014807

DRAFT: AUGUST, 1986

NOTES ON AURIFEROUS PYRITIC "REPLACEMENT ORE" IN THE WELLS-BARKERVILLE GOLD CAMP, NTS(93H/4)

by R.D. HALL

INTRODUCTION

Discovery of rich placer gold on Williams Creek in 1860 sparked the famous Cariboo Gold Rush and marked an important turning point in the early history of the Province of British Columbia. The Cariboo Gold Belt, located within the Barkerville Tectonic Terrane of the Omineca Belt, has produce in excess of 2.6 million ounces of placer gold and about 1.23 million ounces of lode gold since 1874 and 1933, respectively. Although lode prospects occur over a strike length of 45 kilometres, auriferous quartz veins and auriferous pyrite "replacement" lodes mined at Wells are thought to be the source for much of the placer gold. The current level of gold dxploration and mining activity within the belt is modest.

Considerable "replacement" ore, averaging about 0.66 oz gold/st and accounting for 32% of previous lode production, occurs within carbonate strata near Wells. Production for the 6 year period prior to closure of the Aurum Mine in 1967 was highly dependent on development of "replacement" ore.

The purpose of these notes is to summarise the geological setting and nature of this very interesting and economically important type of mineralisation.

MOSQUITO CREEK

LODE PRODUCTION

Lode gold mineralisation in the Wells-Barkerville camp is essentially continuous over a 12km strike length between Island Mountain and Antler Mountain. Hardrock mines at Wells, about 80km west of Quesnel, produced 138,755 ounces of silver and 1.23 million ounces of gold (at an average recovered grade of 0.41 oz gold/st.

Principal lode production was from the Cariboo Gold Quartz Mine (CGQM) and Island Mountain Mine (IMM), also known as the Aurum Mine during the period 1954 to 1967. The Mosquito Creek Gold Mine (MCGM), which overlaps the northwest workings of the IMM, has produced 33,649 ounces of gold from 81,505st of mainly "replacement" ore. Auriferous pyrite in quartz veins averaging 0.38 oz gold/st and auriferous pyrite "replacement" bodies averaging 0.66 oz gold/st were the types of lodes mined.

With the exception of a significant gap between workings of the IMM and MCGM, a volume with strike length of 4km , maximum vertical range of 650m and horizontal width of about 200m has been explored underground.

REGIONAL GEOLOGY

The Barkerville Tectonic Tarrane, bounded by the Eureka Thrust to the west and Pundata-Pleasant Valley thrusts to the east, consists of an upper Proterozoic to Permian clastic (and lesser volcanic) miogeoclinal sequence formed adjacent to ancient continental North America. The Barkerville Terrane was regionally metamorphosed and deformed during part of the late Permian through Jurassic. The Willow Fault system and similar strike-slip fault systems bounding the western flank of the northern Rocky Mountain Trench were subsequently activated.

Lode gold deposits at Wells are located east of the Willow Fault and occur within strata assigned to the "Downey Creek" succession of the Snowshoe Group. The deposits are associated with the refolded, overturned limb and axial zone of a southwesterly verging antiform. The "Downey Creek" succession may be structurally repeated on a regional scale within similar south-westerly verging and northwesterly plunging folds on the northeast flank of the Lightning Creek Anti-clinorium.

A prominent lineation plunging about 22° to the northwest corresponds to axes of regional folds, but may be an overprint related to right lateral displacement along the Willow Fault.

MINE GEOLOGY

The "Mine sequence" at Wells consists of rhythmically bedded dolomitic and siliceous clastic metasediments representing part of a submarine turbidite fan complex. Units of sandy and carbonaceous limestone within the turbidite sequence host conformable "replacement" lenses. Medium to dark grey units of graphitic gritty quartzite host crosscutting auriferous quartz lodes.

The mine sequence strikes northwest, dips moderately to steeply northeast and is cut by a flatter but folded northeast dipping cleavage. Strata are refolded and offset by northerly striking high angle faults and a myriad of southwesterly striking low angle faults. Orientation of these faults and quartz stopes in the MCGM appear to be consistent with models of fracturing associated with right lateral strike-slip movement on a major lineament. Map units are rarely continuous, without offset, for several tens of metres along strike and cannot be projected with confidence down dip between levels.

The Mosquito Creek Gold Mine is located in the upper hinge zone of the antiformal structure hosting mineralisation at the CGQM and IMM. The hinge of this fold in the MCGM is cut by a north dipping zone of flat faults, subparallel in strike to the "Main band" limestone unit. A condensed stratigraphic section, correlatable to that in the IMM, is exposed as a window beneath the fault zone. If this interpretation is correct, the mine sequence mapped in the IMM is a folded stratigraphic section.

The "Main band" limestone unit and contained "replacement" ore bodies are displaced at the west end of the MCGM by the "West Fault". This is a major north striking and moderately east dipping structure with an apparent right lateral component of displacement. Results of 125m of drifting on a limestone unit in the footwall of the "West Fault" were negative. Whether or not this unit is the southwest limb of the "Main band" limestone fold structure is open to interpretation.

REPLACEMENT MINERALISATION

"Replacement" ore bodies have a tabular to hand print-like shape in cross section and pencil-like geometry in long section. This geometry may be the result of rodding accompanying deformation of originally more sheet-like mineralisation. The long axes of "replacement" bodies are parallel to the regional lineation and can extend 200m or more down plunge. Individual stopes averaged 2000-7000st of ore (a stope with drift dimensions contains about 5st of ore per foot of plunge length).

"Replacement" ore has been folded, recrystallised and faulted. Wider stopes occur where "replacement" ore and limestone have been thickened by secondary folding. Plunge length of individual stopes was controlled by success in locating extensions of ore beyond flat faults, dipping about 30° in direction of plunge, with apparent left lateral normal displacement.

"Replacement" ore consists of very thinly banded, fine to medium grained, massive euhedral pyrite in a matrix of calcite, vuggy coarse grained dolomite and minor grey silica. Edges of lenses are marked by coarse euhedral pyrite, arsenopyrite, very thin pyritic bands and disseminated pyrite. Fuchite is developed adjacent to "replacement" mineralisation of the "Aurum band" limestone unit in the MCGM.

Gold content of "replacement" ore is positively correlated with pyrite content but is inversly proportional to the grain size of pyrite. Free gold occurs as micron grains on the surface and grain boundaries of pyrite. Assays ranging up to 5 oz gold/st have been obtained in grab samples of very fine crystalline pyrite. High grade "replacement" ore in the "Aurum band" of the MCGM contains about 0.015 to 0.030 oz gold/st for each percent by weight of pyrite. This correlation is more uniform and on average of greater magnitude than for "replacement" ore in the "Main band". Rate of recovery of gold at MCGM is approximately 87%.

Silver content of "replacement"' ore varies with the limestone host. Silver content of "replacement" ore in the "339" limestone unit of the IMM and in the "Main band" of the MCGM was 14 and 37%, respectively, of gold content reported in bullion. Limited multi-element assays in the MCGM confirm that the Ag:Au ratio of "replacement" ore in the "Main band" is enhanced by a factor of 2 to 3 relative to that in the "Aurum band" (the stratigraphic equivalent of the "339" limestone).

Some "replacement" lenses, as represented in vertical longitudinal projection, appear to have a high grade core but this apparent zoning may be an artifact of mining.

GUIDES TO ORE

The most reliable guides to "replacement" ore are:

1. A limestone host
2. Thickening and flattening of the limestone in eye-shaped secondary fold structures associated with flat faults.
3. Bleaching of the limestone or burning of the carbonaceous component
4. Location of very thinly banded, coarse grained pyrite ± arsenopyrite "stringer" mineralisation
5. An elevated, flat topped spontaneous potential signature

Exploration and development of "replacement" ore may best be accomplished by:

1. Drifting in the structural footwall of limestone units
2. Long hole drill testing in the dip of the limestone
3. Raising up the dip of limestone units to evaluate intercepts
4. Stoping up the plunge of the larger ore lenses
5. Long hole drill testing the floor of stopes to discover adjacent "replacement" lenses.

SUMMARY

Hardrock mines at Wells, B.C. produced 138,755 ounces of silver and 1.23 million ounces of gold at an average recovered grade of 0.41 oz gold/st. Approximately 32% of this was derived from conformable, auriferous pyrite "replacement" bodies, averaging 0.66 oz gold/st, within units of limestone.

The gold mineralisation is intimately associated with

1. The refolded, southwest overturned limb and axial region of a southwesterly verging and shallowly northwesterly plunging antiform.
2. A system of low and high angle faults probably developed as a result of right lateral strike-slip movement along the Willow Fault.

Transition over a strike length of 5km from core to periphery of an epigenetic hydrothermal system is indicated by changes in grade, habit and host rocks of gold mineralisation at Wells. Auriferous quartz lodes in the "Rainbow Formation" give way to pyrite "replacement" ore in limestone units of the "Baker Formation" and in turn to auriferous zones of disseminated pyrite and pyrite-calcite-quartz stringers within talc-dolomite altered units of chloritic siliceous sandstone and/or tuff. The extent and economic significance of this latter variety of mineralisation is unknown.

Limited K/Ar radiometric dating of sericite from auriferous quartz veins in the CGQM, MCGM and Cariboo-Hudson Mine cluster about 140 million years (Late Jurrasic-Early Cretaceous). This is younger than the period of regional metamorphisim and deformation deduced from geological observations and dating of conodonts. Folding and faulting of gold mineralisation observed at Wells was probably related to a history of movement on the Willow Fault system.

A 200 t.p.d. mining operation with direct operating costs of about $170/st and recovered grade in excess of 0.4 oz gold/st would be profitable in the Wells area. Such an operation would be dependent on discovery of replacement ore at a rate of about 10 st per lineal foot of drifting and 1.3 st per foot of development drilling. Rate of discovery of replacement ore in the MCGM has been less than this.

The future of the Mosquito Creek Gold Mine is dependent on discovery of large replacement ore bodies in the

1. "Main band" at the west end of the mine both above the 1st level and at depth in the footwall of the "West Fault".
2. "Aurum band", below the 4th level in the gap between workings of the MCGM and IMM.

SELECTED REFERENCES

Aldrick, D.J. The Mosquito Creek Mine, Cariboo Gold Belt (93H/4)

Benedict, P.C. 1936. Geology of the Island Mountain Mine and other nearby locations in the Barkerville District, B.C.; Private report to Cariboo Gold Quartz Mines Ltd., 24 pp.

__________, 1945. Structure at Island Mountain Mines, Wells, B.C.; C.I.M.M. Trans., Vol. 48, pp. 755-770.

Campbell, D.D. 1966. Potential of Ore Reserves and Production, Cariboo Gold Quartz Mine, Wells, B.C.; Private report to Cariboo Gold Quartz Mine., 28 pp.

Hanson, G. 1935. Barkerville Gold Belt, Cariboo District, B.C.; Geol. Surv. Can., Mem. 181, 42 pp.

Johnson, W.A. and Uglow, W.L. 1926. Placer and Vein Gold Deposits of Barkerville, Cariboo District, B.C.; Geol. Surv. Can., Mem. 149, 246 pp.

Keys, M.R. 1954. The Geology of Island Mountain Mine; Private report to Cariboo Gold Quartz Mines Ltd., 23 pp.

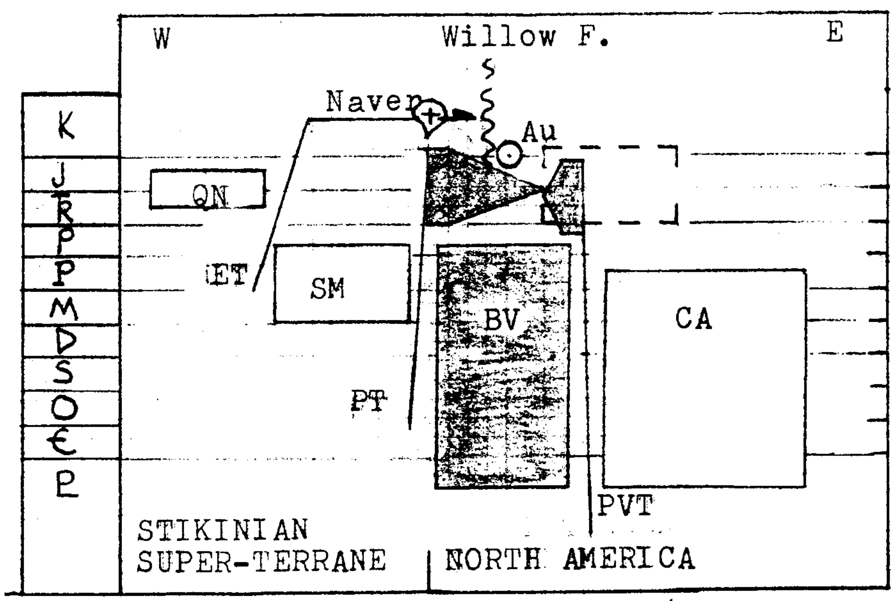
Skerl, A.C. 1948. The Geology of the Cariboo Gold Quartz Mine, Wells, B.C.; Private report to Cariboo Gold Quartz Mines Ltd., 34 pp.; also Econ. Geol., Vol. 43, pp. 571-597.

Struik, L.C. 1982. Snowshoe Formation (1982), Central British Columbia; in Current Research, Part B, Geol. Surv. Can., Paper 82-1B, pp. 117-124.

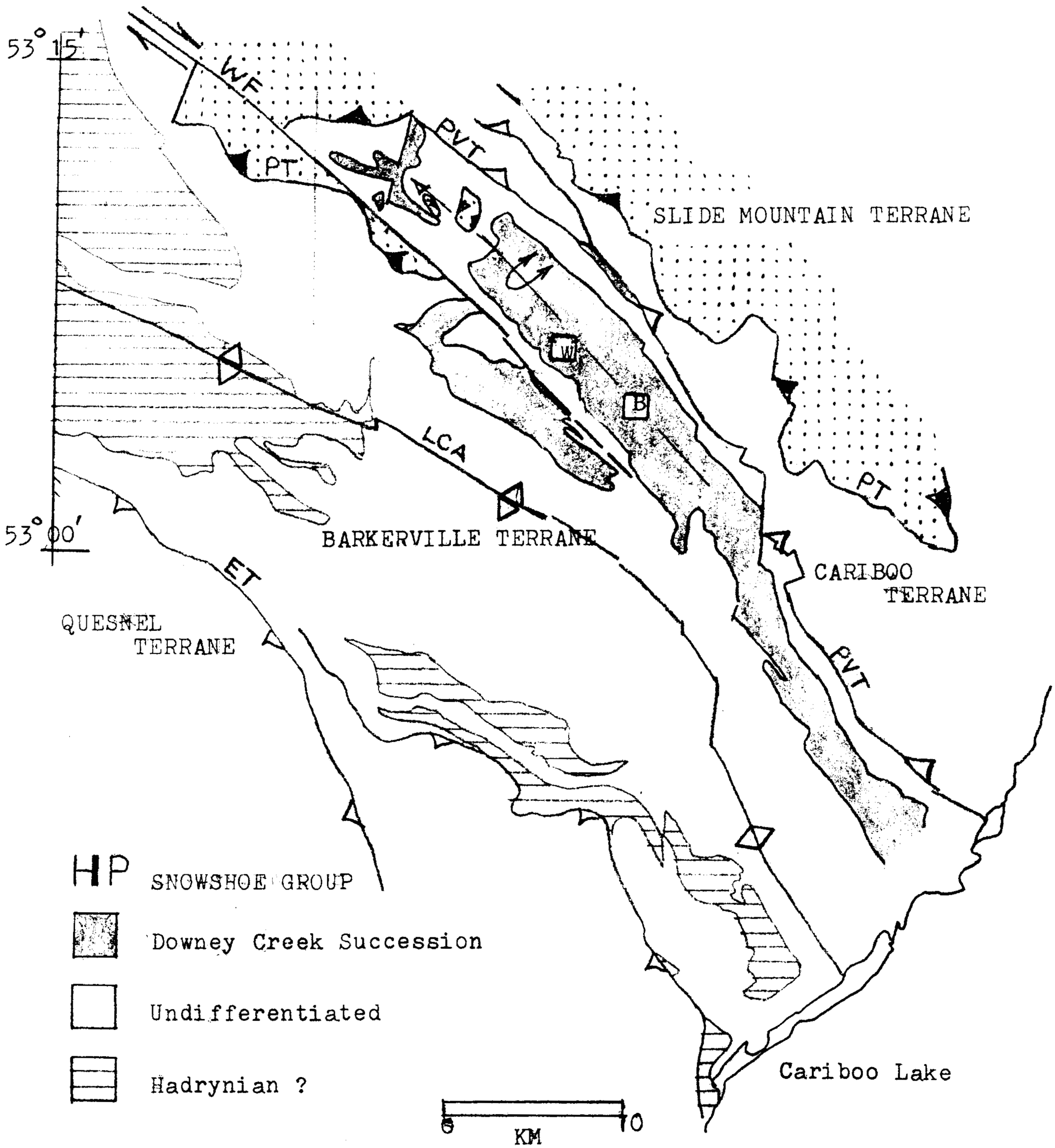
Sutherland Brown, A. 1957. Geology of the Antler Creek Area, Cariboo District, British Columbia, B.C. Ministry of Energy, Mines and Pet. Res., Bull 38, 105 pp.

Wright, R.T. 1984. "Discover Barkerville, A Gold Rush Adventure, A Guide to the Town and its Time". Vancouver, B.C., Maclean Hunter, 1984.

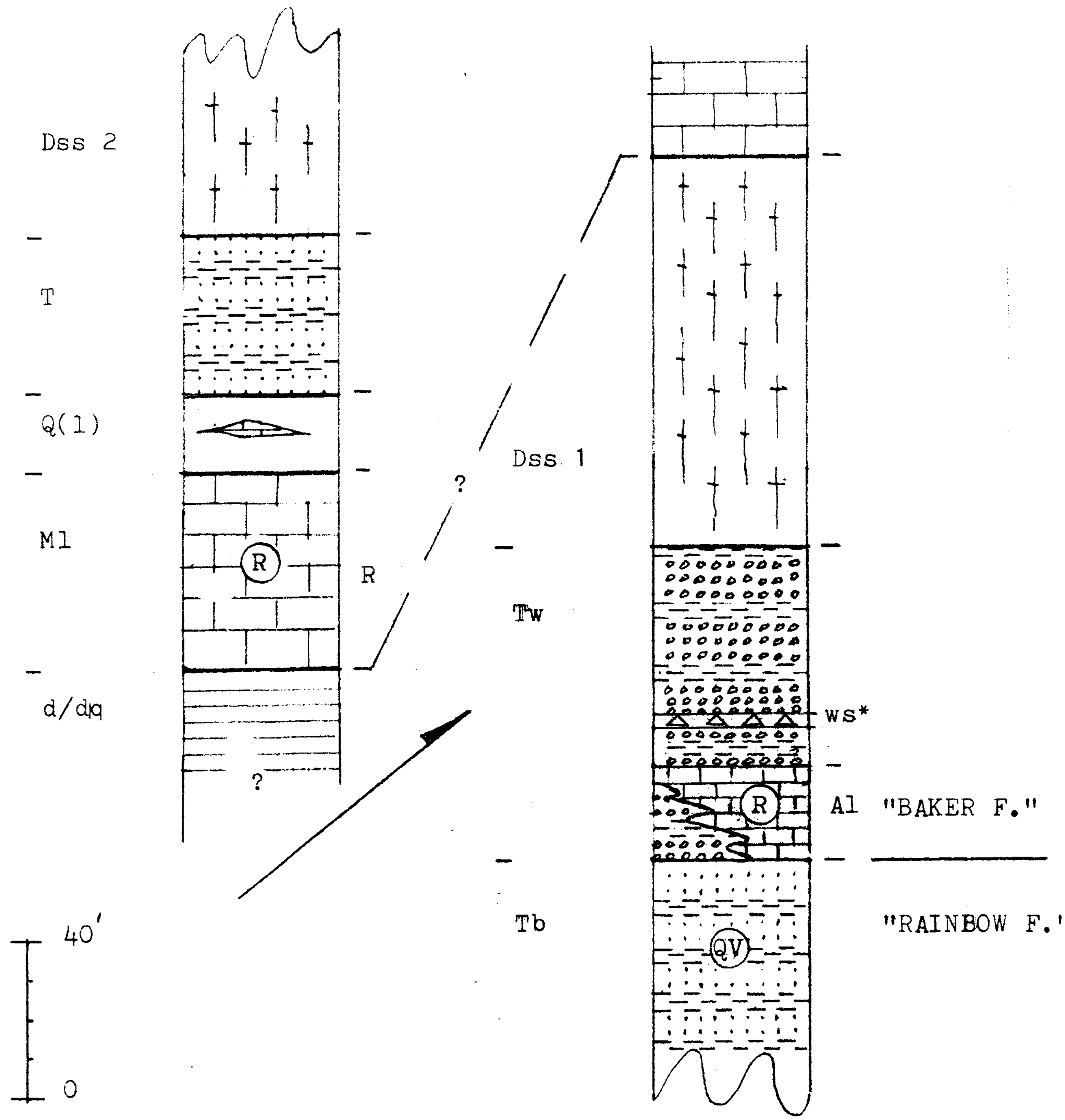
OMINECA BELT



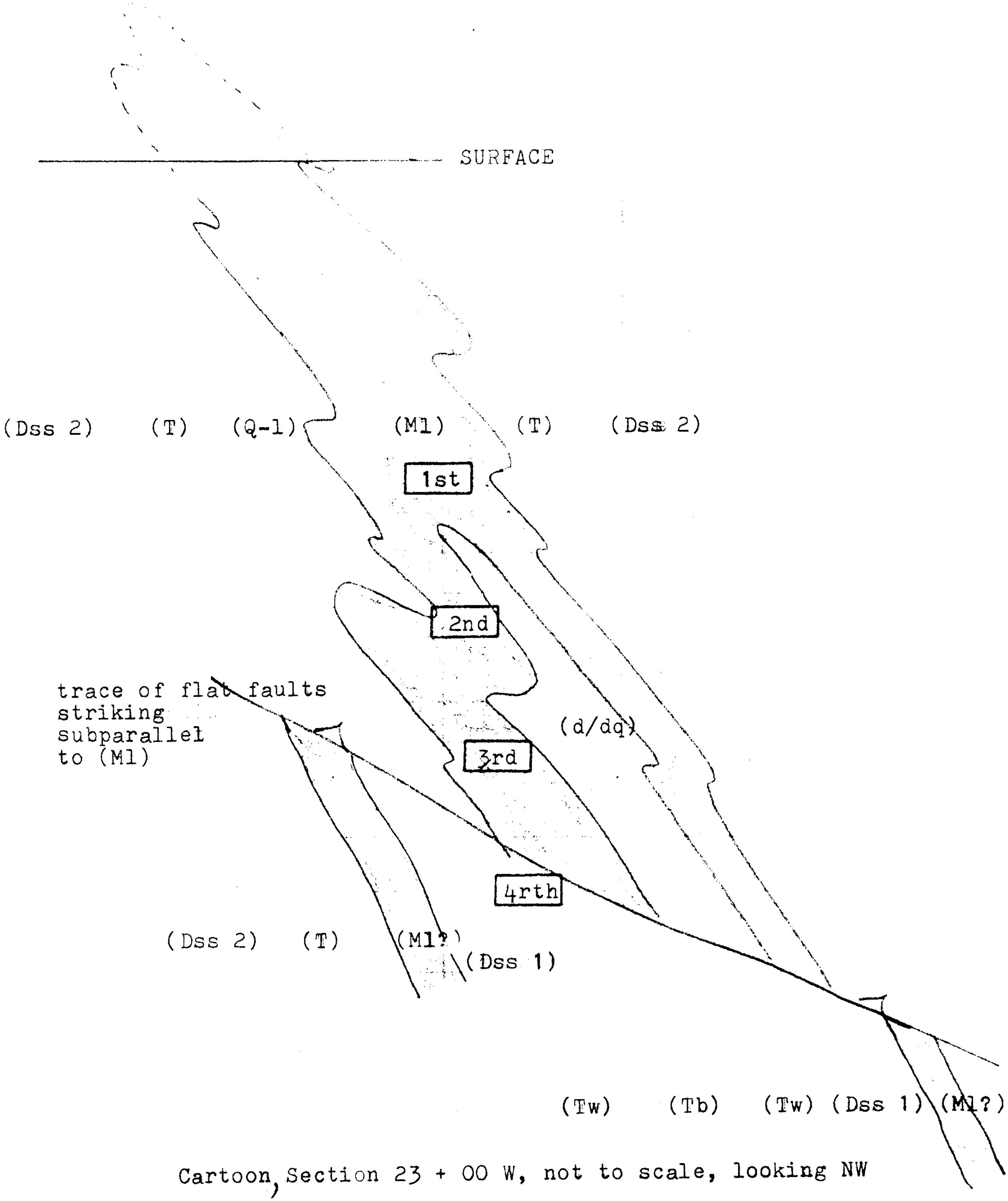
Time-Space Diagram (modified after Struik, 1985)



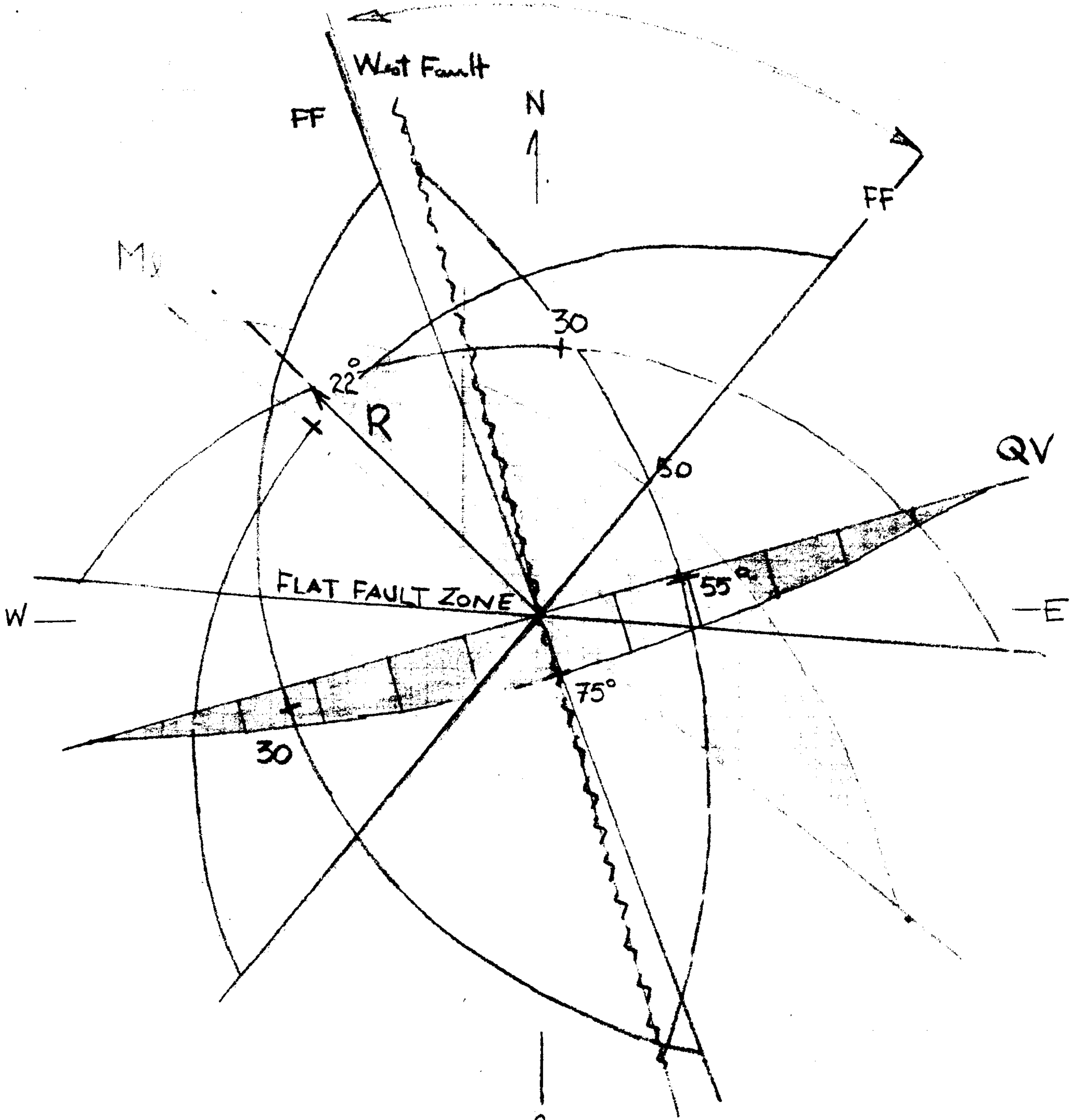
Simplified Regional Geology (modified after Struik, 1982)

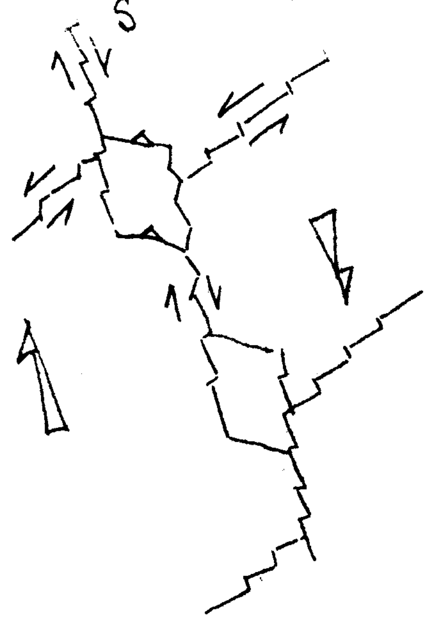


Schematic Interpretation of Stratigraphy in the MCGM

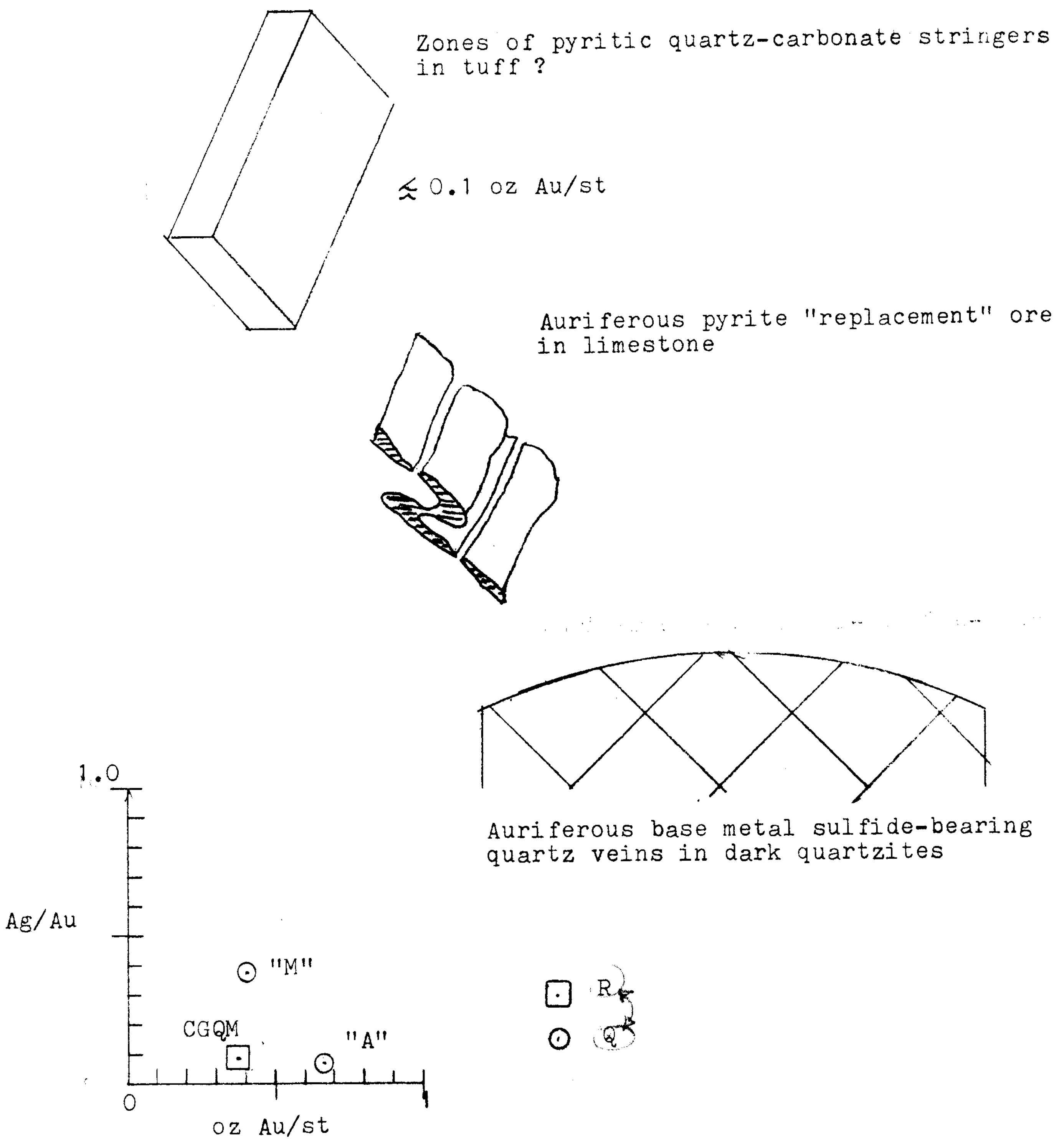


Cartoon, Section 23 + 00 W, not to scale, looking NW

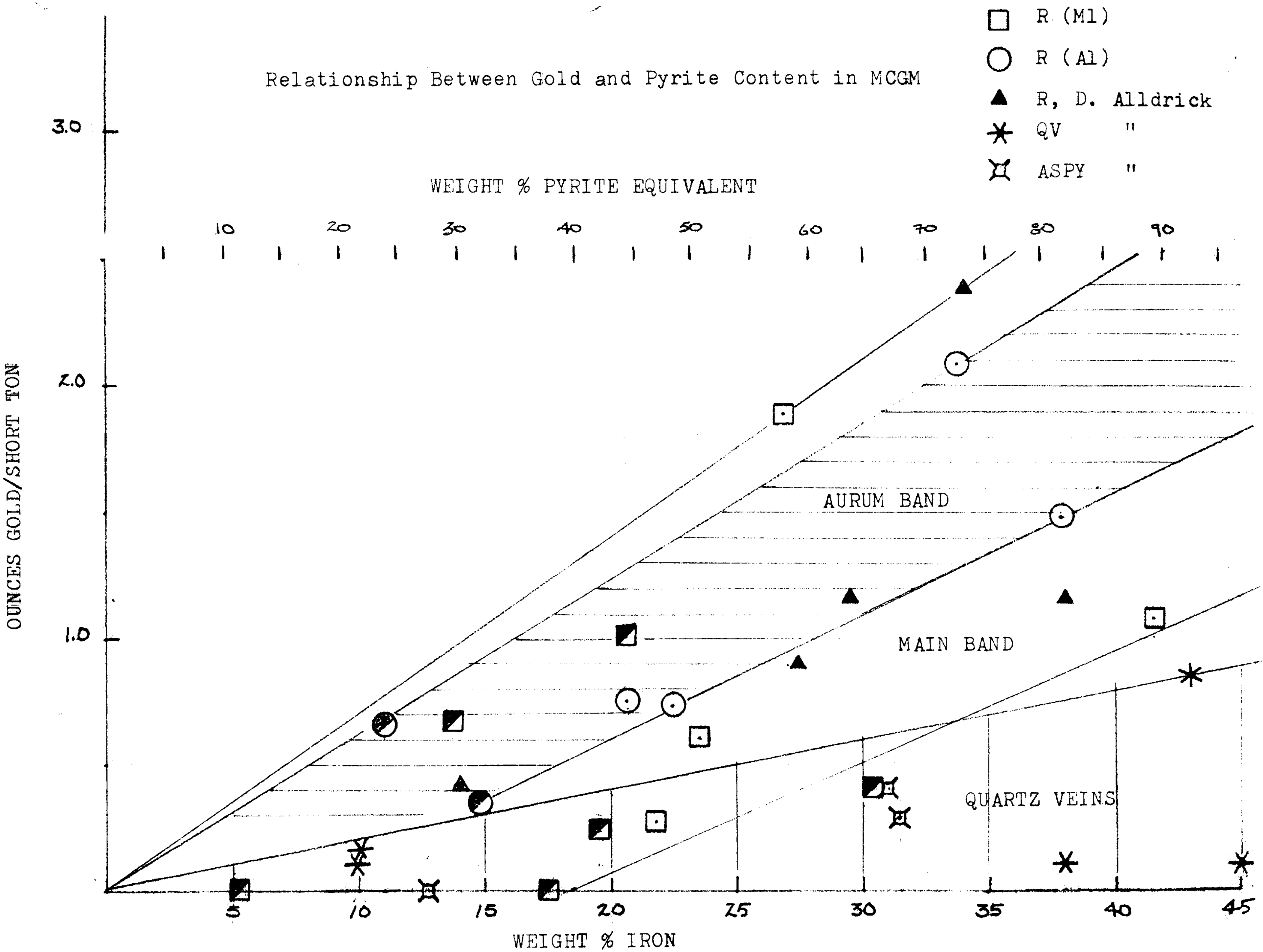




Schematic - Principal
Structures MCGM



Schematic epigenetic hydrothermal gold system at Wells


Relationship Between Gold and Pyrite Content in MCGM
R (M1)
R (A1)
R, D. Alldrick
QV "
ASPY "
WEIGHT % PYRITE EQUIVALENT
10
20
30
40
50
60
70
80
90
3.0
2.0
1.0
OUNCES GOLD/SHORT TON
AURUM BAND
MAIN BAND
QUARTZ VEINS
5
10
15
20
25
30
35
40
45
WEIGHT % IRON

PAST PRODUCTION, WELLS, B.C.

MINE	YEARS	QTZ VEIN ORE	REPLACEMENT ORE		TOTAL & RECOVERED GRADE	TOTAL RECOVERED OZ. GOLD	OZ. SILVER
CGQM	1939-59	1,626,699 @ 0.39		55,252 @ 0.60	1,681,951 @ 0.373	626,755	56,092
IMM	1934-67	761,646 @ 0.35		483,649 @ 0.67	1,245,295 @ 0.457	569,528	81,658
MCGM	1980-	8,862 @ 0.14	81-83	56,894 @ 0.43 }			
				12,254 @ 0.37 }	69,148 @ 0.40	27,384	?
			84	2,426 @ 0.63	?	?	?
			85-86	9,931 @ 0.31	9,931 @ 0.27	2,705	1,005
				81,505 @ 0.41			
TOTALS		2,397,207 @ 0.37		620,406 @ 0.63			

Incomplete