

78-1 275 - 330 UH mineralized zone = black graphitic argillite and shale with laminae of v.f. gr py  $\pm$  sphal. Nodular carbonate Bedding highly contorted with numerous soft sed deform. struct e.g. load casts micrograbens, isoclinal folding Ave grade 1.7% Zn Few Ba beds. Some very graphitic horizons.

78-2 99 - 135 UH mineralized zone similar to 78-1 intersect Some blebby barite Much of soft sed def may be due to biol act. Py laminar and beds made up of closely spaced framboids QZ-Ca tension gashes Zn 1-2% Ba 9.5% Ba  $\gg$  than in DDH 78-1 Perv graphite.

PARTY CHIEF .....

WEATHER .....

135-174 Ba dies out toward  
bottom of zone Py beds  
often lenticular Very contorted  
and disrupted bedding Nodular  
carb absent Very graph horiz  
common at bottom of zone

78-3 207-242 UH mineralized zone  
Carb nod common Bed distorted  
around nodules Graph horiz  
common Shale interbeds  
more numerous Ba dies  
out around 246 5-8%  
Zn 1-2%

245-255 graphitic black shale

238-294 Disrupted bedding

78-04 20-67 Blk sh and arg  
Min nod  $\text{CO}_3$  Low Zn Ba  
9-10% 41-53 not assayed  
Very graph in places Min  
dissem py in blk sh. More  
barite beds in min sect



67-116 - 1-2% Zn 50-60% Py  
 Nodular carb intensely disrupted  
 bedding Rarely good lam Ba  
 decreases down hole Graph  
 common

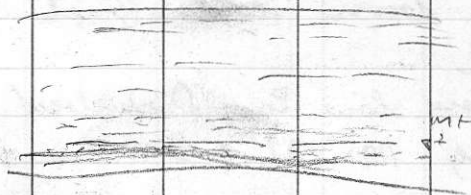
116-159 Very low Ba Disturbed  
 bedding, 119-131 - 5.41 Zn

78-5 66-137 UH mineralized zone  
 similar to previous holes  
 Not assayed for Ba Zn 1-2%  
 Disturbed bedding Some nod  
 CO<sub>3</sub> Few graph Numerous graph  
 shale interbeds 136'-152' 3.66% Ba  
 137-201 152 → Ba gone  
 Nodular CO<sub>3</sub> common  
 Disturbed bedding. Shale interbeds  
 low Zn .5-1.5% range.

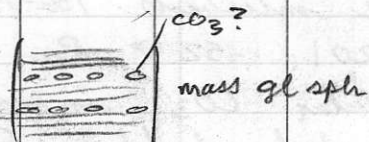
78-6 20-7A Very similar to  
 78-5 Zn 1-3% low Ba, Pb  
 Nodular CO<sub>3</sub> int dist beds  
 7A-117 Some Pb around 75-76'  
 1.3% Pb 9.93 Zn over 3' (S)

JOB .....

DATE ..... PAGE .....



MT  
↓



PARTY CHIEF .....

WEATHER .....

117-161 Nod  $\text{CO}_3$  Low Ba 10-30%  
locally graph.

78-7 225-272 Pb-Zn Zone of LH  
note assayed for Ba  
Much less disturbed planar  
bedding and lam. Lent bedding  
Graph common on bed planes  
Some nod  $\text{CO}_3$  which appears  
to have grown in situ  $\rightarrow$   
some bending of beds.

240-247 15-20% of Pb 1-6% Zn  
Zone end sharply at 267

High grade zone overlain  
by very graphitic horis ?? (S) 7-243

7-248 Nearly mass sulph U. figt.  
lenticular beds of  $\text{CO}_3$

Bd in n.s. v. f and planar

78-8 397-420 Extremely graph  
shale overlying highly  
disturbed py shale interbeds  
Min zone starts at 414  $\rightarrow$   
444 5-8% comb Pb-Zn

JOB .....

DATE ..... PAGE .....

203  




PARTY CHIEF .....

WEATHER .....

420-465 Pb-Zn zone not mass

Abundant nod  $\text{CO}_3$  40-70%

Strongly bedded?

Bedding parallel but disrupted

No high grade Pb Max 5%

$\text{CO}_3$  nod disrupt bedding

78-9 50-119 2-5% Zn Not assayed

for Ba? Lam py Nod  $\text{CO}_3$

106-110 1.5-2.5 Pb 5.4-7.7 Zn

Nod  $\text{CO}_3$  assoc with strong  
disrupt of bed.

Similar to DDH 1-6

119-142 Same Term in

shale. Min horiz more

comp than here and few (S) 78-9-135

450-497 LH min Horiz

graph shale overlying LH?

LH very sim to UH

Nod  $\text{CO}_3$  disrupt vfg lam

bed py in graph black

shale and arg. Slump struct

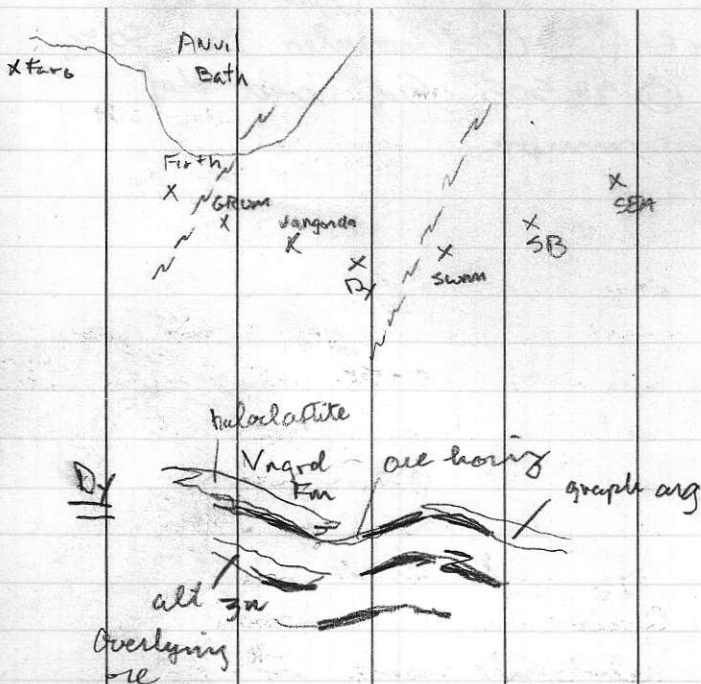
well develop Zn 2-6%

decreasing to 1-3%  $\approx$  493



497-544 CO<sub>3</sub> nodules 30-50%  
⑤ 9-505 Soft sed def  
common





GRUM Deposit - Jim Mustard

Vangorda Gp.

G. Leary S. Allen Bill  
Merces (Mattagami)  
Bill Breerton (?)D1

1700' deep 5 ore horiz

phyl argl

Vangord Fr ms chl ph + chl phylmin bs corral with Kechika <sup>OE-</sup> <sub>LO</sub>

calc bands decrease at

depth → graph arg

Min zn alt  $\bar{c}$  po host

qz rich graph arg

Grade me  $\bar{c}$  qz cont

Haloclastite assoc with ore

Baritic unit assoc  $\bar{c}$  ore

Some py qzite ribbon band

High ser rx in ore zone

Sulphide zoning

Massive py - up to 200'

ave 1% Pb+Zn

F<sub>1</sub> and F<sub>2</sub> foldingDykes cut ore horiz at  
oblique angles - QZ Dr in comp.

Disc leg blind drilling

Vanguardia



Drilled 20 yrs ago

chl physl graph qztc

py qztc

Baritic horizon

Some Pb Zn in qztc

> py less Pb Zn S Gl > py

Px low in baritic horiz

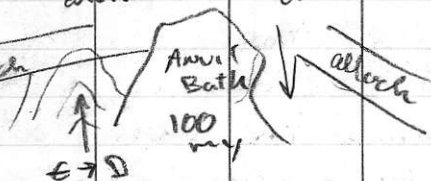
Ba toward edge of zone ??

Sph lighter in baritic zone  
as opposed to ribbon banded Zn.

anvil  
arch

came seg  
on W side of bath

anvil-camber  
allevate



Section (bottom  $\rightarrow$  top)

- ① Windermere (H) grit - base of pile
- ② Faro Grp ( $\approx 0$ )
  - a) qz - fd bt ms sch
  - b) graph - bt - ms - and sch (Faro host)  
also lst lenses, more volc toward top of sequence  $\rightarrow$  Vangorda
- ③ Mt My Group
  - a) qz diap ix
  - b) sil non cal chl ms phyll  
some lst lens, volcanics
- ④ Vangorda Grp.
  - a) cal - graph phyll (host for other deposits)
  - b) cal ms - bt - chl phyll
  - c) metabasite flows tuffs  
common in section  
lava band chl tuff
  - d) lst lens
- ⑤ Menzies ck Fm (MD)
  - a) amyg chl phll  
pellow breccia, lavas
  - b) graph phyll and lst MD age

age set by faunal assembl

⑥ Un or Anvil Gp  
sil xls chert pebble  
congl

Furo

ribbon banded Qtz +  
buckshot facies > 10% 86 Zn  
Qtz + graph, pyritic, sp gl  
baritic facies

F4 folds



F4 folds related to empl of  
Anvil Bath → affects sulph<sup>7</sup> Zn  
confg

qtz-fd schist  
graph horiz

baritic facies cont lens  
across ore horizons Best grades  
assoc with Ba

magnetite pass through deposit also po  
 few bands of mt in py qtzites  
 Swinn shows on aeromag.

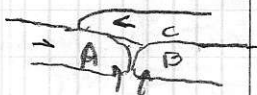
Cut off grade 4% combined

Ore zone - granular c. gr PY  
 in sp-gr matrix Backshot ore  
 Angular clasts common in ore  
 Host rx sphalerite quite graphitic  
 Recrystallized Some cpy  
 Planar bedding in carbon  
 banded qzite No indication of  
 folding

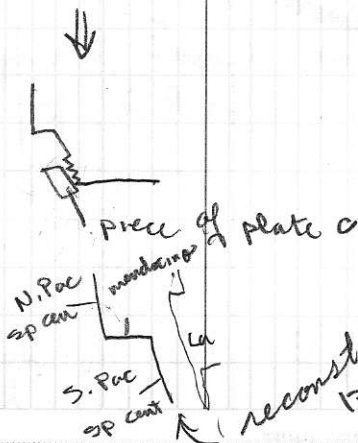
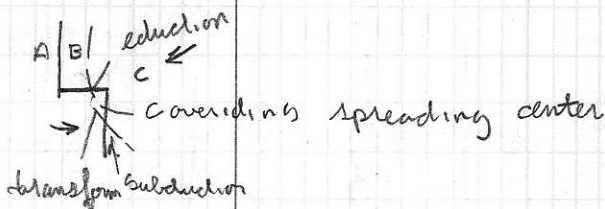


Talk by Ed Farrar Q.U.

overriding of spreading ridge by  
cont plate. Assume shallow sub



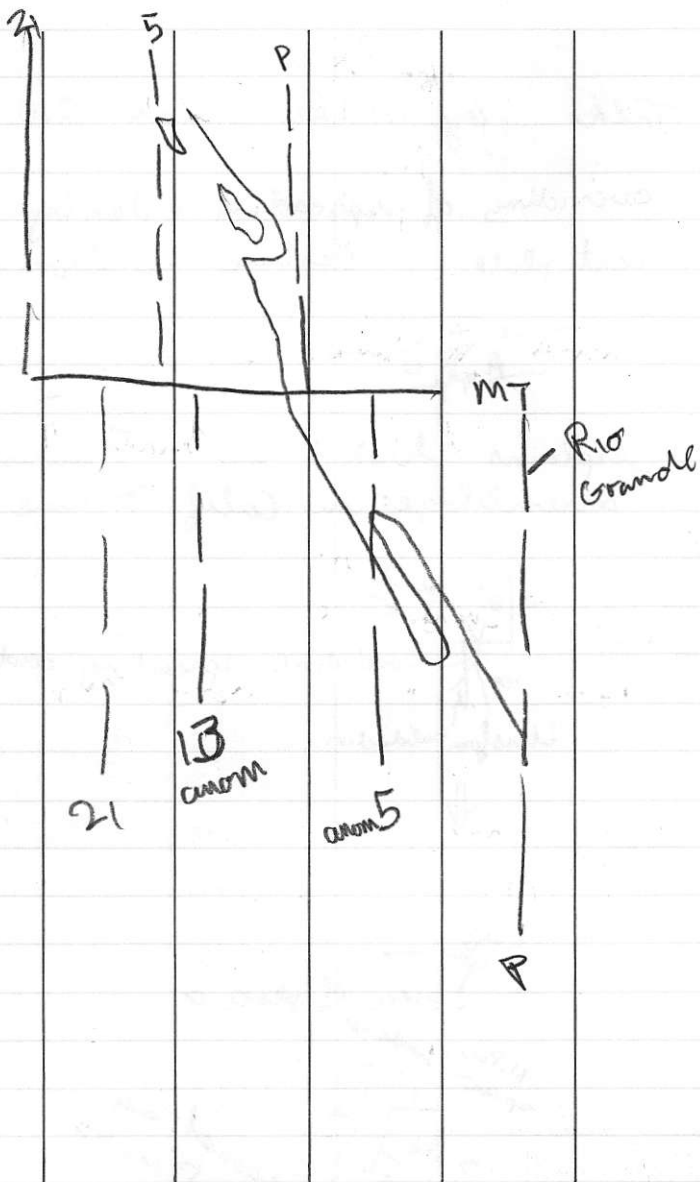
explains high P low T Franciscan  
assemblage in Calif → blue schist





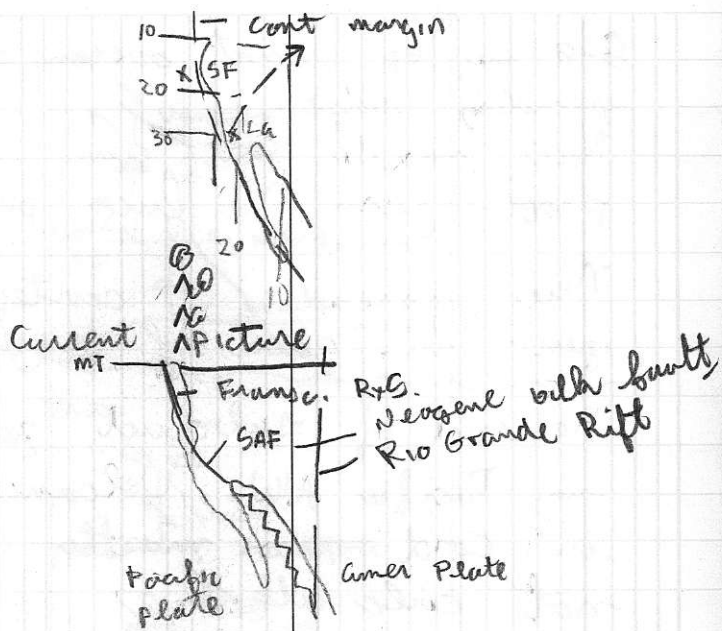
JOB .....

DATE .....PAGE .....



PARTY CHIEF .....

WEATHER .....



Primary mantle upwelling now beneath Colo.

Seismicity rest to upper 10 km of SAP.



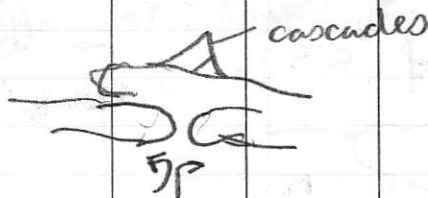
Cessation of vol S of mendocino trend.

8-9 my bp. cont overan  
 spreading ridge  
 New mantle mat gen to  
 prod Juan De fuca plate

New spreading center  
 gen in area of overlap.

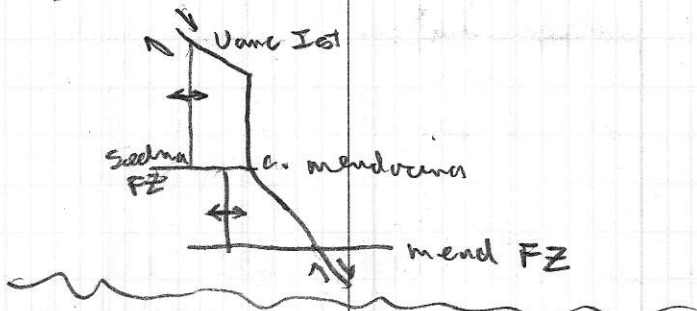
No evid of subduct zone  
 in Pacific NW. Volcanism  
 in Cord row mostly basaltic  
 not calc alkaline

East pacific rise gen  
 Volc of cascades

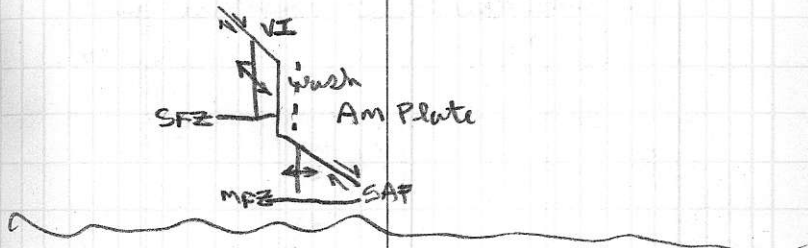


Volc → basalt ca 10 my.

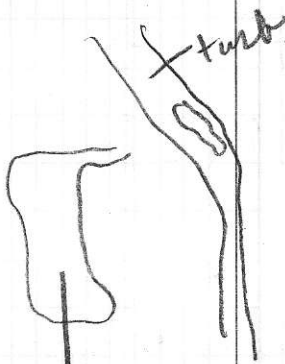
15 ma



9 ma



\*



Turb sed greatly rem. from cont margin.

turb in E. abyssal plain. Sed 100 m thick. Reflects pos against cont margin.

JOB .....

DATE .....PAGE .....

March 13 - Earthquakes



PARTY CHIEF .....

WEATHER .....

JOB ..... Northern .....

DATE ..... Dec 2, 1979 ..... PAGE .....

Steve Gordy | GSC  
Nahanni | St radiography

Feb 1, 1980

Dr. Chris Brooks.  
Univ of Montreal  
- isotope geochemist

PARTY CHIEF .....

WEATHER .....



Day Deposit  
 Brian Hill - Gypsum

- shale hosted

-

Askin	
Menzie Crk	- volcanic
Road R.	- shale
Vangorda	- calc phy
Mt Mye	- non calc phy

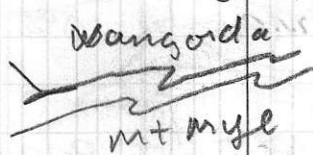
Vangorda = Rabullkettle  
 Menzies Crk = Road River

Mt Mye - Vangorda bound  
 marked by graph phy.

basaltic flows / pyro  
 same strat setting as  
 Mt Mye

1500 m x 650 m dep  
 SW bound undefined

- 800 m to sulphide

Dy 
  
Wangonda  
mt myl

Z sym first phase folds

5 horizons Sect 18+00Z

- alt overprint  
chloritic phyllite

- ore zones lenticular

- anvil cycle

graph phy → py qtz

→ base metal qtz →

mass baritic sulf +

mass py sulf + carb foe

ps in ft wall, py towards  
hang wall

foot wall. Cpy toward  
mt<sup>py</sup> toward here



baritic MS  $\rightarrow$  10% Pb+Zn  
 barite + sp + gl  
 lam text - granular  
 also mass py.

lateral zoning

- 1) baritic MS toward margin  
 (best grade)
- 2) sulph bearing Qtz - larger bit  
 dist -  
 - pyritic + base metal
- 3) Sulph bearing graph cgtz

alt overprint indicates  
 conduit to S

$\frac{Cu}{Cu+Pb+Zn}$  highest to S,  
 toward conduit  
 Sulph bear Qtz  
 baritic MS

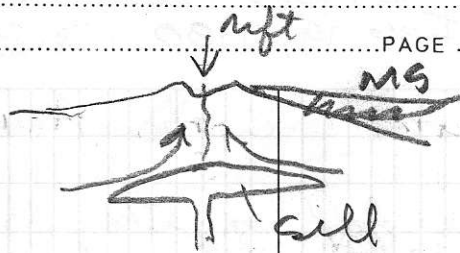


deposit in  
 dep away from  
 vent

JOB .....

DATE .....

PAGE .....



PARTY CHIEF .....

WEATHER .....



W. Roberts

Cyprus Anvil

On behalf of the MEG  
 I would like to thank  
 Wayne for his excellent  
 presentation on the Cirque  
 deposit. I had the  
 good fortune to spend  
 several weeks with  
 Wayne last summer  
 at beautiful Pretzel lake  
 and to experience some  
 of the excitement associated  
 with the discovery  
 of this significant new  
 mineral deposit. <sup>It is</sup> <sup>clearly</sup>  
 testimony to the excellent work <sup>done</sup> <sup>by</sup>  
 Wayne and his crew  
 should be congratulated  
 for a job well done  
 Wayne, we look forward  
 to hearing more about  
 the Cirque deposit in  
 the future, and wish on

done  
on  
the  
property





you all the best of luck  
in future  
exploration and hopefully  
development of the  
Crique property

- 5 types of mineralisation
  - 3 banded
    - bedded < bedded textal
    - breccia
  - 2 sulphide
    - mass recr.
    - lam

- ore zone thickens at depth  
pyritic zone thins  
= uniform total thick

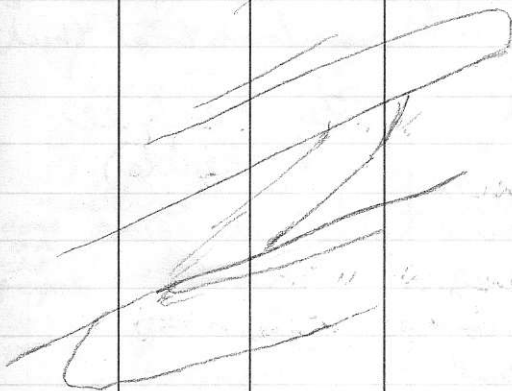
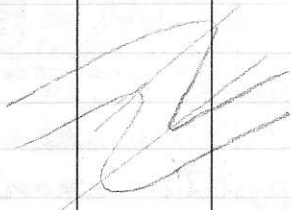
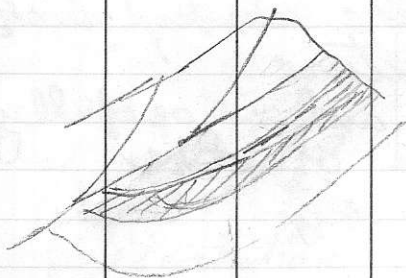


Zn Fe free  
(saleable)

- best grade in massive recrystallized pyrite
- photomicro - gal + sp  
interstitial to Ba
- Frambooidal py 
- best inter 60m. 
- separate Ag bearing phase present

JOB .....

DATE .....PAGE .....



PARTY CHIEF .....

WEATHER .....

Cyprus

W. Roberts	Sen Geol
Peter Dean	Environ
G. Simpson	G. Simp-
T. Doyle	H BOG
P. Black	?
D. Kilby	Sen Geol

J. Fyles  
 N. Carter  
 A. Sutherland Brown  
 E. McGregor

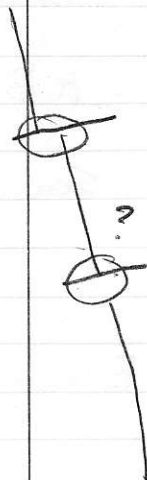
Sullivan Furo 10-12  
 Urque 6-8

Grinding time  
 less power required.



thickness isopachs.

mineral deposits very  
evenly spaced.



Faro 40% of Yukon mine  
- 20% of Japan's total  
Zn  
40% of Japan's total  
Pb

5-6000 tpd at Cirque  
→ 600 tons conc

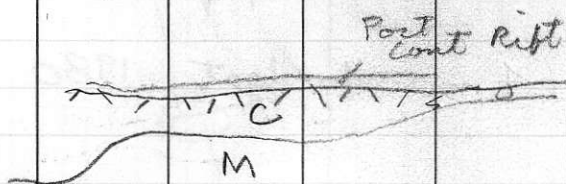
600 Faro employees  
6-700 Cirque

Faro 1700 pop.

\$3-4 m budget 1980

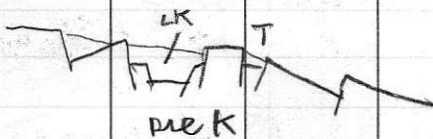


Dr. Charlotte Keen  
Rifted Continental Margins



- crust attenuated

Labrador



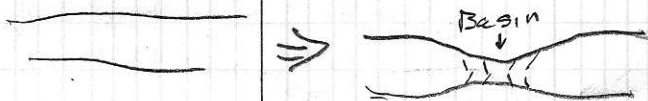
Continental rifting in Cret

- long complicated history  
- 50 my Early → Late Cret

- Volc near base of seqs.

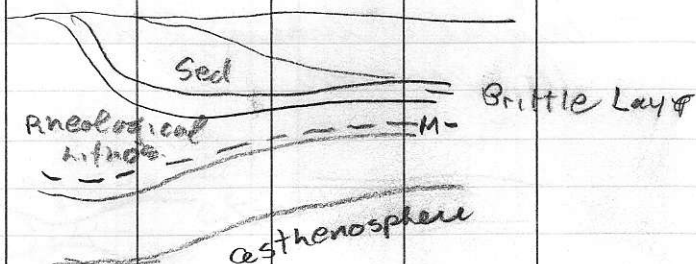
- extension during rifting

- net deposition during rifting ~~not~~ → ext + thinning
- crustal thinning not due to erosion

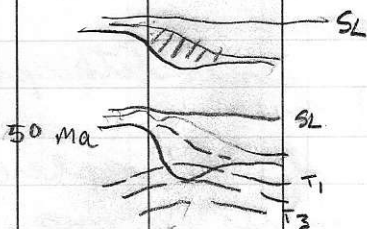


- heating followed by cooling → contraction and subsidence  
cooling of cont lithosphere
- loading of lithosphere by sediments along margins of continent
- isostatic process
- heating related to amount of extension and crustal thinning

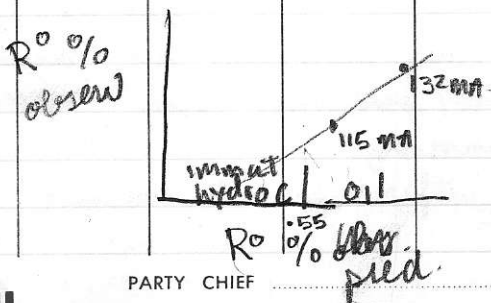
# Model - Atlantic Cont Margin



10 ma after rifting began



Isotherms raised in basin



JOB .....

DATE *Oct 29/80* .....

PAGE .....

*Peter ↑*

PARTY CHIEF .....

WEATHER .....



1979

Paleont Assoc Lond

The Dev System

Spec Paper No 23

Univ Press Oxford

B. H. Blackwell

Broad St

Oxford OX1 3BQ

England

1.5 kg. / Sawl hand sp.

- ① Wash sample LABEL -  
 3 buckets / sample - 1 wk  
 - 10% glacial acetic acid  
 square buckets 3 gals. cap.  
 - 1 l of acid / bucket  
 - fill bucket to 2 <sup>3</sup>/<sub>4</sub> gal  
 - respirator  
 - let sit for week  
 - large screens

20.85

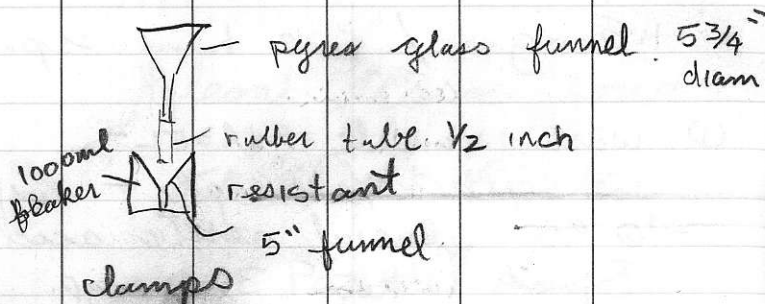
5 Fine  $\mu$ m

< 1mm No	18	1.00 mm (16 mesh)
	170	.090 $\mu$ m (170 mesh)
	140	.106 $\mu$ m - 1mm.

- top sieve but in plastic beaker to dry then bagged.  
 - bottom screen residue dried in crucible 80°C  
 - heavy liquid sep. tetrabromoethane \* fume hood. dilute to 2.85 s.g.

PARTY CHIEF .....

WEATHER .....



- fill funnel to  $\frac{1}{2}$
- put in sample so particles will circulate freely
- stir
- use acetone to clean stirrer
- stir every  $\frac{1}{2}$  hr
- start at 10 -
- wind down at 3
- transfer labels to crucible  $\rightarrow$  funnel.
- Whatman filter paper  
24 cm No 4.

return Tetra brom to containers

- 2 filter papers

1 with heavies

1 " " lights

- wash paper with acetone

Collect acetone - brom will

wash  $\bar{c}$  water

leave paper in funnels to  
dry - 1 hr or so

\* - conodonts in heavies

- check light for  
ostracodes, radi, any  
sil foss.

- put in plastic vial, save

cono 2.7 - 2.9

Tetra 2.95 - dilute to 2.05

1 l  $\approx$  100ml acetone

- large heavy con  $\bar{c}$   
dolomite - use undil  
Tetra brom to sep dol.



pyrite 3.3

Bruce Cameron  
- wife does picking  
on contractual basis

Frans separator  
- rep py from conod.

### Settings

First run .9 ammmeters

Sec run 1.5 - might talk some cono.

10° Angle - tilt,  
15° - 18° on back

fine wet brush for  
picking use grid  
Put on microslide.

USGS Prof Paper 995

Conod colour alt  
- an Index to Org  
meta

Anita Epstein, Jack B Epstein  
Leonard D Harris

Harrison + Crosfields  
810 Derwent Way  
Annacis Ind Est  
New Westminister  
V3M 5R1

45gal.

100% glacial Acetic Acid  
dolly to clamp  
or plus pump.  
vacuum or tube pump.

Formic acid 10%

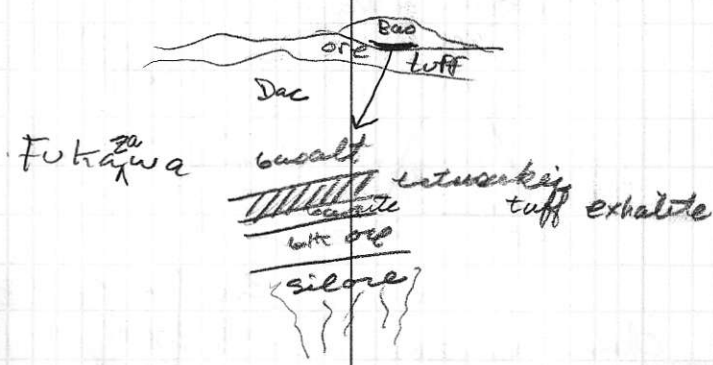
GAC Calgary

Ruitenberg

M.D. Petersen

CONOCO Expl Research  
1000 - South St + Pine  
Ponca City  
Oklahoma  
74601

# S.I. halogenopoulous tuff exhalites

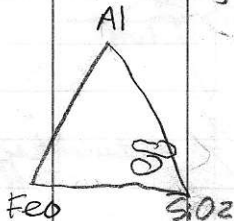
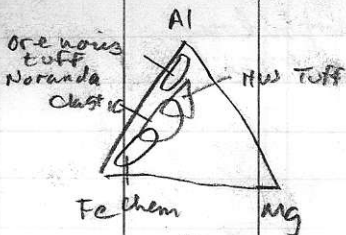


## Noranda

4 tuff exhalites  
hem, chl in exhalite

- PI, PO
- both clastic + chem comp
- alb → chl
- chl → ser





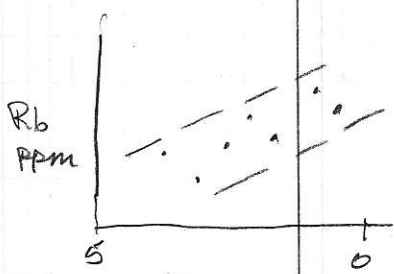
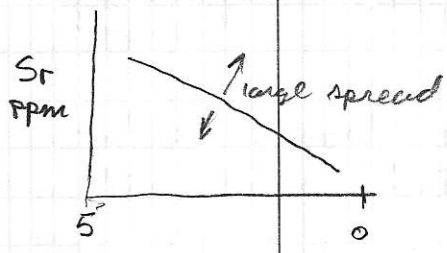
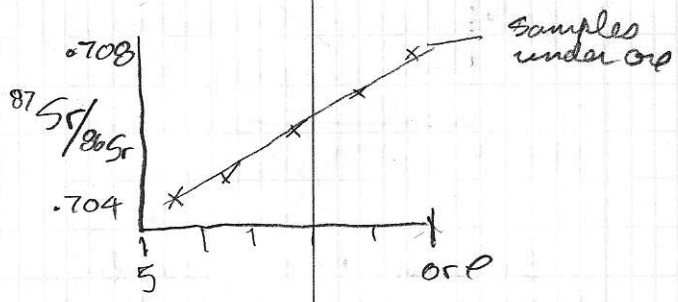
	Ag	Cu	Zn	Pb	Co	Ba
Chem	2.02	76	198	306	64	↓
clastic	.68	46	200	116	34	↓

Co increase toward ore  
in exhalite

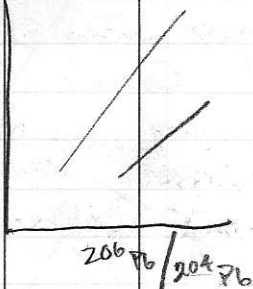
Pb " " "

# Doe et al

## Radiogenic Daughter Element Conc



20876  
-----  
20476



Si and Na depletion  
below ore body



h. Cathles (Penn State)  
Hydrothermal circul. models

- hydrodynamic modelling
- rapid emplacement
- high heat flow.
- 4.5 m tons Cu + Zn + Pb  
in Noranda

int vol required to prod  
deposits

- simulation will not  
circulate more fluid than  
size

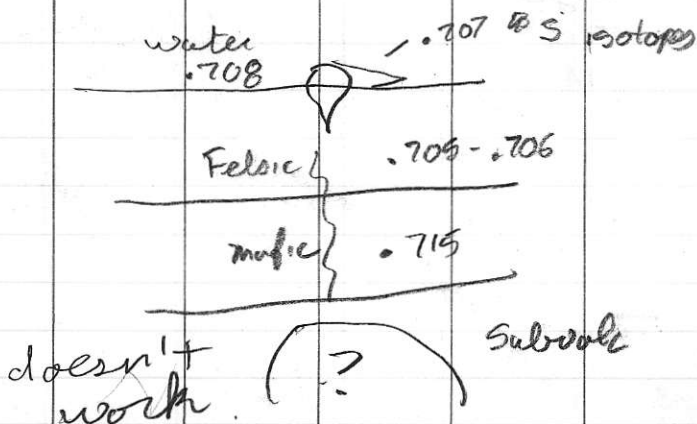
M      0.1 - 1m



Campbell et al.

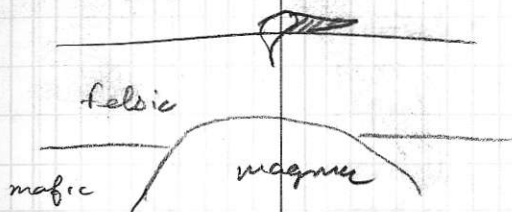
Rare earth

- ① - can dist between ore bearing + barren acid volcanics
- ② - felsic volc assoc with ore highly diff  $\bar{c}$  RE depletion
- ③ - genetic link  $\bar{c}$  subvolc magma chamber



O + H isotope indicate  
20% magmatic component

if subvolc magma  
int volc pile then  
S isotope ratios ok



REE can't distinguish model

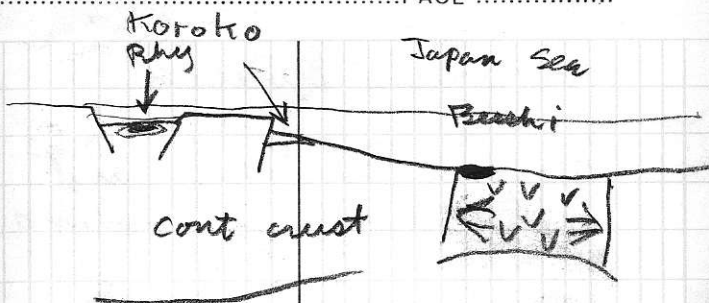
Urabe et al.

Besshi or Kuroko type deposits

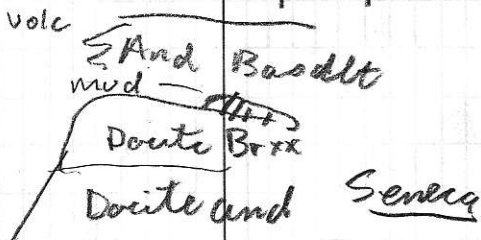
graph felsic schist horiz  
in mafic volc

serp + amphibolite



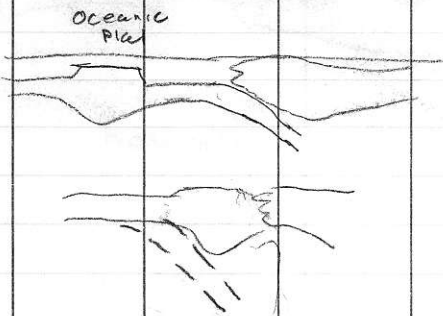


NORANDA



Zvi Ben Avraham

Oceanic Plateaus and  
allochthonous Terrains



J. Lowey  
Ar

AC Flt 267  
2.15

JOB .....

DATE ..... PAGE .....

J. Monger - End of Cord.

PARTY CHIEF .....

WEATHER .....



JOB .....

DATE Nov 1 / 81 .....

PAGE .....

# Metals in Shales Symp.

Tony Dunn U of WO  
working on Tachodi  
Pb-Zn Hodder

Gil Arsenault U of NB  
at UWO Working  
on Rocher Deboulle.

## ① Gustafson

Sediment-hosted Dep Cu Pb  
Zn.

- occur in several diff kinds of clastic rxn.
- summarized Stanton's theories
- define syng, diagen, epigen terms

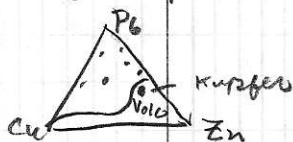
PARTY CHIEF .....

WEATHER .....



graph %Cu vs tonnes  $\times 10^6$   
 world mine prod  
 superimposed

- ternary plot Cu Pb Zn



dist sed host from volc  
 hosted

- changes in seawater S isotope ratios
- wide scatter from of isotopes for sed hosted as opposed to volc hosted
- high the seawater comp indicated
- all formed in epicontonic basins  
 Faulted basin margins &  
 fault central

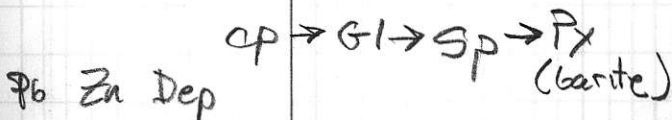
Cu deposits mainly assoc  $\bar{0}$   
 non faulted basin marg.  
 as opp to Pb Zn

- Section marine  $\bar{c}$  terrestrial  
 \*red beds for Cu  
 Marine trans over redbed.  
 Redbeds present in some  
 sed-hosted Pb Zn but  
 no direct assoc observed  
 Redox fronts for Cu  
 deposited

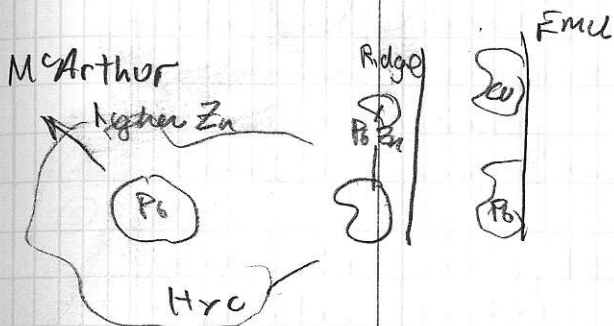
Zoning

Py  
 cp  
 cc Zn  
 HM

Cu dep







K spar alt zone →  
 + Albite Kspar → albite

Pew re equil  $\bar{c}$  carbonates

Cu dep lack barite,  
 usually in perm units

## ② Maynard : Shale Basins + Deposits

Slide 1 Types of basins

① Alluvial ② Humstrine ③ Petture

- cratonward prograding

- oceanward prograding <sup>e.g.</sup> Belt series

- thin + cratonic

④ Carbonate - Shale Rims (etc)

⑤ Rifts

- deep water e.g. Red Sea

- shallow mainly  
coarse clastics.

⑥ Abyssal

Classification of different  
shale basins

② J. Leventhal

- ~~Eng.~~ Dev. sh from  
apalach basin

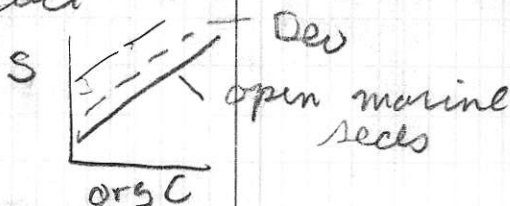
replacement of C by  
Sulphides. Metals  
follow C

U Mg V aligned  $\bar{C}$

other metals  $\bar{C}$  Fe + S

U vs C good relation

Oxy of C uses oxy  
bact work on  $SO_4$



ash layers source  
of metals enriching  
shales above ash.

## ④ T Finlow Bates

Mt. ISA

- heated brines as transp agent.
- buoyant brines at wgs.

↳ high salinity brine  
can carry more Zn  
w ppt at higher  
T than Zn.

JOB .....

DATE ..... PAGE .....

N. Williams

HYC

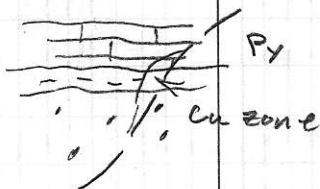
M+ISA

PARTY CHIEF .....

WEATHER .....



Brown Stratabound Cu  
 - Cu from underlying red beds



Cu-Cl fluids in red beds  
 migrating into shales

- volc beds in sect hosting  
 Cu bearing beds.

Jack Harrison

Belt Sb.  
 Study

- Stratabound Cu Ag
- Belt Supergroup  
 shale + quartzite  
 e.g. Spar Lake 60-70 mt  
 ~ 7 Cu 1 oz Ag
- billions of tons Cu, Ag.

Revelt Fm

- reduced green argillite in core
- ox to purple peripheral

Sparr Lk Zoning

- Cu sulph along bed  
 $\pm$  replacement  
of Zn  
 EP
- Cu sulphides late replacement features

good talk - gen overview of belt

Reynolds - Strat + Sedimentology  
low grade Cu Ag mineral



Spokane - fine clastics  
area thin + fine to  
w

Drilled 22 holes

- gently dipping section
  - Blacktail Mtn area.
  - logged in detail
  - bornite + chalcocite
  - 6 purple units
  - interbedded green units
  - ore in green units
  - finely lam to x lam
  - green beds 1/2 m to 1m
  - load struct
  - coarse siltite → argillite
  - reducing environ
  - on shelf?
  - mud breccias
  - subaerial → fluvial
  - mud flat:
- |       |          |
|-------|----------|
| shelf | mud flat |
|-------|----------|


Successive transgressive  
cycles E Cu in cycles



0.03 - 0.07 org C content  
in purple + green beds

A occur of Cu  
|| to bed + also  
blebby dissemin Cu

- cc + bn in quartzite  
unit

- Cu in fluid escape  
structures 

- microfaulting  
beds # 15 - 2m

- Cu conc in core  
of beds.

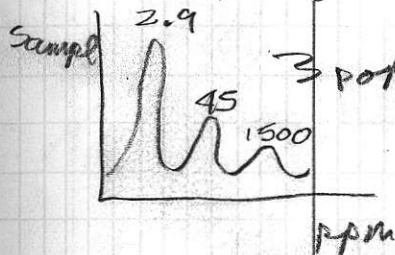
- compact → fluid escape  
→ diagenesis.

- remobilized

J. J. Connor in  
Blacktail Mtn. area.  
Cu - Ag occur.

- Spokane Fm  
at rich <sup>red + green</sup> argillite + siltite  
15 cm sample int.  
several 1000 samples.

- Cu 45 ppm Green Wedge  
- low Cu popul in  
sampling at 2.9 ppm



may be 4 populations  
at 2.9 22 100 1500  
- requires 2 mineralized  
populations - a  
green bed pop +  
mineralized horiz

$g_3 + g_5$  - green bed  
mineralized horizon.

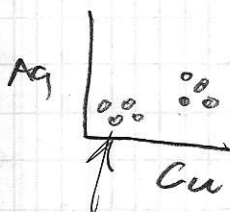
background (near)

pop. in purple beds

- neg pop in  $P_4 +$

$g_4$  beds.

- Cu deficiency = Cu  
excess in minor  
mineral horizon



•••

correlation  
of  $Ag \bar{C}u$

neg Cu anom.

( $Ag$  being rearranged  $\bar{C}u$ )

- Blacktail Mtn dist  
similar to overall  
Belt dist.

- Cu dist at BTM  
also happening through  
out Belt Patent for  
rearrangement of  $Cu + Ag$

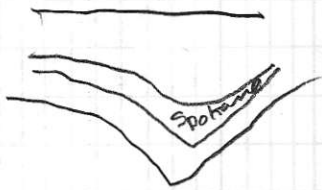
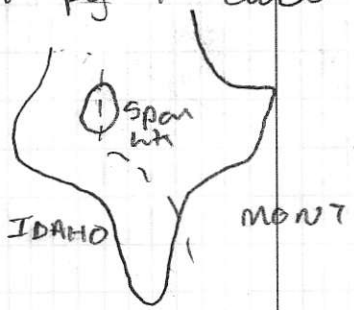
# Blacktail Mtn drilling prog

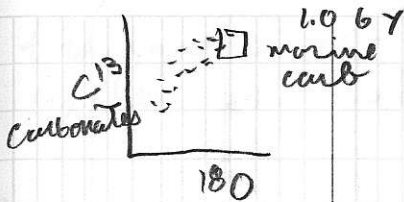


- shallow water

Robert Rye - Stable  
Isotopes (all last  
of speakers on strata  
Cu Ag in belt supergroup)

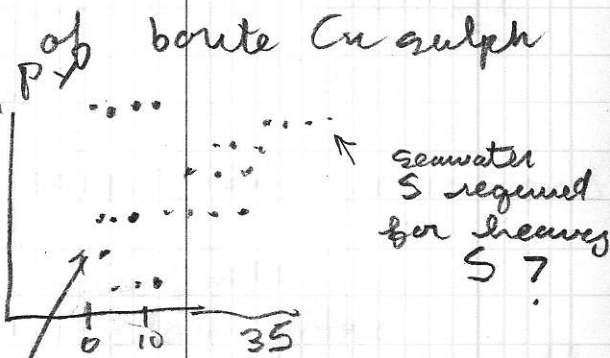
also barite in basin  
+ py + carb + Cu



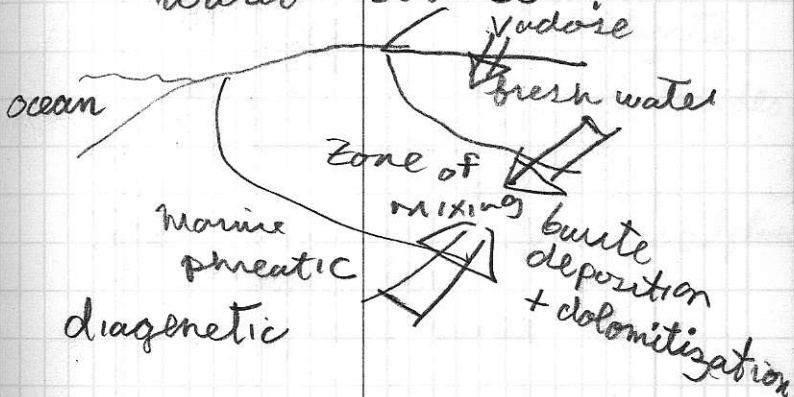


Samples from Missoula middle Belt Ravalli Group

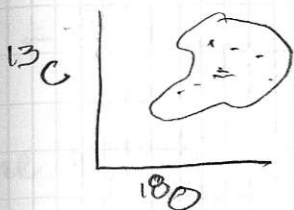
- 34
- or S of
- + P
- Manana
  - Shep
  - Snowship
  - Helena
  - Empire
  - Spokane
  - 9+ Reg. 10
  - Ravalli



isotopically light Ba S derived from fresh water source?



transgressive - regressive cycles on delta flats



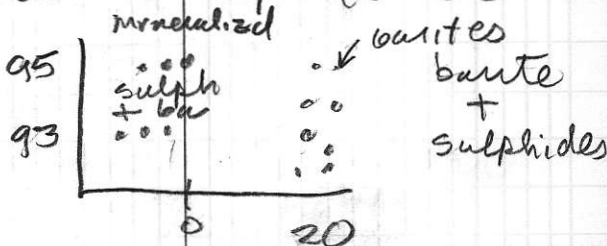
Carbonate Isotope

no exceptional variations

Sulfur Isotopes

Blackhall Mtns

Ba present in all beds up to 5000

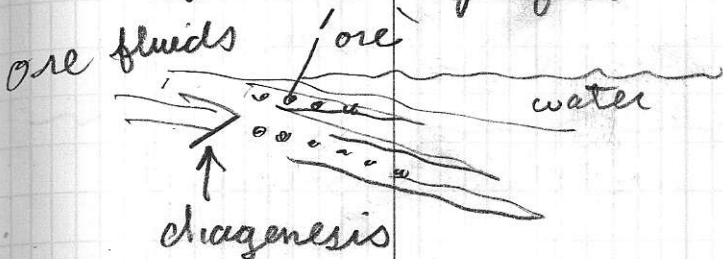


Two sources for sulphur  
 - seawater  
 - fresh water

○ permil average

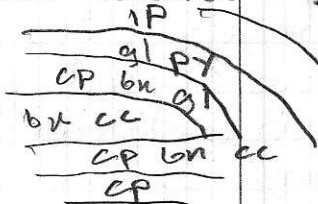
→ bacteria values

- limited to small isolated aquifers



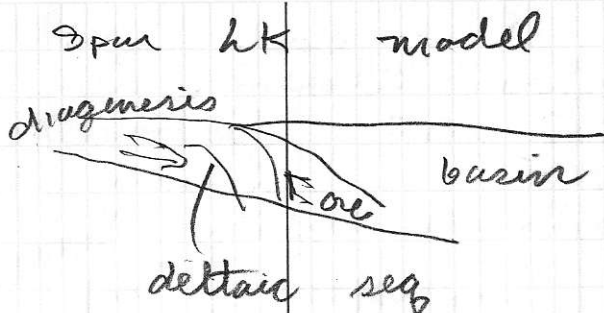
fresh water

stable isotope



sulphide zonation at Spar Lake

origin of py should be studied using isotope



## Paleozoic Rocks in Nevada

- org matter in shales  
pot source for metals  
low T accum
- cond nec  
marine basin  
> 5% org C  
< 10%  $CaCO_3$   
high cont of sopropel  
slow rate of sed  
anoxic
- metal  
X ray diff  
reflect light



large low grade  
res metals + oils  
Woodruff FM Dev  
Vinninni Ord

eugeosyn  $\left\{ \begin{array}{l} \text{antithet} \\ \text{orogenic} \end{array} \right.$   $\leftarrow$  Roberts Mtn allocht.  
miogeosyn.  
Paleozoic belt.

Woodruff FM Nevada  
50m thick

- 10% Van Oxide
- mudst slt chert
- oil
- py marc
- bluish wht opal silica
- diagenetic Si from radiolarians.
- marc + molys pres
- brownish black sapropel.
- kerogen

- org mat perw dissemin debris & calced qz
- spores, sp, py, marc in opal sil units

### Woodruff

- interbed mudst sltst + carb beds
- V rich
- 14 gal oil / ton
- liq bitumen.
- 26% V in bitumen

### Vinnini Fm.

- grapt mudst
- grey wth patch allu prod of pyro

All within few km of Roberts Mtn Thrust.  
Org C 4 - 20%

- conodonts.  $\bar{c}$  colour index of 1 ~~is~~ less than  $50^{\circ}\text{C}$ .

Ag 5 ppm.

- V, 2.5%

Zn 4 - 1.8%

- Ag in organic  
Cr Mo Se, V

Py + Sp present.

## George Derbyborough.

- geochemistry to find stratabound base metal deposits
- Zn Pb ratios in Yukon - B.C. 1 - 3.5  
5 - 40 m tons  
same as other sed hosted deposits

JOB .....

DATE .....

Metals in Dept  
Miss.

~~Runmed~~

Zn/Pb ratio increases  
away from ore

Org Rich Marine Shales  
vs

	Zn	Pb	
highest	1500	50	30
medium			

Sea Water mean rat B.3 to 100

~~Pb~~

Pb 20 - 120 Mo 20 1000

Zn 100 - 18,000 V 100 5000

Ag 2 - 20 Cr 50 1000

Ba 100 - 5000 Ni 20 1000

Cu 20 - 400 Se 20 350

Cd 20 300

barite  $\tau$  galena  
 barite chertal  
 bedded pyrite

PARTY CHIEF .....

WEATHER .....



Tect + Dep similarities

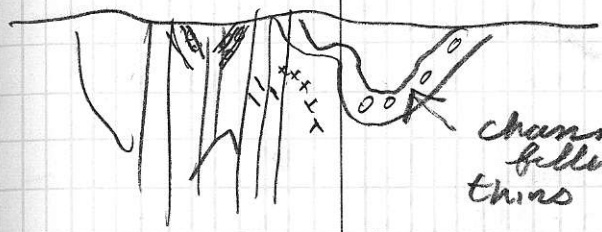
- graben

JASON

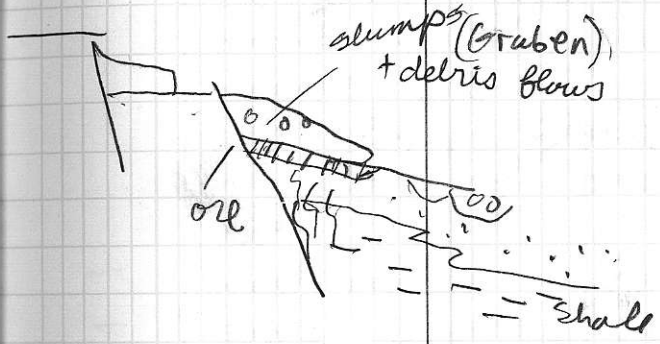


coarse clastic

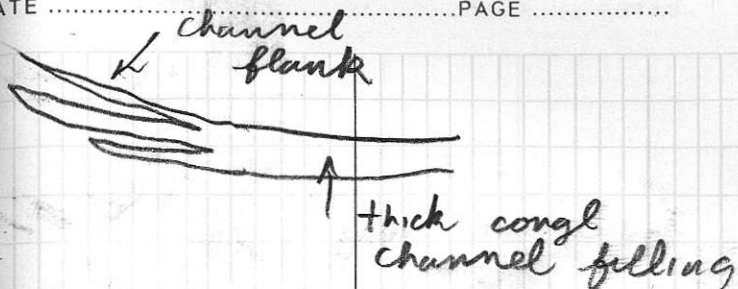
fine clastics



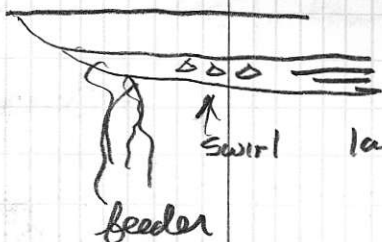
channel filling thins W



congl - chert frags. detritus from eros of Road River?



- fine lam in canol shales = anoxic environ
- silty bands
- current ripples - deep marine setting
- clasts of semi lithif material in debris flow. well inded in place coarse pebbles dep along growth fault slumping of prev slumy mat.
- mud matrix
- some graded sst. bouma AE bed.
- CANOL : Late Dev.



conduit

boxx

Si

Sider

unqtz

sid c py

q1 sp

surf  
prof

distal

lam ba  
sp

Two distinct facies

①

Graben margin

②

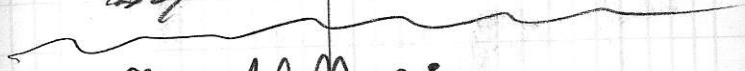
~~set~~ Center - thickness  
set + congl turb  
from western  
source.

Graben Margin Facies

- local source, sed boxx  
debris flows turb  
currents hemipelagic  
settling sulfide ppt

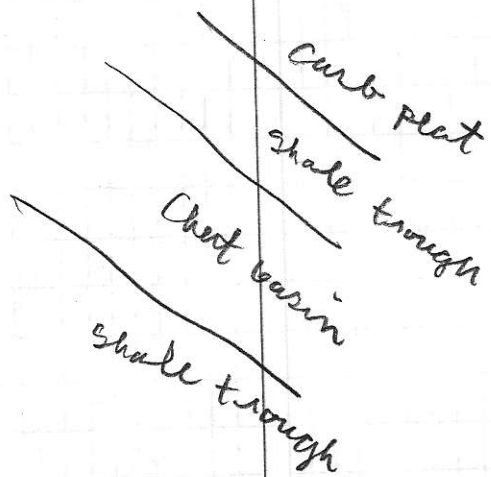
thin seq lenticles

Center  
~~by~~



Good fellow:

Nahanni Map Area



lower Ord: XY Annu  
 UD - 1M: McMillan Pass  
 Tom, Jason, Teu





# X7 Pb-Zn Deposit

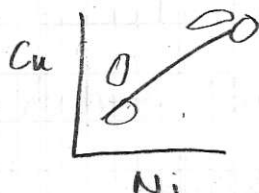
✓ high C V rich  
shales below deposit

C up to 8%

✓ present in illite

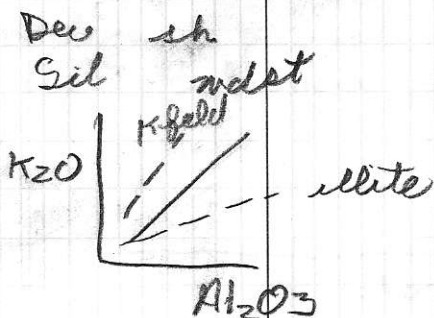
✓ enrichment highest  
near margins decreasing  
to center of basin

Ni/Cu ~~above~~ high  $\bar{e}$  C  
in ~~pyrite~~ pyrite (diag)



in pyrite

2000 - 3000 ppm Ni  
low Cu Ni in active  
zone.



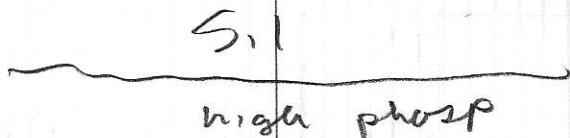
Sysed ore dep origin  
for K-Feld

Org C + CO<sub>2</sub>  
in fw + hw phosphate  
unit

### Active Zones

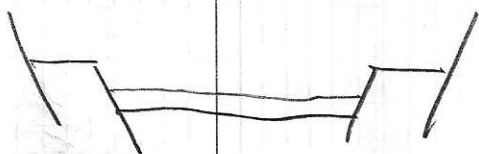
- phosphate unit overtes  
dep. up to 50m
- blk carb 5%  
in fluorapatite
- whitish bands in  
chert

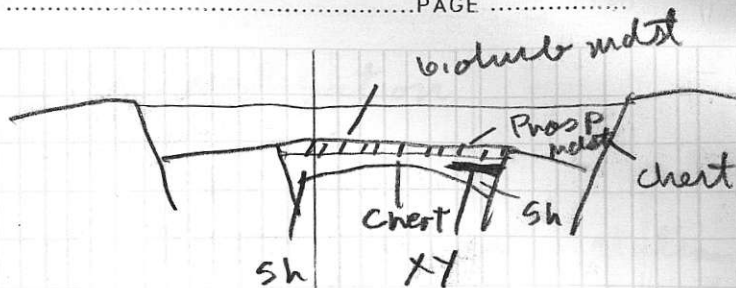
Overlying phosph chert  
is Silurian siltst



\* 3-4% Ba in Sil  
siltst overlying Howards  
Pass dep migrated  
from underlying dep.

Graben + horst in Lt





Prosop diagenetic from  
org matter

Volcan - Mako/Shankley

- stratiform sulphide
- disc 1978 Welcome N
- RioCanex 1979, 80
- E - UDM
  - UD black clastics
  - moD x siliceous sh
  - MD } Jussly Bear (1st 75m)
  - MD } Upper RR (equiv 1st)
  - UD-ID Upper RR
  - vt mo Sunblood - Host
  - Rabbitkettle

# Mineralization in

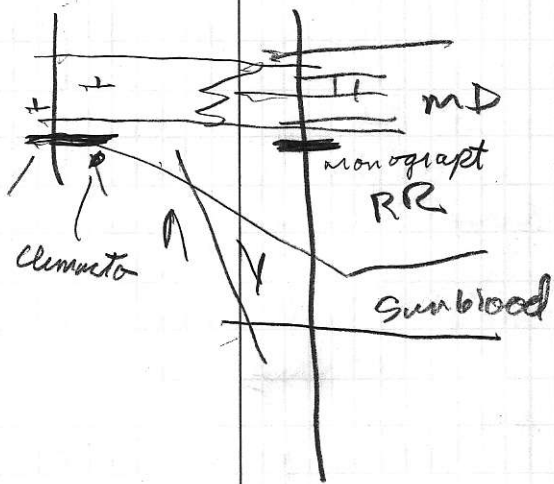
## RR shales

~~XXXX~~

mineral

Vulcan  
trend

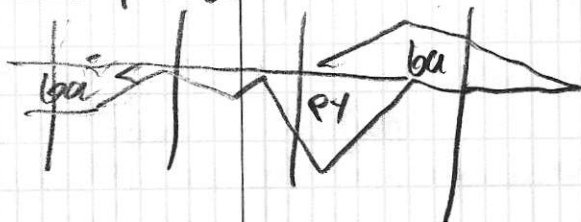
Sunblood





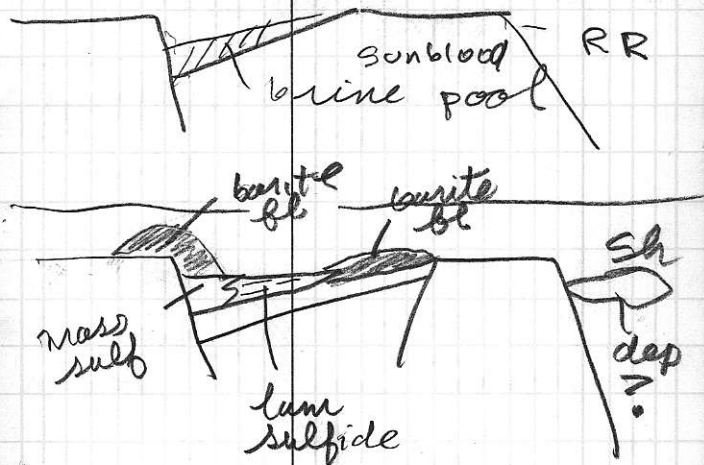
Types of mineral

- mass fgr py
- finely lam sp in str
- fold py beds slumping
- cgr white barite C
- fl
- mass gal pods in barite
- barite peripheral to sulphides



ave	S34S	43.6	Ba
		22.4	Py
		19.1	SP
		21.7	GI

- changes of 34S with changes in oil mat.
  - $H_2S$  in mineral fluids
- Model



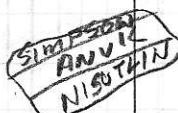
barite close to vent  
 c. gr near vent  
 barite mixed by upward  
 percol of fluids

# D. Templemann-Kluit

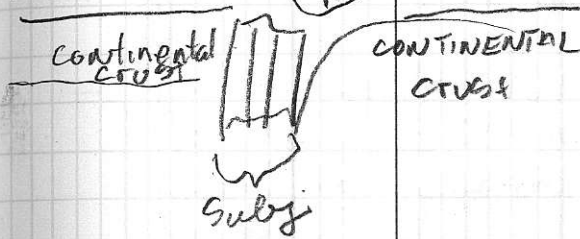
Part 1 Fact

Part 2 Fiction

- deal mainly  $\bar{e}$  overthrust rocks.
- intermontane belt part of accreted terrane



- gran } sheared  
 - oph } deformed.  
 - sed }  
 Pen def.



- 450 km UK-ET along Tintina Trench.
- Klippen on blocks autoch rts
- Nisutlin - siliceous cataclastics





- no tectonic mixing of packages of alloch
- very planar sharp contact

Simpson  
sheared  
az monz

---

Anvil amph  
serp

sharp cont  
penet fabric  
mylonitiz  
recrystal  
→ gneissic

- no unbrasive relat.  
K-Ar 300 m.y  
cooling period  
UR-LJ  
Upper Paleo strained  
in Mesozoic

Anvil Allocht -  
lies on cont rxs  
as klippen with  
Notsuttlin missing

serp ← sharp cont

Nasira  
old-Dew  
shelf

ANVIL - dunitite

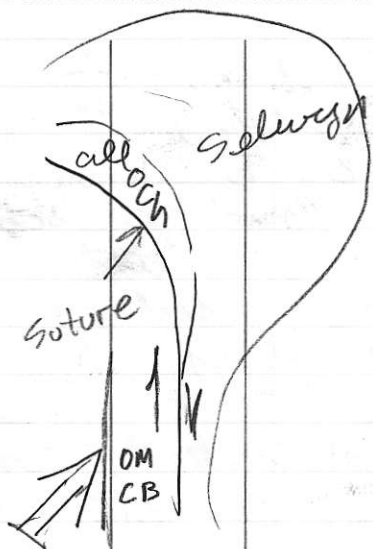
NISUTLIN - flaser strain  
layering mylonite

- no tectonic mixing
- anvil also amphibolite
- fabrics in anvil  
mylon basalt → amphibolite  
→ <sup>amph</sup> gneiss
- fossil list fusulinids  
→ U Paleo age.
- no good oph seq.

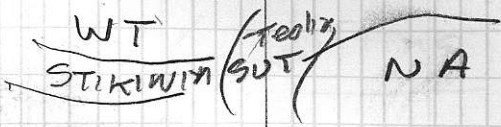
NISUTLIN ALLOCH

- layer due to  
mylonization

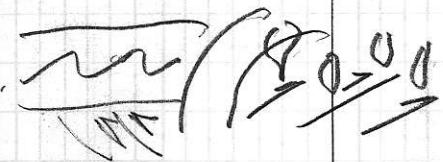
- cherty rxs. lt to  
dk layering → flaser  
fabric  $\bar{c}$  kinks  
→ klonidite schist  
musc qz schist
- arkasic sed rx  
originally
- lst → Perm conod.  
if in strat cont
- mica → 210 - 160 my  
deform time
- $\checkmark$  R conodonts in  
immature seds  
overlying suture  
 $\bar{c}$  underlying  
platformal success-  
 $\bar{c}$  R cono's
- no strain in  
underlying rxs.



LTR - E5

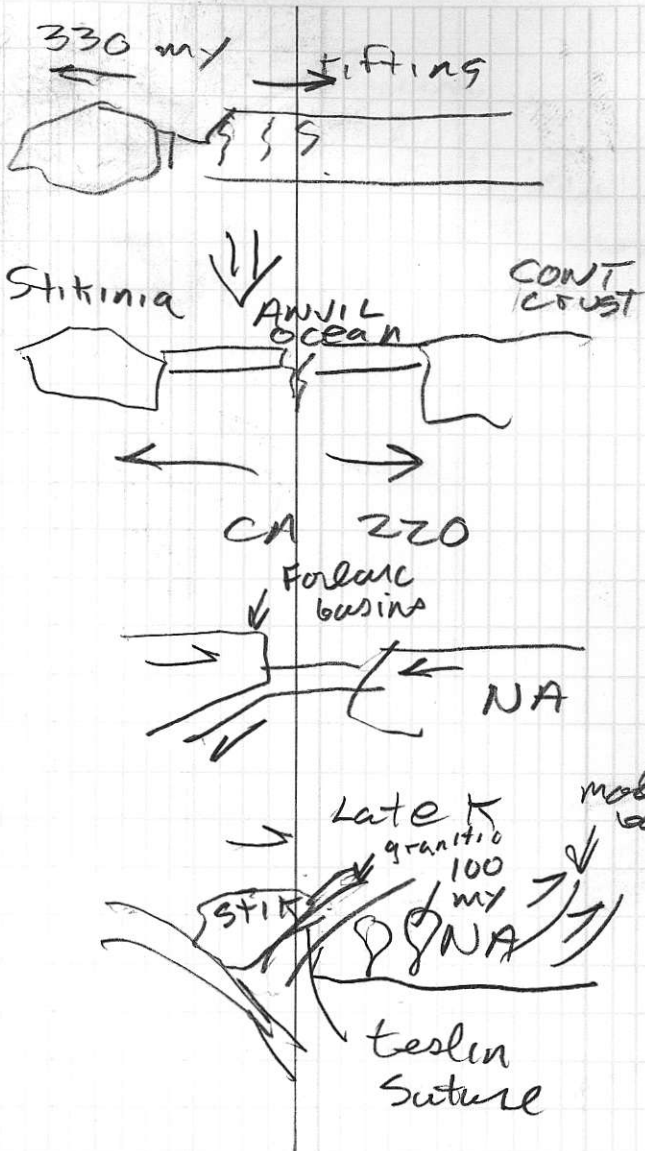


Arc Obduct



Strain 210 - 160  
 formed in High T P  
 subduction zone





# Summary

- ① hard strain  
in alloch
- ② boundary between  
Omneau + dntermord

# Paul Ralpho

Emission  
Absorption

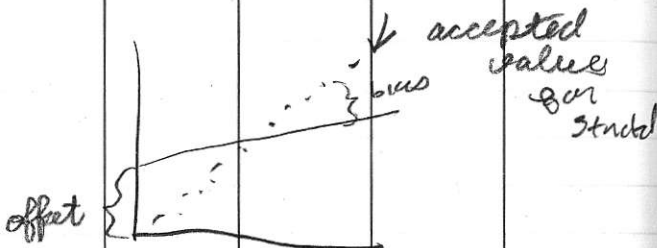
XRF, ES, Fluorescence, N. Cell  
- AA, Coulomb, W Infrared XRF

Diffraction  
Scattering

Reflect + Refract

species

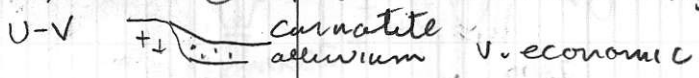
Nuclear  
atomic  
ionic  
molecular



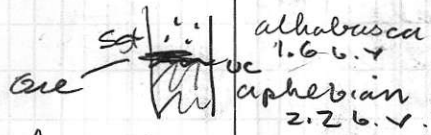


### Types of U Deposits

- ① Regmatites
- ② Intrusive - carbon + rhy
- ③ Roll Front U. imp
- ④ Hydro vns - Uran City, Eldorado
- ⑤ Supergene - desert weathering



- ⑥ Miscell Blind R, Blizzard.
- ⑦ Unconformities Key Lk, Rabbit Lk.  
Tahlelha 80% world prod.



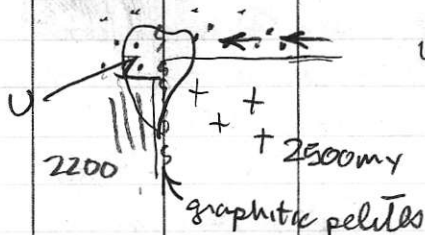
also Au, Co, Ni, Ag  
alhabasca FM - flat lying  
sst + grits (1600 my on  
glaconites + dykes)



graphitic rxs in Sect at bound  
between Archean + Aphelbian

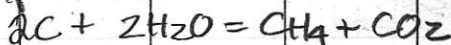


gneisses under sst deeply weathered (red colour)



uranium  
1000-1300my

react  $\bar{e}$  C  $\rightarrow$   
methane  $\rightarrow$  reduction  
of metals



- in Australia U vein does not go up into sst.