017641

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VANCOUVER 1, B.C., CANADA

12 March, 1964

Dr. A. Sutherland Brown
Dept. of Mines and Petroleum Resources
Victoria, British Columbia

Dear Dr. Brown:

Thank you for shoring up my Tasu notes.

Both Dr. Smith and Mr. Tough were interested in what is to them a new stress on the sill concept, their concern being with the different continuity of the ore bodies.

Dr. Smith commented on the Christmas tree shown intruding greenstone overlain by limestone and argillite; he does not believe that the argillite was intruded.

There is no completion date in sight yet for Ken's final report, but Mr. Tough assures you that you will be getting a copy one of these days.

Again, thank you for going to the considerable trouble of spelling out the porphyry situation, tabulation and all. We appreciate the gift of your time.

Yours truly,
Helen Paulson

March 5, 1964.

Miss Helen Paulson,
Falconbridge Nickel Mines Ltd.,
504 - 1112 West Pender Street,
Vancouver 1, B.C.

Dear Miss Paulson:

I have read your notes on returning to the office today. They admirably summarize my views except that I must have overstated the case in regard to the porphyries. I am sure that the bulk of the porphyries are pre-skarn, pre-ore, and are primarily sills in a flat Christmas-tree type laccolith as you have shown with dyke-like connection, feeders, etc. This group of porphyries varied widely in original character mainly by abundance of phenocrysts and matrix grain size. Later metamorphism and metasomatism has made it look even more varied including the types covered by your white and mottle porphyries and possibly some that you might classify as grey and diorite porphyry. However there is also no doubt that some of the rocks classified in the latter two categories are post-ore. They can clearly be seen in the field to cut ~~mountain~~ MAGNETITE orebodies and skarn. They are generally as undeformed as the later basalt-diabase-gabbro suite--only rarely show a slight skarning--almost certainly not of the original intense skarn period. The grey porphyry and diorite porphyry are volumetrically unimportant compared to mottle porphyries and even to the late basalt-diabase-gabbro suite. In tabular summary:

DYKE & SILLS

Type	Characteristics	Relations
A Mottle porphyry	Chiefly sills	Skarned, mineralized
B Diorite		Skarned, mineralized, may or may not be San Cristoval EARLY or late phase of same
C Diorite porphyry	Related to D? Dykes	Undeformed, possibly cut by major faults? possibly slightly skarned?

D	Grey porphyry	1. 40% phneocrysts 2. 10-20% phenocrysts	Dykes	Undeformed, not cut by major faults
E	Basalt suite	1. Gabbro 2. Diabase 3. Basalt	Dykes, various crystallinity according chiefly to width of dyke	" "

lc THE DOMINANT ORIENTATIONS MAY BE MEANINGFUL:

A Chiefly sills, dykes - possibly chiefly N 60° W / steeply E
B Too few to characterize, some N 40° E / steeply
C N 45° W ?
D N 45° W / 65° W
E N - N 15° W / steeply E or W

lc MULTIPLE DYKES OF VARIOUS PHASES OF BASALT SUITE OR OF OR E WITH C AND D OCCUR.

Regarding the possible metalization: It is clear that the mottle porphyry is host--as important or more important than the limestone. The "smoky" is also a host but possibly a minor one although this is not proven because drilling generally is stopped on entering it (see orebodies ca. E21000 N18500). Further the mottle porphyry as dykes does not seem to be as readily replaced as the sills. Clastic or vaguely clastic textures in the mottle porphyry sills are common and were originally interpreted by Ken Polk as ignimbritic block flows. My own feeling is that these acidic sills were brittler than either limestone or the fine-grained chloritic layered greenstones of the Karmutsen and that they shattered readily on the folding. They might then have been subject to percolating calcareous waters to create a more intimate relation prior to mineralization.

If you have any additional comments or questions on my views I would be happy to have them.

Yours truly,

A. Sutherland Brown,
Geologist.

ASB:rm

Dr. Brown:
If I have misquoted you, would you please red-pencil; if not, please throw away.
Helen Paulson

Orig + 4 copies

TO: WJT
AS
JJM

Notes on Victoria Trip

On February 13 J. J. McDougall and H. Paulson visited the Dept. of Mines and Petroleum Resources in Victoria.

The attached material, applicable to Tasu, was released by Dr. A. Sutherland Brown:

1. Unpublished Queen Charlotte geological map. This second edition, post-dating the edition of 1960, includes some reclassifications. It is not much use in this 1:500,000 reduction, but Dr. Brown tells us that we may come and copy the 1:250,000 original if we wish.
2. Stratigraphic section for the Queen Charlottes, which section incorporates the color legend for the above geological map.
3. Dr. Brown's generalized geological map of Tasu. This is more or less the same as our generalization, except that it carries a major fault zone marking the approximate northern limits of the main limestone body.

The Feldspar Porphyries

In the area covered by the Wesfrob geological map the post-Kunga, pre-gabbro intrusives are substantially all feldspar porphyries. Dr. Brown discussed the problem of fitting them into the rock chart and of dating them.

Lithologic Descriptions

Although Dr. Brown does not wholly agree with the lithological variations picked out by Wesfrob, he is not yet ready to publish alternatives. The writer, therefore, (from memory) reviews the Wesfrob porphyry classification as it stands. The types granted identity exist among a welter of ~~gradations~~ approximations, departures and unfamiliar, one-of-a-kind occurrences. They are listed below according to color, progressing from white porphyry to diorite porphyry; i.e., from light- to medium-colored appearance.

White porphyry - Not personally observed, but assumed by the writer to be the lightest-colored in the sequence and a very bleached phase of the mottled porphyry described below.

Mottled porphyry - Usually the host for skarn and magnetite. Vitreous; off-white porphyroblasts with blurred, resorbed margins, commonly 1/4" to 1/2" in diameter or centers averaging 1/8" or less; ground mass glassy-textured, bleached grey or bleached tan offering little contrast to the porphyroblasts; altogether, the rock appears fused.

Dr. Brown displayed an uncommon phase having scattered black amphibole lathes about 1/4" in length. Current drilling in the No. 5 zone has turned up mottled porphyry that is less fused-looking and contains enough dark crystalline aggregates to suggest true granite-textured diorite. The occurrence in one illustration of the hybrid types that complicate lithologic classification.

The writer is under the impression that zones 1 through 3 held little of this salt-and-pepper diorite — what Dr. Brown calls "honest-to-God diorite". In these zones Wesfrob's diorites are mainly types which approach the andesitic end of the scale.

Grey porphyry - Vitreous; ground mass medium grey or medium grey-green, aphanitic to fine-grained; lighter-colored phenocrysts, commonly less than 1/16", occurring in varying amounts from almost absent to such abundance that the rock appears equigranular.

Diorite porphyry - Resembles the grey porphyry above, but although tending towards a more greenish, andesitic appearance, the key difference is lustre. In the type specimens the diorite porphyry is stony rather than vitreous; i.e., dull rather than glossy. The difference in lustre, however, is often so nebulous that choosing between grey porphyry and diorite porphyry is a subjective matter.

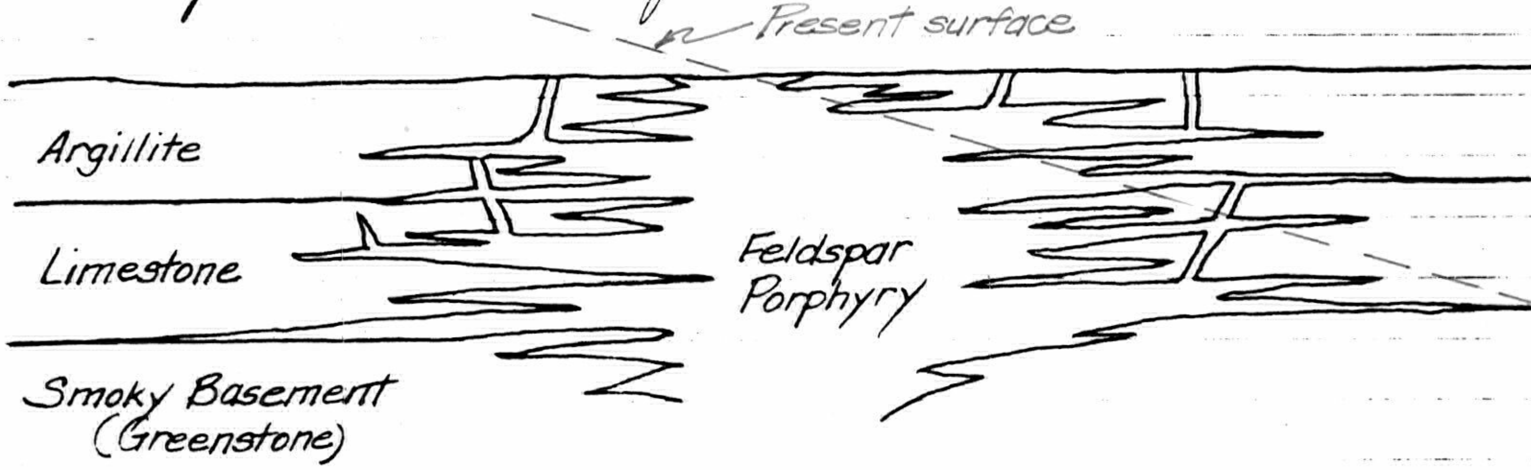
Dating

Wesfrob classes the mottled porphyry as pre- and the other porphyries as post-ore. Dr. Brown believes them all, with negligible exceptions, to be pre-ore. His dating has several bases. First, he draws analogy with Jedway and other coastal iron deposits where the lithology is identical to Tasu's but no mystery because their dyke and sill swarms are not so numerous as to be self-obscuring. Second, Tasu at least offered no contradiction because neither in the core nor in the field did he personally see porphyry and ore together where one unquestionably cut out the other. Further, late differentiation of iron is known to be a characteristic of the diorite magmas of the B.C. coast.

Thus Dr. Brown sees a single, continuing episode of igneous activity ending with first skarn alteration, then magnetite deposition. J.J. McDougall adds to the post-porphyry idea by noting the preference of skarn and ore for the porphyry rather than the limestone. He theorizes that the limestone furnished CO_2 as a precipitating agent, but, turning plastic and impregnable, could not itself become host. The brittle porphyry, on the other hand, shattered to furnish avenues along which the residual, mineralizing solutions could penetrate.

Form of Emplacement

The sheer numbers of intrusives make for ambiguity. One interpreter of the drill logs may show a dyke grading in composition through several rock types and slicing across ore lenses; his successor sees tiers of sills paralleling the ore lenses. Dr. Brown inclines toward the latter concept; he believes that while dykes are undoubtedly numerous at Pasu, Wesfrob should place more than its present emphasis on sills. He pictures the emplacements as follows:



Miscellaneous

Dr. Brown displayed a hand specimen demonstrating the effects of metasomatism on limestone. It was fine- to medium-grained, saccharoidal, vaguely bedded or banded in dirty grey and dirty greenish grey, the lustre not pearly but so stony as to appear almost earthy. The description is forced, for the specimen was in reality so non-descript that only the presence of monotis gave it away; where fossils are missing in such a specimen, one would hardly think to check with hydrochloric acid. Some limestone in the Wesfrob core is equally strange — for example, a type so impregnated that it looks andesitic. The point again is the atypical, not to say sham, nature of many Tasu rocks.

Dr. Brown tells us that he expects no further allocation, and so is finished with the Queen Charlotte Islands.

H. Paulson

TABLE OF FORMATIONS FOR QUEEN CHARLOTTE IS.

AGE		STRATIGRAPHIC UNITS		THICKNESS IN FEET	LITHOLOGY	FOSSILS	INTRUSIVE ROCKS
…ERNARY	RECENT				ALLUVIUM, ORGANIC [illegible]RRANE		
…ERNARY	PLEISTOCENE	CAPE BALL FM.		500±	MARINE STONY CLAY[illegible] TILL, OUTWASH SANDS & G[illegible]EL		
CONFORMABLE TO UNCONFORMABLE							
TERTIARY	PLIOCENE MIOCENE?	SKONUN FORMATION		4500+	MARINE TO NON-MARINE, CALCAREOUS SANDSTONES TO POORLY LITH[illegible] SANDS, SHALY MUDSTONES; MIN[illegible] CONGLOMERATE, LIGNITE	EXTENSIVE FLORA & FAUNA	
UNCONFORMABLE, POSSIBLY INTERFINGERING WITH TOP OF TARTU FACIES							
TERTIARY		MASSET VOLCANIC FORMATION	DANA INLET FACIES	5,000+	SUBMARINE ? PYROCLASTIC BRECCIAS OF MIXED BASIC & ACID CLASTS, RELATED VOLCANIC SANDSTONES, LESSER PORPHYRY & RHYOLITE FLOWS		↑
TERTIARY		MASSET VOLCANIC FORMATION	KOOTENAY INLET FACIES	4,000+	SUB AERIAL RHYOLITIC ASH FLOW TUFFS AND BRECCIAS, DACITIC FLOWS, MINOR COLUMNAR BASALT FLOWS	WOOD	
TERTIARY		MASSET VOLCANIC FORMATION	TARTU INLET FACIES 18000 — BASALT MEMBER	TMC 5000	COLUMNAR BASALT FLOWS, MINOR BASALTIC & ACIDIC PYROCLASTIC ROCKS		POST-TECTONIC BATHOLITHS EMPLACED
TERTIARY		MASSET VOLCANIC FORMATION	TARTU INLET FACIES — RHYOLITE MEMBER	TMB 5,5-7,000	RHYOLITE FLOWS?, ASH FLOWS, MINOR COLUMNAR BASALT FLOWS	? TASU "gabbro" dykes →	↓
TERTIARY	PALEOCENE	MASSET VOLCANIC FORMATION	TARTU INLET FACIES — MIXED MEMBER	TMA - 6000-6500	BASALT BRECCIAS & COLUMNAR FLOWS, RHYOLITE AIR FALL & ASH FLOW TUFFS & FLOWS?	AGE (K-A) ON MICA IN A RELATED SILL WOOD	RELATED SILLS PORPHYRITIC ANDESITE PLUGS
UNCONFORMABLE CONTACT WITH ALL OLDER UNITS							
…PPER …ACEOUS		…ROUP	SKIDEGATE FORMATION	2,000+	WELL BEDDED, INTERCALATED, GREY SHALY SILTSTONE, GREYWACKE, & BUFF WEATHERING CALCAREOUS, SILTSTONE	INOCERAMUS SP.?	
CONFORMABLE CONTACT							
…PPER …ACEOUS		…ROUP	HONNA	1,300	POLYMICTIC ROUNDSTONE CONGLOMERATE [illegible]	I[illegible]	

JURASSIC	CALLOVIAN	VANCOUVER GROUP	YAKOUN * FORMATION 3,000 - 6,000 * HIGHLY VARIABLE TYPE SECTION USED	495	...CALCAREOUS SILTSTONE; RARE PEBBLY VOLCANIC SANDSTONE	. CHONDROCERAS ?	EMPLACE...
				D MBR. 800	TUFF, LAPILLI TUFF, CRYSTAL TUFF, CROSS-BEDDED TUFFACEOUS SANDSTONE, PEBBLY SANDSTONE		
				C MBR. 950	PORPHYRITIC ANDESITE AGGLOMERATE, & CRYSTAL TUFF		[TASU feldspar porphyries & magnetite]
	BAJOCIAN			B MBR. 100+	SHALE, TUFFACEOUS SHALE & SANDSTONE	. STEPHANOCERAS CHONDROCERAS	RELATED DYKES, SILLS
				A MBR. 650	CALCITE CEMENTED SCORACEOUS LAPILLI TUFF		
			CONFORMABLE TO SLIGHTLY UNCONFORMABLE, & INTRUSIVE				
LOWER JURASSIC	TOARCIAN		MAUDE FORMATION	UP TO 600	INTERBEDDED GREY SHALE, BLOCKY DARK GREY ARGILLITE, LIGHT GREY CALCAREOUS SHALE, GREENISH GREY SANDSTONE.	. HARPOCERAS . FANNINOCERAS . LEPTALEOCERAS ?	
	PLIENSBACHIAN						
			CONFORMABLE CONTACT				
	SINEMURIAN [TASU limestones & argillites]		KUNGA FORMATION UP TO 3,400	ARGILLITE MBR. UP TO 1,900	THINNLY BEDDED BLACK ARGILLITE, DARK GREEN TUFFACEOUS ARGILLITE; LIGHT GREY CLASTIC LIMESTONE; DARK GREY FELDSPATHIC GREYWACKE.	ARNIOCERATIDS . ARNIOTITES KWAKIUTLANUS	
UPPER TRIASSIC	NORIAN			BLACK LIMESTONE MBR. 700 - 900	THINNLY BEDDED BLACK CARBONACEOUS LIMESTONE, SHALY LIMESTONE, CALCAREOUS ARGILLITE, SOME GREY CROSS BEDDED CLASTIC LIMESTONE	. MONOTIS SUBCIRCULARIS . DISCOPHYLLITES HALOBIA	
	KARNIAN			MASSIVE LIMESTONE MBR. 200 - 600	GREY WEATHERING MASSIVE LIMESTONE SOME CHERTY LIMESTONE, CLASTIC LIMESTONE, SOME WELL BEDDED.	. AULACOCERAS, ARCESTES	GREENSTONE SILLS ?
			CONFORMABLE CONTACT				
	[TASU Smoky basement (greenstone)]		KARMUTSEN VOLCANIC FORMATION	8,000 + TO POSSIBLY 13,000 +	SPILITIC BASALT PILLOW LAVAS, PILLOW BRECCIAS, AQUAGENE TUFFS; MASSIVE SPILITIC BASALT FLOWS & SILLS; MINOR INTERLAVA LIMESTONE, LESS SHALE & VOLCANIC SANDSTONE; METAMORPHIC EQUIVALENTS, MOSTLY FINE AMPHIBOLITES	CRINOID COLUMNS	RELATED DYKES & SILLS

ASB.