattern; very chloritic; a few brown dolomitic siltstone beds 4" to 6" thick which are greenish grey on fresh surfaces.

4" fracture filled with barite.

Purple argillite partings along bedding.

Diorite sill; dark grey to black.
Greenish-grey-weathering siltstones; purplish grey on fresh surfaces; beds ¼" to 2".

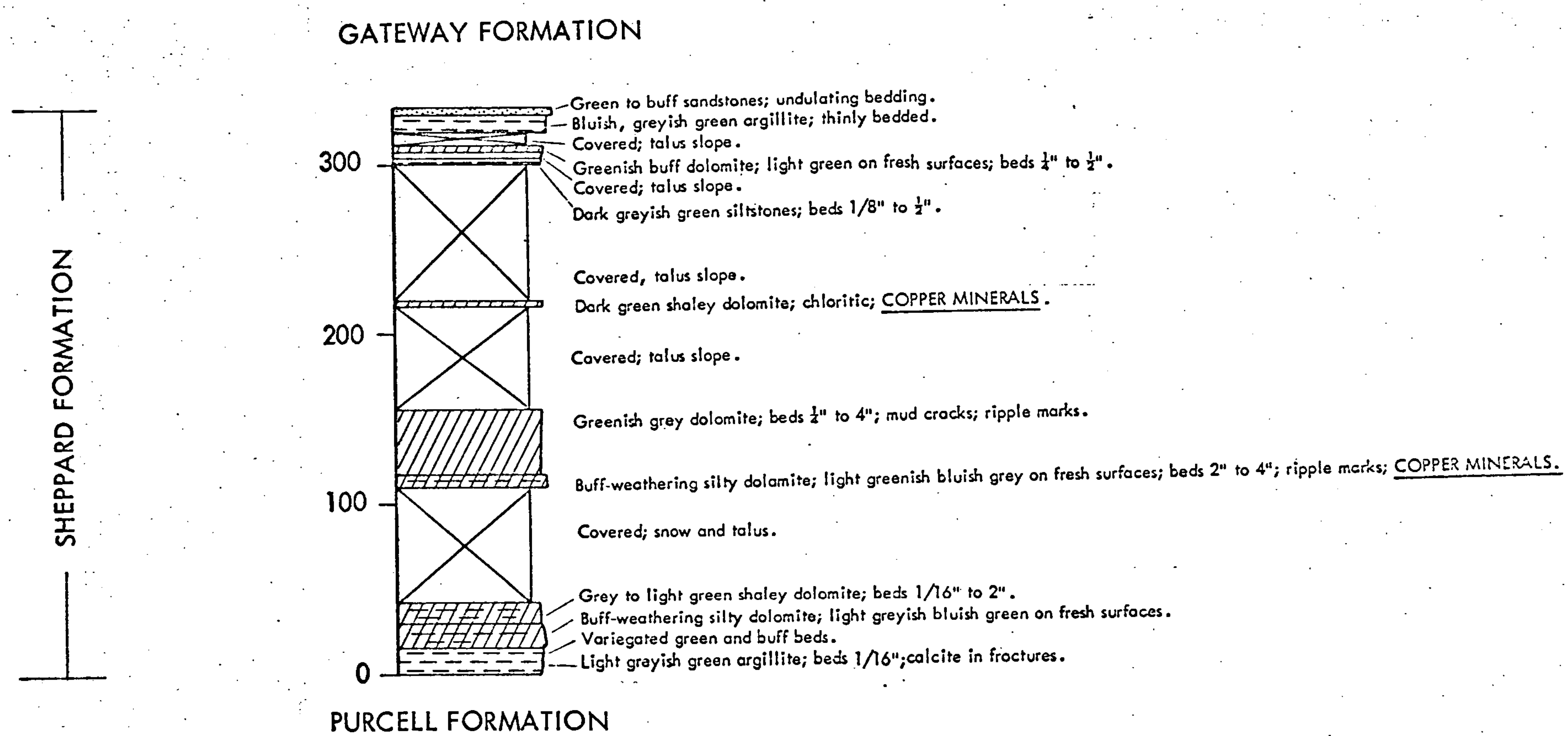
Brownish purple argillaceous siltstone; beds ¼" to 2"; red argillite partings; a few beds of brown-weathering dolomitic siltstone from 2" to 6" thick.

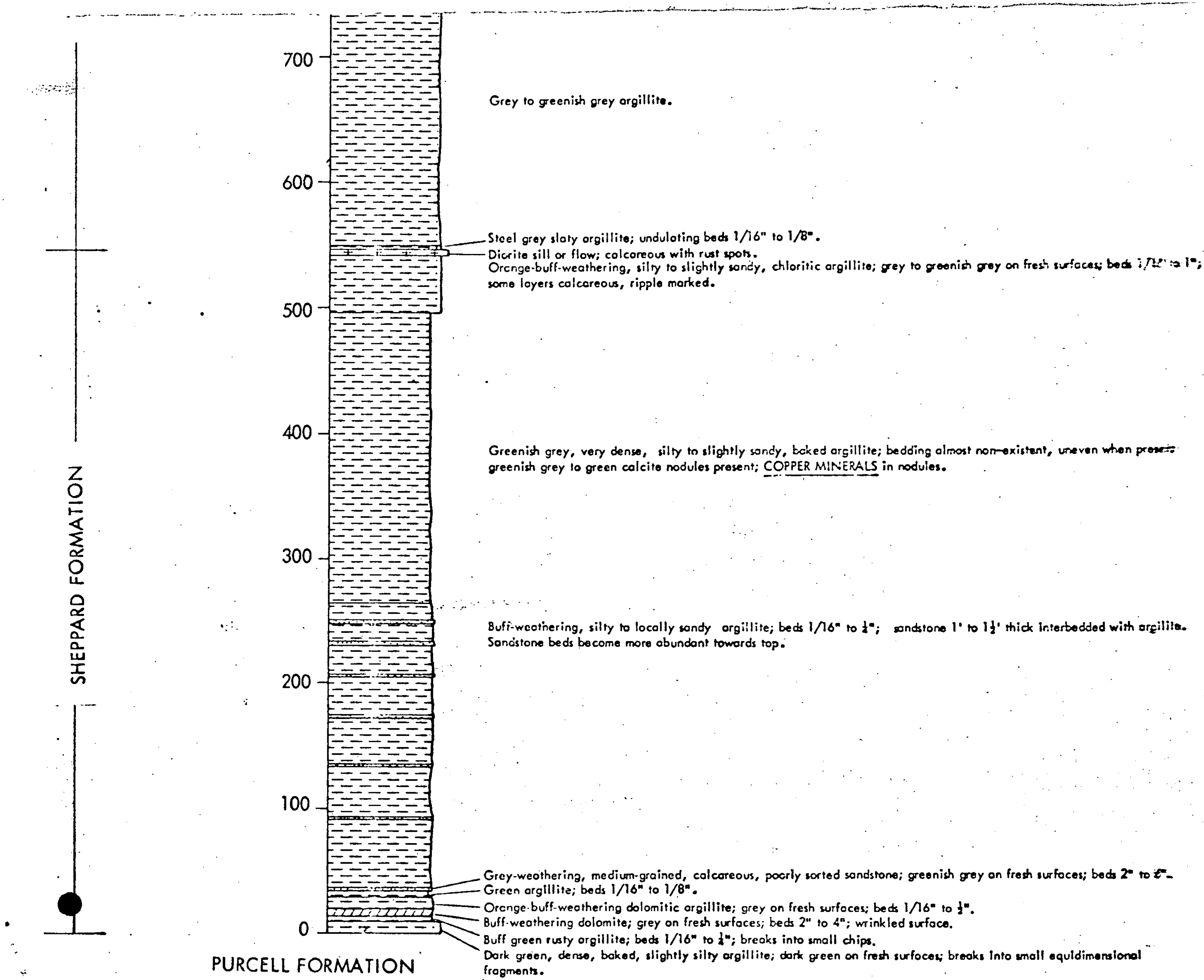
Covered; red argillaceous siltstone in talus.
Diorite sill; dark grey.

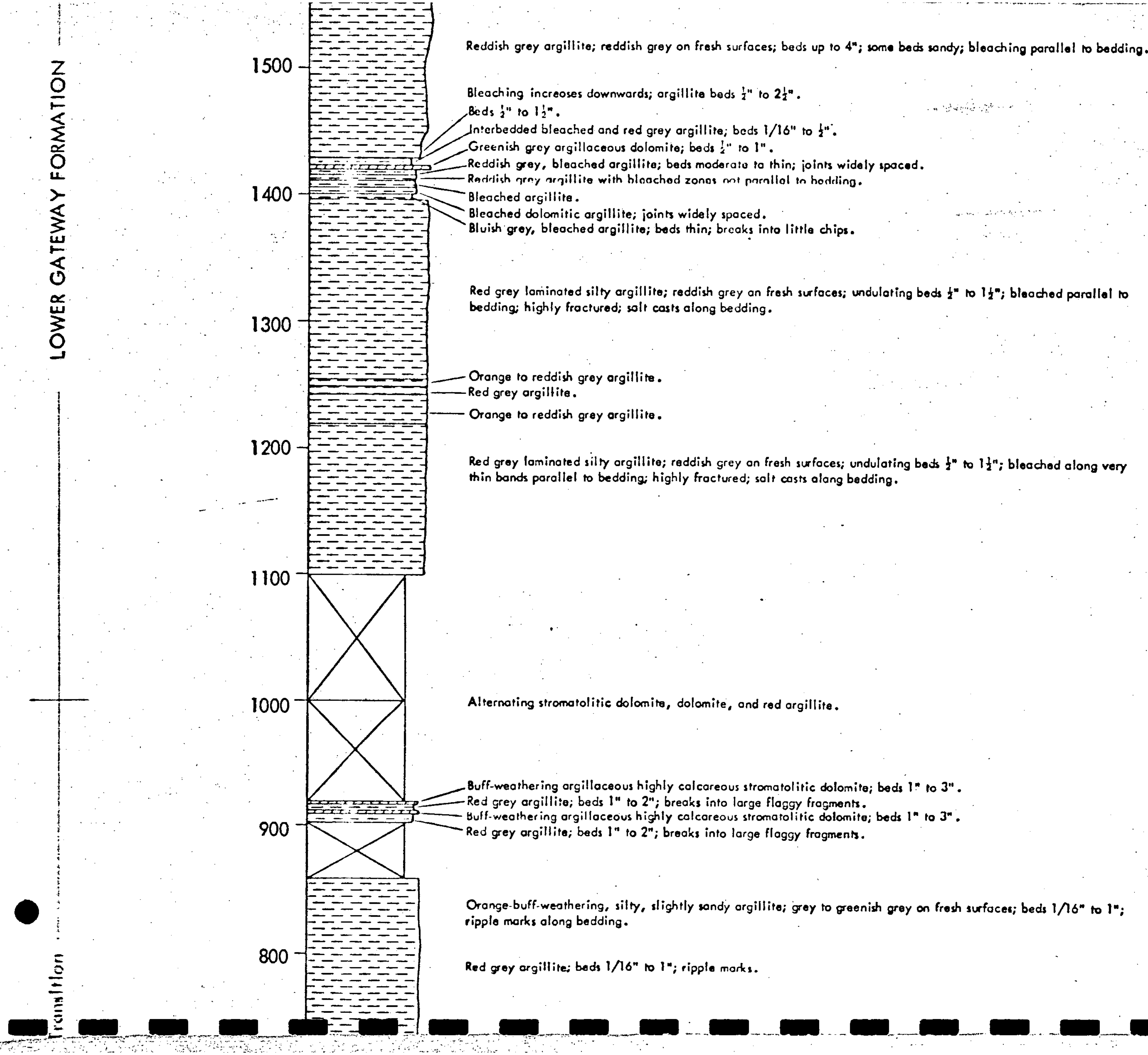
Red and brown banded siltstones and argillaceous siltstones; beds ½" to 8"; brown silty beds ½" to 8" thick.
High angle fault.

Purplish-brown-weathering siltstone; purplish grey on fresh surfaces; beds 2" to 3"; thin argillite partings; at 476.5' is a 1' bed of brown-weathering dolomitic siltstone.

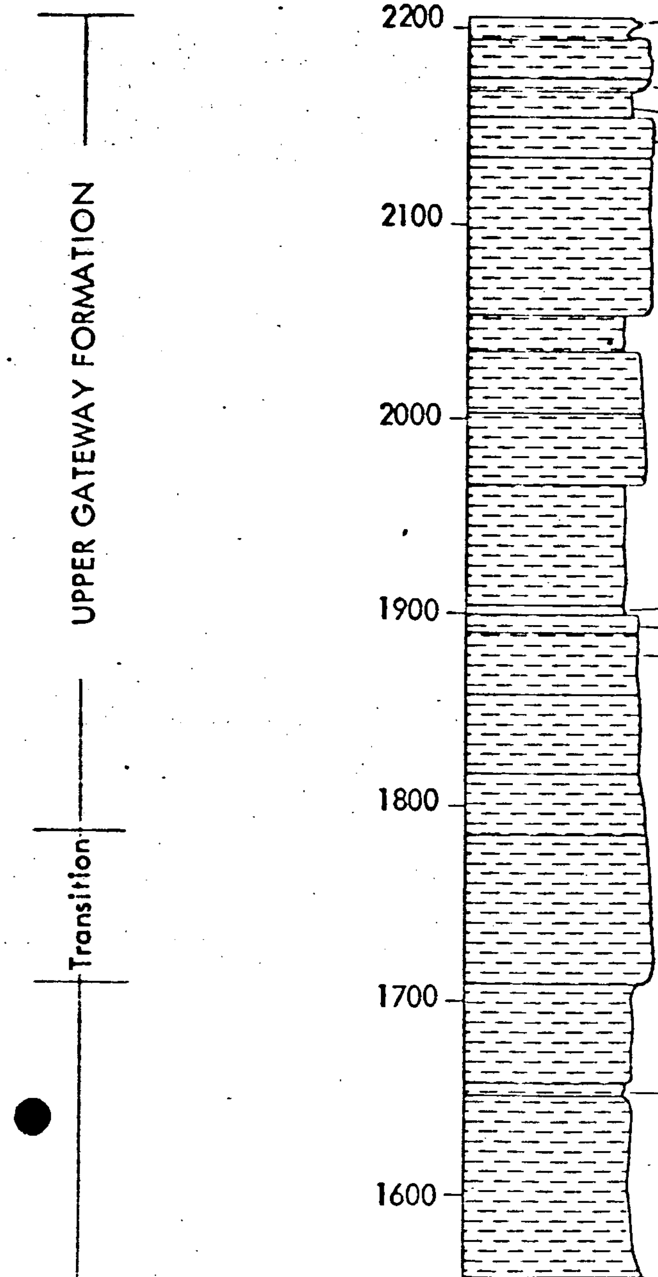
SECTION 5 - YARROW CREEK




700
600
500
400
300
200
100
0
Grey to greenish grey argillite.
Steel grey slaty argillite; undulating beds 1/16" to 1/8".
Diorite sill or flow; calcareous with rust spots.
Orange-buff-weathering, silty to slightly sandy, chloritic argillite; grey to greenish grey on fresh surfaces; beds 1/16" to 1"; some layers calcareous, ripple marked.
Greenish grey, very dense, silty to slightly sandy, baked argillite; bedding almost non-existent, uneven when present; greenish grey to green calcite nodules present; COPPER MINERALS in nodules.
Buff-weathering, silty to locally sandy argillite; beds 1/16" to ¼"; sandstone 1' to 1½' thick interbedded with argillite. Sandstone beds become more abundant towards top.
Grey-weathering, medium-grained, calcareous, poorly sorted sandstone; greenish grey on fresh surfaces; beds 2" to 6".
Green argillite; beds 1/16" to 1/8".
Orange-buff-weathering dolomitic argillite; grey on fresh surfaces; beds 1/16" to ½".
Buff-weathering dolomite; grey on fresh surfaces; beds 2" to 4"; wrinkled surface.
Buff green rusty argillite; beds 1/16" to ½"; breaks into small chips.
Dark green, dense, baked, slightly silty argillite; dark green on fresh surfaces; breaks into small equidimensional fragments.
SHEPPARD FORMATION
PURCELL FORMATION


LOWER GATEWAY FORMATION
Transition
1500
1400
1300
1200
1100
1000
900
800
Reddish grey argillite; reddish grey on fresh surfaces; beds up to 4"; some beds sandy; bleaching parallel to bedding.
Bleaching increases downwards; argillite beds ½" to 2½".
Beds ½" to 1½".
Interbedded bleached and red grey argillite; beds 1/16" to ½".
Greenish grey argillaceous dolomite; beds ½" to 1".
Reddish grey, bleached argillite; beds moderate to thin; joints widely spaced.
Reddish grey argillite with bleached zones not parallel to bedding.
Bleached argillite.
Bleached dolomitic argillite; joints widely spaced.
Bluish grey, bleached argillite; beds thin; breaks into little chips.
Red grey laminated silty argillite; reddish grey on fresh surfaces; undulating beds ½" to 1½"; bleached parallel to bedding; highly fractured; salt casts along bedding.
Orange to reddish grey argillite.
Red grey argillite.
Orange to reddish grey argillite.
Red grey laminated silty argillite; reddish grey on fresh surfaces; undulating beds ½" to 1½"; bleached along very thin bands parallel to bedding; highly fractured; salt casts along bedding.
Alternating stromatolitic dolomite, dolomite, and red argillite.
Buff-weathering argillaceous highly calcareous stromatolitic dolomite; beds 1" to 3".
Red grey argillite; beds 1" to 2"; breaks into large flaggy fragments.
Buff-weathering argillaceous highly calcareous stromatolitic dolomite; beds 1" to 3".
Red grey argillite; beds 1" to 2"; breaks into large flaggy fragments.
Orange-buff-weathering, silty, slightly sandy argillite; grey to greenish grey on fresh surfaces; beds 1/16" to 1"; ripple marks along bedding.
Red grey argillite; beds 1/16" to 1"; ripple marks.

PHILLIPS FORMATION



Yellow orange argillite with some rusty layers; interbedded recessive and resistant layers; 1/16" beds in recessive unit break into small shaley chips; silty to sandy resistant argillite beds 4" thick.

Greenish cream silty argillite with some 3" beds of buff argillite; creamy argillite beds 1/16" to 1".

Greenish grey silty to sandy argillite; undulating beds 1/16" to ½"; alternates with similar buff argillites.

Dark greenish grey silty to sandy argillite; beds 1/16" to ½"; reddish grey argillaceous partings along bedding planes.

Interbedded greenish creamy grey silty argillite and buff argillite; slightly undulating beds 1/16" to 1".

Greenish grey silty to sandy argillite; beds 1/16" to ½"; some pink mineral (barite?) in fractures; undulating bedding breaks into small fragments; alternates with a more buff argillite of similar composition.

Alternating orange, red, and buff argillites.

Greenish buff, silty to sandy argillite; beds ½" to 3".

Red and buff argillites.

Greenish grey buff, silty to slightly sandy argillite; beds ½".

Orange buff, very silty to sandy argillite; beds ½"; with rusty streaks; breaks into small chips.

Brownish buff, silty to sandy argillite; beds ½" to 3"; breaks into large fragments; salt casts along bedding.

Brownish buff argillite; silty to sandy; beds ½" to 3"; interbedded with pinkish red grey argillite.

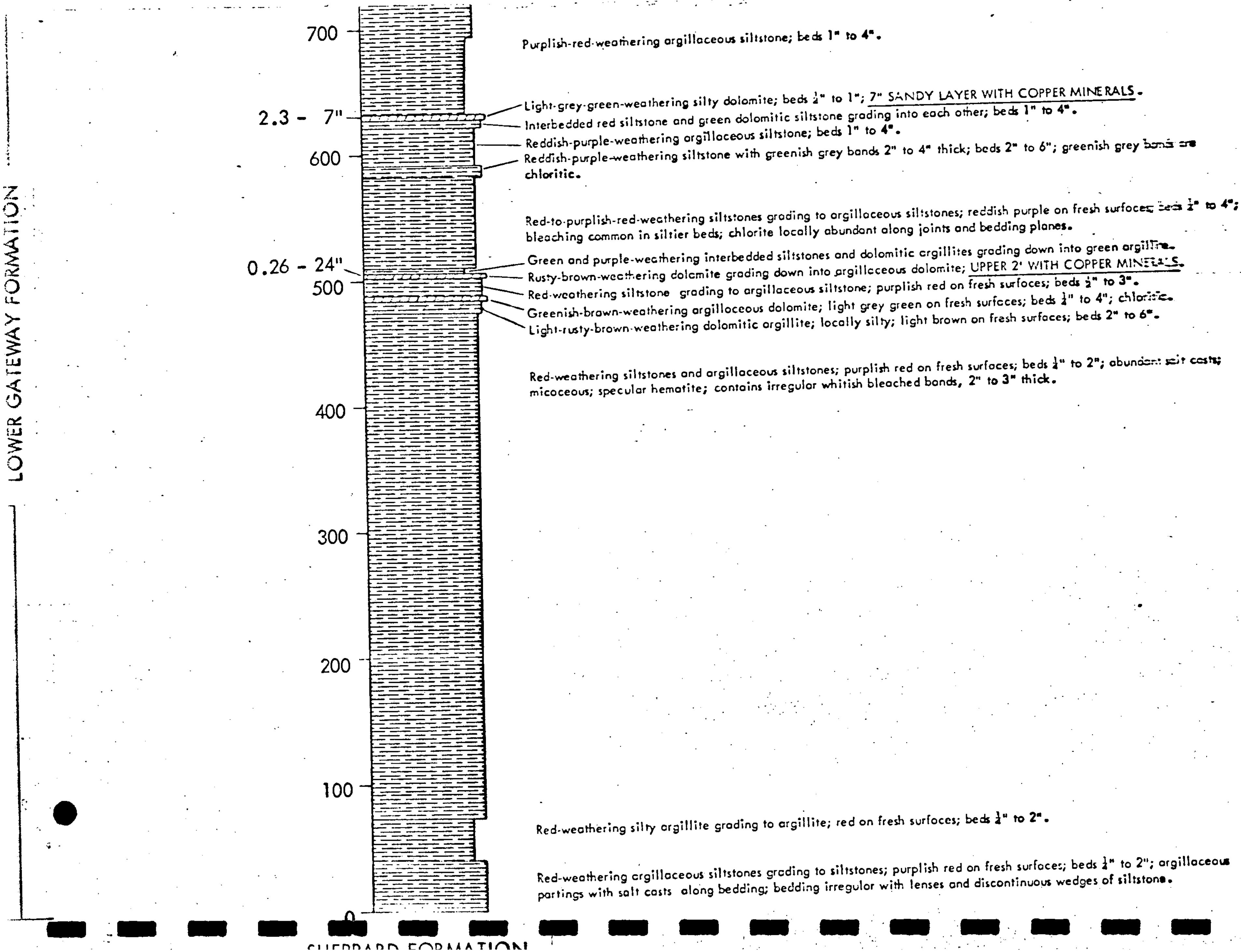
Laminated greenish grey and buff, silty to sandy argillite with a few red grey beds; beds 1/16" to 3"; breaks into elongated fragments.

Interbedded bleached and red sandy argillite; bleached argillite dominant; undulating beds 1/16" to 3"; laminated in places; breaks into elongated fragments; salt casts.

Reddish brown grey laminated sandy argillite; beds 2" to 4"; slightly bleached along bedding; beds break into elongated chips and contain salt casts.

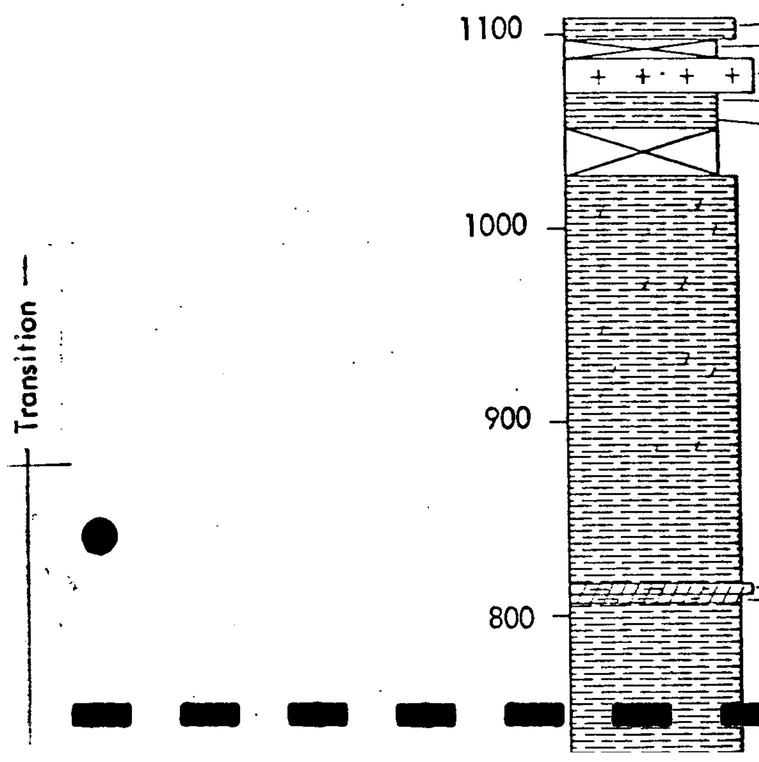
Grey to buff, silty to sandy, dolomitic argillite; beds ½" to 4".

Reddish brown grey laminated sandy argillite; beds 2" to 4"; slightly bleached along bedding; breaks into elongated chips and contains salt casts.


LOWER GATEWAY FORMATION
700
2.3 - 7"
600
0.26 - 24"
500
400
300
200
100
0
SHEPPARD FORMATION
Purplish-red-weathering argillaceous siltstone; beds 1" to 4".
Light-grey-green-weathering silty dolomite; beds ½" to 1"; 7" SANDY LAYER WITH COPPER MINERALS.
Interbedded red siltstone and green dolomitic siltstone grading into each other; beds 1" to 4".
Reddish-purple-weathering argillaceous siltstone; beds 1" to 4".
Reddish-purple-weathering siltstone with greenish grey bands 2" to 4" thick; beds 2" to 6"; greenish grey bands are chloritic.
Red-to-purplish-red-weathering siltstones grading to argillaceous siltstones; reddish purple on fresh surfaces; beds ½" to 4"; bleaching common in siltier beds; chlorite locally abundant along joints and bedding planes.
Green and purple-weathering interbedded siltstones and dolomitic argillites grading down into green argillite.
Rusty-brown-weathering dolomite grading down into argillaceous dolomite; UPPER 2' WITH COPPER MINERALS.
Red-weathering siltstone grading to argillaceous siltstone; purplish red on fresh surfaces; beds ½" to 3".
Greenish-brown-weathering argillaceous dolomite; light grey green on fresh surfaces; beds ¼" to 4"; chloritic.
Light-rusty-brown-weathering dolomitic argillite; locally silty; light brown on fresh surfaces; beds 2" to 6".
Red-weathering siltstones and argillaceous siltstones; purplish red on fresh surfaces; beds ¼" to 2"; abundant salt casts; micaceous; specular hematite; contains irregular whitish bleached bands, 2" to 3" thick.
Red-weathering silty argillite grading to argillite; red on fresh surfaces; beds ¼" to 2".
Red-weathering argillaceous siltstones grading to siltstones; purplish red on fresh surfaces; beds ¼" to 2"; argillaceous partings with salt casts along bedding; bedding irregular with lenses and discontinuous wedges of siltstone.

SECTION 3 - SAGE MOUNTAIN

Remainder of section covered.



Dark purplish grey to reddish purple siltstone; purplish red on fresh surfaces; beds 1" to 3".

Mostly covered with some green and purple siltstone.

Diorite sill; dark green to black; medium-grained.

Dark-purplish-black-weathering siltstone; thin purple laminae; beds 1" to 3".

Purplish-brown-weathering to purplish-red-weathering siltstone; beds ½" to 3"; purple argillaceous partings.

Covered.

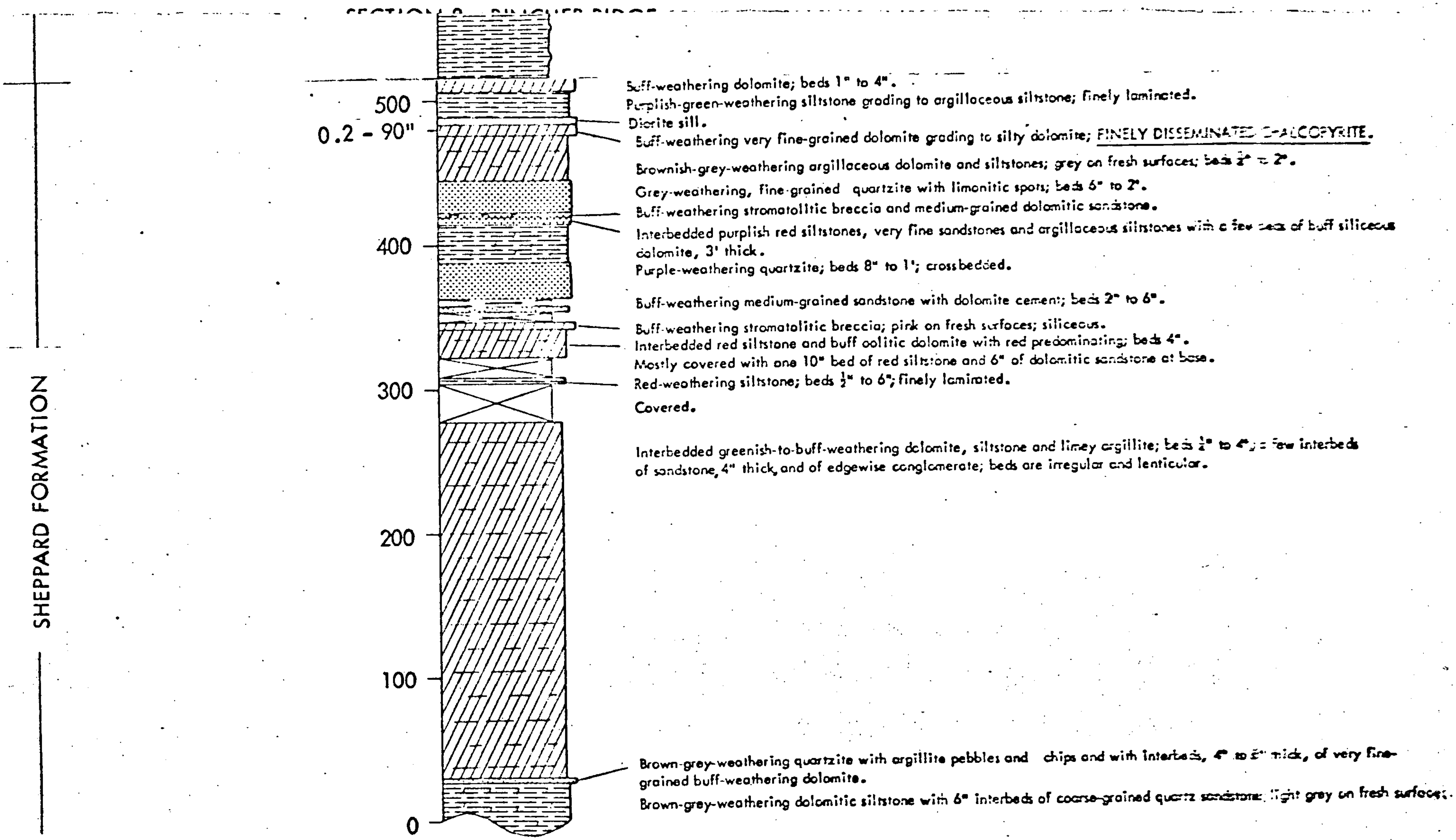
Interbedded unit of brown dolomitic siltstone and purplish red siltstone; red siltstones are very finely laminated and 8" to 2' thick; dolomitic units are 2" to 8" thick.

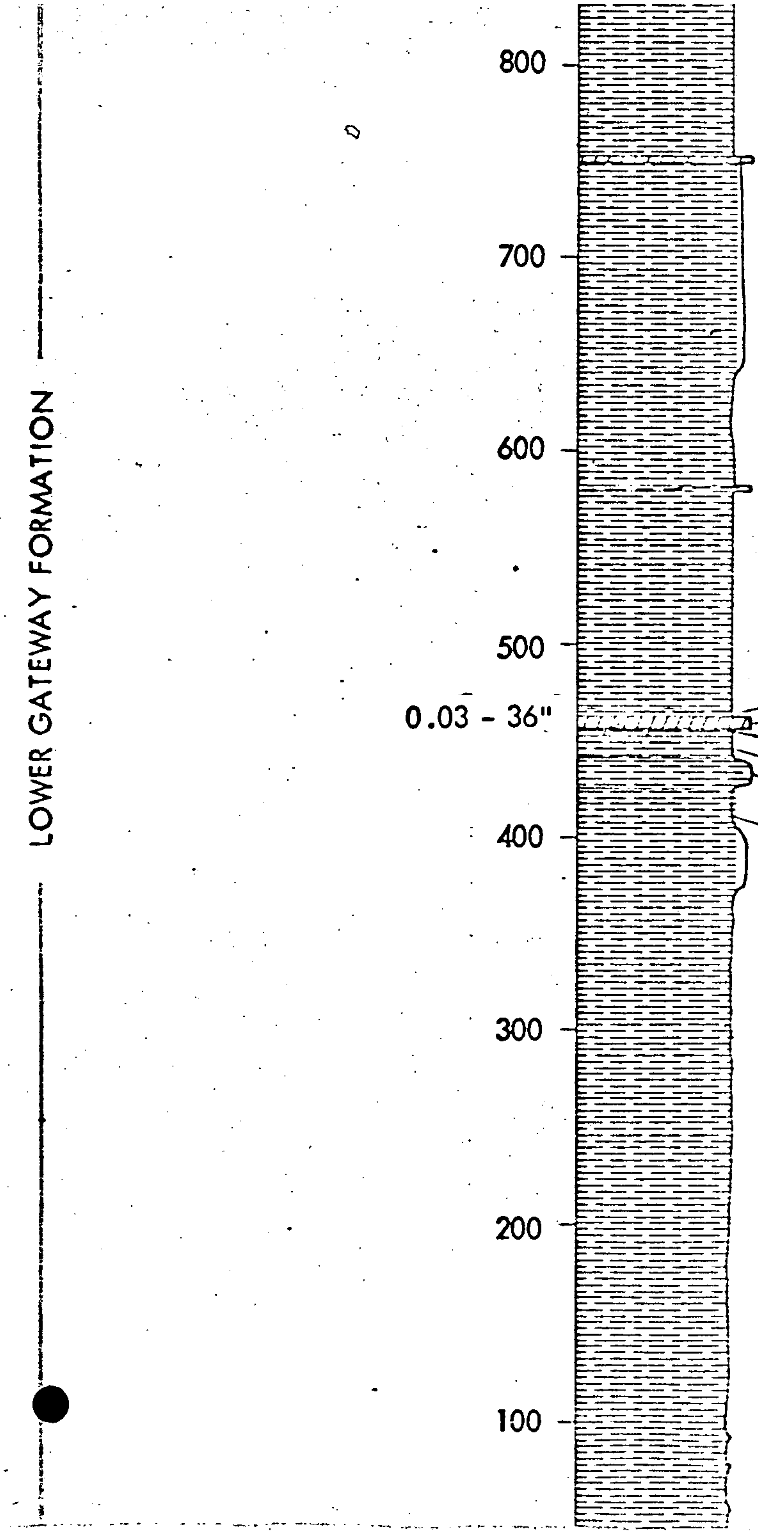
Light-purplish-brown-weathering siltstone; beds 3" to 8"; purplish red argillaceous partings; a few silty dolomite beds up to 1' thick; micaceous.

Buff-weathering dolomite grading down into argillaceous and silty dolomite with purple partings.

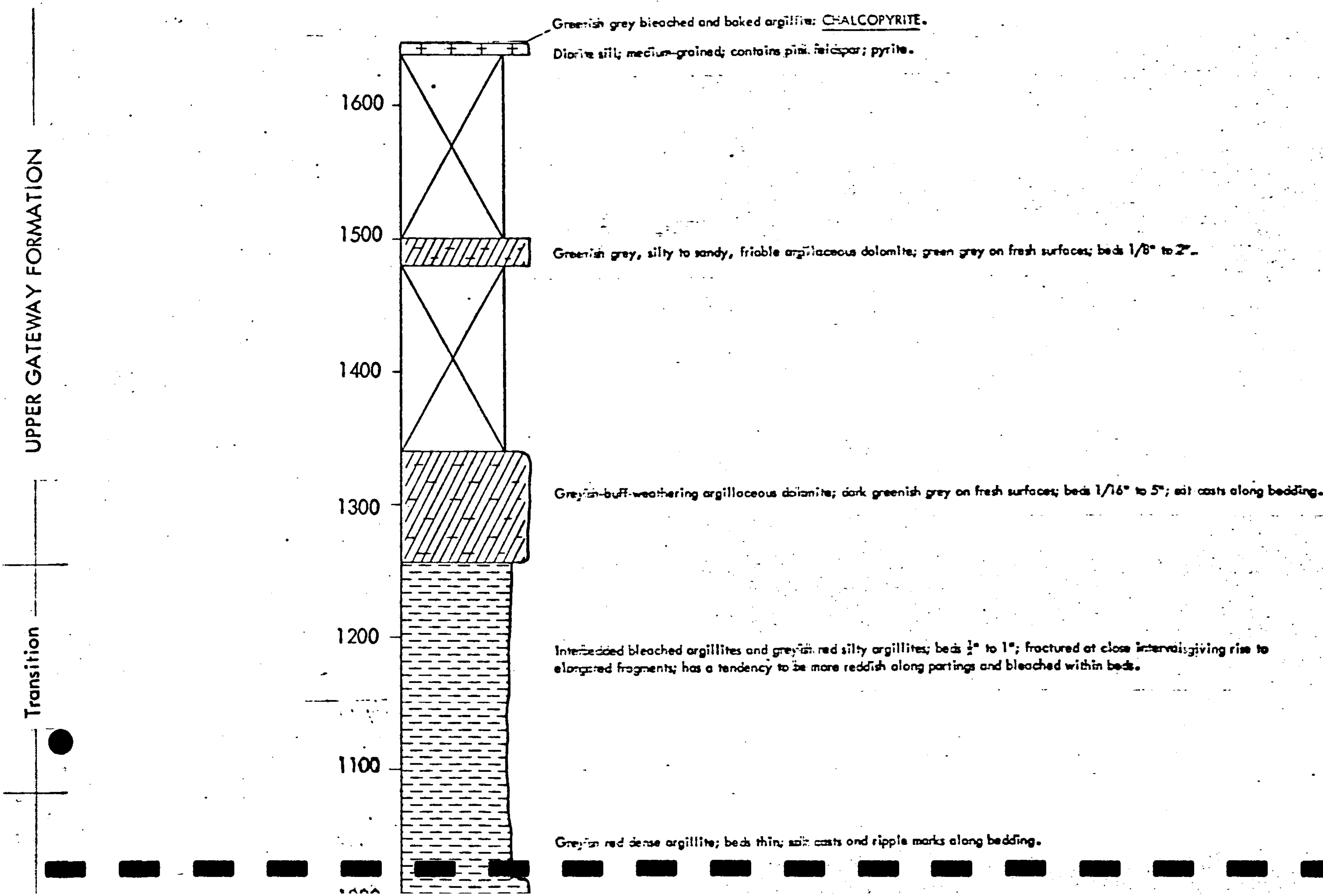
Greenish-brown-to-buff-weathering silty dolomite; grey green on fresh surfaces; beds 2" to 8".

Purplish-red-weathering siltstones grading to argillaceous siltstones; beds 1" to 5"; small hematitic spots parallel bedding.

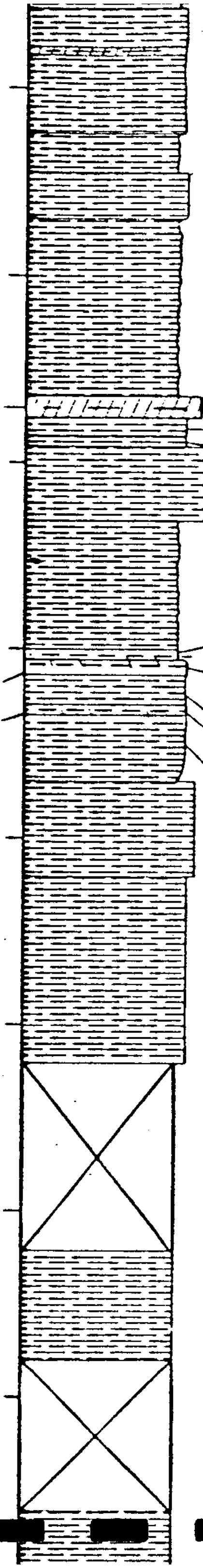

SHEPPARD FORMATION
500
0.2 - 90"
400
300
200
100
0
Buff-weathering dolomite; beds 1" to 4".
Purplish-green-weathering siltstone grading to argillaceous siltstone; finely laminated.
Diorite sill.
Buff-weathering very fine-grained dolomite grading to silty dolomite; FINELY DISSEMINATED CHALCOPYRITE.
Brownish-grey-weathering argillaceous dolomite and siltstones; grey on fresh surfaces; beds ¼" to 2".
Grey-weathering, fine-grained quartzite with limonitic spots; beds 6" to 2'.
Buff-weathering stromatolitic breccia and medium-grained dolomitic sandstone.
Interbedded purplish red siltstones, very fine sandstones and argillaceous siltstones with a few beds of buff siliceous dolomite, 3' thick.
Purple-weathering quartzite; beds 8" to 1'; crossbedded.
Buff-weathering medium-grained sandstone with dolomite cement; beds 2" to 6".
Buff-weathering stromatolitic breccia; pink on fresh surfaces; siliceous.
Interbedded red siltstone and buff oolitic dolomite with red predominating; beds 4".
Mostly covered with one 10" bed of red siltstone and 6" of dolomitic sandstone at base.
Red-weathering siltstone; beds ½" to 6"; finely laminated.
Covered.
Interbedded greenish-to-buff-weathering dolomite, siltstone and limey argillite; beds ¼" to 4"; a few interbeds of sandstone, 4" thick, and of edgewise conglomerate; beds are irregular and lenticular.
Brown-grey-weathering quartzite with argillite pebbles and chips and with interbeds, 4" to 8" thick, of very fine-grained buff-weathering dolomite.
Brown-grey-weathering dolomitic siltstone with 6" interbeds of coarse-grained quartz sandstone; light grey on fresh surfaces.


LOWER GATEWAY FORMATION
800
700
600
500
0.03 - 36"
400
300
200
100
Light-green-weathering, very fine-grained dolomite; beds 1" to 4".
Red-weathering argillaceous siltstone and silty argillite becoming sandier and thicker at top with bands, bleached white, throughout.
Light green dolomitic argillaceous siltstone; finely laminated.
Red argillaceous siltstone which forms series of resistant bands in outcrop; bleached whitish bands throughout; finely laminated 1" beds of green argillite near top.
Light green dolomitic argillite; very finely laminated with beds $\frac{1}{4}$" to $\frac{1}{2}$".
Greenish-buff-weathering, very fine-grained dolomite; beds 1" to 18".
Light green dolomitic argillite; very finely laminated.
Purplish red argillaceous siltstone; grey green bands increasing toward top.
Light-green-weathering argillaceous siltstone containing dolomitic beds, $\frac{1}{2}$" to 1" thick, which weather out as brown bands; grades down into 18" basal greyish purple siltstone.
Red-weathering silty argillite grading to siltstone; beds $\frac{1}{4}$" to 2"; finely laminated and with thin argillaceous partings; salt casts abundant on bedding planes; siltstone lenses form resistant ribs, 1" to 4" thick; light brownish grey siltier beds are present sporadically throughout; locally more resistant due to increased sand content.
Small scale crossbedding and ripple marks.
White bands comprise 50% and produce striped appearance.
Regular alternation of brownish grey siltstones and red argillaceous siltstones.

SECTION 12 – LOAF MOUNTAIN



LOWER GATEWAY FORMATION



Purple-weathering silty argillite; beds ½" to 2" breaks into thin plates.

Purple-weathering argillaceous siltstone grading to silty argillite; beds 1" to 8".

Buff-weathering dolomitic siltstone; green to grey on fresh surfaces; beds 1" to 4".

Purplish-red-weathering siltstone grading to argillaceous siltstone; beds 4" to 1'; breaks into angular blocks; top 10' interbedded with buff-weathering dolomitic siltstones.

Purplish-red-weathering interbedded siltstone and argillaceous siltstone; beds 1" to 2"; siltstone more resistant.

Red-weathering finely laminated siltstone; beds 2" to 6" with thin argillaceous partings along bedding.

Purplish-red-weathering interbedded siltstones and argillite grading to silty argillite; hematite stain as sub-parallel lines along bedding at 73'.

Green-weathering silty argillaceous dolomite; beds 2" to 6"; MALACHITE noted along bedding across 6".

Purplish-red-weathering siltstone grading to argillaceous siltstone; beds 2" to 1'.

Purplish-red-weathering argillite grading to argillaceous siltstone; beds ½" to 1" breaking into small fragments.

Red-weathering finely laminated siltstone grading to argillaceous siltstone; beds 2" to 1'.

Reddish purple interbedded argillaceous siltstone and siltstone; locally with crossbedding and convolute bedding.

Buff-weathering dolomitic siltstone grading over 2' into purplish-green-weathering dolomitic argillite; greyish green on fresh surfaces; beds ½" to 3".

Greenish-buff-weathering very fine-grained dolomite; grey green on fresh surfaces; bottom of unit rapidly grading into green-weathering dolomitic argillite; beds ¼" to 3". MALACHITE staining along joint surfaces of dolomite.

Red weathering siltstone; beds 1" to 4".

Green-weathering dolomitic argillite; beds ¼" to 6"; MALACHITE stain noted along joint surfaces and most abundant in basal 9" dolomite bed.

Red-weathering siltstone grading to argillaceous siltstone with ½" to 1" interbeds of argillaceous siltstone; beds 4" to 1'; red-weathering recessive argillite to argillaceous siltstone forms basal 2' of unit.

Red-weathering siltstone; beds 2" to 1'; containing thin ripple marked argillaceous units with beds ¼" to 1"; base of unit marked by ½" to 1" jet black argillite bordered by a bleached zone; cross bedding shows transport from SE.

Red-weathering finely laminated argillaceous siltstone; beds 4" to 1'.

Covered.

Red-weathering finely laminated argillaceous siltstone; beds ¼" to 4"; possible faulting at 155'.

Covered; red argillaceous siltstone in scree.

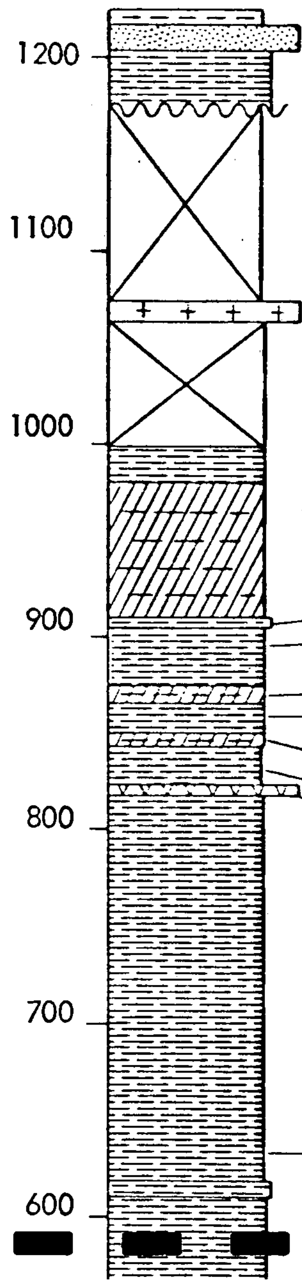
[redacted]ed-we[redacted]g silt[redacted]gradi[redacted]rgilla[redacted]iltsto[redacted]rplish[redacted]n fre[redacted]aces; [redacted] to 1[redacted] ripple marked argillaceous partings.

SECTION 15 - SUNKIST MOUNTAIN

PHILLIPS FORMATION

UPPER GATEWAY FORMATION

Transition



Light-green-weathering argillite; beds 1/8" to 1/4".

Grey-weathering quartz sandstone; greenish grey on fresh surfaces; beds 1" to 1'; with argillaceous interbeds.

Dark-green-weathering argillite grading to argillaceous siltstone; medium grey on fresh surfaces; beds 1/2" to 1"; with 6" to 8" micaceous argillite interbeds.

Mostly covered; some green siltstone in outcrop.

Dark-purplish-green-weathering medium-grained diorite sill.

Mostly covered; some interbedded green-and-brown-weathering siltstone.

Purplish-brown-weathering argillaceous siltstone; beds 1/4" to 1" with purple argillaceous partings.

Interbedded brown and green silty dolomite grading to dolomitic siltstone; beds 1/2" to 2"; colored intervals 2" to 6" thick; a few 1' beds of green siltstones.

Brownish-green-to-green-weathering siltstone; beds 1/2" to 2"; rusty spots parallel bedding.

Interbedded purplish-brown-and-brownish-green-weathering siltstone grading to argillaceous siltstone; grey brown on fresh surfaces; beds 1/2" to 2" with rippled purple argillaceous partings; a few 4" to 6" beds of dolomitic siltstone.

Brown-weathering dolomitic siltstone; grey brown on fresh surfaces; beds 1/2" to 1".

Red-weathering siltstone grading to argillaceous siltstone; purplish brown on fresh surfaces; beds 1/4" to 1" with a few 1" beds of brown dolomite.

Greenish-brown-weathering dolomitic siltstone; light brown on fresh surfaces; beds 1/4" to 1".

Purplish-brown-to-grey-weathering argillaceous siltstone; beds 1/4" to 2" with purple argillaceous partings.

Light-grey-weathering porphyritic trachyte sill.

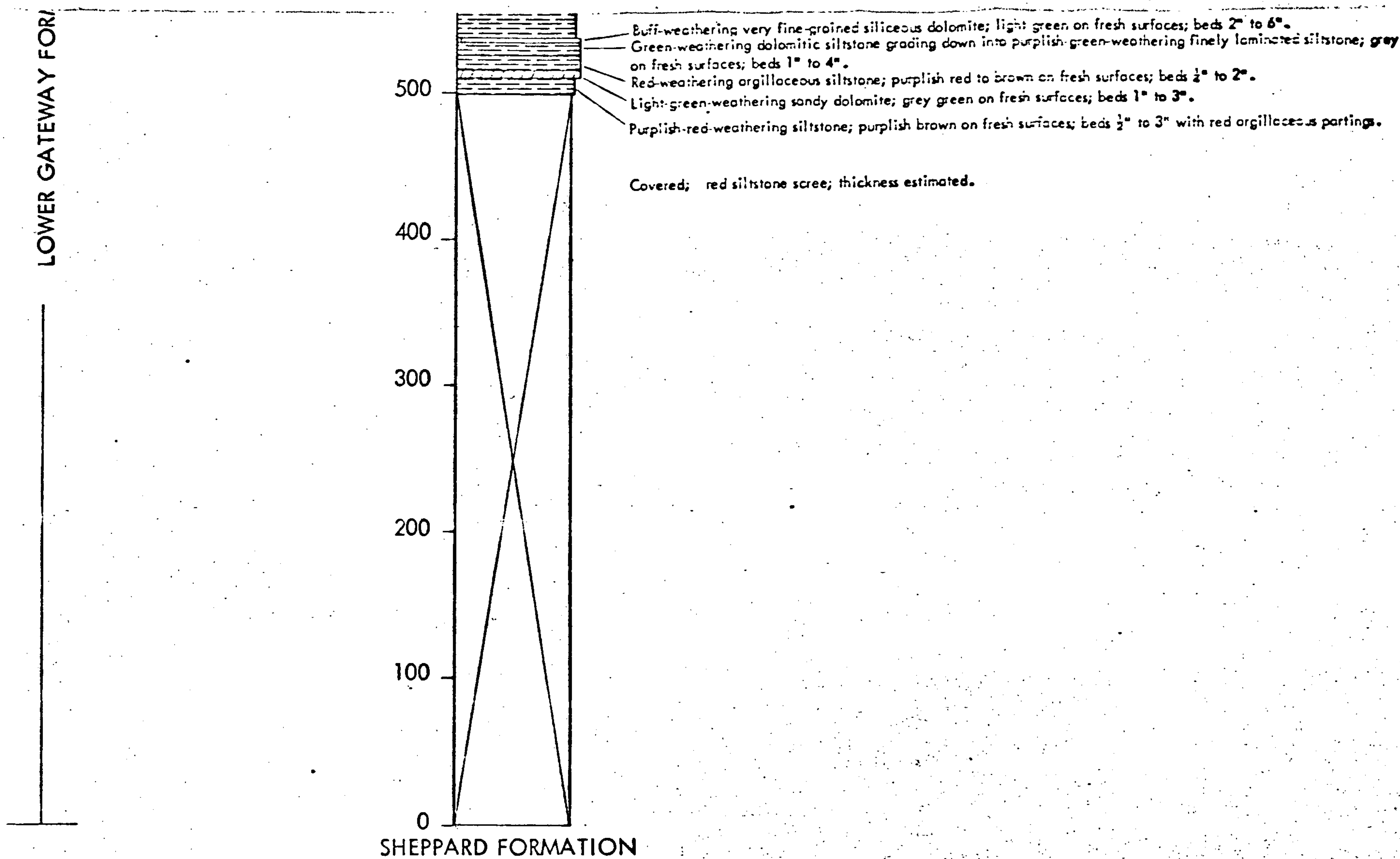
Brownish-purple-weathering siltstone; purplish brown on fresh surfaces; beds 1" to 3" with partings and laminae.

9' bed of light green microceous siltstone.

Green-weathering siltstone grading to dolomitic siltstone; light grey green on fresh surfaces; beds 1/2" to 2". MALACHITE and BORNITE in 2" vuggy sandy bed.

...ATION

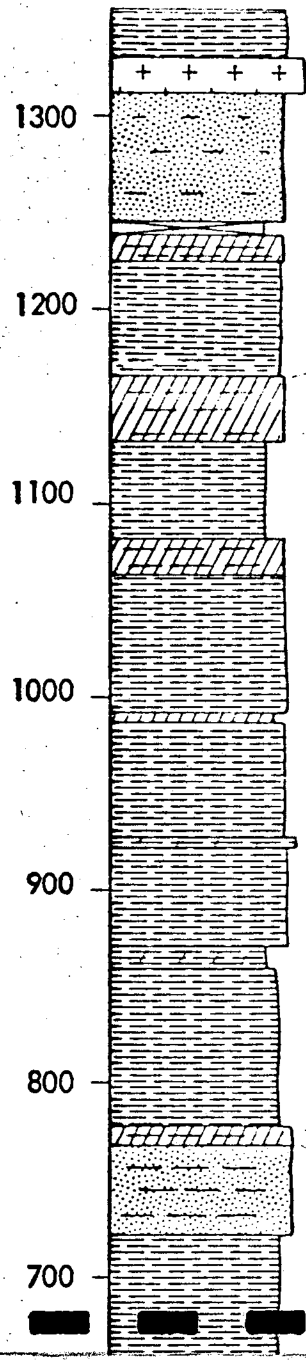
Purplish-red-weathering siltstone; greyish purple on fresh surfaces; beds 1" to 4"; purple laminations and partings


LOWER GATEWAY FOR
Buff-weathering very fine-grained siliceous dolomite; light green on fresh surfaces; beds 2" to 6".
Green-weathering dolomitic siltstone grading down into purplish-green-weathering finely laminated siltstone; grey on fresh surfaces; beds 1" to 4".
Red-weathering argillaceous siltstone; purplish red to brown on fresh surfaces; beds ½" to 2".
Light-green-weathering sandy dolomite; grey green on fresh surfaces; beds 1" to 3".
Purplish-red-weathering siltstone; purplish brown on fresh surfaces; beds ½" to 3" with red argillaceous partings.
Covered; red siltstone scree; thickness estimated.
500
400
300
200
100
0
SHEPPARD FORMATION

SECTION 16 – BOVIN LAKE

PHILLIPS FORMATION

UPPER GATEWAY FORMATION



Green-weathering very finely laminated siltstone; green on fresh surfaces; beds 1" to 3" with dark green banding.

Dark-purplish-green-weathering medium-grained diorite sill.

Green-weathering very fine-grained argillaceous sandstone with argillaceous interbeds; green on fresh surfaces; lenticular sandstone beds 2" to 3"; argillite beds 1/4" to 1/2"; top 40' has purple argillaceous partings.

Buff-weathering argillaceous dolomitic siltstone; green on fresh surfaces; beds 1" to 3".

Brownish-green-weathering argillaceous siltstone; beds 1/4" to 3" with green argillaceous partings; upper 30' of unit has a few brown silty beds 1" to 2" thick.

Rusty brown dolomitic siltstone; beds 1/2" to 1".

Greenish-brown-weathering silty dolomite; light grey green on fresh surfaces; beds 1" to 2".

Brownish-green-weathering silty argillite; grey green on fresh surfaces; beds 1" to 3"; top 10' of unit siltier.

Buff-brown-weathering dolomitic siltstone; light grey on fresh surfaces; beds 1" to 2" with argillaceous partings and salt casts.

Green-weathering argillaceous siltstone; green on fresh surfaces; beds 1/4" to 3" with a few purple argillaceous partings.

Buff-to-brown-weathering very fine-grained siliceous dolomite; green on fresh surfaces; beds 2" to 4"; barite on joint surfaces.

Greenish-grey-weathering very finely laminated argillaceous siltstone; greenish grey on fresh surfaces; beds 1/4" to 2" with thin purple argillaceous partings.

Buff-weathering finely laminated dolomitic siltstone; grey green on fresh surfaces; beds 1" to 2".

Greenish-purple-weathering argillaceous siltstone; purplish grey on fresh surfaces; beds 1/2" to 3" with purple argillaceous partings; a few 4" to 6" brown silty bands.

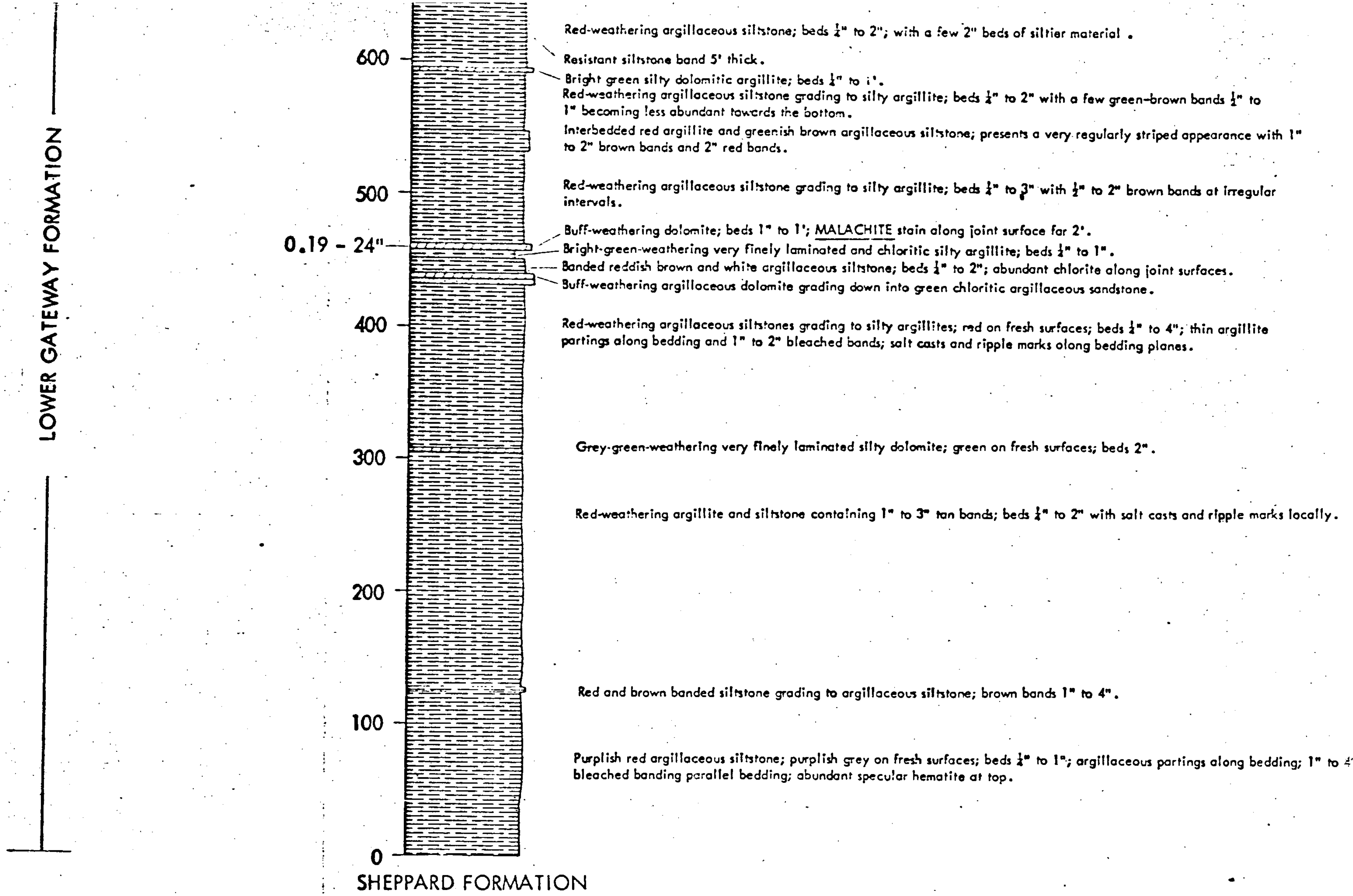
Greenish-grey-weathering very finely laminated dolomitic siltstone; light grey on fresh surfaces; beds 1" to 3".

Red-weathering argillaceous siltstone; red to brown on fresh surfaces; beds 1/2" to 3".

Buff-weathering silty dolomite with purple argillaceous partings grading to 1' basal bed of red silty argillite.

Buff-weathering silty dolomite; light green on fresh surfaces; beds 4".

Red argillaceous sandstone grading to coarse siltstone with 1" to 1' green-brown interbeds; beds 1/2" to 1'.


LOWER GATEWAY FORMATION
Red-weathering argillaceous siltstone; beds 1/4" to 2"; with a few 2" beds of siltier material.
600
Resistant siltstone band 5' thick.
Bright green silty dolomitic argillite; beds 1/4" to 1'.
Red-weathering argillaceous siltstone grading to silty argillite; beds 1/4" to 2" with a few green-brown bands 1/2" to 1" becoming less abundant towards the bottom.
Interbedded red argillite and greenish brown argillaceous siltstone; presents a very regularly striped appearance with 1" to 2" brown bands and 2" red bands.
500
Red-weathering argillaceous siltstone grading to silty argillite; beds 1/4" to 3" with 1/2" to 2" brown bands at irregular intervals.
Buff-weathering dolomite; beds 1" to 1'; MALACHITE stain along joint surface for 2'.
0.19 - 24"
Bright-green-weathering very finely laminated and chloritic silty argillite; beds 1/4" to 1".
Banded reddish brown and white argillaceous siltstone; beds 1/4" to 2"; abundant chlorite along joint surfaces.
Buff-weathering argillaceous dolomite grading down into green chloritic argillaceous sandstone.
400
Red-weathering argillaceous siltstones grading to silty argillites; red on fresh surfaces; beds 1/4" to 4"; thin argillite partings along bedding and 1" to 2" bleached bands; salt casts and ripple marks along bedding planes.
300
Grey-green-weathering very finely laminated silty dolomite; green on fresh surfaces; beds 2".
Red-weathering argillite and siltstone containing 1" to 3" tan bands; beds 1/4" to 2" with salt casts and ripple marks locally.
200
Red and brown banded siltstone grading to argillaceous siltstone; brown bands 1" to 4".
100
Purplish red argillaceous siltstone; purplish grey on fresh surfaces; beds 1/4" to 1"; argillaceous partings along bedding; 1" to 4" bleached banding parallel bedding; abundant specular hematite at top.
0
SHEPPARD FORMATION

SECTION 17 - WALL LAKE

Top eroded.

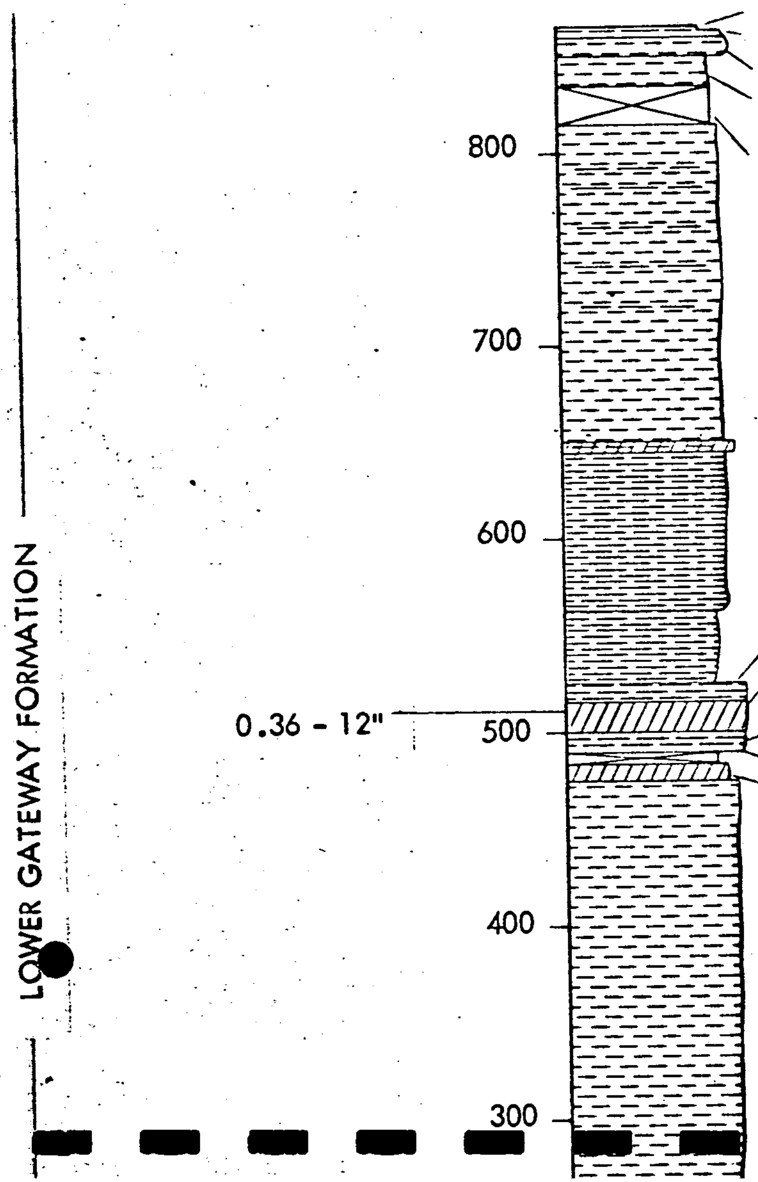
Purplish-red-weathering argillaceous siltstone; purple on fresh surfaces; beds $\frac{1}{2}$" to 2".

Greenish-grey-weathering argillaceous siltstone; light green on fresh surfaces; beds $\frac{1}{2}$" to 2".

Purplish-red-weathering siltstone; greyish purple on fresh surfaces; beds 1" to 3".

Purplish-red-weathering argillaceous siltstone; purple on fresh surfaces; beds $\frac{1}{4}$" to 1"; contains 1' bed of greenish grey silty dolomite; light grey on fresh surfaces.

Covered; brown dolomitic siltstone; brownish grey on fresh surfaces in scree.



Purplish-red-weathering, very finely laminated argillaceous siltstone; beds 1" to 4"; light brown bleached banding; sub-parallel hematitic dots along bedding occur locally.

Greenish-grey-weathering silty dolomite; light grey on fresh surfaces; beds $\frac{1}{2}$" to 3"; ripple marks near base.

Purplish-red-weathering, very finely laminated argillaceous siltstone; reddish purple on fresh surfaces; beds 1" to 4"; salt casts along bedding.

Purplish-red-weathering silty argillite; purple on fresh surfaces; beds $\frac{1}{2}$" to 1"; chlorite locally abundant.

Dark-green-to-purplish-green-weathering argillaceous siltstone; greenish purple on fresh surfaces; beds 1" to 3".

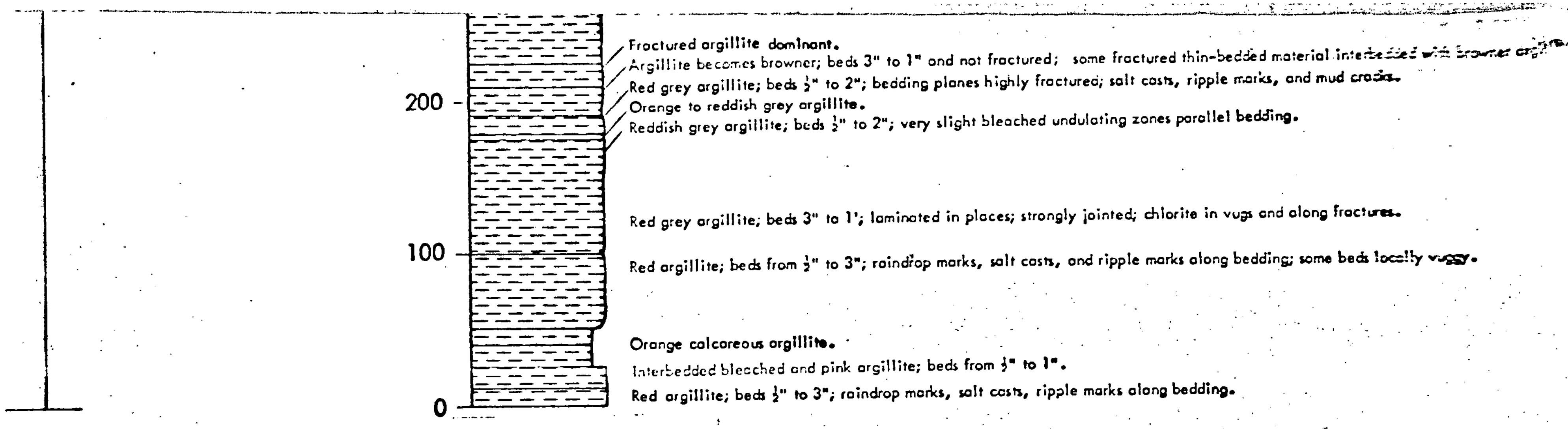
Light-greenish-grey-weathering fine-grained dolomite; light grey on fresh surfaces; beds 1" to 6"; chloritic partings along bedding. MALACHITE along joints across 1'.

Purple argillaceous siltstone; purple on fresh surfaces; beds 1" to 4"; abundant specular hematite.

Purplish red argillaceous siltstone; beds $\frac{1}{4}$" to $\frac{1}{2}$".

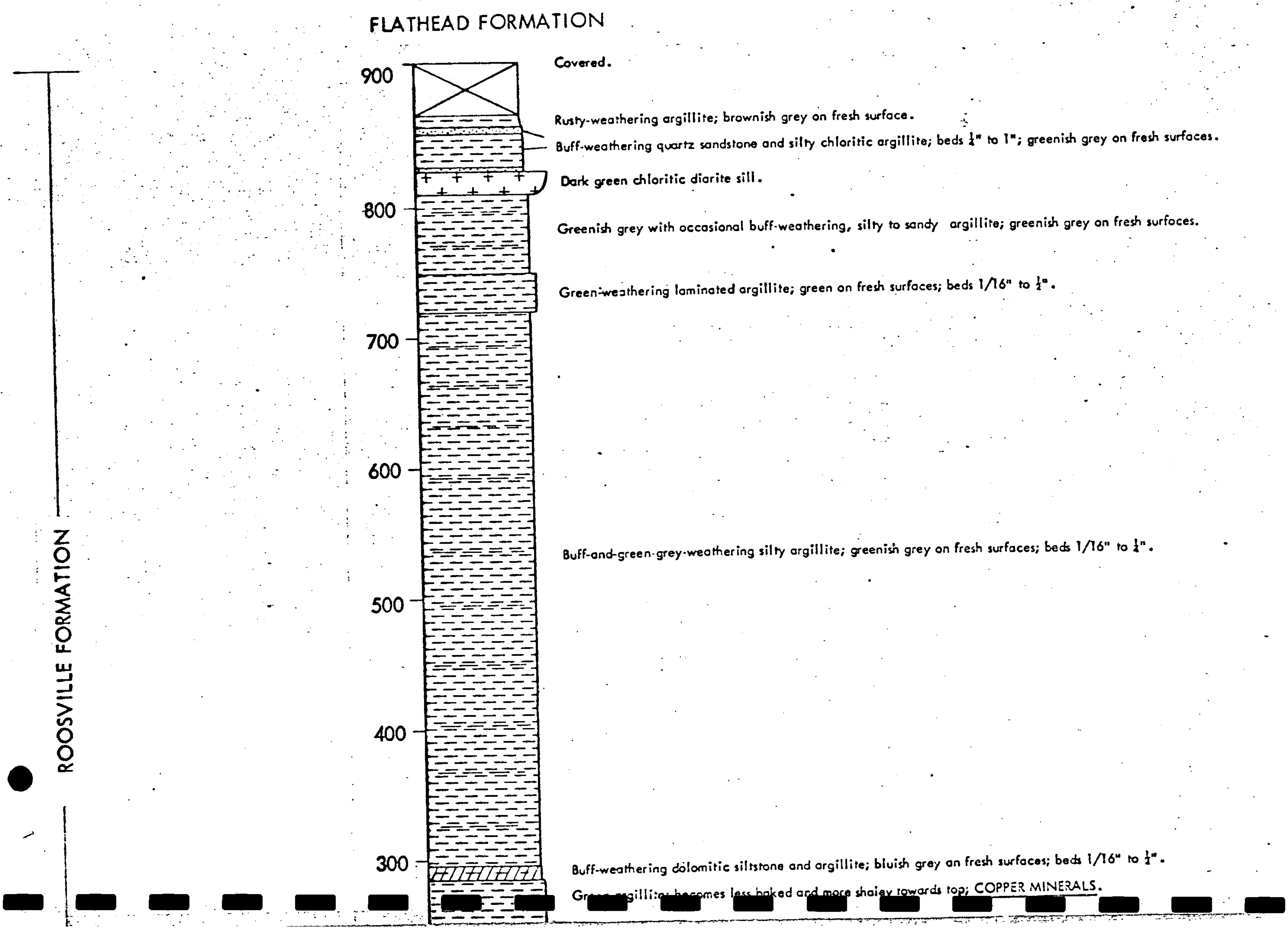
Buff-weathering fine grained dolomite; light grey on fresh surfaces; beds $\frac{1}{4}$" to 2" with thin green-grey micaceous argillaceous partings along bedding planes.

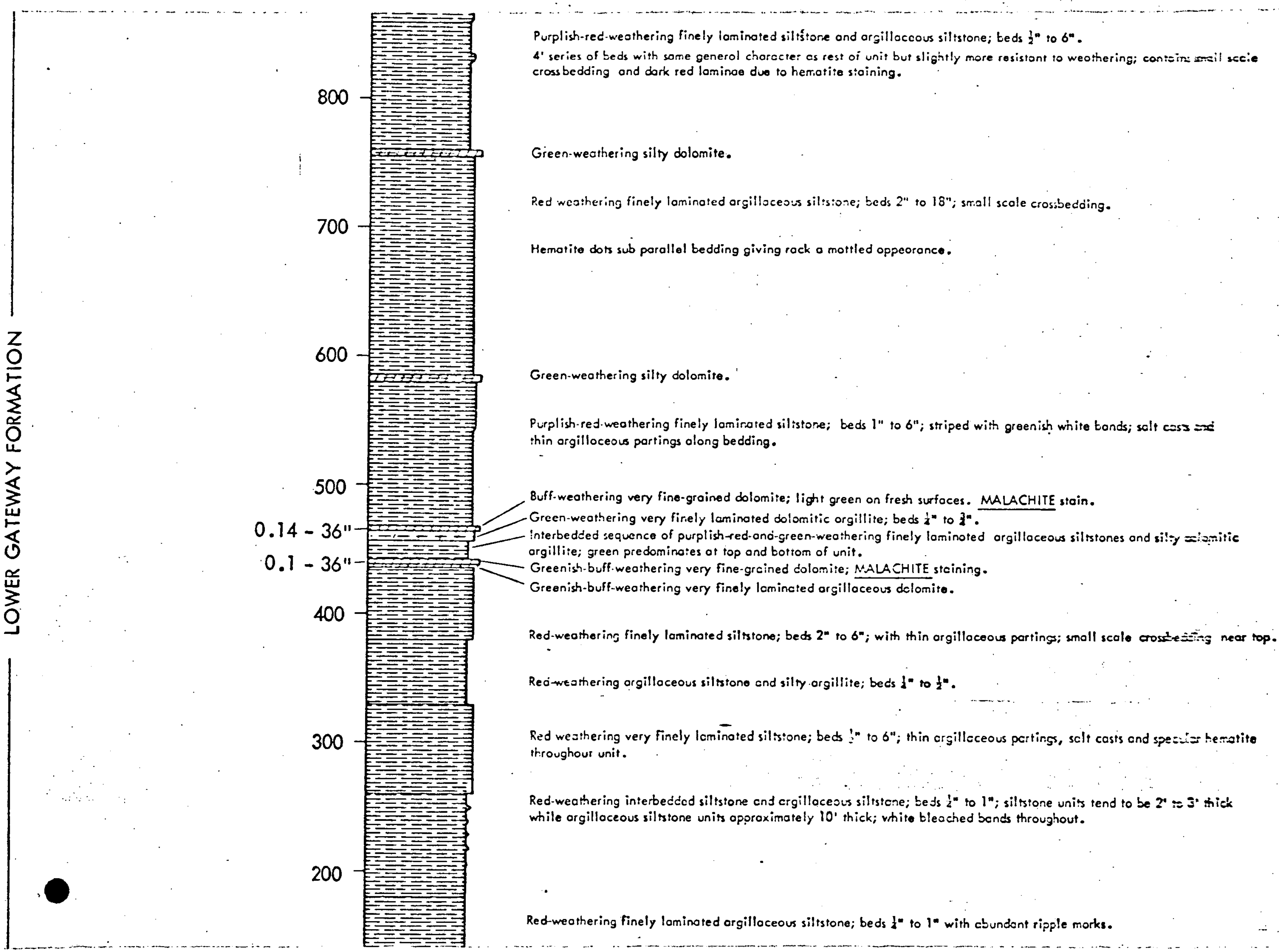
Red grey argillite; beds $\frac{1}{2}$" to 2"; argillite fractured but not in elongated fragments; ripple marks and salt casts.



SHEPPARD FORMATION

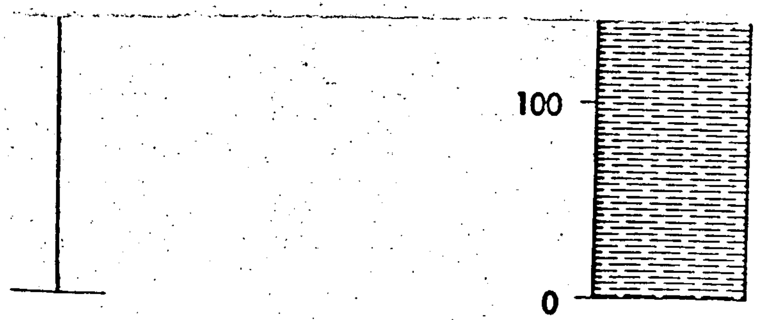
SECTION 26 - VICTORIA RIDGE





LOWER GATEWAY FORMATION
Purplish-red-weathering finely laminated siltstone and argillaceous siltstone; beds ½" to 6".
4' series of beds with same general character as rest of unit but slightly more resistant to weathering; contains small scale crossbedding and dark red laminae due to hematite staining.
800
Green-weathering silty dolomite.
Red weathering finely laminated argillaceous siltstone; beds 2" to 18"; small scale crossbedding.
700
Hematite dots sub parallel bedding giving rock a mottled appearance.
600
Green-weathering silty dolomite.
Purplish-red-weathering finely laminated siltstone; beds 1" to 6"; striped with greenish white bands; salt casts and thin argillaceous partings along bedding.
500
Buff-weathering very fine-grained dolomite; light green on fresh surfaces. MALACHITE stain.
0.14 - 36"
Green-weathering very finely laminated dolomitic argillite; beds ¼" to ¾".
Interbedded sequence of purplish-red-and-green-weathering finely laminated argillaceous siltstones and silty dolomitic argillite; green predominates at top and bottom of unit.
0.1 - 36"
Greenish-buff-weathering very fine-grained dolomite; MALACHITE staining.
Greenish-buff-weathering very finely laminated argillaceous dolomite.
400
Red-weathering finely laminated siltstone; beds 2" to 6"; with thin argillaceous partings; small scale crossbedding near top.
Red-weathering argillaceous siltstone and silty argillite; beds ¼" to ½".
300
Red weathering very finely laminated siltstone; beds ½" to 6"; thin argillaceous partings, salt casts and specular hematite throughout unit.
Red-weathering interbedded siltstone and argillaceous siltstone; beds ½" to 1"; siltstone units tend to be 2' to 3' thick while argillaceous siltstone units approximately 10' thick; white bleached bands throughout.
200
Red-weathering finely laminated argillaceous siltstone; beds ¼" to 1" with abundant ripple marks.

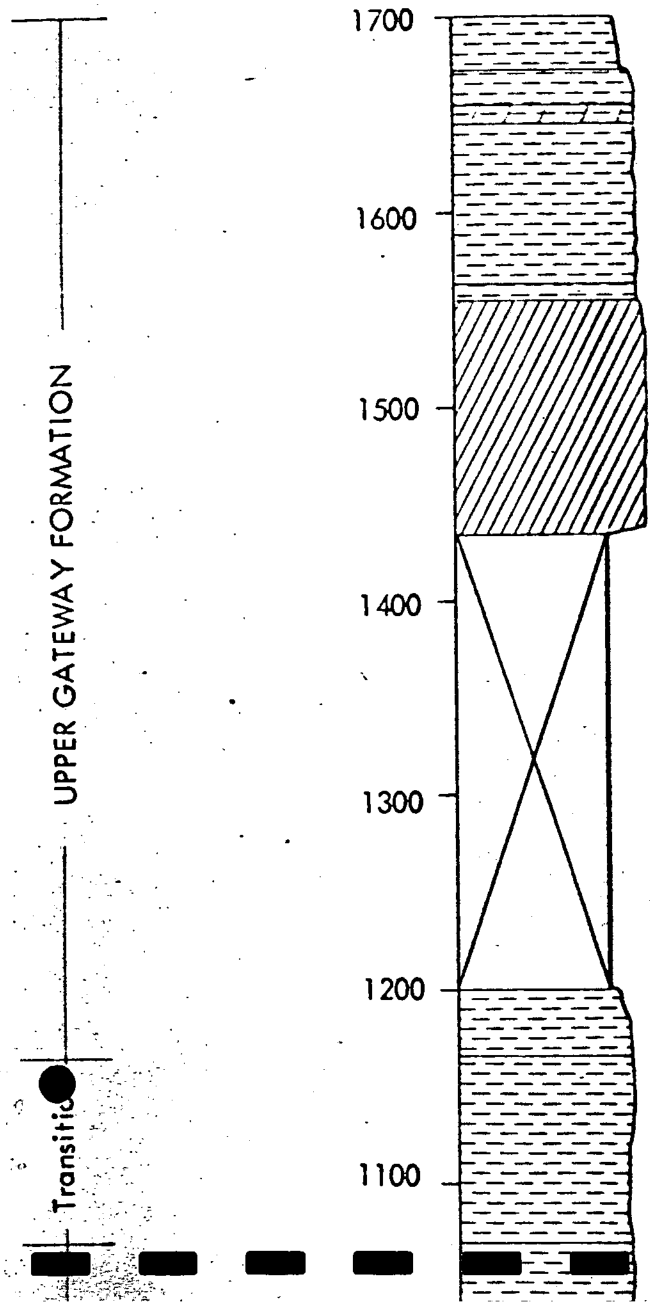
SECTION 8 - LYS RIDGE



SHEPPARD FORMATION

SECTION 9 - LYS RIDGE

PHILLIPS FORMATION



Light greyish green argillite; very thin beds; mostly non-calcerous.

Greyish-green-to-buff-weathering argillite, sandstone and dolomite; argillites dominate; ripple marked.

Dark green dolomitic argillite; maroon shale partings; beds of variable thicknesses.

Greyish-green-to-buff-weathering argillite, sandstone and dolomite; argillite dominant; ripple marked.

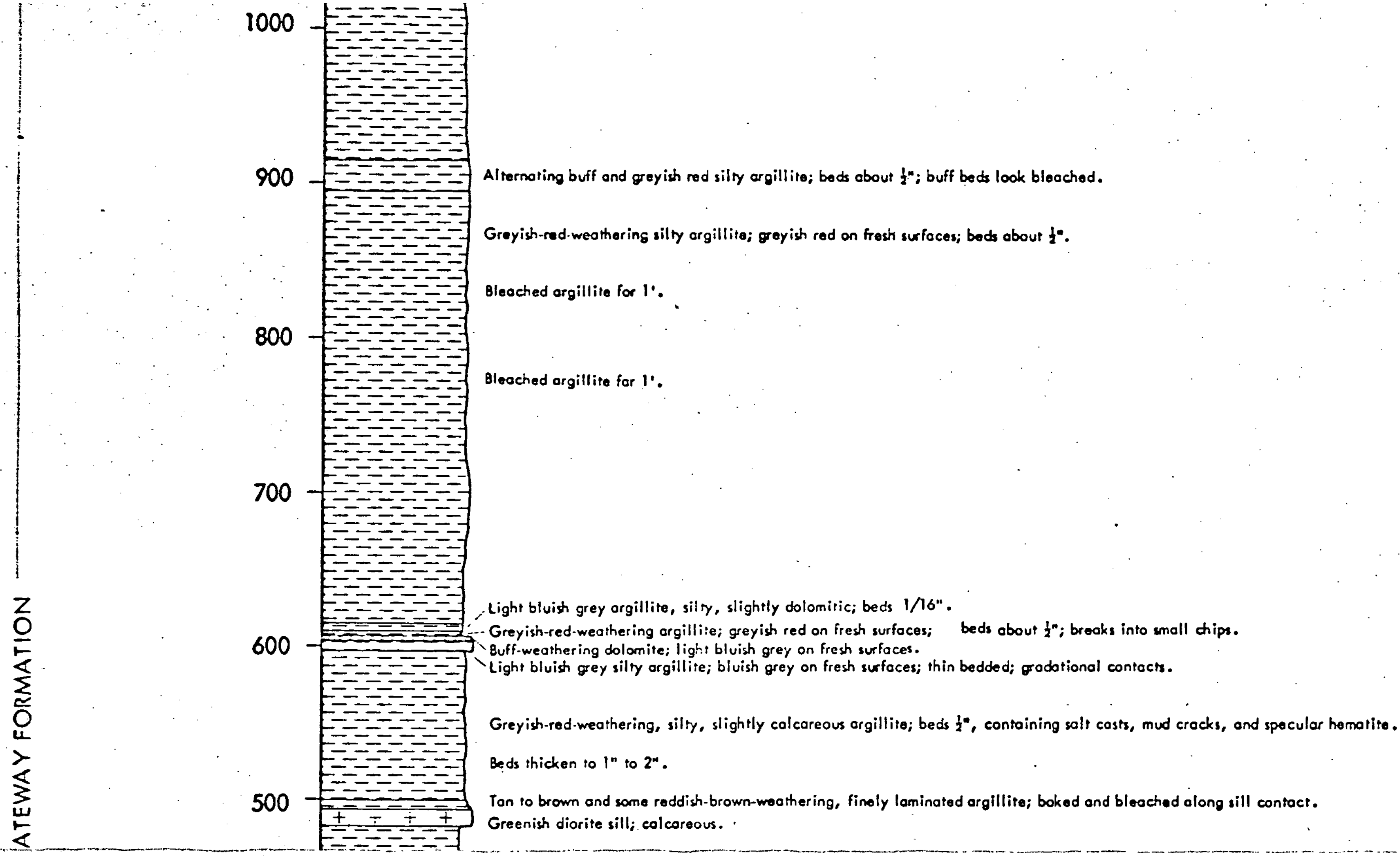
Greyish-red-to-purplish-red-weathering silty, slaty argillite; very thin bedded; salt casts.

Buff-weathering silty dolomite; greenish grey on fresh surfaces; beds ½" to 2"; ripple marks on bedding planes; section partially covered by talus.

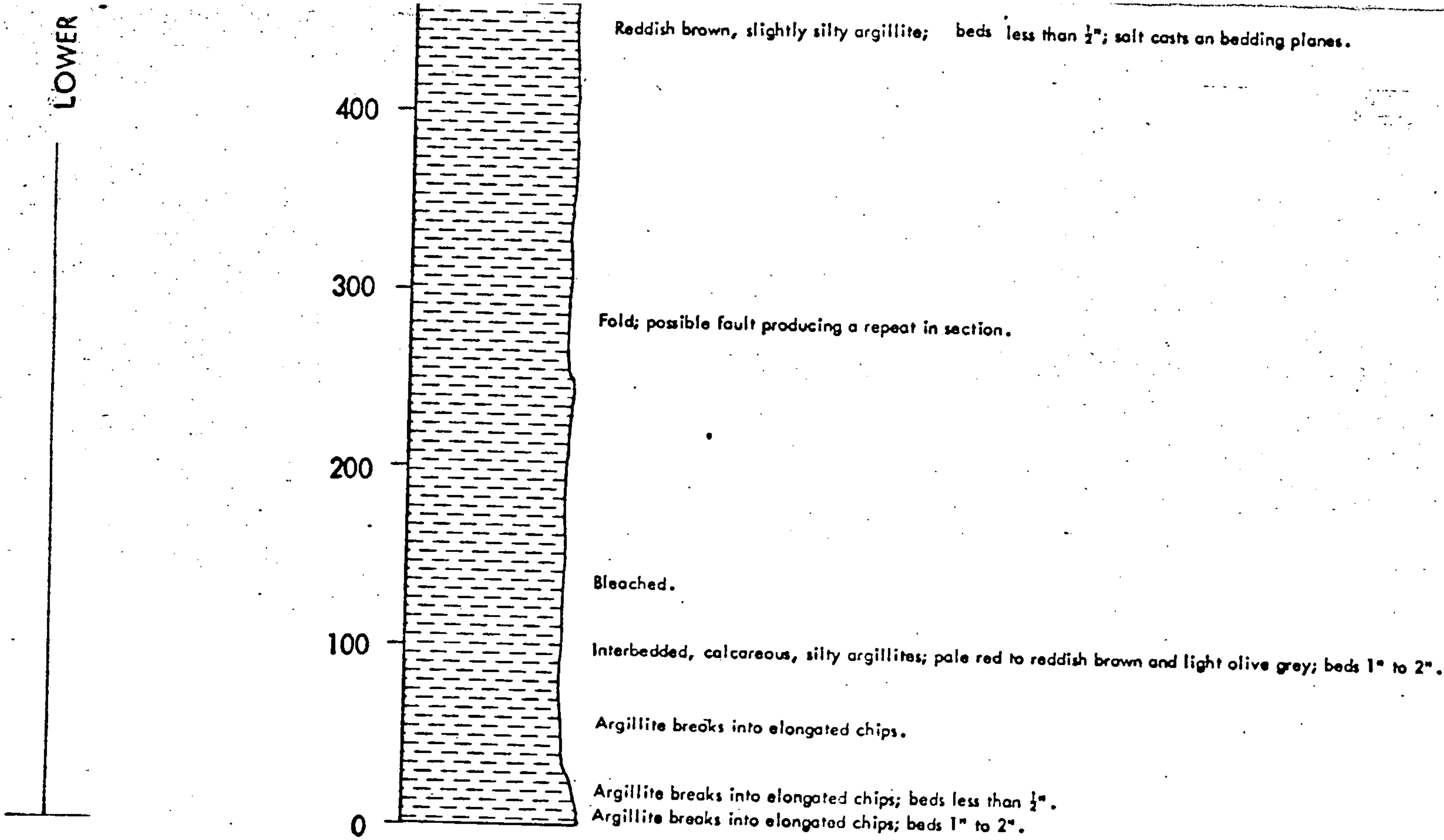
Buff-weathering argillite; beds ½".

Variegated buff-and-greyish-red-weathering argillite; beds about ½".

Greyish red argillite; greyish red on fresh surfaces; beds about ½".

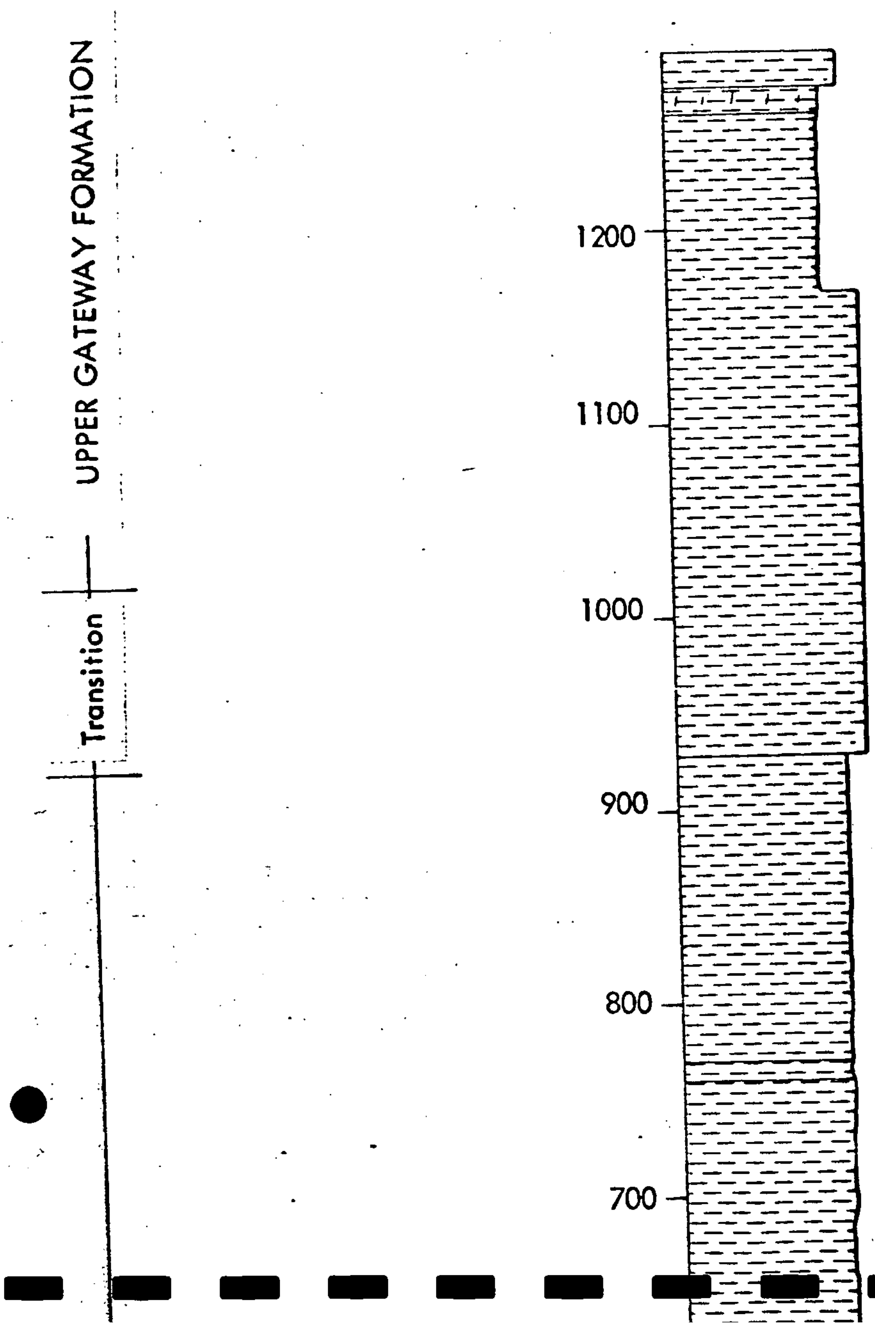


ATEWAY FORMATION
1000
900
800
700
600
500
Alternating buff and greyish red silty argillite; beds about ½"; buff beds look bleached.
Greyish-red-weathering silty argillite; greyish red on fresh surfaces; beds about ½".
Bleached argillite for 1'.
Bleached argillite for 1'.
Light bluish grey argillite, silty, slightly dolomitic; beds 1/16".
Greyish-red-weathering argillite; greyish red on fresh surfaces; beds about ½"; breaks into small chips.
Buff-weathering dolomite; light bluish grey on fresh surfaces.
Light bluish grey silty argillite; bluish grey on fresh surfaces; thin bedded; gradational contacts.
Greyish-red-weathering, silty, slightly calcareous argillite; beds ½", containing salt casts, mud cracks, and specular hematite.
Beds thicken to 1" to 2".
Tan to brown and some reddish-brown-weathering, finely laminated argillite; baked and bleached along sill contact.
Greenish diorite sill; calcareous.



SHEPPARD FORMATION

SECTION 10 - LYS RIDGE



Green silty argillite; thinly bedded with mud cracks.

Greyish red and greyish green dense dolomitic argillite; thinly bedded.

Buff-to-light-grey-and-green-weathering argillite; dark greyish green to light greyish green on fresh surfaces; beds 1" thick; a few pinkish to greyish red beds; closely jointed.

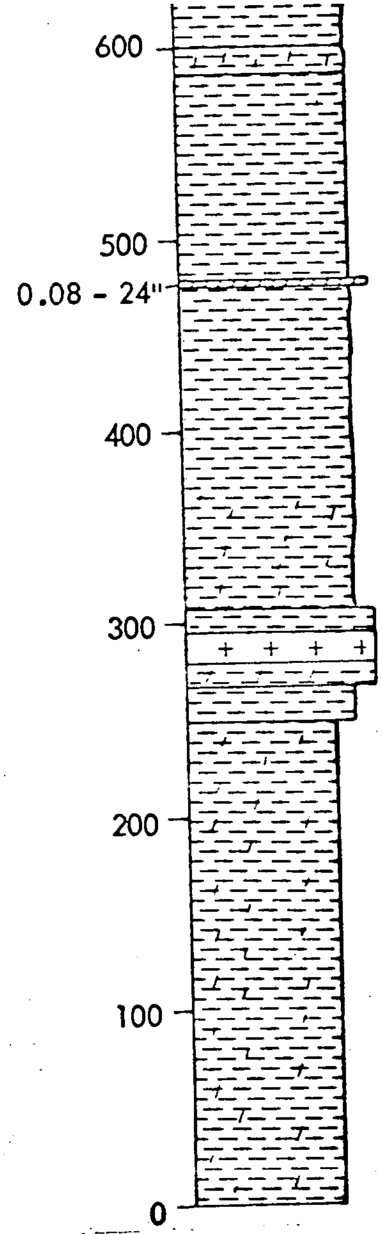
Interbedded buff to light greenish grey argillite and greyish red to maroon silty to sandy argillite; closely jointed.

Reddish grey silty argillite; beds ½" thick with bulbous bleach marks, specular hematite and salt casts; closely jointed.

Lower beds interbedded with buff colored greenish grey argillite.

Reddish grey silty argillite; beds ½" with bulbous bleach marks and specular hematite; closely spaced joints.

LOWER GATEWAY FORMATION



Light greenish grey slightly dolomitic argillite.

Reddish grey silty argillite; beds ½" thick with bulbous bleach marks and specular hematite; jointing very closely spaced.

Buff-weathering argillaceous dolomite; greenish grey on fresh surfaces; beds ½" to 4". <u>COPPER MINERALS</u>

Gradational contact of bleached and unbleached argillites.

Greyish red, silty argillite; locally very slightly dolomitic; laminated, moderately thickly bedded; specular hematite in fractures.

Variably colored laminated slaty argillite; moderately thickly bedded; widely spaced joints.

Dark green diorite sill; narrow chilled margin on upper and lower contacts.

Brownish grey and greyish red laminated silty, slightly dolomitic argillite; beds 5" to 6"; widely spaced jointing.

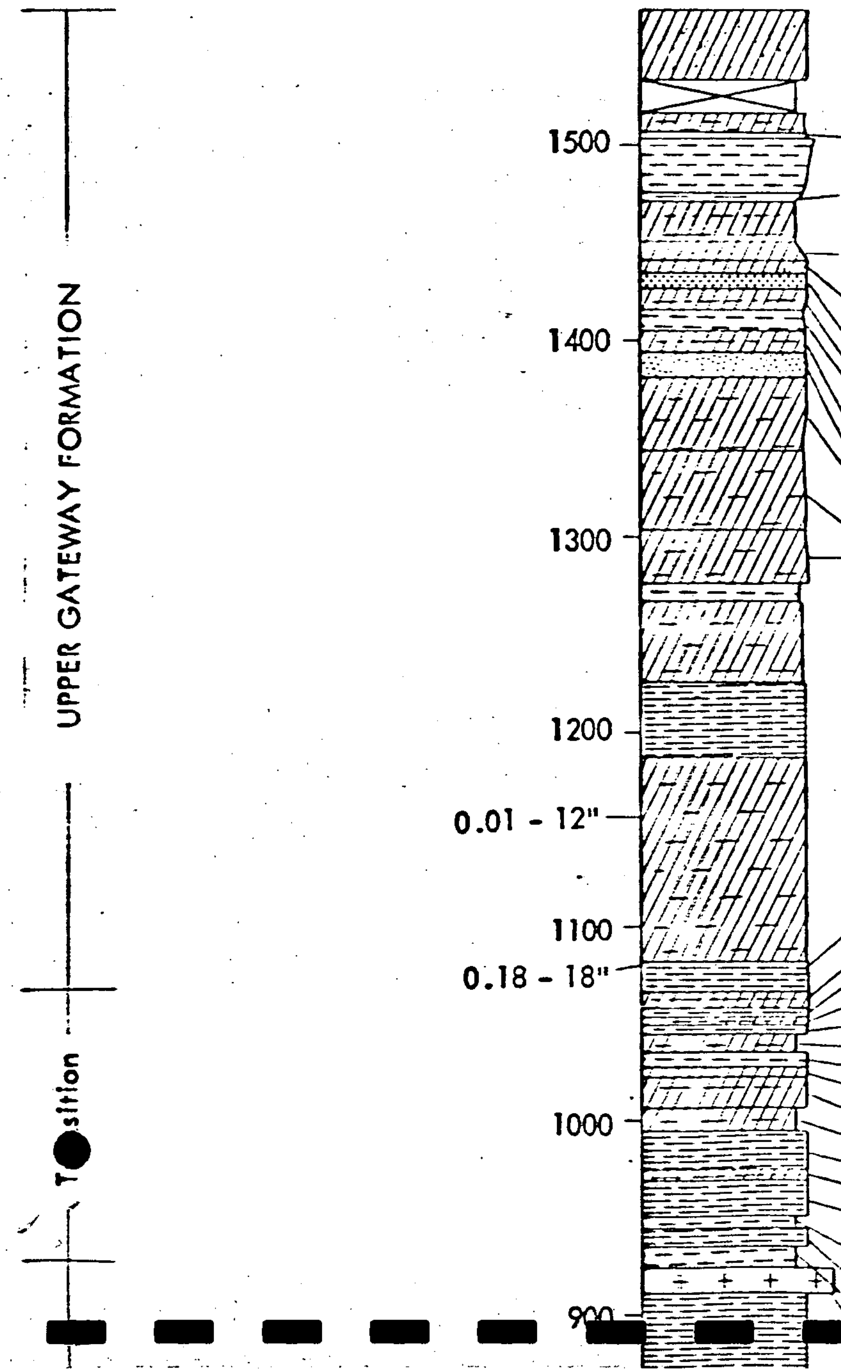
Interbedded greyish red and bleached argillite; slight bleaching and baking; gradational lower and upper contacts.

Pale-red-and-greyish-red-weathering slightly silty, dolomitic argillite; pale red to greyish red on fresh surfaces; mud cracks, raindrop marks, salt casts; moderately close jointing.

SHEPPARD FORMATION

SECTION 11 - BARNABY RIDGE

PHILLIPS FORMATION



Green-weathering medium-grained dolomitic sandstone and sandy argillite; green on fresh surfaces; beds 6" to 1'.

Covered; green argillite scree.

Interbedded green-weathering argillite and argillaceous dolomite; beds 2" to 3".

Interbedded buff-weathering dolomite and green argillite; beds 4" to 6"; chloritic partings in dolomite.

Green-weathering argillite grading to silty argillite; beds ½" to 3"; becoming dolomitic at top.

Purple-weathering argillite grading to argillaceous siltstone; beds ½" to 2".

Green-weathering argillaceous dolomite grading to dolomitic argillite; beds ½" to 2"; with resistant interbeds of green dolomitic siltstone.

Rusty-brown-weathering dolomite grading to sandy dolomite; greenish grey on fresh surfaces; beds ½" to 6"; lower 3' more resistant.

Greenish-buff-weathering argillaceous dolomite; greenish grey on fresh surfaces; beds 1/8" to 1"; siltier units weather more resistant.

Buff-to-light-grey-weathering quartzite; grey on fresh surfaces; beds 3" with interbeds of buff sandy dolomite.

Buff-weathering dolomite grading to silty argillaceous dolomite; beds 1/8" to 6".

Green weathering dolomitic argillite; beds 1/8" to 1" with interspersed dolomite beds; lower 3' is buff-weathering dolomite.

Greenish-buff-weathering silty argillaceous dolomite; beds 1/8" to 3"; lower 2' is green dolomitic argillite.

Purplish-green-weathering fine-grained dolomitic sandstone; beds ½" to 2"; with argillaceous partings.

Greenish-buff-weathering argillaceous dolomite grading to dolomitic siltstone; green to brownish green on fresh surfaces; beds ¼" to 1"; bottom 2' buff-weathering dolomitic siltstone.

Green-weathering finely laminated dolomitic argillite; beds 1/8" to 1".

Buff-weathering argillaceous dolomite; beds ¼" to 2".

Green-weathering silty argillite; beds ¼" to 1".

Buff-to-green-weathering dolomitic siltstone; dolomitic argillite and argillaceous siltstone; beds ¼" to 6"; 4" bright green argillite at base.

½"-band of black argillite.

Interbedded purple argillaceous siltstone and brown dolomite; beds ¼" to 4".

Green-to-greenish-buff-weathering finely laminated argillaceous dolomitic siltstone grading to dolomitic argillite; beds ¼" to 1". MALACHITE stain in 6" bed of dolomitic siltstone.

Purplish-brown-to-buff-weathering argillaceous siltstone grading to silty dolomite, beds ¼" to 2".

Interbedded buff-weathering silty dolomite and green dolomitic siltstone; beds ½" to 2".

Purplish-weathering argillaceous siltstone; beds ¼" to 1".

Buff-weathering silty dolomite grading up into grey green siltstone.

Purplish-red-weathering argillaceous siltstone; beds ¼" to 1".

Buff-weathering dolomitic siltstone.

Purplish-brown-weathering silty argillite grading to fine grained argillaceous sandstone; beds approximately 1".

Buff-weathering silty dolomite; beds ¼" to 2".

Interbedded purplish-red-weathering argillites and dolomitic siltstones; beds ¼" to 4".

Greenish-buff-weathering argillaceous dolomite; beds ¼" to 2"; breaks into thin irregular plates.

Reddish purple weathering argillaceous siltstone; beds ½" to 6" with local 4" brown bands.

Buff-green-weathering dolomitic siltstone grading to argillite; beds ¼" to 1".

Interbedded purplish-brown-weathering fine-grained argillaceous sandstone; and purplish green argillaceous siltstone; beds ¼" to 2".

Purplish-red-weathering argillite grading to silty argillite; beds ½" to 1".

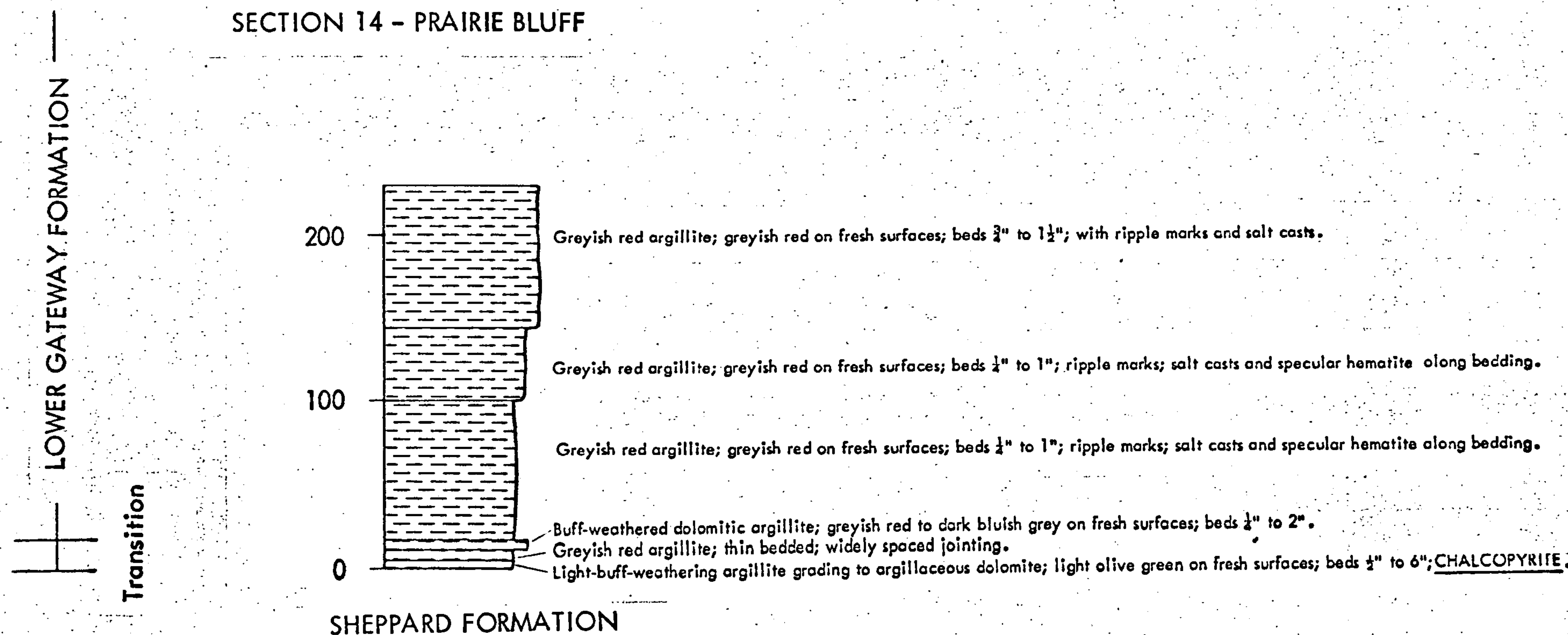
Purplish-brown-weathering siltstone with 1/8" purple argillite laminae.

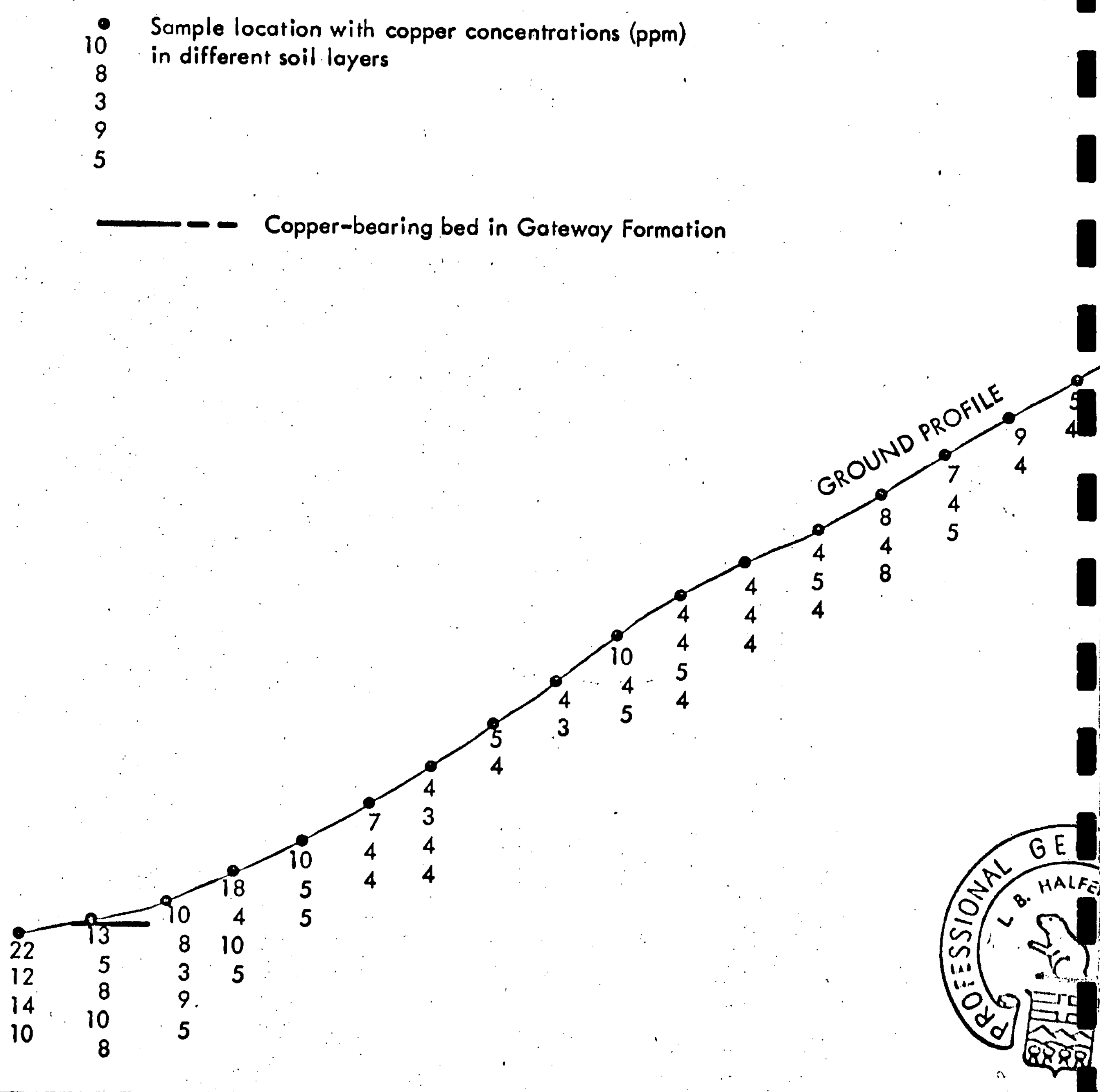
Greenish purple very finely laminated argillite; contains small scale crossbeds.

Dark [illegible]h gre[illegible]te si[illegible]

Purplish-red-weathering siltstone grading to argillaceous siltstone; beds 4" to 1'.

SECTION 14 - PRAIRIE BLUFF





Sample location with copper concentrations (ppm) in different soil layers
Copper-bearing bed in Gateway Formation
GROUND PROFILE

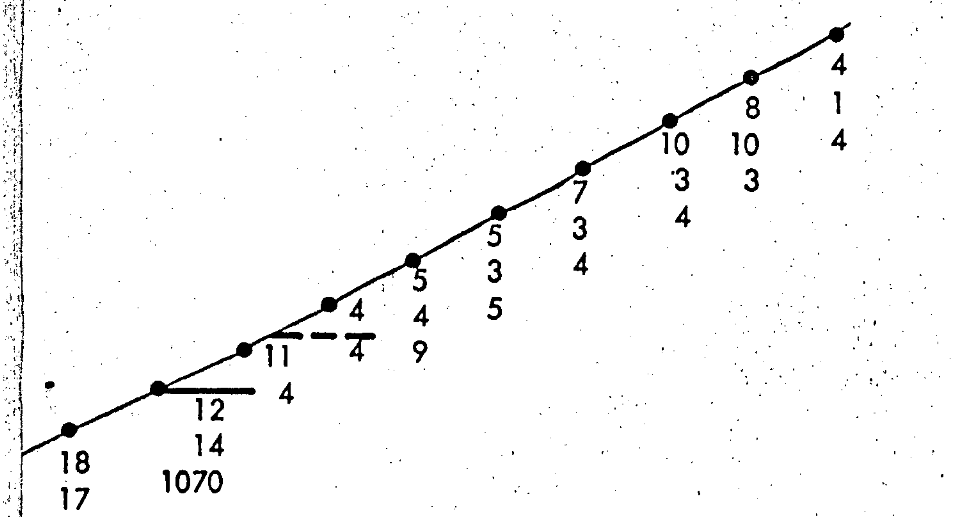


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Fig. 4 Copper Concentrations in Soils on Sage Mountain

(Cross-section beside measured Section 3)

0 50 100 200 300
SCALE IN FEET

Drawn: AK August 1971

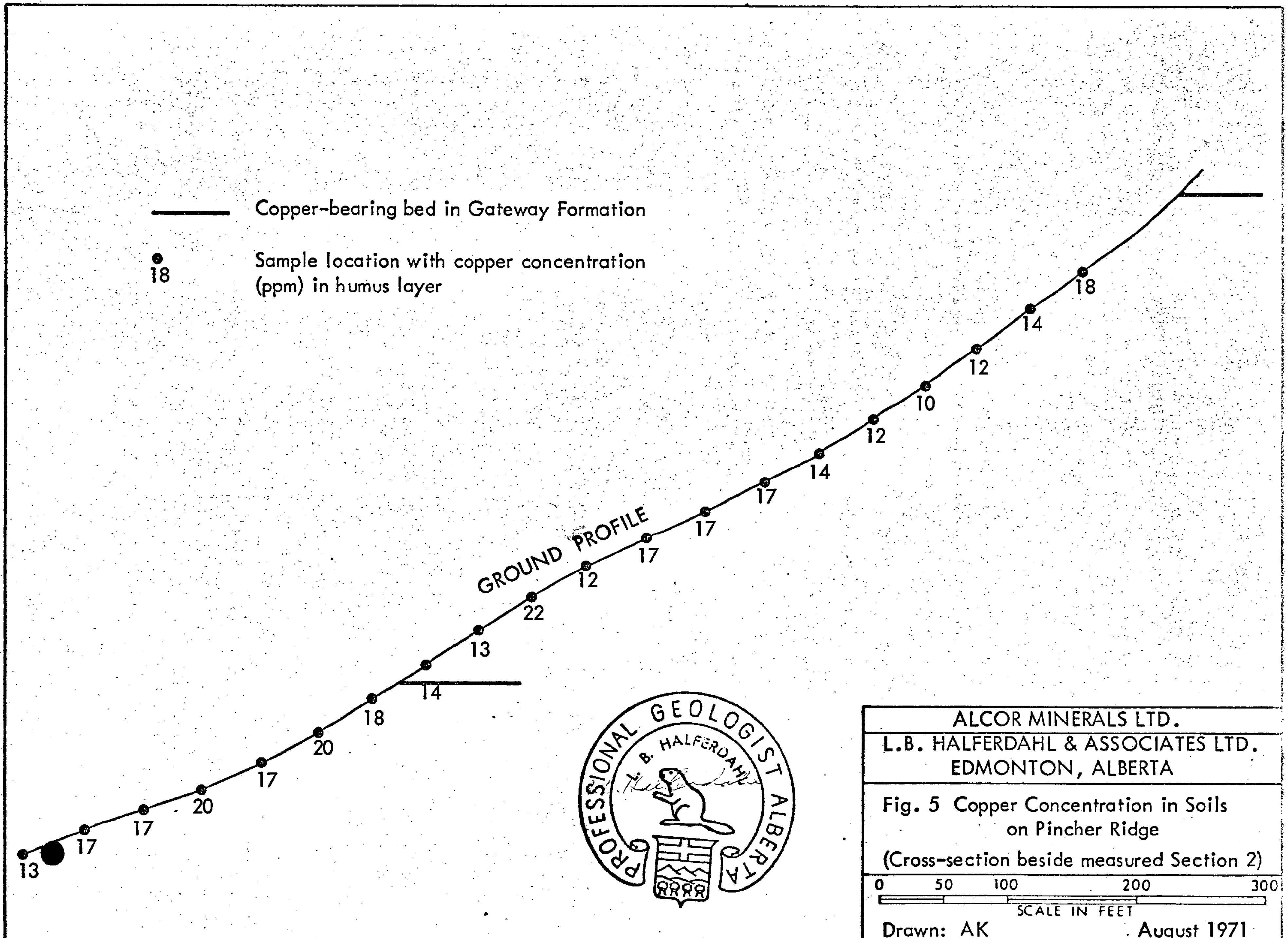

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Fig. 5 Copper Concentration in Soils on Pincher Ridge

(Cross-section beside measured Section 2)

0 50 100 200 300
SCALE IN FEET

Drawn: AK August 1971

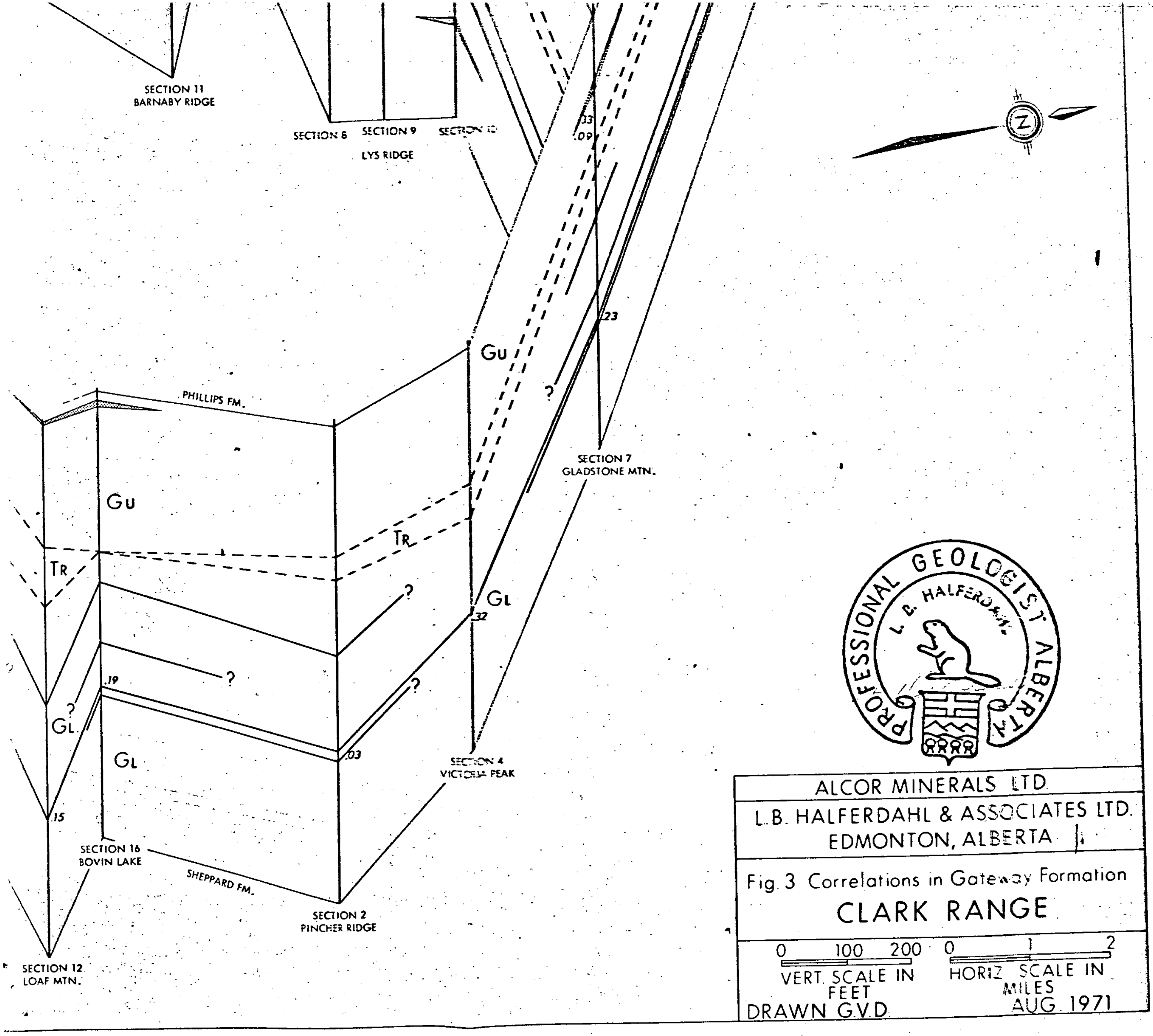
SECTION 11
BARNABY RIDGE
SECTION 8
SECTION 9
SECTION 10
LYS RIDGE
.33
.09
.23
Gu
PHILLIPS FM.
?
SECTION 7
GLADSTONE MTN.
Gu
TR
TR
?
GL
.32
.19
?
?
?
GL
GL
.15
.03
SECTION 4
VICTORIA PEAK
SECTION 16
BOVIN LAKE
SHEPPARD FM.
SECTION 2
PINCHER RIDGE
SECTION 12
LOAF MTN.
PROFESSIONAL GEOLOGIST ALBERTA
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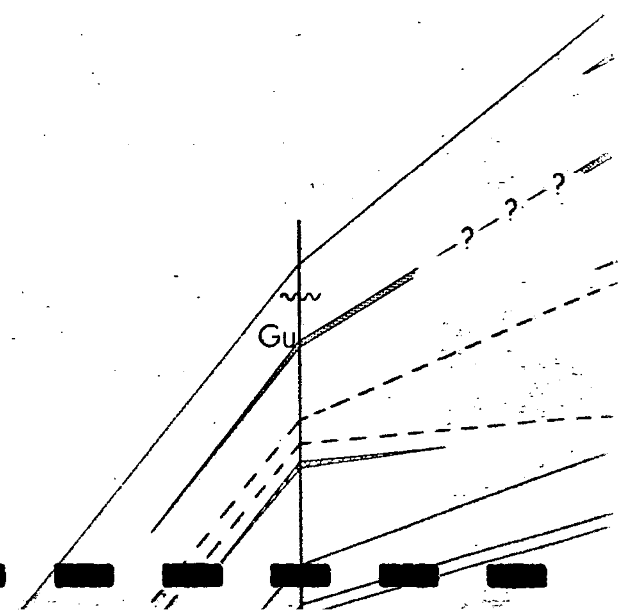
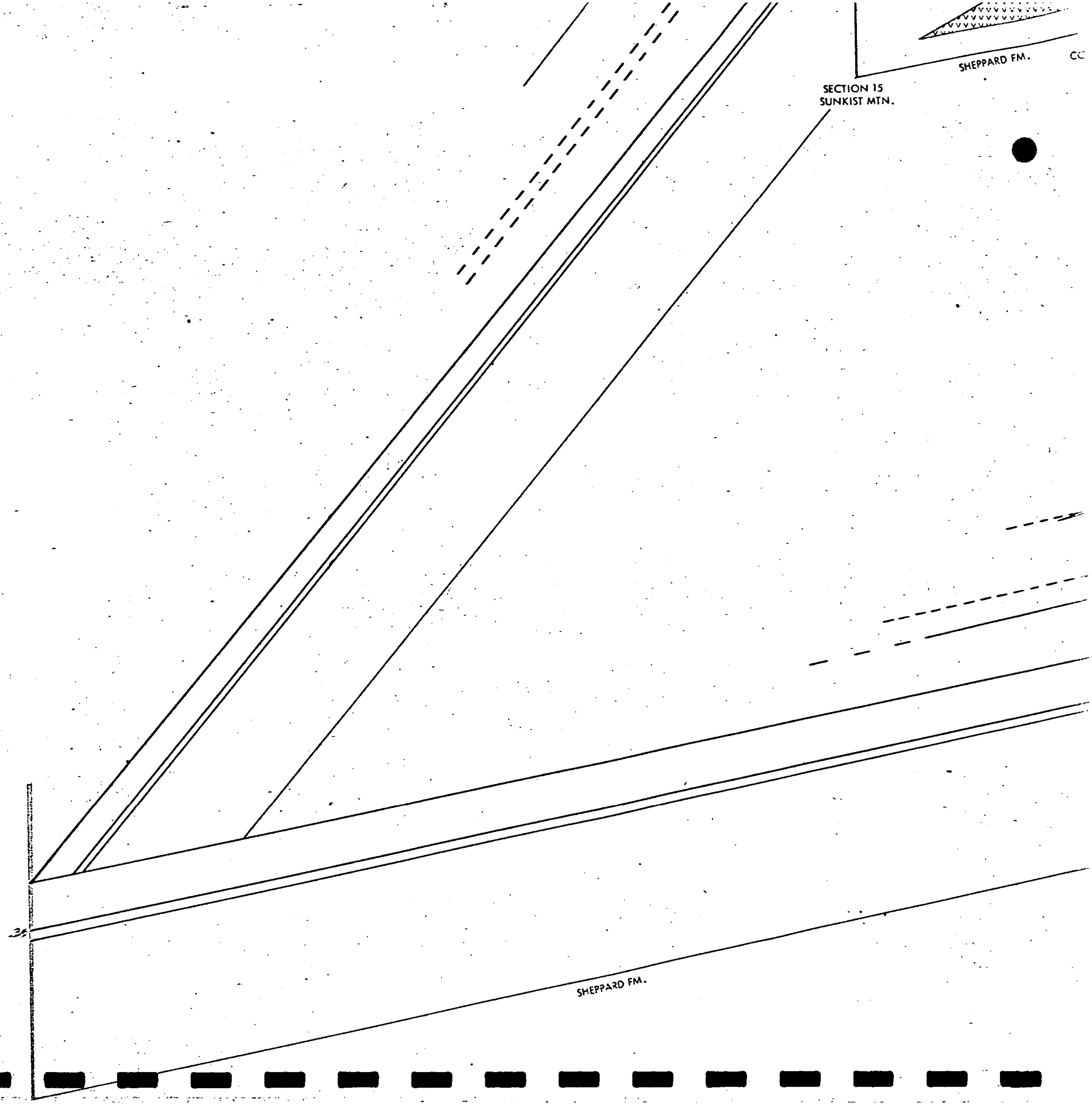
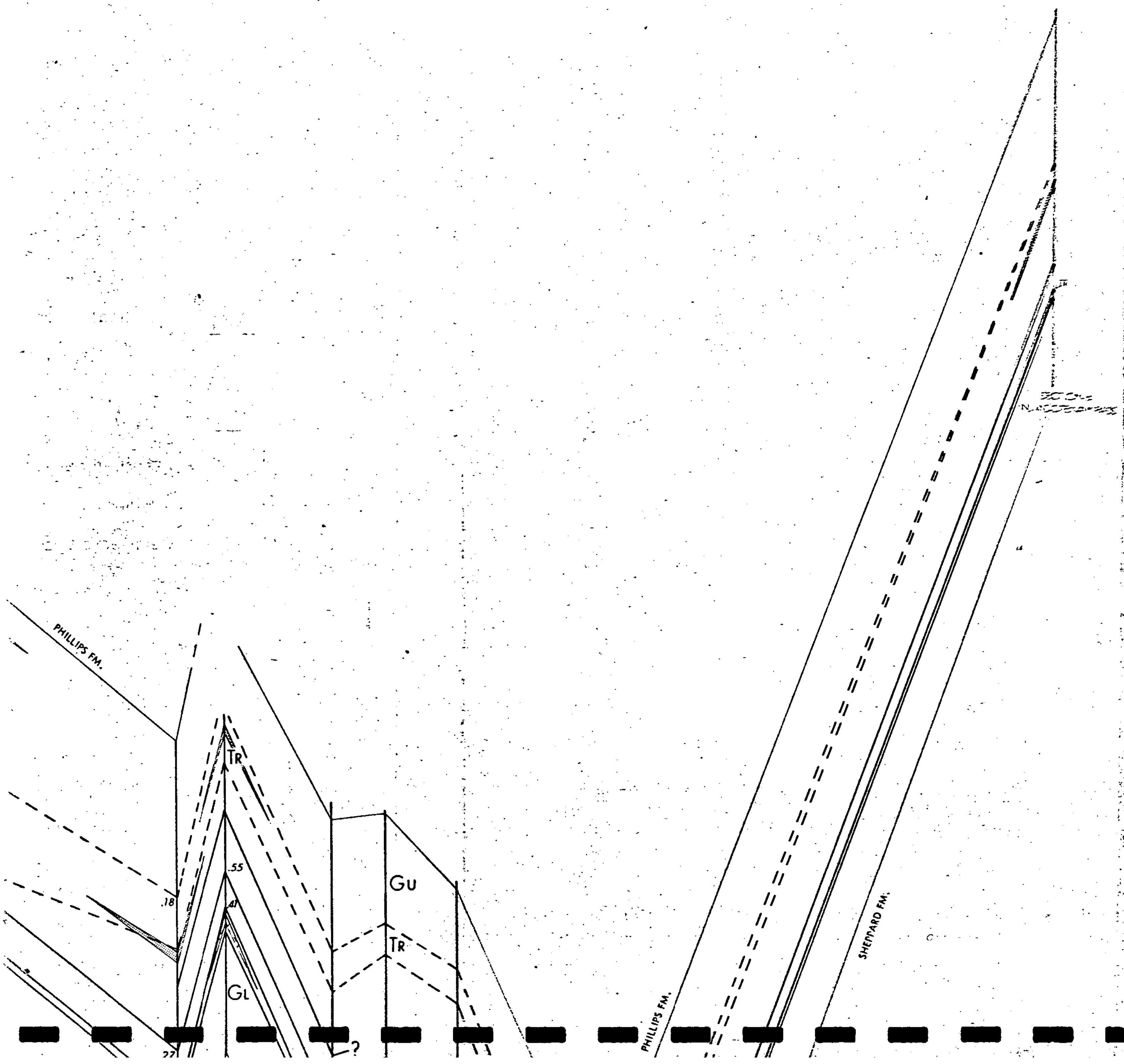
Fig. 3 Correlations in Gateway Formation
CLARK RANGE
0 100 200
VERT. SCALE IN FEET
0 1 2
HORIZ. SCALE IN MILES
DRAWN G.V.D.
AUG. 1971

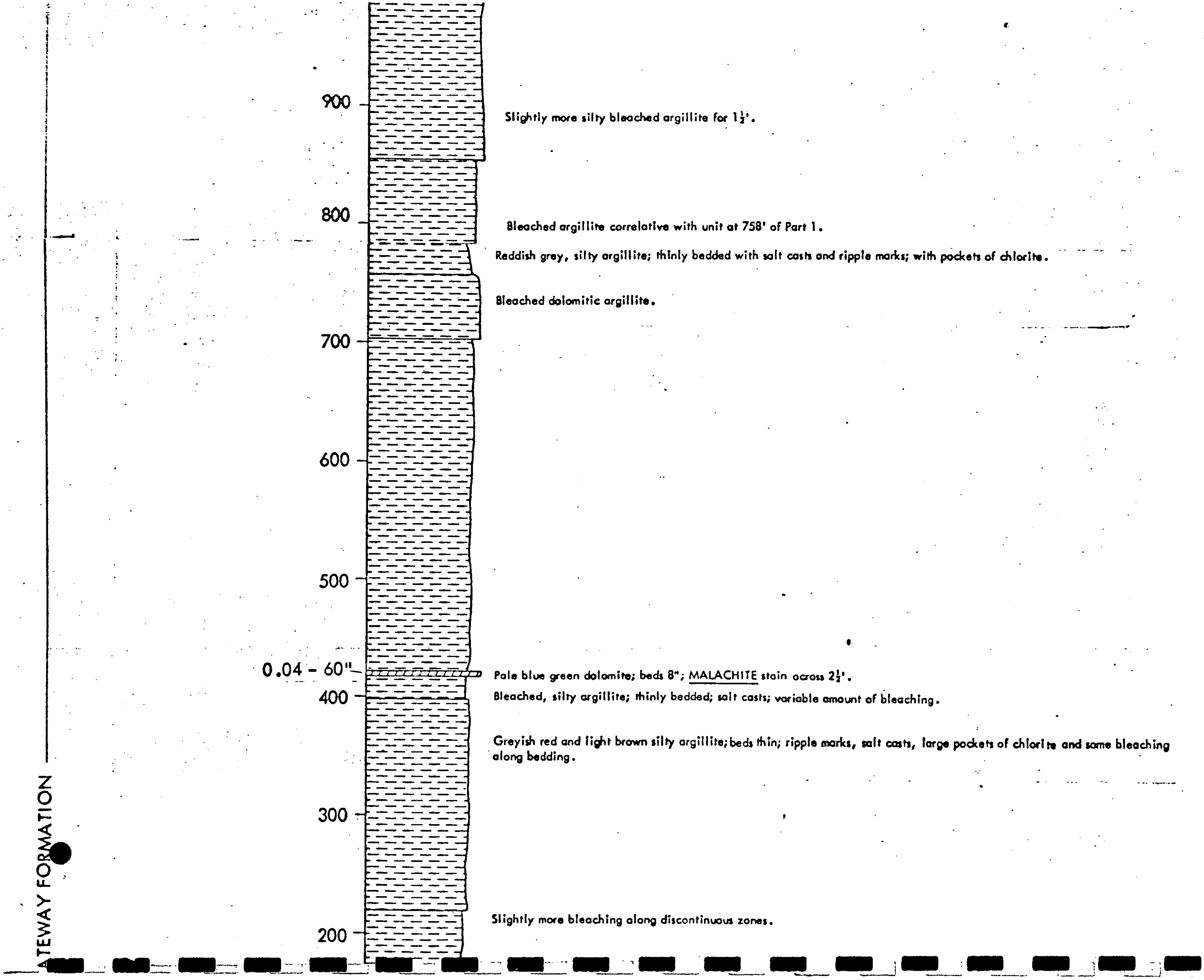
LEGEND

———	Carbonate beds
.03	Mineralization and % Cu.
(pattern)	Trachyte
(pattern)	Diorite
Gu	Upper Member Gateway Formation
Tr	Transition
Gl	Lower Member Gateway Formation
~~	Fault

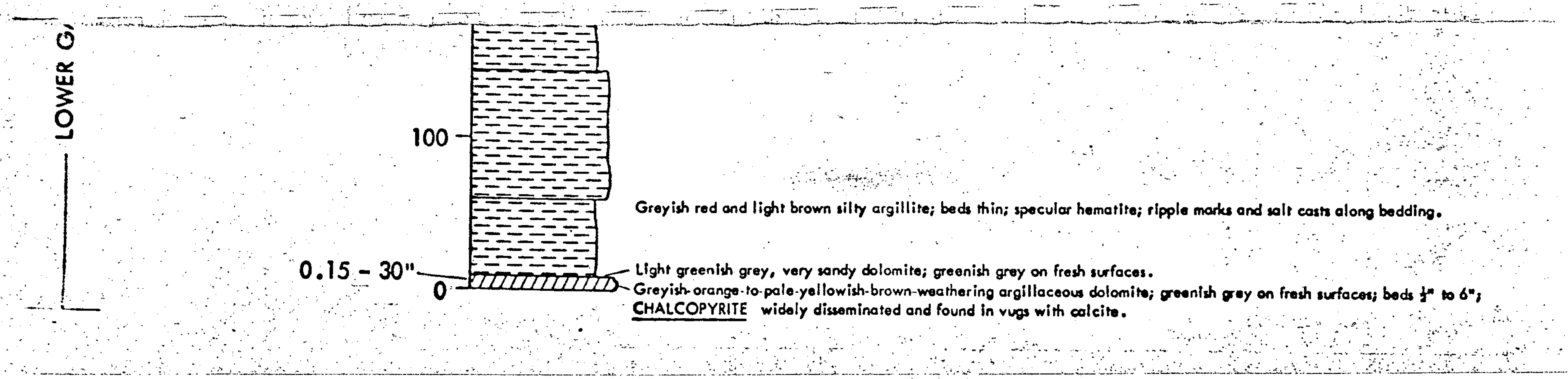



SHEPPARD FM.
SECTION 15
SUNKIST MTN.
SHEPPARD FM.


PHILLIPS FM.
.18
TR
.55
.41
GL
GU
TR
?
.27
PHILLIPS FM.
SHEPPARD FM.



900
Slightly more silty bleached argillite for 1½'.
800
Bleached argillite correlative with unit at 758' of Part 1.
Reddish grey, silty argillite; thinly bedded with salt casts and ripple marks; with pockets of chlorite.
Bleached dolomitic argillite.
700
600
500
0.04 - 60"
Pale blue green dolomite; beds 8"; MALACHITE stain across 2½'.
400
Bleached, silty argillite; thinly bedded; salt casts; variable amount of bleaching.
Greyish red and light brown silty argillite; beds thin; ripple marks, salt casts, large pockets of chlorite and some bleaching along bedding.
300
Slightly more bleaching along discontinuous zones.
200
ATEWAY FORMATION



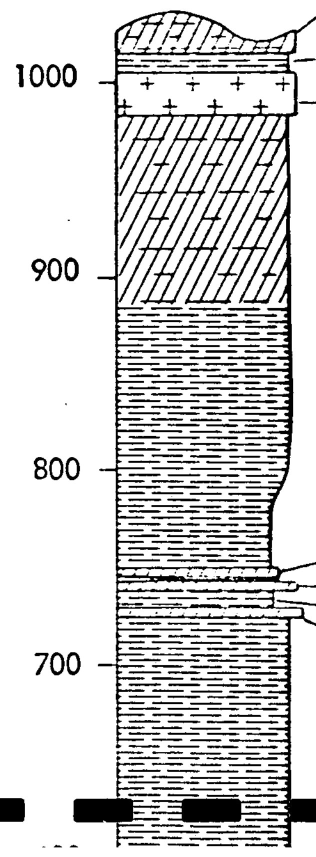
LOWER G
100
0.15 - 30"
0
Greyish red and light brown silty argillite; beds thin; specular hematite; ripple marks and salt casts along bedding.
Light greenish grey, very sandy dolomite; greenish grey on fresh surfaces.
Greyish-orange-to-pale-yellowish-brown-weathering argillaceous dolomite; greenish grey on fresh surfaces; beds ½" to 6";
CHALCOPYRITE widely disseminated and found in vugs with calcite.

UPPER GATEWAY FORMATION

Transition

SECTION 13 – RAINY RIDGE

Top of section eroded.



Brown-weathering dolomitic siltstone grading to argillaceous siltstone; greenish grey on fresh surfaces; locally contains purple argillaceous partings, beds ½" to 3".

Dark purple very finely laminated argillaceous siltstone; beds ½" to 2"; grading into a 2' basal unit of green dolomite; beds 2".

Diorite sill; dark rusty grey, medium-grained.

Interbedded brownish purple siltstone grading to argillaceous siltstone and brownish-green-weathering dolomitic siltstone; beds ¼" to 2"; thin argillaceous partings along bedding of siltstones.

Purplish-red-weathering argillaceous siltstone with scattered 2" to 6" beds of brown-weathering sandy, dolomitic siltstone; beds ½" to 2".

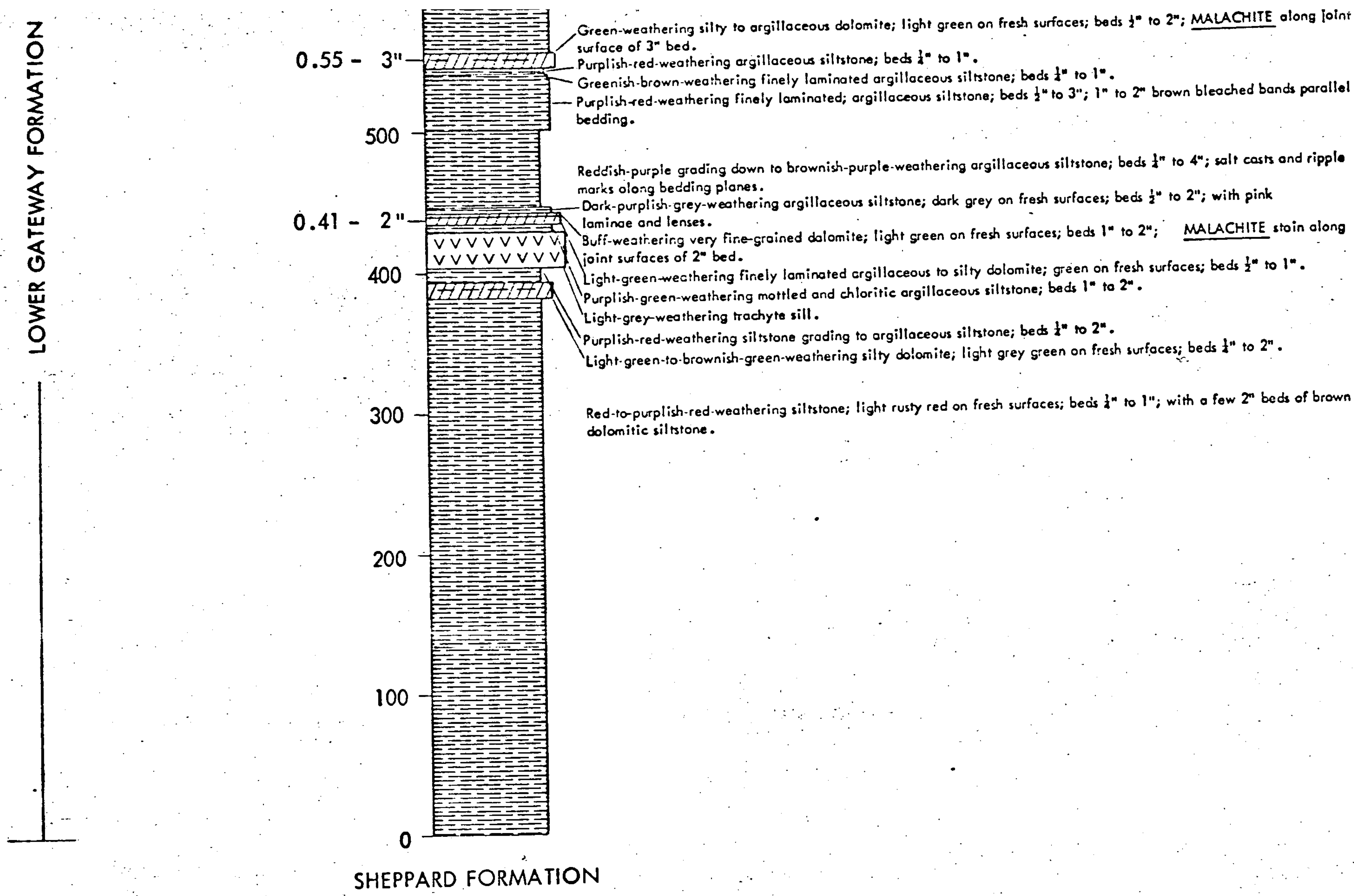
Buff-weathering argillaceous grading to silty dolomite; beds 1" to 3".

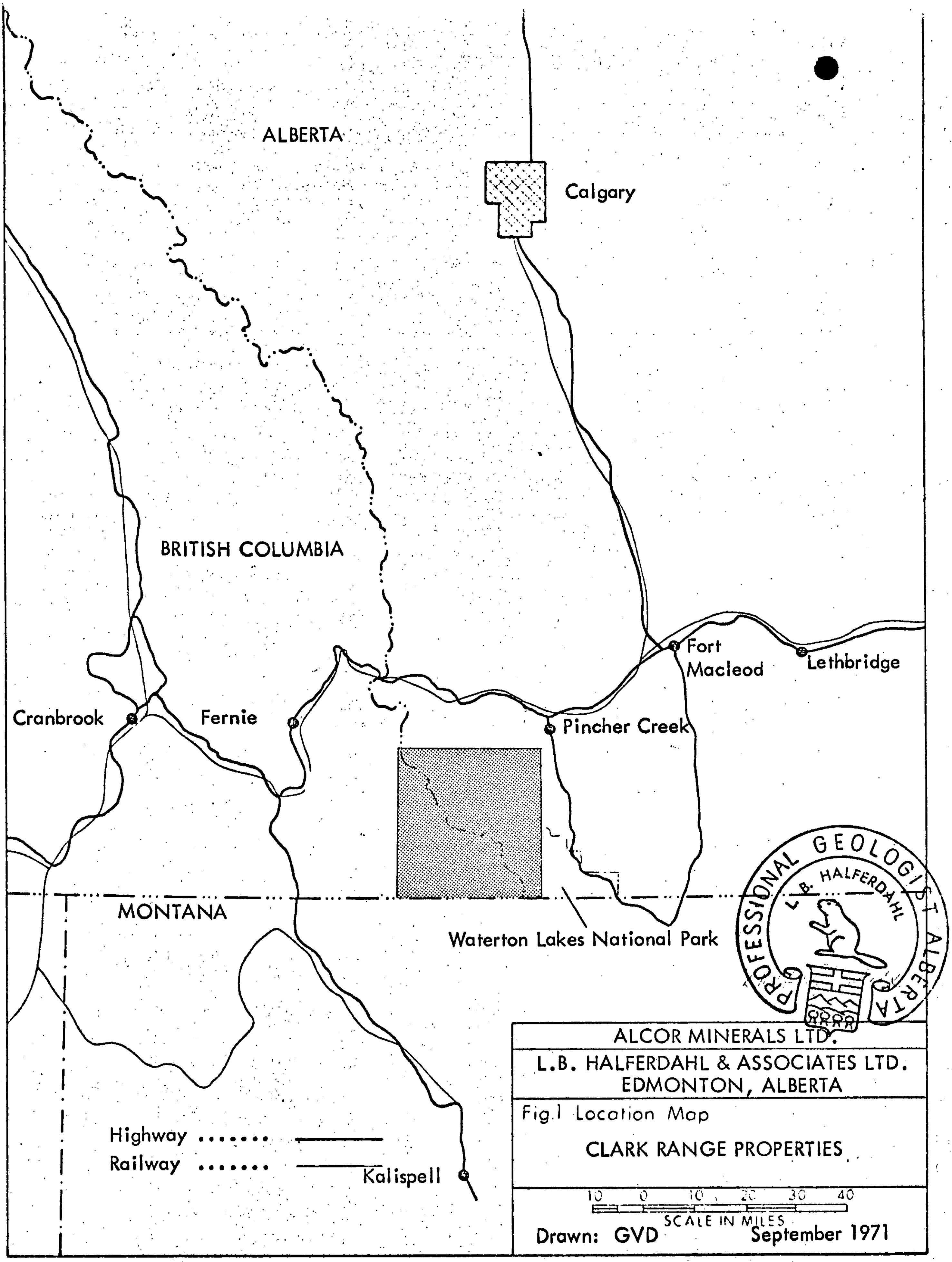
Buff-weathering silty dolomite; light green on fresh surfaces; beds 1" to 3".

Reddish-purple-weathering argillaceous siltstone; beds ½" to 3"; base marked by 6" brown-weathering sandy bed.

Buff-weathering dolomitic siltstone; light greenish grey on fresh surfaces; beds ½" to 1".

Brownish purple grading down to purplish-red-weathering argillaceous siltstone; beds ½" to 3".


LOWER GATEWAY FORMATION
0.55 - 3"
0.41 - 2"
500
400
300
200
100
0
Green-weathering silty to argillaceous dolomite; light green on fresh surfaces; beds ½" to 2"; MALACHITE along joint surface of 3" bed.
Purplish-red-weathering argillaceous siltstone; beds ¼" to 1".
Greenish-brown-weathering finely laminated argillaceous siltstone; beds ¼" to 1".
Purplish-red-weathering finely laminated; argillaceous siltstone; beds ½" to 3"; 1" to 2" brown bleached bands parallel bedding.
Reddish-purple grading down to brownish-purple-weathering argillaceous siltstone; beds ¼" to 4"; salt casts and ripple marks along bedding planes.
Dark-purplish-grey-weathering argillaceous siltstone; dark grey on fresh surfaces; beds ½" to 2"; with pink laminae and lenses.
Buff-weathering very fine-grained dolomite; light green on fresh surfaces; beds 1" to 2"; MALACHITE stain along joint surfaces of 2" bed.
Light-green-weathering finely laminated argillaceous to silty dolomite; green on fresh surfaces; beds ½" to 1".
Purplish-green-weathering mottled and chloritic argillaceous siltstone; beds 1" to 2".
Light-grey-weathering trachyte sill.
Purplish-red-weathering siltstone grading to argillaceous siltstone; beds ¼" to 2".
Light-green-to-brownish-green-weathering silty dolomite; light grey green on fresh surfaces; beds ¼" to 2".
Red-to-purplish-red-weathering siltstone; light rusty red on fresh surfaces; beds ¼" to 1"; with a few 2" beds of brown dolomitic siltstone.
SHEPPARD FORMATION


ALBERTA
Calgary
BRITISH COLUMBIA
Fort Macleod
Lethbridge
Cranbrook
Fernie
Pincher Creek
MONTANA
Waterton Lakes National Park
Highway
Railway
Kalispell
PROFESSIONAL GEOLOGIST ALBERTA
L.B. HALFERDAHL
ALCOR MINERALS LTD.
L.B. HALFERDAHL & ASSOCIATES LTD.
EDMONTON, ALBERTA
Fig.1 Location Map
CLARK RANGE PROPERTIES
10 0 10 20 30 40
SCALE IN MILES
Drawn: GVD
September 1971

BONDAR-CLEGG & COMPANY LTD.
geochemists • assayers • analytical chemists
1500 PEMBERTON AVENUE, NORTH VANCOUVER, B.C.
PHONE: 988-5315 TELEX: 04-54554

REPORT OF: Mercury (Geochem) REPORT No. IT 21 - 97

PROJECT: DATE: August 9, 1971

REPORTED TO: Loring Laboratories Ltd.
629 Beaverdam Road
Calgary, Alberta
Att: Mr. C.L. McIsaac

P.O. No. 629

Sample No.	Client No.	Hg ppb	Sample No.	Client No.	Hg ppb
1	GK 3 1A	24	32	GK 3 9A	55
2	1B	13	33	9B	18
3	1C	40	34	GK 3 10A	33
4	1D	15	35	10B	31
5	GK 3 2A	44	36	10C	44
6	2B *	22	37	GK 3 11A	37
7	2B *	15	38	11B	42
8	2C	54	39	11C	72
9	2D	52	40	11D	21
10	2E	20	41	GK 3 12A	32
11	GK 3 3A	62	42	12B	40
12	3B	85	43	12C	51
13	3C	15	44	GK 3 13A	38
14	3D	131	45	13B	96
15	3E	54	46	13C	10
16	GK 3 4A	51	47	GK 3 14A	37
17	4B	8	48	14B	20
18	4C	61	49	14C	107
19	4D	21	50	GK 3 15A	45
20	GK 3 5A	44	51	15B	42
21	5B	27	52	15C	70
22	5C	62	53	GK 3 16A	64
23	GK 3 6A	66	54	16B	30
24	6B	14	55	GK 3 17A	45
25	6C	38	56	17B	27
26	GK 3 7A	55	57	GK 3 18A	60
27	7B	10	58	18B	39
28	7C	34	59	GK 3 19A	42
29	7D	8	60	19B	28
30	GK 3 8A	40	61	19C	144
31	8B	10	62	GK 3 20A	60
			63	20B	41

[redacted]

Ronald J. Sawyer, Chief Chemist

* Duplicate numbers on bags.

BONDAR-CLEGG & COMPANY LTD.
geochemists • assayers • analytical chemists
1500 PEMBERTON AVENUE, NORTH VANCOUVER, B.C.
PHONE: 988-5315 TELEX: 04-54554

REPORT OF: Mercury (Geochem) Cont'd. REPORT NO. IT 21 - 97

PROJECT: DATE:

REPORTED TO:

Sample No.	Client No.	Hg ppb
64	GK 3 21A	48
65	21B	30
66	GK 3 22A	31
67	22B	22
68	22C	56
69	GK 3 23A	36
70	23B	24
71	23C	73
72	GK 3 25A *	66
73	25A *	72
74	25B *	20
75	GK3 25B *	27
76	25C *	60
77	25C *	54
78	GK 3 26A	18
79	26B	48
80	26C	33
81	GK 3 27A	Indicated Higher than 300 but lack of sample prevented checking
82	GK 3 27B	26
83	27C	33
84	GK 3 X	24

[redacted]

Ronald J. Sawyer, Chief Chemist

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 [illegible]rthgate Bldg.,
10049 Jasper Ave.,
Edmonton 15, Alberta.

File No. 4270
Date July 13th 1971
Samples Geo-Chem
Cold Extraction

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu ppm	Zn ppm
GK - 3 - 1a	2	4
GK - 3 - 1b	1	2
GK - 3 - 1c	2	2
GK - 3 - 1d	1	2
GK - 3 - 2a	3	17
GK - 3 - 2b	nil	2
GK - 3 - 2b	1	2
GK - 3 - 2c	1	2
GK - 3 - 2d	1	2
GK - 3 - 2e	1	2
GK - 3 - 3a	2	8
GK - 3 - 3b	2	2
GK - 3 - 3c	1	2
GK - 3 - 3d	2	2
GK - 3 - 3e	1	2
GK - 3 - 4a	10	32
GK - 3 - 4b	1	3
GK - 3 - 4c	2	2
GK - 3 - 4d	1	2
GK - 3 - 5a	2	5
GK - 3 - 5b	2	2
GK - 3 - 5c	1	2
GK - 3 - 6a	1	19
GK - 3 - 6b	2	2
GK - 3 - 6c	2	2
GK - 3 - 7a	3	10
GK - 3 - 7b	1	2
GK - 3 - 7c	1	2
GK - 3 - 7d	1	2
GK - 3 - 8a	5	15

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.
Pulps Retained one month unless specific arrangements made in advance.

[redacted]
Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD
401 Northgate Bldg.,
10049 Jasper Ave.,
EDMONTON 15, Alberta.

File No. 4270
Date July 13th 1971
Samples Geo-Chem
Cold Extraction

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu ppm	Zn ppm
GK - 3 - 8b	2	2
GK - 3 - 9a	1	5
GK - 3 - 9b	1	2
GK - 3 - 10a	2	10
GK - 3 - 10b	1	2
GK - 3 - 10c	1	2
GK - 3 - 11a	1	3
GK - 3 - 11b	1	2
GK - 3 - 11c	1	2
GK - 3 - 11d	1	2
GK - 3 - 12a	3	10
GK - 3 - 12b	2	2
GK - 3 - 12c	3	2
GK - 3 - 13a	2	9
GK - 3 - 13b	1	2
GK - 3 - 13c	1	2
GK - 3 - 14a	1	60
GK - 3 - 14b	3	15
GK - 3 - 14c	1	2
GK - 3 - 15a	1	2
GK - 3 - 15b	2	2
GK - 3 - 15c	3	25
GK - 3 - 16a	2	2
GK - 3 - 16b	1	2
GK - 3 - 17a	3	11
GK - 3 - 17b	2	2
GK - 3 - 18a	1	5
GK - 3 - 18b	1	2
GK - 3 - 19a	3	20
GK - 3 - 19b	3	2

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

[redacted]

Licensed Assayor of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 N[illegible]thgate Bldg.,
10049 Jasper Ave.,
EDMONTON 15, Alberta.

File No. 4270
Date July 13th 1971
Samples Geo-Chem
Cold Extraction

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu ppm	Zn ppm
GK - 3 - 19c	109	2
GK - 3 - 20a	3	18
GK - 3 - 20b	3	2

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.
Pulps Retained one month unless specific arrangements made in advance.

[redacted]
Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 N[illegible]thgate Bldg.,
10049 Jasper Ave.
Edmonton 15, Alberta.

File No. 4290
Date July 19th 1971
Samples Geo-Chem
COLD EXTRACTION

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu ppm	Zn ppm
GK - 3 - 21a	3	24
GK - 3 - 21b	1	2
GK - 3 - 22a	2	26
GK - 3 - 22b	2	3
GK - 3 - 22c	6	49
GK - 3 - 23a	5	14
GK - 3 - 23b	1	2
GK - 3 - 23c	3	28
GK - 3 - 25a	3	2
GK - 3 - 25a	3	2
GK - 3 - 25b	1	3
GK - 3 - 25b	2	16
GK - 3 - 25c	1	2
GK - 3 - 25c	3	3
GK - 3 - 26a	1	2
GK - 3 - 26b	2	2
GK - 3 - 26c	1	2
GK - 3 - 27a	1	6
GK - 3 - 27b	1	2
GK - 3 - 27c	1	2
GK - 3X	1	2

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

[redacted]

Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 N[illegible]thgate Bldg.,
10049 Jasper Ave.,
EDMONTON 15, Alberta.

File No. 4401
Date August 11th 1971
Samples Geo-Chems & Rock

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu ppm
G-G-2-1	18
G-G-2-2	14
G-G-2-3	12
G-G-2-4	10
G-G-2-5	12
G-G-2-6	14
G-G-2-7	17
G-G-2-8	17
G-G-2-9	17
G-G-2-10	12
G-G-2-11	22
G-G-2-12	13
G-G-2-13	14
G-G-2-14	18
G-G-2-15	20
G-G-2-16	17
G-G-2-17	20
G-G-2-18	17
G-G-2-19	17
G-G-2-20	13
V-S-25-1 Rock	2600

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.
Pulps Retained one month unless specific arrangements made in advance.

[redacted]
Licensed Assayer of British Columbia

APPENDIX 3: FIELD CREW AND FIELD TIME

FIELD CREW

J. Gorham	Assistant	June 2 – August 4
L. B. Halferdahl	Geologist	June 2 – June 7 June 26 – June 29 July 8 – July 12 July 31 – August 2
A. Kahil	Geologist	June 2 – August 4
F. Nichols	Assistant	June 2 – August 4
G. Van Dyck	Geologist	June 2 – August 2

FIELD TIME

In the summary below the field time has been divided into three divisions: geological work and administration, camp work and travelling time, and days off. The first can be considered productive work; the second is necessary work including packing in of fly camps and vehicle problems; the third includes time off because of poor weather.

	Geological Work Administration		Camp Work Travelling		Time Off		Total	
	Days	%	Days	%	Days	%	Days	%
June 2 – 30	89	71.2	21	16.8	15	12.0	125	100
July 1 – 31	90	69.8	8	6.2	31	24.0	129	100
August 1 – 4	11	73.3	4	26.7	0	0	15	100
Total	190	70.6	33	12.3	46	17.1	269	100

To: L. B. HALFERDAHL & ASSOCATES LTD.
401 Northgate Bldg.,
10049 Jasper Ave.,
EDMONTON 15, Alberta.

File No. 4290
Date July 19th 1971
Samples Geo-Chem

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Mo ppm
GK - 3 - 21a	4	10	35	3	1
GK - 3 - 21b	4	17	49	3	1
GK - 3 - 22a	5	17	42	1	1
GK - 3 - 22b	4	10	22	2	2
GK - 3 - 22c	9	12	46	2	3
GK - 3 - 23a	5	44	52	1	1
GK - 3 - 23b	3	9	15	2	2
GK - 3 - 23c	5	17	32	2	2
GK - 3 - 25a	7	17	46	1	2
GK - 3 - 25a	10	29	77	2	1
GK - 3 - 25b	3	9	50	2	2
GK - 3 - 25b	3	9	20	2	1
GK - 3 - 25c	4	17	33	3	2
GK - 3 - 25c	4	15	32	3	3
GK - 3 - 26a	8	17	47	1	3
GK - 3 - 26b	10	14	32	2	3
GK - 3 - 26c	3	7	32	2	2
GK - 3 - 27a	4	10	23	1	1
GK - 3 - 27b	1	9	13	1	1
GK - 3 - 27c	4	10	23	2	1
GK - 3X	3	10	28	nil	3

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

[redacted]

Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 Northgate Bldg.,
10049 Jasper Ave.,
EDMONTON 15, Alberta.

File No. 4270
Date July 13th 1971
Samples Geo-Chem

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Mo ppm
GK - 3 - 19c	1070	20	50	2	7
GK - 3 - 20a	11	33	73	1	3
GK - 3 - 20b	4	14	20	1	2

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.
Pulps Retained one month unless specific arrangements made in advance.

[redacted]
Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 Northgate Bldg.,
10049 Jasper Ave.,
Edmonton 15, Alberta.

File No. 4270
Date July 13th 1971
Samples Geo-Chem

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Mo ppm
GK - 3 - 8b	4	12	31	1	3
GK - 3 - 9a	4	25	33	2	3
GK - 3 - 9b	3	10	26	2	3
GK - 3 - 10a	10	29	108	2	2
GK - 3 - 10b	4	17	32	1	2
GK - 3 - 10c	5	18	59	2	4
GK - 3 - 11a	4	21	28	2	2
GK - 3 - 11b	4	17	28	2	3
GK - 3 - 11c	5	18	35	2	4
GK - 3 - 11d	4	10	29	1	4
GK - 3 - 12a	4	15	30	2	3
GK - 3 - 12b	4	17	33	1	4
GK - 3 - 12c	4	15	49	3	4
GK - 3 - 13a	4	14	29	1	2
GK - 3 - 13b	5	15	44	2	5
GK - 3 - 13c	4	7	13	1	2
GK - 3 - 14a	8	23	67	1	2
GK - 3 - 14b	4	12	27	1	2
GK - 3 - 14c	8	17	46	3	5
GK - 3 - 15a	7	21	57	2	3
GK - 3 - 15b	4	20	71	2	5
GK - 3 - 15c	5	20	57	3	5
GK - 3 - 16a	9	33	84	1	2
GK - 3 - 16b	4	17	41	1	5
GK - 3 - 17a	5	20	49	2	2
GK - 3 - 17b	4	15	39	2	4
GK - 3 - 18a	18	21	55	2	3
GK - 3 - 18b	17	18	69	3	3
GK - 3 - 19a	12	33	71	2	2
GK - 3 - 19b	14	12	144	nil	4

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.
Pulps Retained one month unless specific arrangements made in advance.

[redacted]
Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 Northgate Bldg.,
10049 Jasper Ave.,
EDMONTON 15, Alberta.

File No. 4368
Date August 2nd 1971
Samples Chips

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu %	Pb %	Zn %
5816	.02	.02	.02
5817	.01	.02	.01
5818	.01	.02	.01
5819	.11	—	—
5820	.22	—	—
5893	.22	—	—
5894	.11	—	—
5895	.02	—	—
5896	.05	—	—
5897	.04	—	—
5899	.01	—	—
5900	.01	—	—
6085	.01	—	—
6086	.02	—	—

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.
Pulps Retained one month unless specific arrangements made in advance.

[redacted]
Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCAITES LTD.
401 Northgate Bldg.,
10049 Jasper Ave.,
EDMONTON 15, Alberta.

File No. 4270
Date July 13th 1971
Samples Geo-Chem

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Mo ppm
GK - 3 - 1a	22	12	25	4	2
GK - 3 - 1b	12	7	31	3	2
GK - 3 - 1c	14	10	55	4	3
GK - 3 - 1d	10	7	126	3	2
GK - 3 - 2a	13	28	67	3	2
GK - 3 - 2b	5	9	28	2	1
GK - 3 - 2b	4	9	22	3	2
GK - 3 - 2c	8	15	46	2	3
GK - 3 - 2d	10	17	62	3	3
GK - 3 - 2e	8	9	66	2	1
GK - 3 - 3a	10	20	43	4	2
GK - 3 - 3b	8	12	44	3	2
GK - 3 - 3c	3	7	26	1	3
GK - 3 - 3d	9	17	36	3	5
GK - 3 - 3e	5	12	67	2	3
GK - 3 - 4a	18	38	90	3	2
GK - 3 - 4b	4	10	31	1	1
GK - 3 - 4c	10	20	144	3	5
GK - 3 - 4d	5	10	33	3	2
GK - 3 - 5a	10	25	86	1	2
GK - 3 - 5b	5	10	32	3	2
GK - 3 - 5c	5	10	36	3	3
GK - 3 - 6a	7	23	67	2	1
GK - 3 - 6b	4	14	34	3	3
GK - 3 - 6c	4	15	95	4	4
GK - 3 - 7a	4	20	79	2	2
GK - 3 - 7b	3	10	27	3	1
GK - 3 - 7c	4	15	29	2	3
GK - 3 - 7d	4	12	28	2	3
GK - 3 - 8a	5	21	32	2	3

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.
Pulps Retained one month unless specific arrangements made in advance.

[redacted]
Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 Northgate Bldg.,
10049 Jasper Ave.,
Edmonton 15, Alberta.

File No. 4305
Date July 22nd 1971
Samples Chips

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu %	Pb %	Zn %
5332	.33	---	---
5333	.40	---	---
5334	.17	---	---
5335	.22	---	---
5336	.09	---	---
5337	.16	---	---
5338	.09	---	---
5339	.12	---	---
5340	.23	---	---
5811	.09	---	---
5812	.13	---	---
5813	.03	.07	.01
5814	.04	.17	.13
5815	.03	.16	.24

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

[redacted]

Licensed Assayer of British Columbia

APPENDIX 2: CERTIFICATES OF ASSAY AND GEOCHEMICAL ANALYSES

To: L.B. Halferdahl & Associates Ltd.
401 [illegible]orthgate Bldg.
10049 Jasper Ave.
Edmonton 15, Alta.

File No. 4188
Date June 22, 1971
Samples chip

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	% Cu
Sample #	
3451-B	.01
3452-B	.01
3453-B	.01
3454-B	.01
3455-B	.08
3456-B	.11
3457-B	.10
3458-B	.14
3459-B	.11
3460-B	.12
3461-B	.03

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

[redacted]

Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 N[illegible]hgate Bldg.,
10049 Jasper Ave.,
EDMONTON 15, Alberta.

File No. 4208
Date June 28th 1971
Samples Chips

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu %
B-3462	.04
B-3463	.15
B-3464	.02
B-3465	.03
B-3466	.41
B-3467	.55
B-3648	.32
B-3649	.01
B-3650	.27
A-6084	.16
B-13323	.18
B-13324	.01

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.

Pulps Retained one month unless specific arrangements made in advance.

[redacted]
Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 N[illegible]thgate Bldg.,
10049 Jasper Ave.,
Edmonton 15, Alberta.

File No. 4270
Date July 13th 1971
Samples Chips

Certificate of ASSAY
LORING LABORATORIES LTD.

SAMPLE No.	Cu %
3468 B	.19
3469 B	.13
3470 B	.03
3471 B	.26
3472 B	2.30

Geo-Chems to follow:

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.
Pulps Retained one month unless specific arrangements made in advance.

[redacted]
Licensed Assayer of British Columbia

To: L. B. HALFERDAHL & ASSOCIATES LTD.
401 [illegible]rthgate Bldg.,
10049 Jasper Ave.,
EDMONTON 15, Alberta.

File No. 4290
Date July 19th 1970
Samples Chips

Certificate of ASSAY
LORING LABORATORIES LTD.

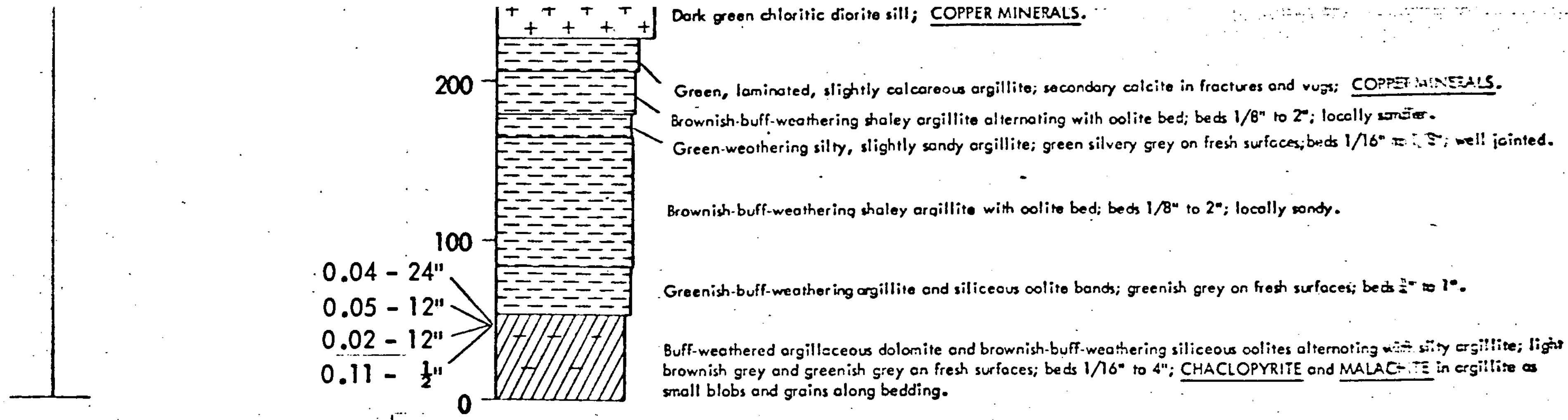
SAMPLE No.	Cu %
3473	.36
3474	.33
3475	.16
5331	.04

Geo-Chems to follow:

I Hereby Certify THAT THE ABOVE RESULTS ARE THOSE ASSAYS MADE BY ME UPON THE HEREIN DESCRIBED SAMPLES . . . .

Rejects Retained one month.
Pulps Retained one month unless specific arrangements made in advance.

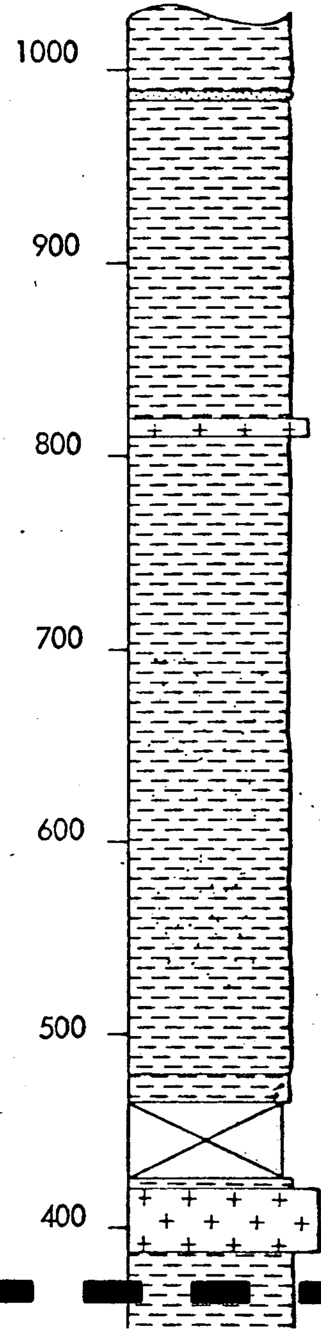
[redacted]
Licensed Assayer of British Columbia



PHILLIPS FORMATION

SECTION 28(a) - JUTLAND MOUNTAIN

ROOSVILLE FORMATION



Greenish grey argillite; beds ¼" to 2"; few oolitic beds.

Red grey and grey interbedded argillite.

Red grey laminated argillite; beds ½" to 3".
Diorite sill.

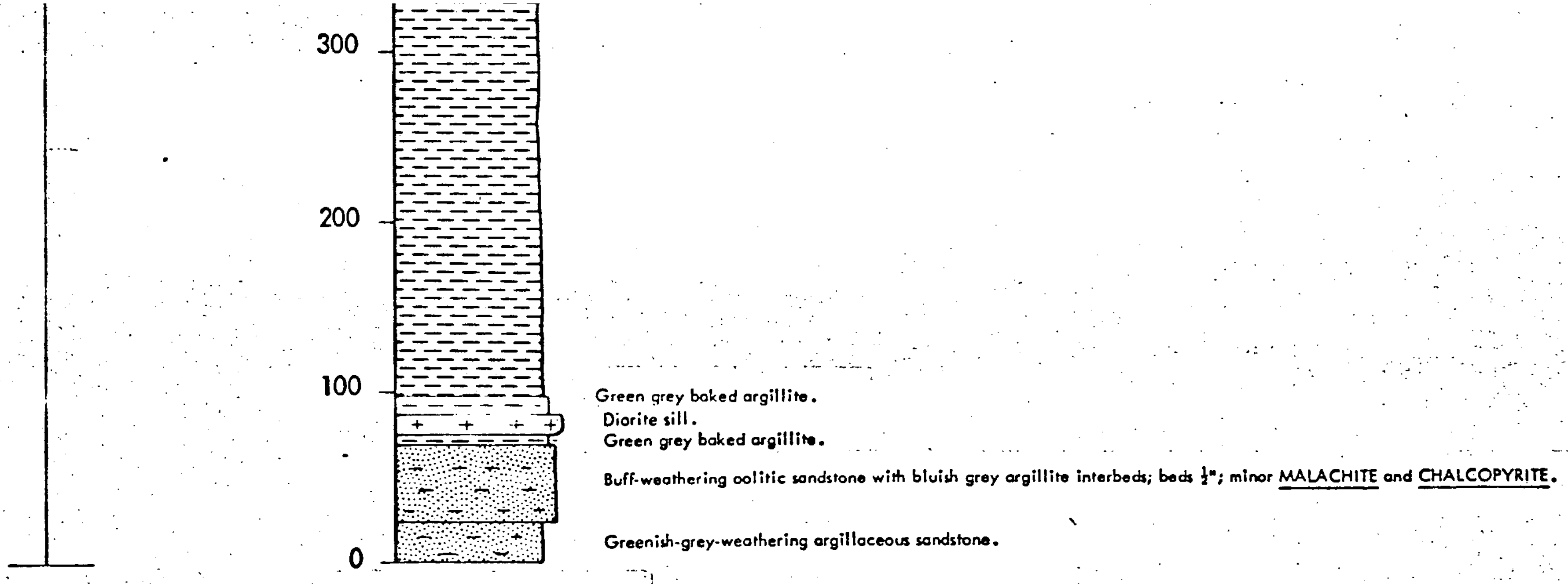
Red grey finely laminated argillite with interbeds of blue grey argillite; beds 1/16" to ¼"; ripple marks.

Greenish-grey-weathering finely laminated sandy argillite becoming less sandy towards bottom with decrease in bedding thickness; beds 1/16" to 3" at bottom.

Rusty-weathering argillite; grey on fresh surfaces; beds 1/16" to ½".

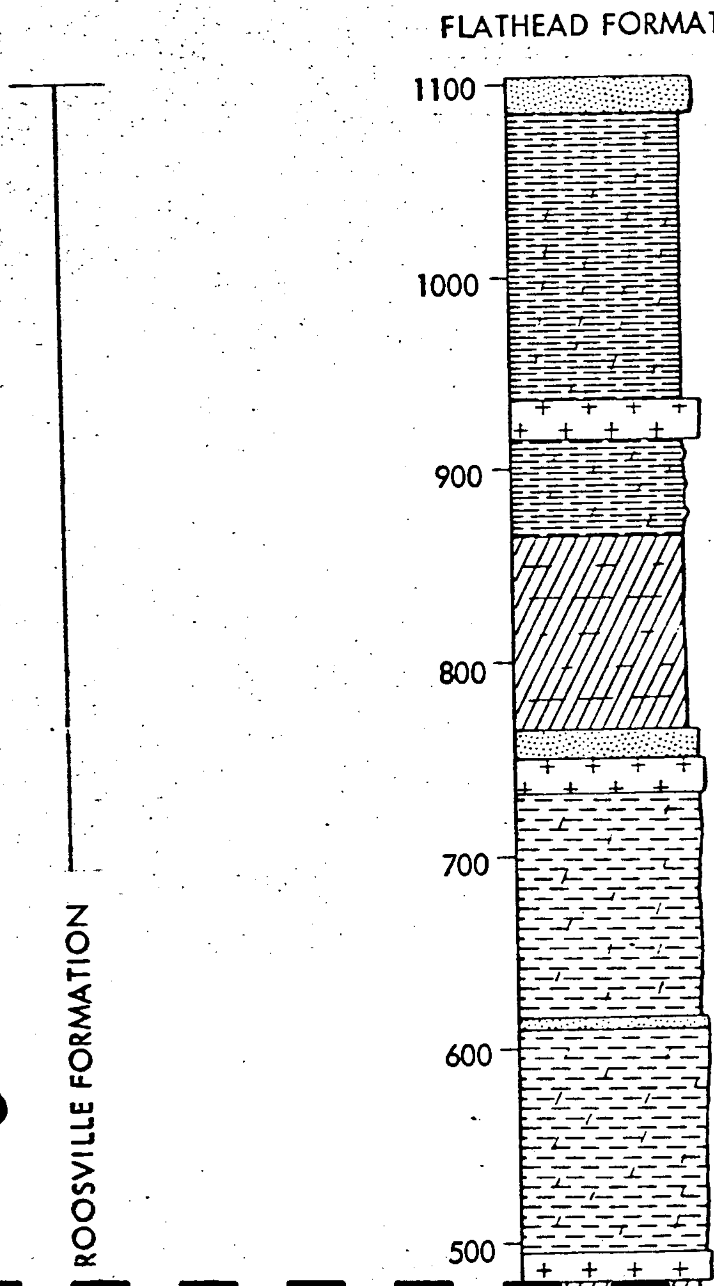
Covered.
Green grey argillite; beds ½".
Dark grey medium-grained diorite sill.

Gree[redacted] argil[redacted]eds ½"



PHILLIPS FORMATION

SECTION 28(b) - JUTLAND MOUNTAIN



Creamy-orange-weathering sandstone with purple argillaceous partings.

Green-weathering dolomitic argillite grading to silty dolomite with sandy interbeds up to 4' thick and comprising 50% of unit.

Dark grey to black, fine-grained diorite sill.

Green-weathering dolomitic argillite to silty dolomite with sandy interbeds up to 2'; some red argillite partings.

Green-weathering laminated dolomitic argillite grading to silty dolomitic argillite and silty dolomite; beds 1/8" to 6"; contains sandy grey red weathering interbeds which are dark grey on fresh surfaces.

Brown-to-pinkish-cream-weathering sandstone; greenish grey on fresh surfaces; beds ¼" to 1".

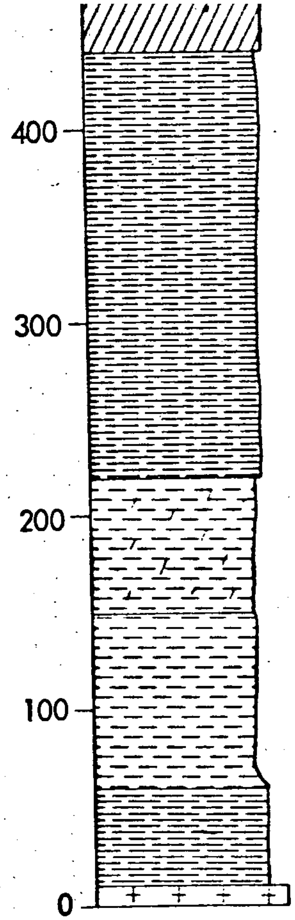
Diorite sill; coarse to medium-grained.

Green-weathering laminated dolomitic argillite grading to silty dolomitic argillite and silty dolomite; beds 1/8" to 6" with sandy interbeds becoming more abundant toward bottom and a few 2' stromatolitic dolomite beds.

Brownish grey weathering oolitic sandstone; beds 2" to 6" with argillaceous partings; MALACHITE, CHALCOPYRITE and BORNITE in vugs up to 1/8".

Green-weathering laminated dolomitic argillite grading to silty dolomitc argillite and silty dolomite; beds 1/8" to 6"; containing a few sandy interbeds and a 2' bed of stromatolitic dolomite.

Dark grey to black, medium-grained diorite sill.



Buff-weathering dolomite; green on fresh surfaces; beds $\frac{1}{2}$" to 6".

Dark-green-weathering slightly dolomitic argillaceous siltstone; dark green on fresh surfaces; beds $\frac{1}{4}$" to 6".

Green-weathering laminated dolomitic argillite grading to silty dolomitic argillite and silty dolomite; beds 1/8" to 6".

Green-weathering argillite; beds thin, with a few 4" to 8" interbeds of green siltstone and brown-weathering sandstone.

Green-to-greenish-grey-weathering siltstone to argillaceous siltstone; beds $\frac{1}{4}$" to 2"; a few red argillaceous partings and a 2' bed of brown-weathering sandstone; green on fresh surfaces.

Diorite sill; medium-grained.

QUARTZ MINERAL EXPLORATION PERMIT No.140

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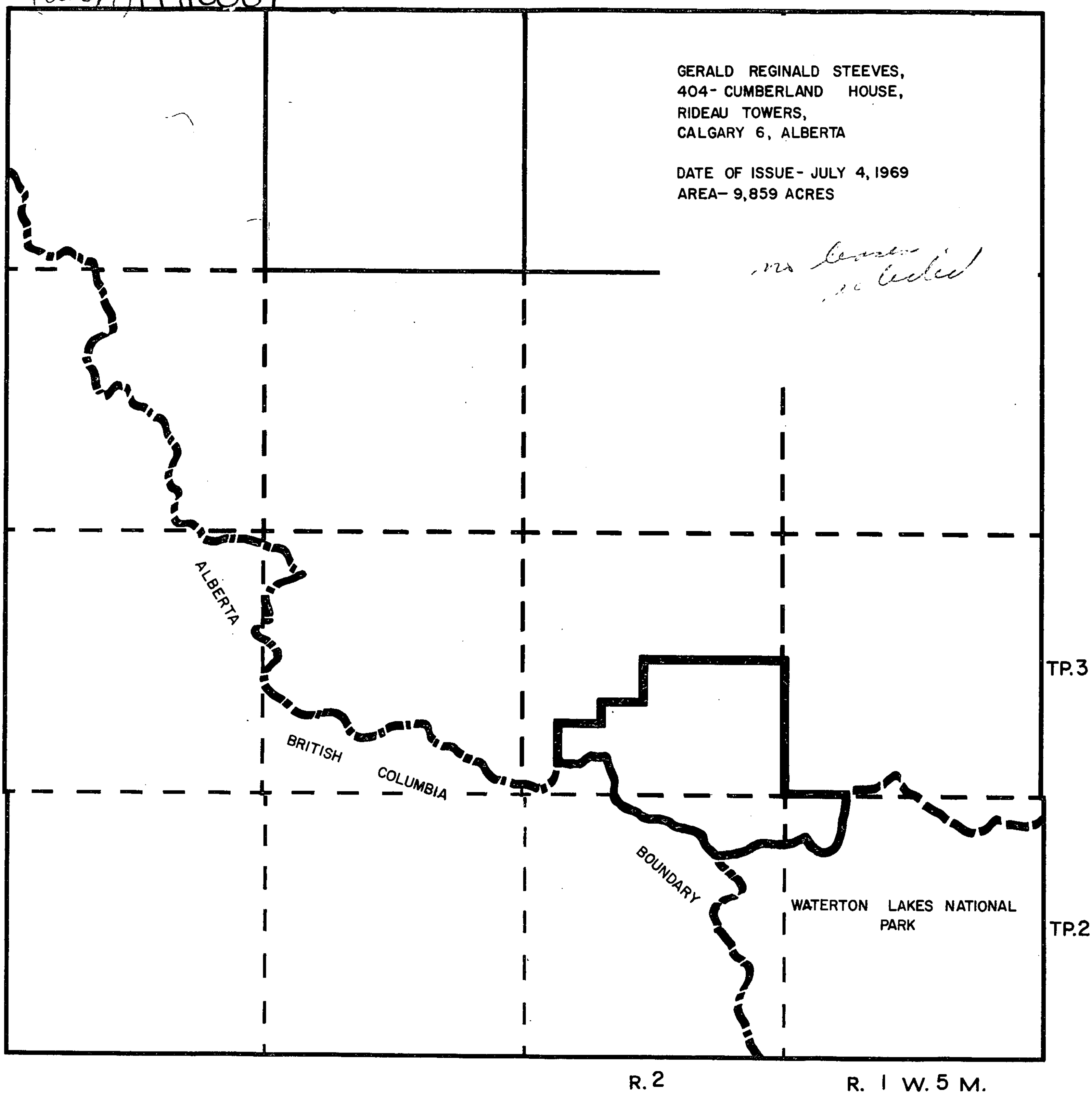

QUARTZ MINERAL EXPLORATION PERMIT No. 140