

# Mineral exploration campaigns: an overview

by

Warren Pratt

Specialised Geological Mapping Ltd.

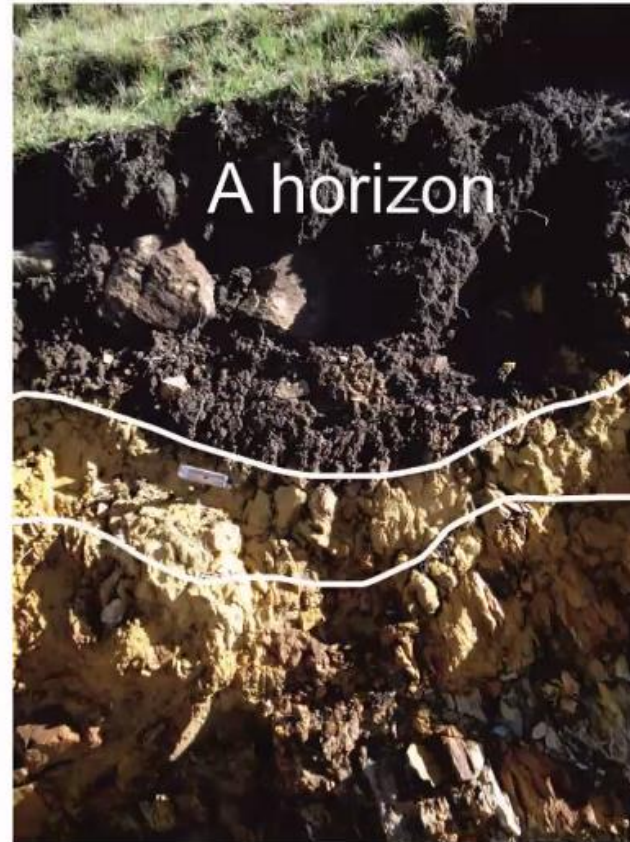
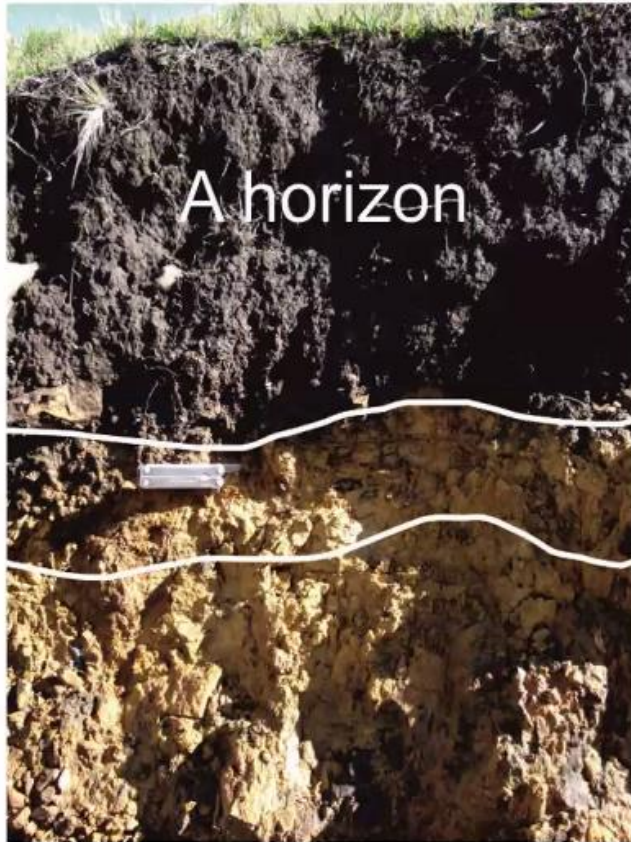
Lecture notes of SEG-RWTH AACHEN web seminar

11/3/2021

## Gossan with free gold in Tz



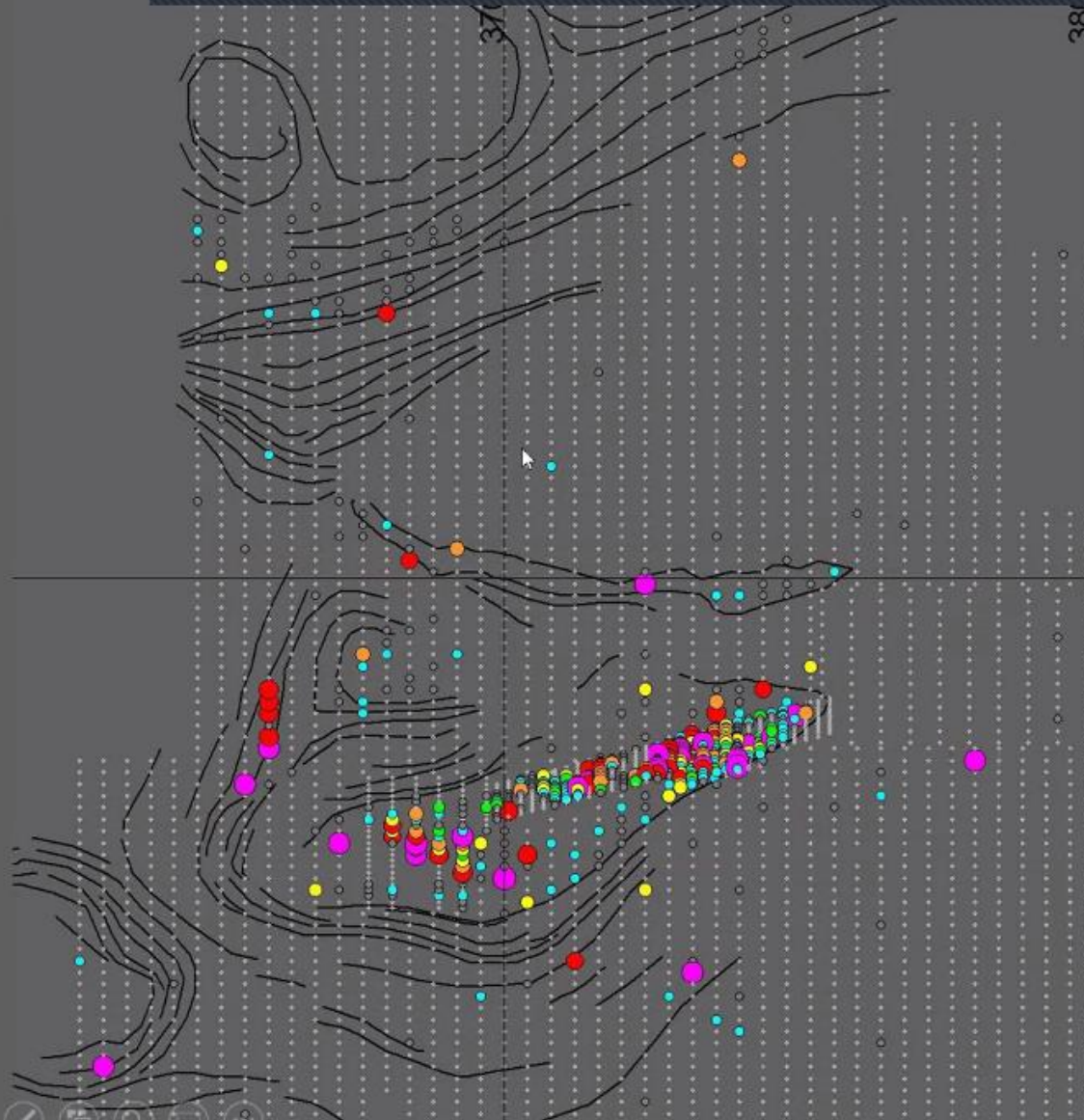
# Soil sampling orientation study



B horizon

C horizon  
(weathered  
friable  
rock)

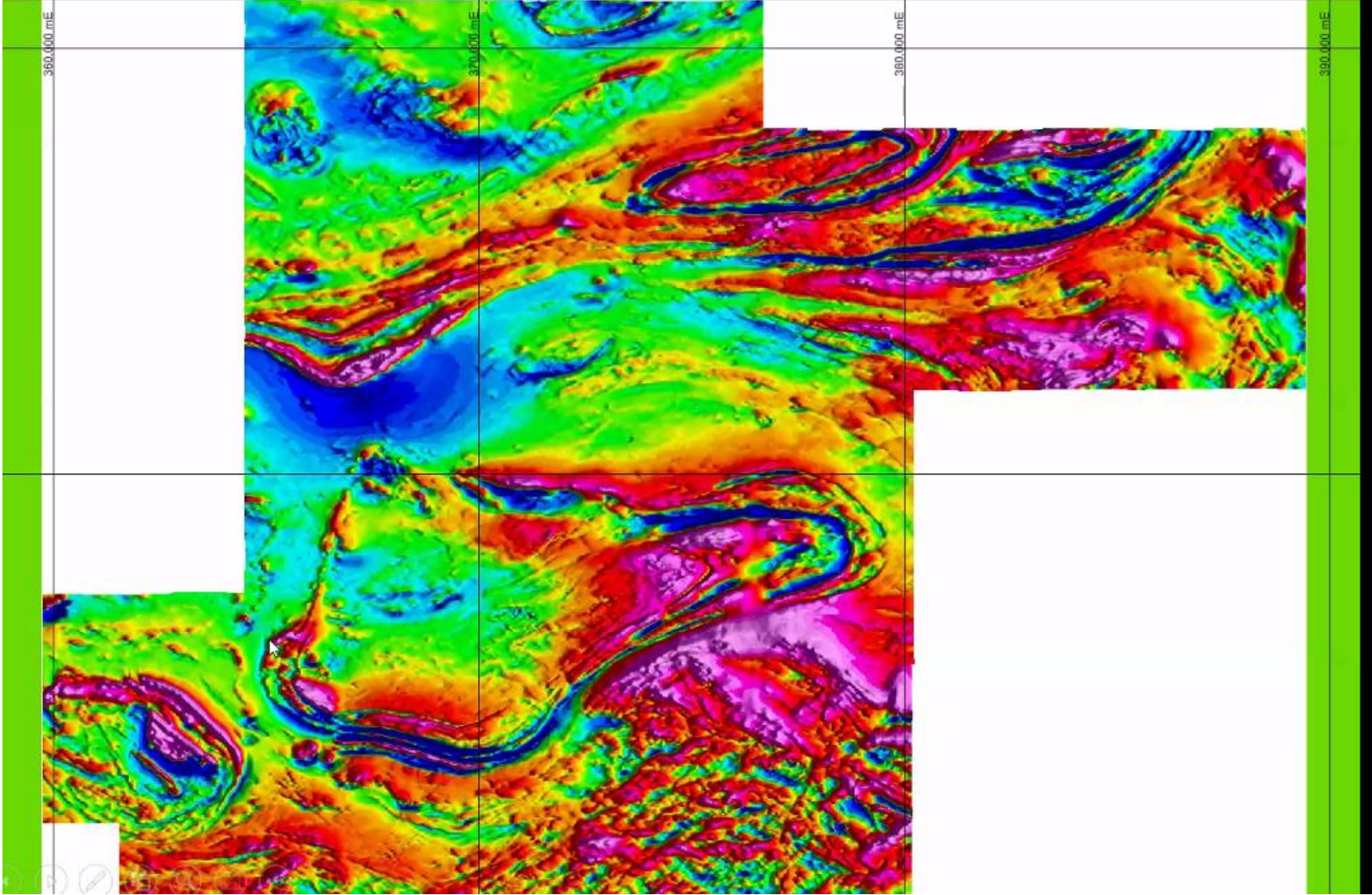




380

# SOIL SAMPLING





560,000 mE

1,420,000 mN

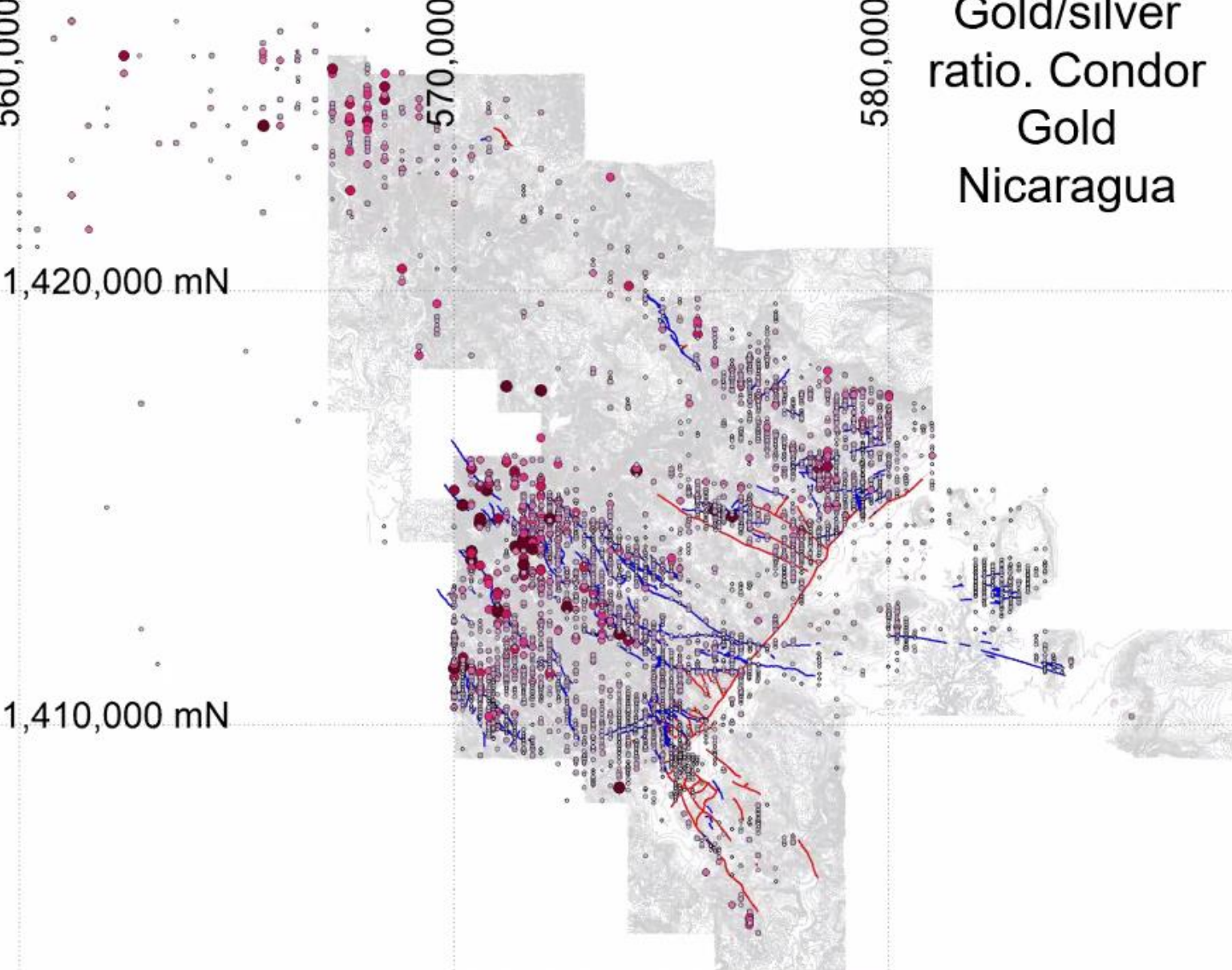
1,410,000 mN

570,000

580,000



Gold/silver  
ratio. Condor  
Gold  
Nicaragua



# CAÑICAPA - ECUADOR

High sulphidation  
epithermal gold.

More than 3 km of  
trenches dug by 40  
indigenous Saraguro



**DEAKIN  
EQUIPMENT**

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3

Outfitting for over  
**30 YEARS**

NO BLANCO  
PERU

project

FEB-MAR 2007

All-Weather  
LEVEL NOTEBOOK  
No. 311

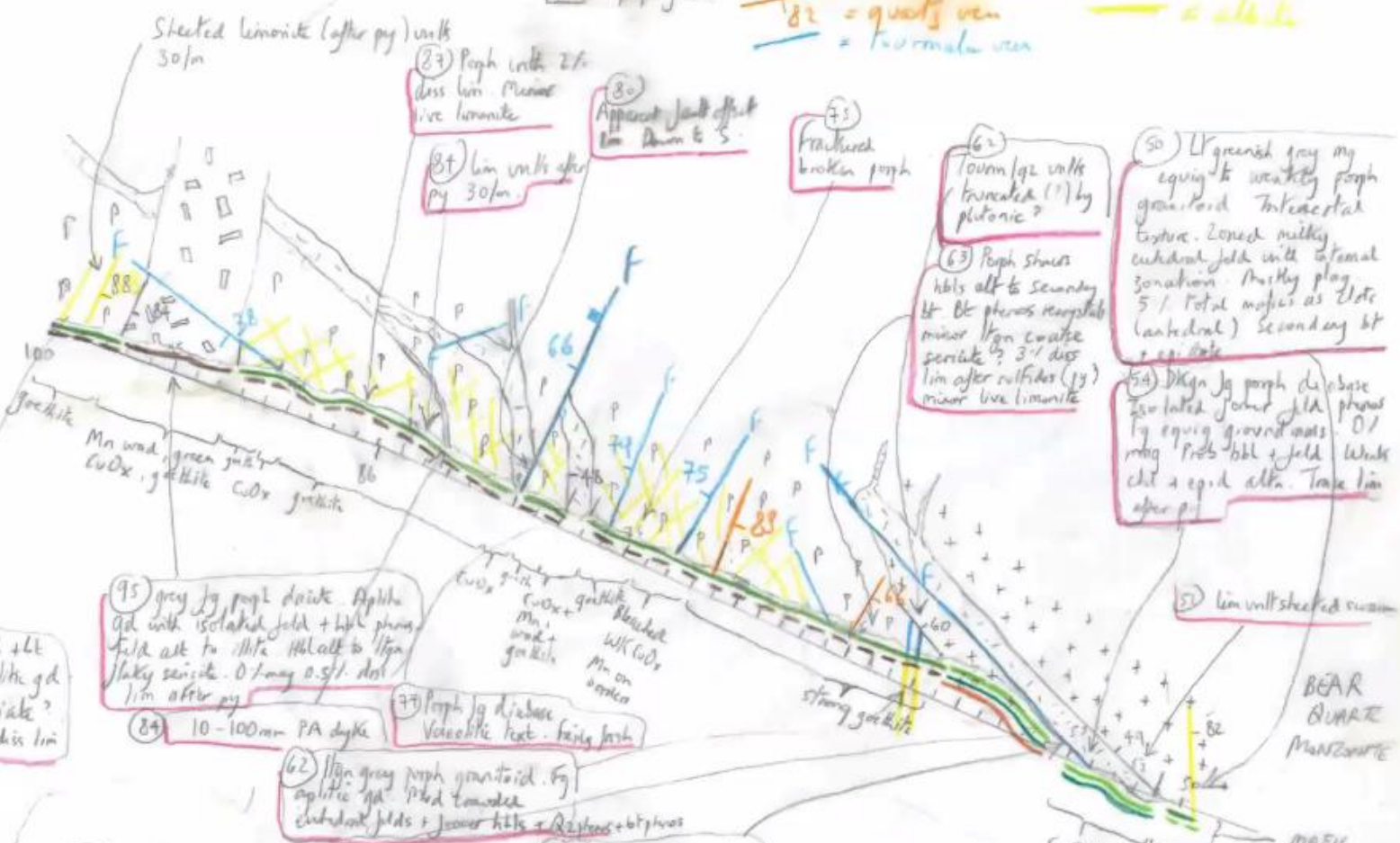
*Write in the Rain*  
LEATHER WRITING PAPER





+ = Bear Qz  
 Mangonite  
 P = Porph ground

81 = Iron sulphide  
 82 = quartz vein  
 = Ferruginous vein  
 = chert  
 = gneiss  
 = sericite  
 = albite



Sheeted limonite (after py) vein  
 30m

27 Porph with 2%  
 less lim. massive  
 live limonite

30 Apparent fault offset  
 1m down to S.

38 lim vein after  
 py 30m.

75  
 fractured  
 broken porph

60  
 100m qz vein  
 brecciated (?) by  
 plutonic?

63 Porph shows  
 hbts alt to secondary  
 bt. bt phos. sericite  
 minor than coarse  
 sericite? 3% disp  
 lim after sulfides (py)  
 minor live limonite

50 LF greenish gray mg  
 equig. to weakly porph  
 granitoid. Interstitial  
 texture. Zoned milky  
 calcareous feld with internal  
 zonation. Mostly plag.  
 5% total mafic as clots  
 (anhedral) secondary bt  
 + epidote

54 DKgn Jg porph de base  
 250m later former Jg  
 by equig ground mass. O/  
 mag. Prob bbl + feld  
 clots + epid. alts. Trace lim  
 after py

51 lim vein sheeted coarse

95 gray Jg porph diabase. Aplitic  
 gtd with isolated feld + hbts phos.  
 feld alt to albite. Hbl alt to Jg  
 slaty sericite. 0-1 mag. 0.5% disp  
 lim after py

77 Porph Jg diabase  
 Vaseolithic text. faint feld

84 10-100mm PA dyke

62 Thin gray porph granitoid. Jg  
 aplitic. Pd. Consider  
 calcareous felds + younger hbts + R2 phos + bt phos

dl + qz + hbts + bt  
 granitoid Aplitic gtd  
 to than sericite?  
 t & bt. 1% disp lim  
 sulphide

- 49W dyke contact
- 51/52 N dyke contact
- 1755 F<sub>2</sub> fault
- 1795 F<sub>2</sub> fault
- 98N dyke contact
- 1000

- 97.5 115/84N dyke contact
- 98 115/88N lim vein
- 99 087/82N lim vein
- 64 051/60N dyke contact
- 62 098/80S 100m qz vein
- 78 111/83N qz vein 20m

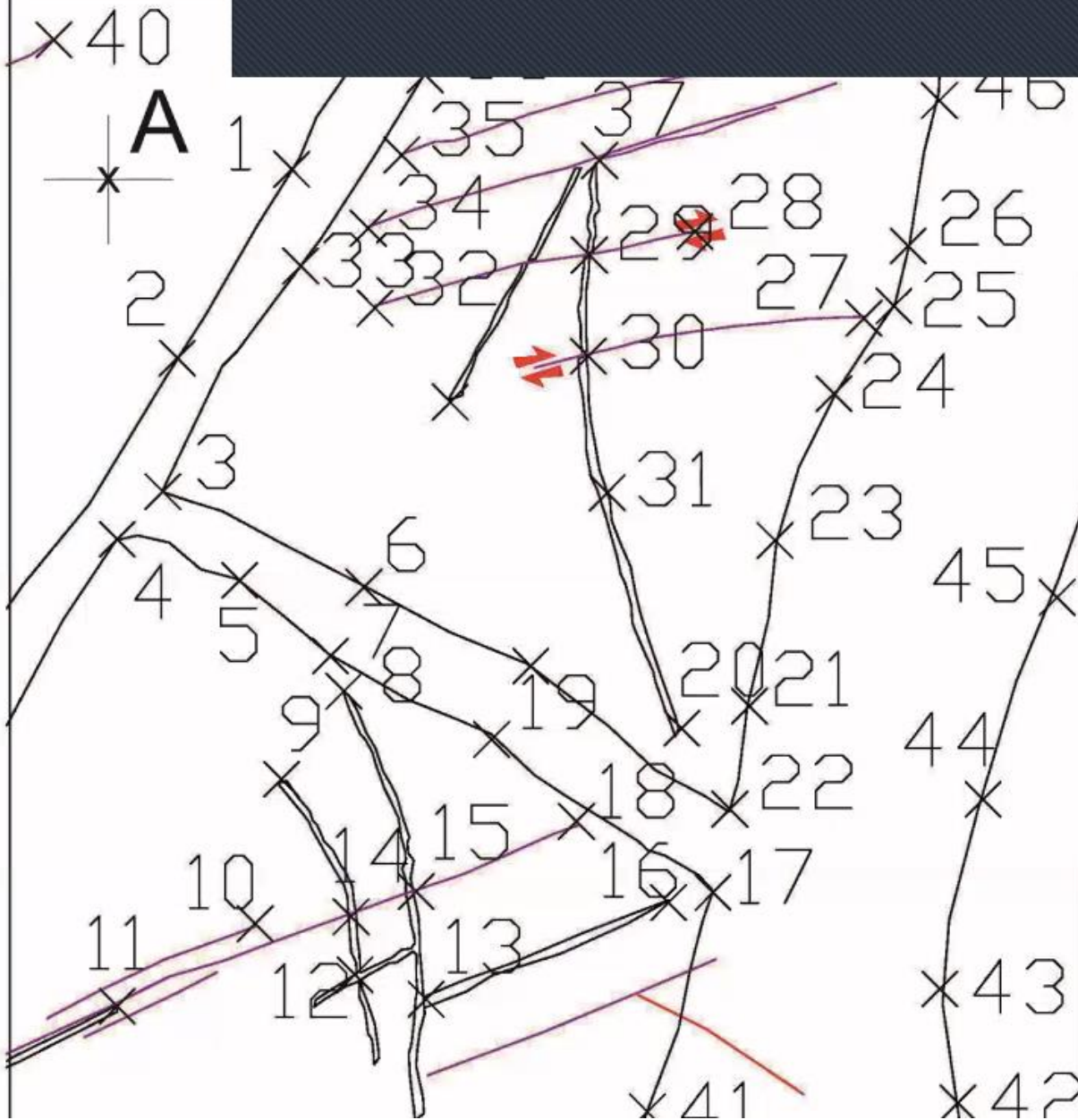
57 Thin mg equig  
 - lots porph granitoid  
 qz interstitial. Magic  
 has gone to ch. epid  
 sphere. Prob feld locally  
 gone to epid.

55 Lower dyke contact  
 is partly faulted,  
 with sericite gouge  
 Diabase is fractured  
 and an incipient bx

BEAR  
 QUARTZ  
 MANGONITE

MAFIC  
 SITES

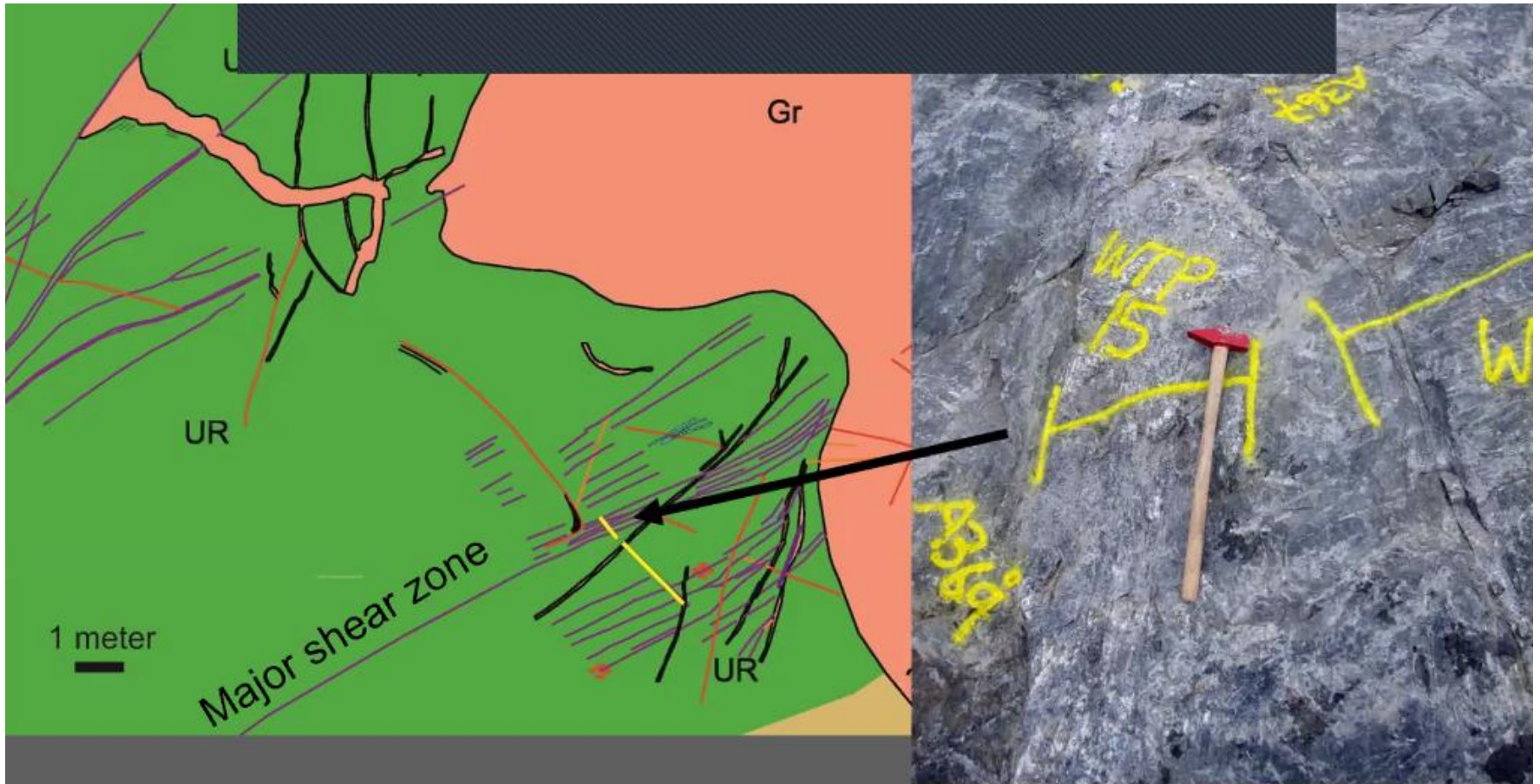




ART  
MEETS  
SCIENCE

1 meter





Channel sample WTP 15 = 28 g/t gold

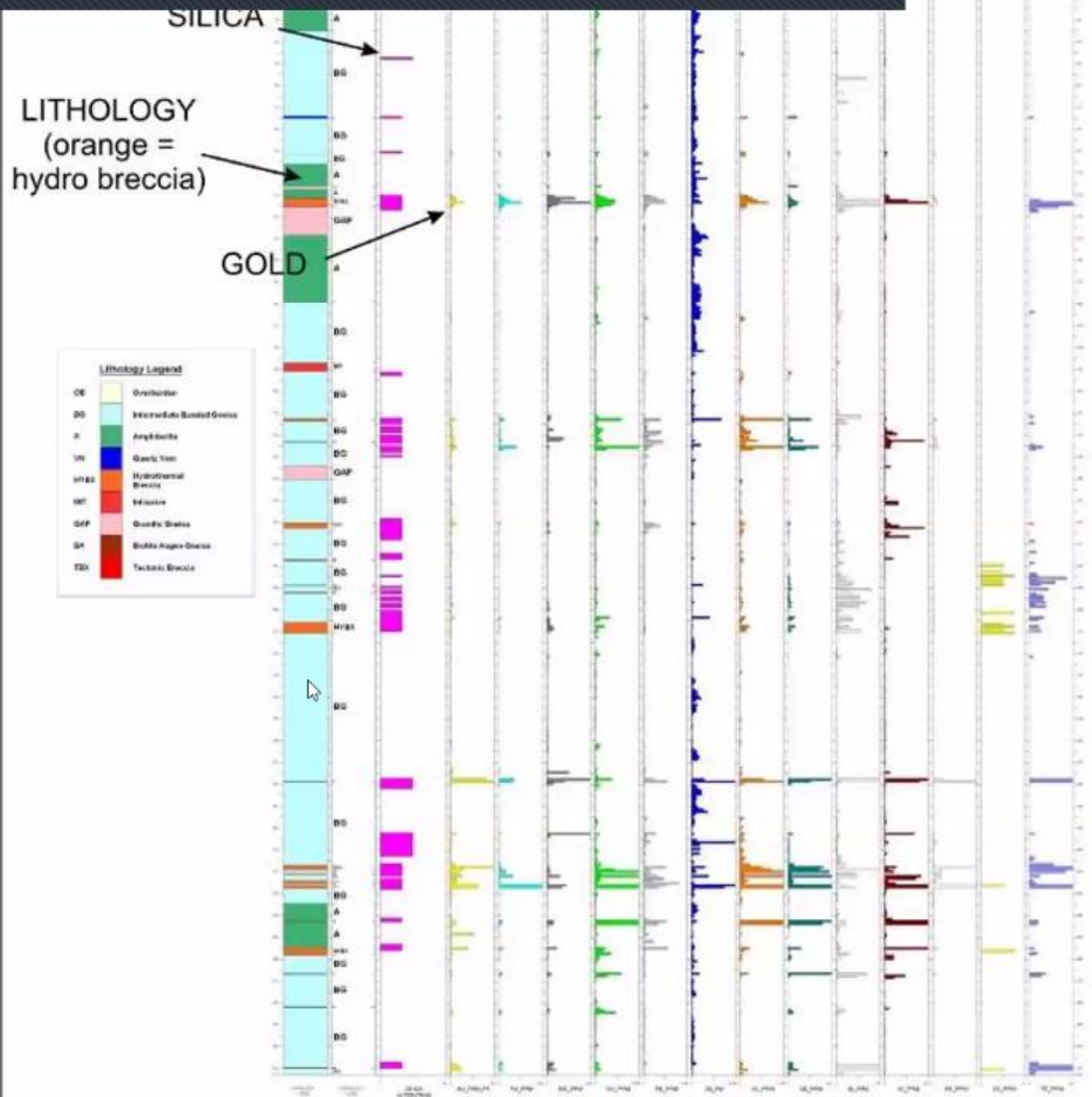
# CORE LOGGING

lies behind all the 3D models

Two things are guaranteed to cause arguments amongst geologists:

- 1) Breccia textures
- 2) Core logging

# Ventana Gold Colombia >8 Moz gold?



# COMMUNITY AND CULTURE







Green to white (or less) poorly sorted, silty, brown  
 with clasts up to 0.2m. Volcanic Matrix Suggests

52.5 Blanks up to at least 0.5m. Poorly sorted, light  
 60.2 Well bedded, well sorted, with and fine fragments. Volcanic Matrix.

70.6 clasts of siltstone up to 0.5m. Black siltstone volcanic

10+ Very poor sorted, angular, brownish, with some siltstone  
 112.8 Other grains of siltstone, volcanic matrix  
 121m matrix containing light  
 124.5 light green to silty, angular, and - some quartz

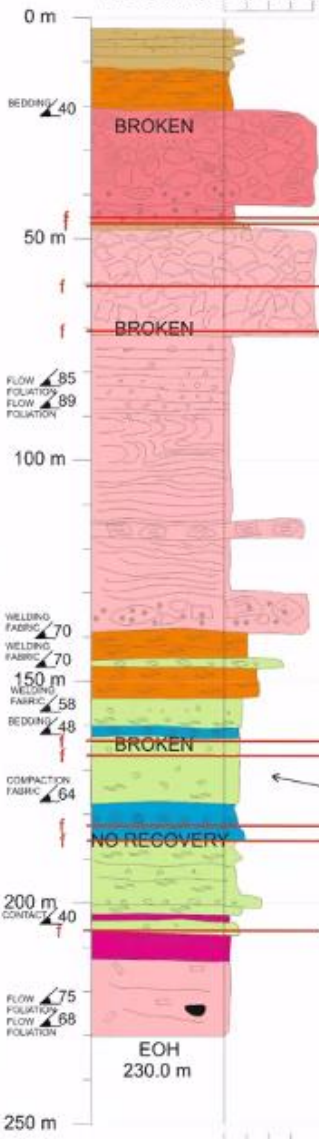
matrix to matrix

245 @ 49.5 0.1m bedded  
 49.8 ss & silt or vein  
 with mudstone  
 containing lignite and coal  
 250 @ 63.7 0.2m thick  
 442 @ 70.6 0.2m thick  
 450 @ 71.5 fault zone zone  
 block shakandi blue  
 tabular siltstone  
 47 @ 73.2 52 - No angle

46 @ 102 & 120m Conformable  
 47 @ 110.8 20m conformable  
 48 @ 112.2 0.1m conformable  
 block of siltstone  
 with grey silty  
 siltstone  
 43 @ 124.5 0.1m  
 with siltstone



LIDC 319



6m Deeply weathered, brown, probable bedded, coarse grained sulfurous sandstone?

11.6m Light green, strongly clay-altered tuff, probably strongly welded. Probably porphy-rich. Small 800c lapilli up to 3mm.

19.5m Top contact of APDA, probably auto-brecciated. Overlain by lapilli tuff, green, strongly smectite altered.

22m Broken zone with strong hornfelsic staining and kaolin-like alteration. No obvious fault zone.

32m Limestone stained, siliceous APDA with probable auto-brecciation. Patches and textures with light green 800c?

39m Crest of strong up-faulted, perlitic bedrock

44m Poorly developed snowflake texture, formerly obsidian.

45.7m Base of felsic flow contact is sharp. Overlies poorly sorted tuffaceous unit with polymict lapilli, mostly felsic, and probable felsic clasts altered to illite, chlorite. Crest up to 10cm, but mostly less than 2mm

46.7m Top of felsic flow marked by perartite with fingers of sand injected into formerly glassy subvolcanic, with perlitic texture.

50m Coarse, hornfelsic-stained auto-breccia altered to illite/kaolinite mix?

54m Continued, light green former glass, with perlitic texture and auto-breccia. Very clay altered.

58.8m Light green hydrothermal auto-breccia, originally glassy.

63.5m Continued formerly glassy auto-breccia and hydrothermalite with perlitic texture.

72m Felsic rock with weak skarn of irregular quartz veins with druse cavities.

83.5m

84.5m 84c Original station strongly flow foliated, abundant spherulites up to 50mm, some with druse quartz < 1cm dia.

131m

136.7m 132m Continued felsic auto-breccia, with strong spherulitic texture and snowflake obsidian. Original obsidian.

142.5m 138m Sharp contact between spherulitic original obsidian and strongly welded tuff.

142.5m 142.5m Probable welded tuff with abundant former glassy horizons. Some with perlitic texture. Scattered angular 800c lapilli, mostly porphyritic felsic rock.

146.0m Poorly sorted tuff with lapilli up to 20mm. Local calcite-altered clasts.

150m Apple green, siliceous welded tuff with distinctive large feldspar crystals. Wrappy, indistinct green, chert (purple staining).

150.5m Approximate base of welded tuff. Underlain by green, poorly sorted, massive, non-welded tuff. Scattered lapilli up to 8mm.

160.5m Accessionary lapilli, well bedded fine grained tuff, locally porphyritic.

162.3m Broken core with smectite alteration. Some slickensided fragments. F2 fault? Abrupt change into oxidized, siliceous rock.

167.9m 160m Light grey, siliceous tuff, with ill-defined texture. Common calcite cemented crackle breccia.

169m Brownish-grey, very siliceous, undisturbed tuff with small porphyres. Weak streaks of calcite veins.

174m 167.2m Strongly broken core with smectite alteration. Probable major fault. Slickensided pieces.

171.2m White-fresh, green, fine grained massive tuff with oxidized purple and 800c lapilli up to 20mm. Probable chlorite, illite, sphene and pyrite alteration.

181m 181m Siliceous light green, fine grained tuff and tuffaceous sandstone with abundant accessory lapilli.

181m Siliceous accessionary lapilli and probable fault zone, oxidized with abundant smectite. F2 major fault.

190.5m Coarse, very siliceous, fine grained sandy tuff with lapilli up to 5mm, locally rich in small porphyres. Contains minor spicules.

197.2m 203.2m Contact with breccia comprising mostly quartz vein fragments with some well rock clasts cemented by granular calcite and loose porous clay (smectite?). Bedrock beneath.

203.2m 203m Vein includes hornblende sprays of fibrous, prismatic, columnar. Hornblende 5. Unconformity. Large parts of vein comprise milky quartz or chloritoid, massive. Cut by the late coarse grained calcite veins.

209m 209m Major diastrophic vein with local scoriolite cross-bedding. Some grey sulfide-rich bands with green copper bodies after sulphides. Minor late, siliceous fault breccia cut by the vein.

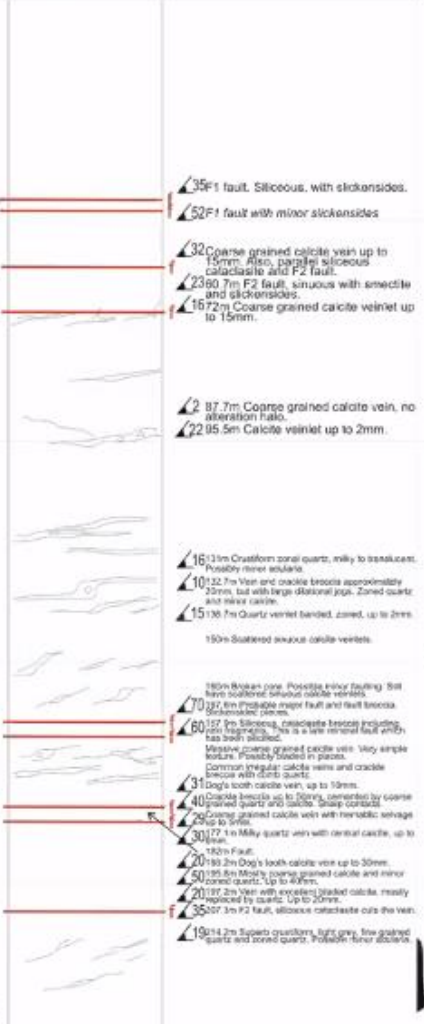
209.4m 214.2m 200c fine Sphero-banded texture with large plates replaced by chertoid and prismatic positive sulfides. Some contrast calcite plates.

213.8m Greenish-grey, siliceous, nepheline phenocrysts and former mafic phenocrysts up to 2mm. Groundmass is speckled and clotted, chlorite-rich. Porphyritic double anhydrite (PDA).

222.8m PDA, greenish-grey siliceous, fine bedded, glomerated spherulitic with smectite. Scattered quartz spherulites. Magmatic and epidote-rich. Weak epidote stockwork.

222.5m Flow foliation is marked by clusters of magnetite and ill-defined veins.

STRUCTURES

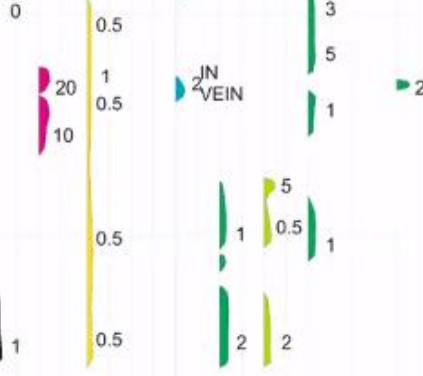


MA SIL PVP SP5 CAI

CHLORITE EPIDOTE ILLITE KAOLINITE SMECTITE

20

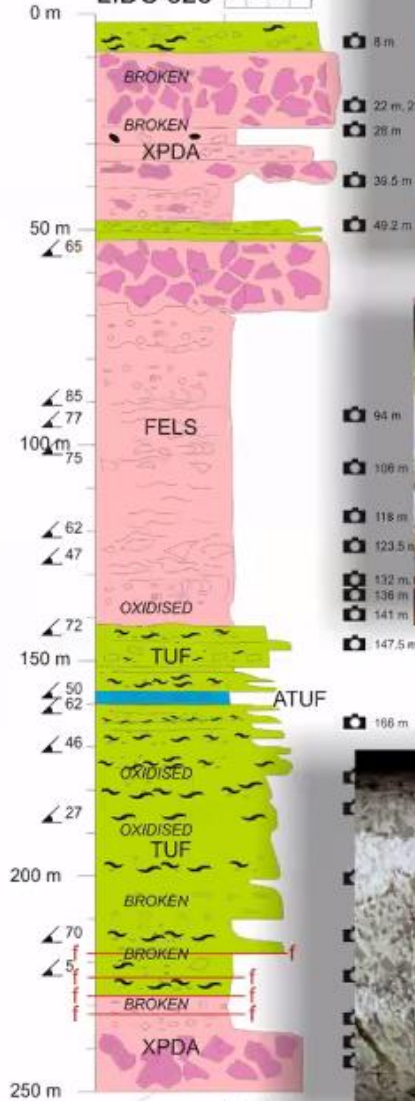
20



Au\_ppm



LIDC 323



ABOVE 94 m Flow banded rhyolite/felsic lava.



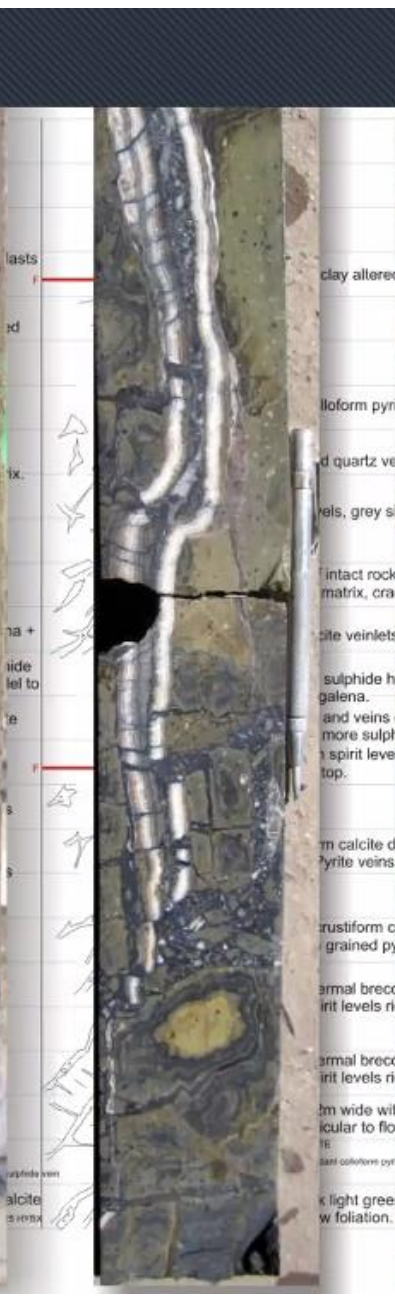
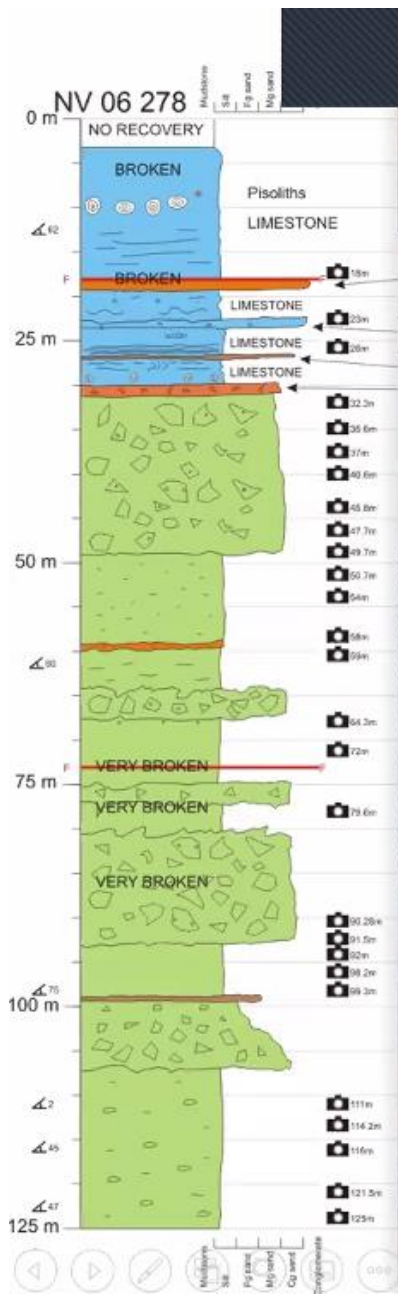
BELOW. 136.4 m Spherulitic rhyolite with spherulites up to > 0.1 m diameter.



147.5 m ABOVE 132 m Spherulitic rhyolite/felsic lava.  
166 m BELOW. 141 m Welded tuff with large pumice flamme.



Fine grained lapilli tuff with small pumices.



lasts

rd

ix.

ra +

side lel to

te

zrphide veins

alcite

5 HV30

clay altered

loform pyrit

d quartz vei

els, grey sil

intact rock matrix, crack

ite veinlets

sulphide hy galena. and veins c more sulphi spirit level. top.

m calcite dc pyrite veins.

rustiform ca grained pyr

armal brecci rit levels ric

armal brecci rit levels ric

tm wide with icular to flow

FE

bari calciferous pyrite

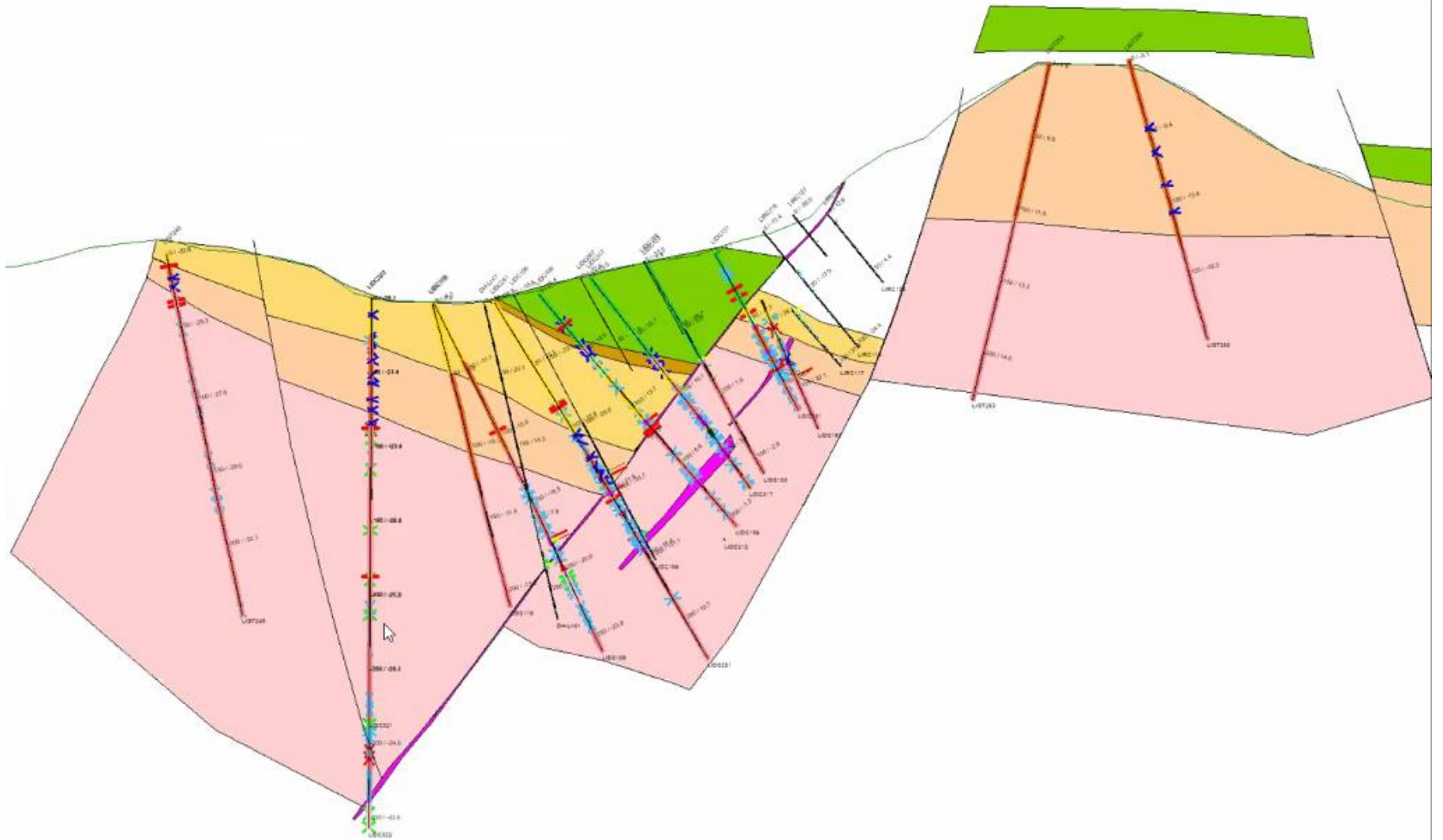
k light green w foliation. S



Smeectite

late dogs tooth calcite.

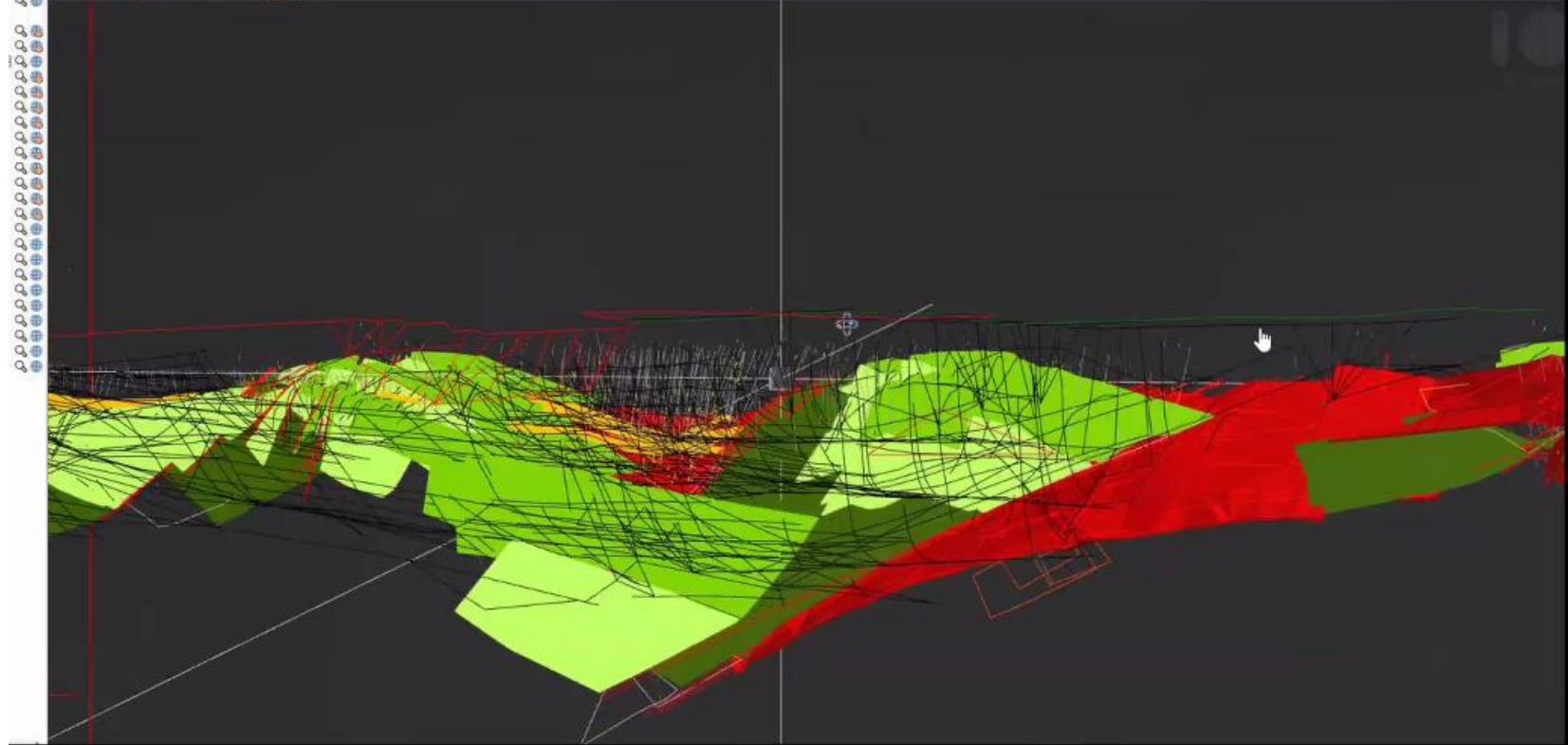
Hole_ID	mFrom	mTo	Description	Code	Value					
CCDC020	165.5	165.6	spirit level		165.6					
CCDC023	105.5	105.6	fault	2 F2 FAULT	15					
CCDC023	108.8	108.9	vein	QZ VNLT	42					
CCDC023	113	113.1	fault	1 F1 FAULT	34					
CCDC023	120	120.1	vein	BX CONTACT	28					
CCDC023	131	131.1	flow foliation		64					
CCDC023	141	141.1	flow foliation		69					
CCDC023	141.5	141.6	vein	CALCITE VN QZ VN	18					
CCDC023	157.4	157.5	vein	CONTACT	40					
CCDC023	160.2	160.3	fault	1 F1 FAULT	45					
CCDC023	170.5	170.6	fault	1 F1 FAULT	35					
CCDC024	205.2	205.3	vein		50					
CCDC025	38.8	38.9	fault	2 F2 FAULT	45					
CCDC025	46	46.1	flow foliation		55					
CCDC025	47	47.1	vein		25					
CCDC025	47.6	47.7	vein		30					
CCDC025	50	50.1	vein		40					
CCDC025	50.5	50.6	flow foliation		50					
				F3 MAJOR						
CCDC025	53	53.1	fault	3 FAULT	40	Hole_ID	mFrom	mTo	check	LITH CODE
CCDC025	65	65.1	flow foliation		60	CCDC020	62	127	0 PA	
CCDC025	100	100.1	spirit level		62	CCDC020	127	128.5	0 TUF	
						CCDC020	128.5	149.5	0 PA	
						CCDC020	149.5	153	0 VN	
						CCDC020	153	159	0 HYBX	
						CCDC020	159	162	0 PA	
						CCDC020	162	165.5	0 VN	
						CCDC020	165.5	165.6	0 FLT	
						CCDC020	165.6	170	0 VN	
						CCDC020	170	174	0 PA	
						CCDC020	174	174.1	0 FLT	
						CCDC020	174.1	185	79.5 PA	
						CCDC023	105.5	105.6	0 FLT	
						CCDC023	105.6	120	0 PABx	
						CCDC023	120	121	0 HYBX	





Package Select/ Navigate Pan Zoom Zoom Reset Zoom View Lock Change View  
Close Navigate Mode In Out View Axes direction View View Manager  
ission navigate

90 : 90 : 20 :



Butte, USA



Warren Pratt



Carlsbad, Mexico



Bingham, USA



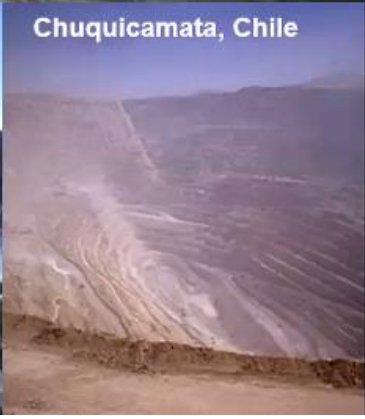
El Teniente, Chile



Escondida, Chile (from space)

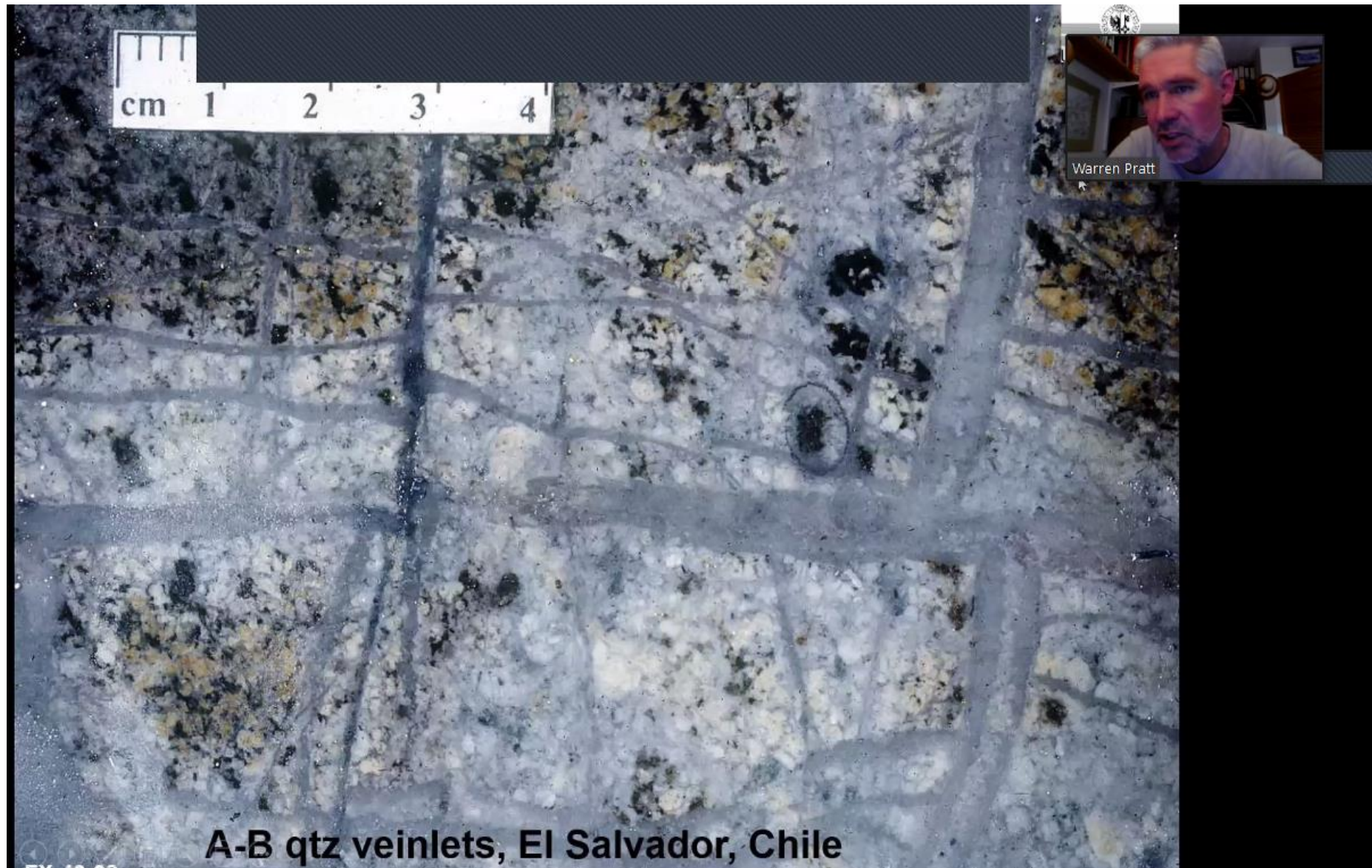


Bajo de la Alumbrera, Argentina



Chuquibambilla, Chile

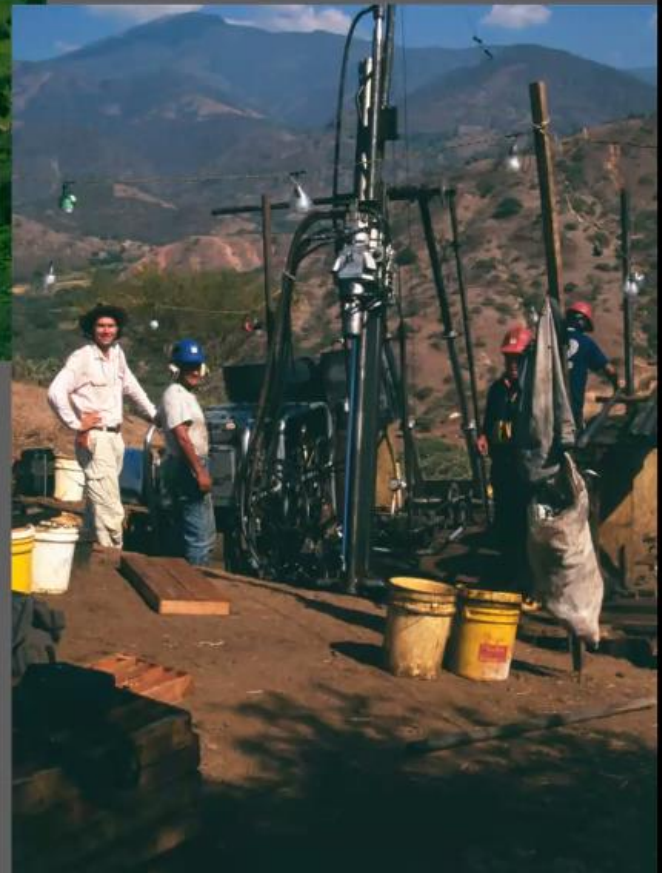
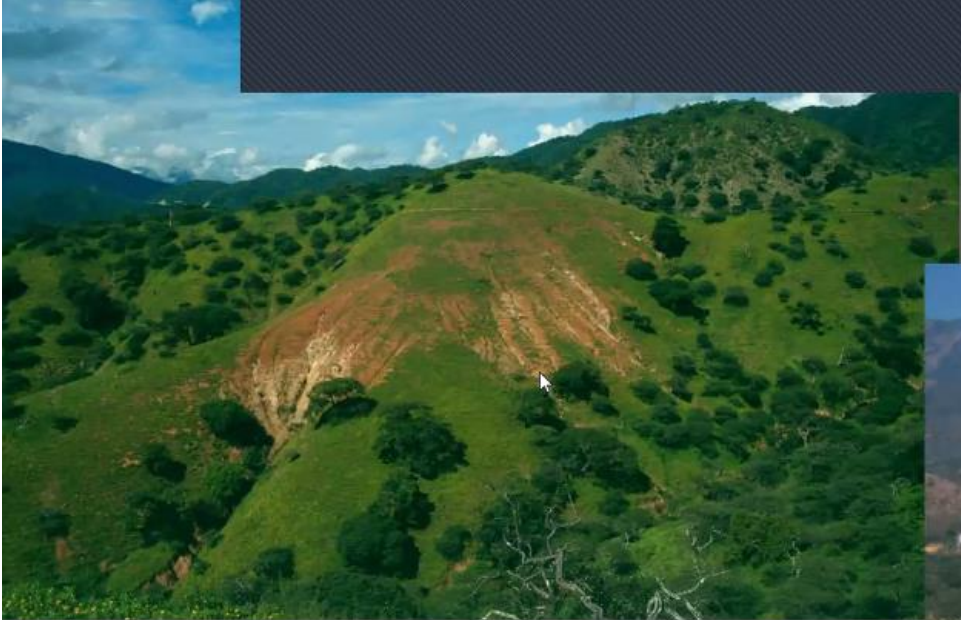




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A-B qtz veinlets, El Salvador, Chile

EX 10 00





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# WHEN RESERVOIR MODELS GO WRONG



- This can be disastrous
- Mostly due to a poor geological model
- This can reflect the quality of 'mapping' (not just conventional 2D mapping, but cross sections, and 3D models)
- The paragenesis may not be understood
- The geology is simply not well enough understood

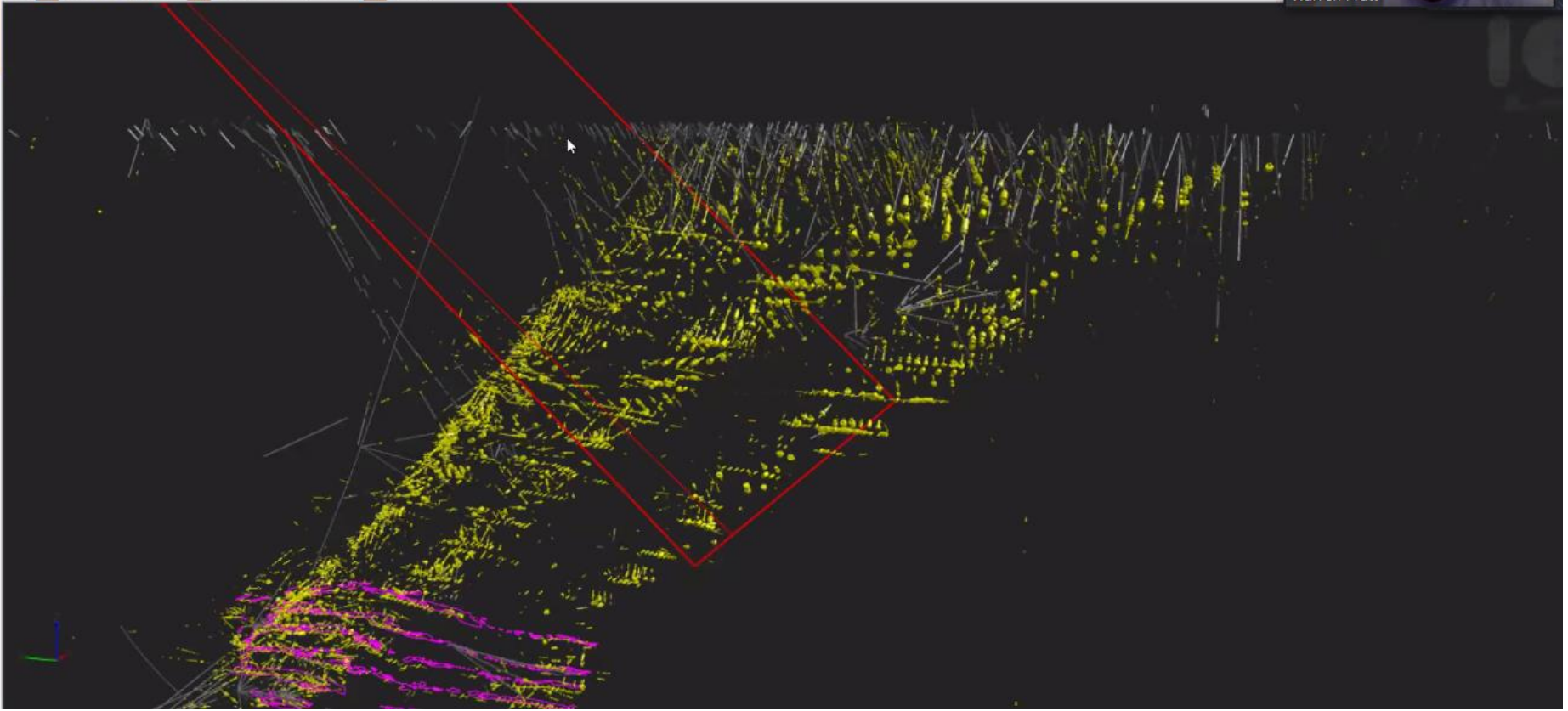
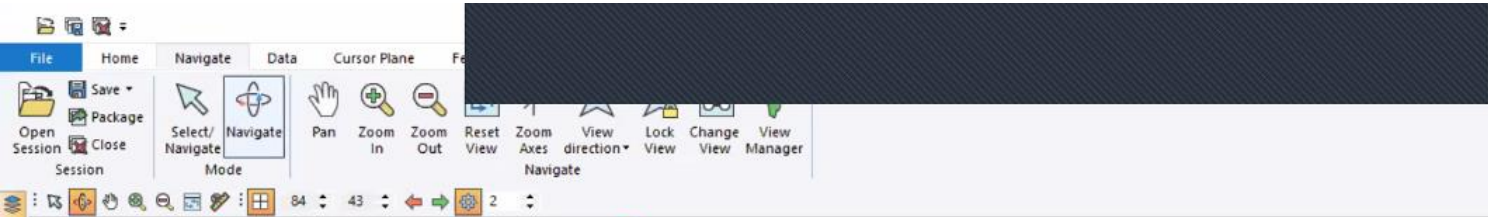
File Home Navigate Data Cursor Plane Fe

Open Session Save Package Close Session

Select/ Navigate Mode

Pan Zoom In Zoom Out Reset View Zoom Axes direction View View Lock Change View View Manager

84 43 2



Home    Navigate    Data    Cursor Plane    Fe

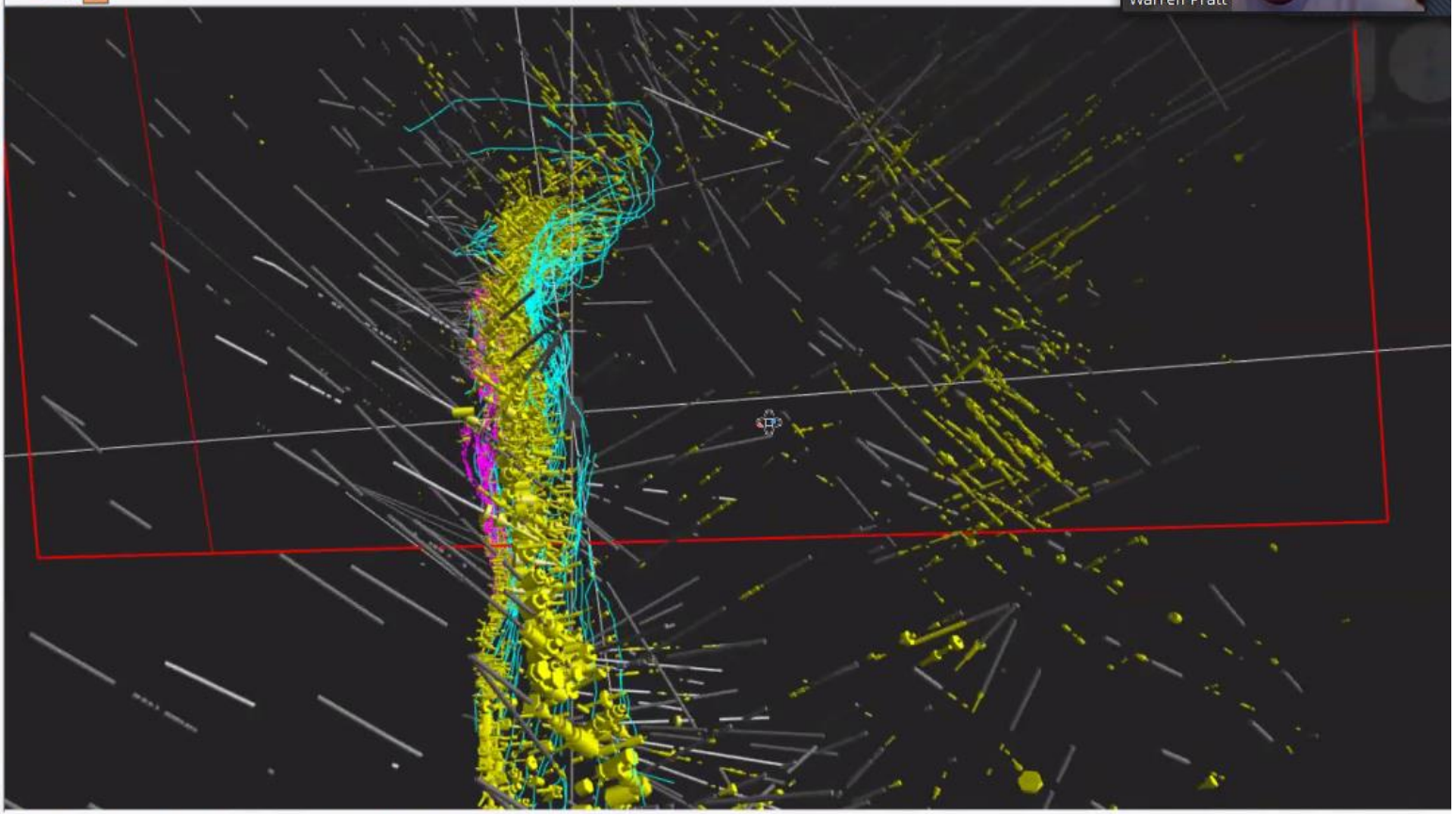
Save    Package    Close    Session

Select/ Navigate    Navigate    Plane Toggle    Plane Settings    Window    Fit    Enlarge Shrink    Plane Orientation Perpendicular    Plane Lock Plane    Align to Section    Plane Clip    Lock Clip    Width 200    Bond    Previous Object    Next Object

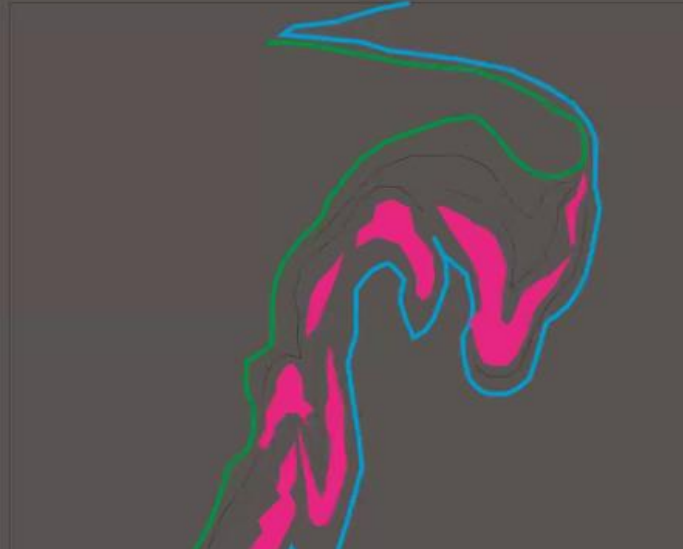
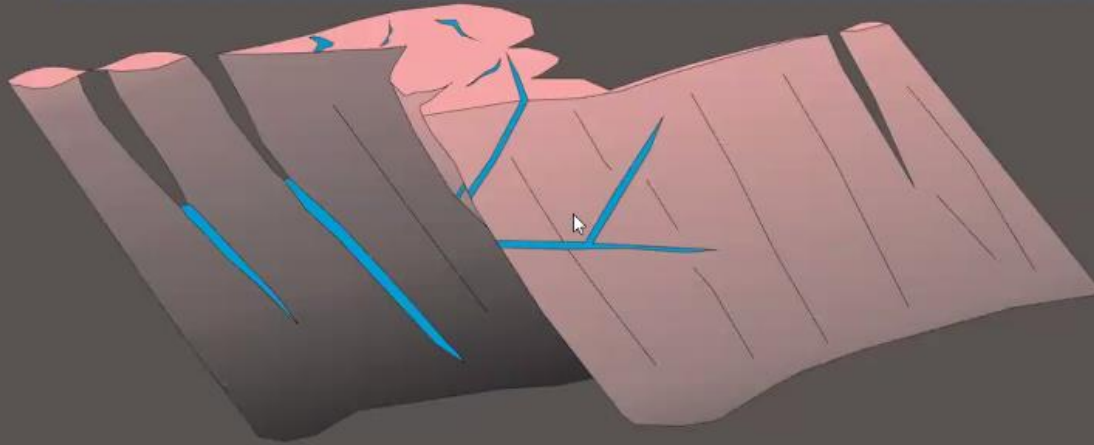
View    Clip    Bond



- 3D Map
- Axis
  - Cosmetic
  - Talc\_model\_WTP
  - feldspar\_porphy...
  - talc\_model
  - talc\_schist\_mappi...
  - lithologies drill
  - gold drill



CATION 10252.66m 5309.73m -192.53m Bearing: 6° Inclination:-48° Distance: 417m    CURSOR PLANE 10307.17m 5445.16m 31.66m Bearing: 84° Inclination: 43°



# Volcanogenic massive sulphide



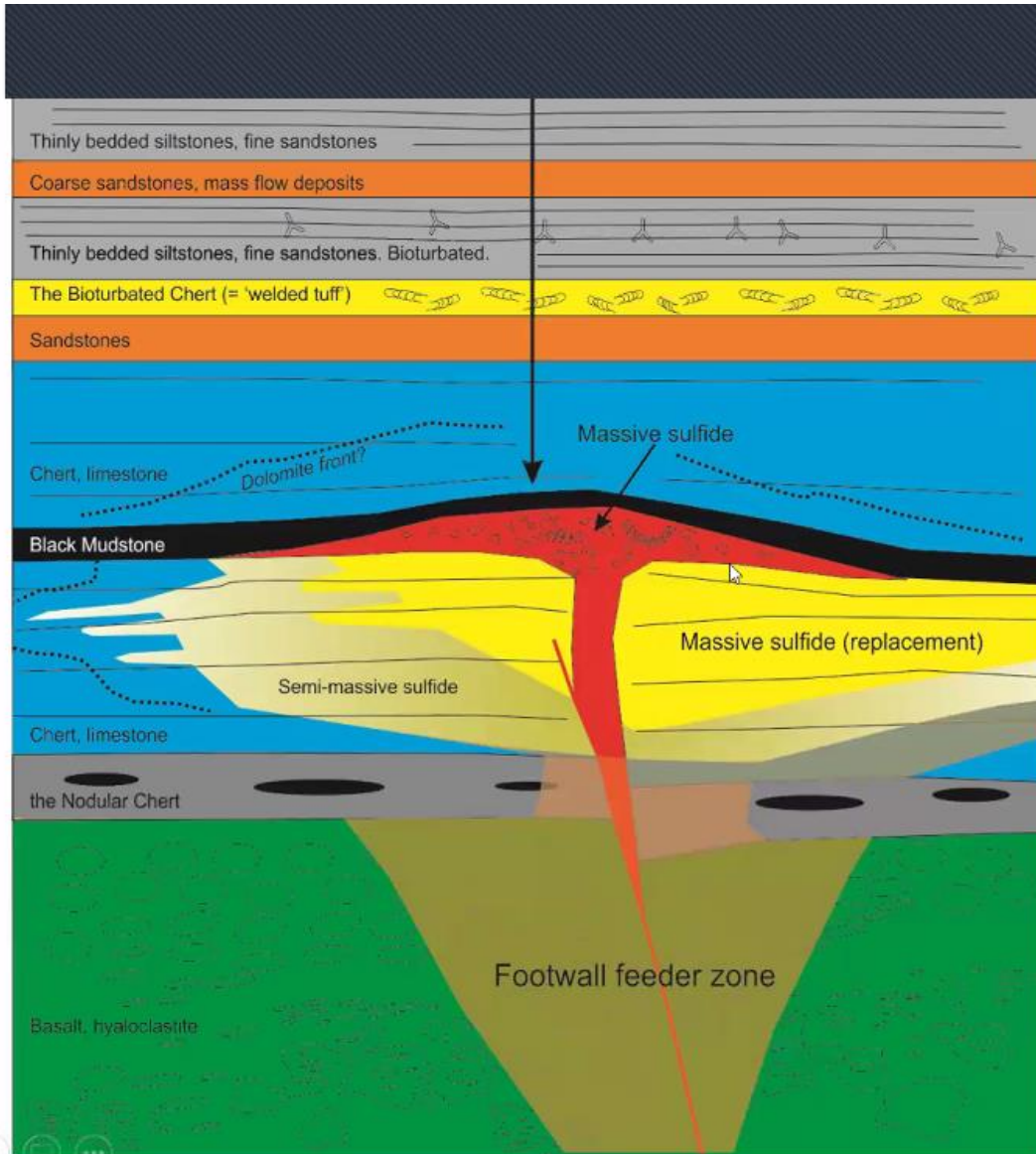
Unusually gold-rich Cyprus-type (?) Cu/Zn massive sulphide

Milling 300 tonnes per day

Associated with a dolomitised limestone

Above pillowed basalts and overlain by cherts and sandstones

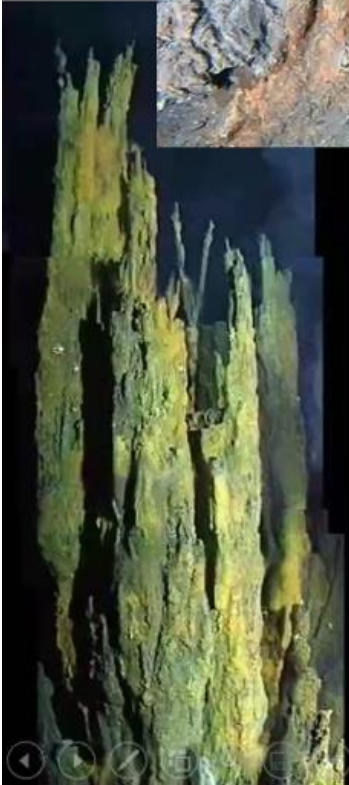




Top of



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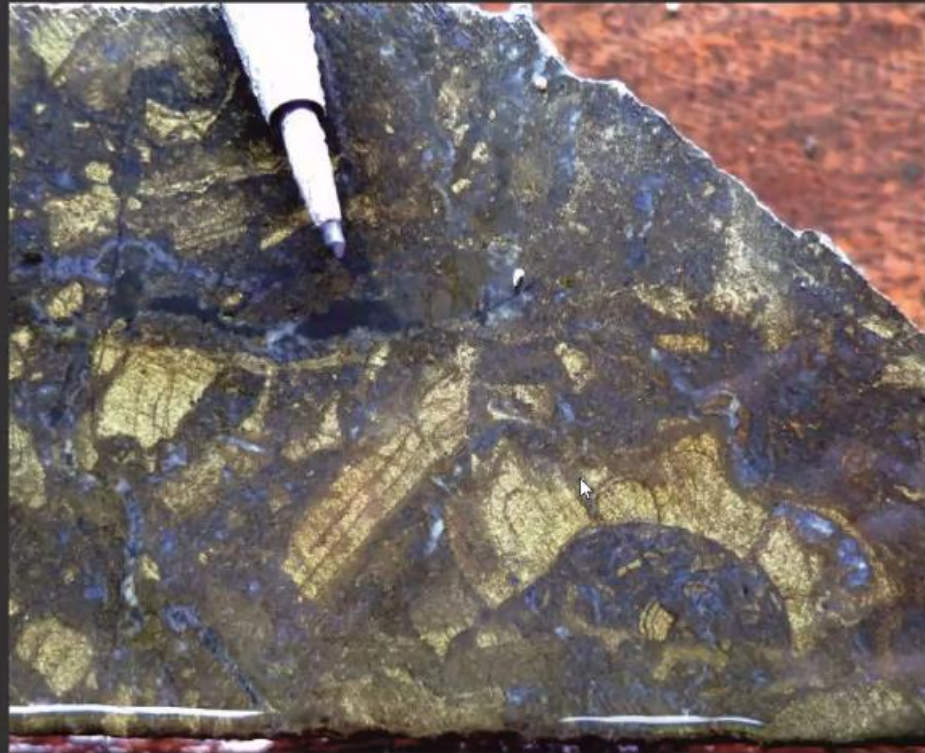
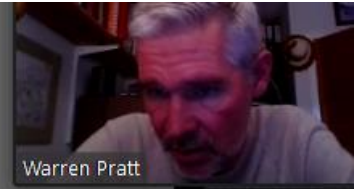
2 cm

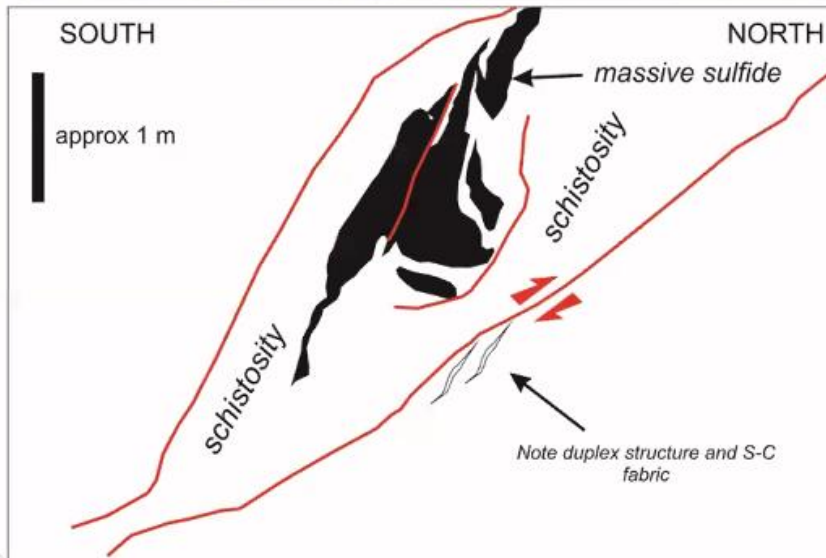


5 cm

*From Jim Franklin*

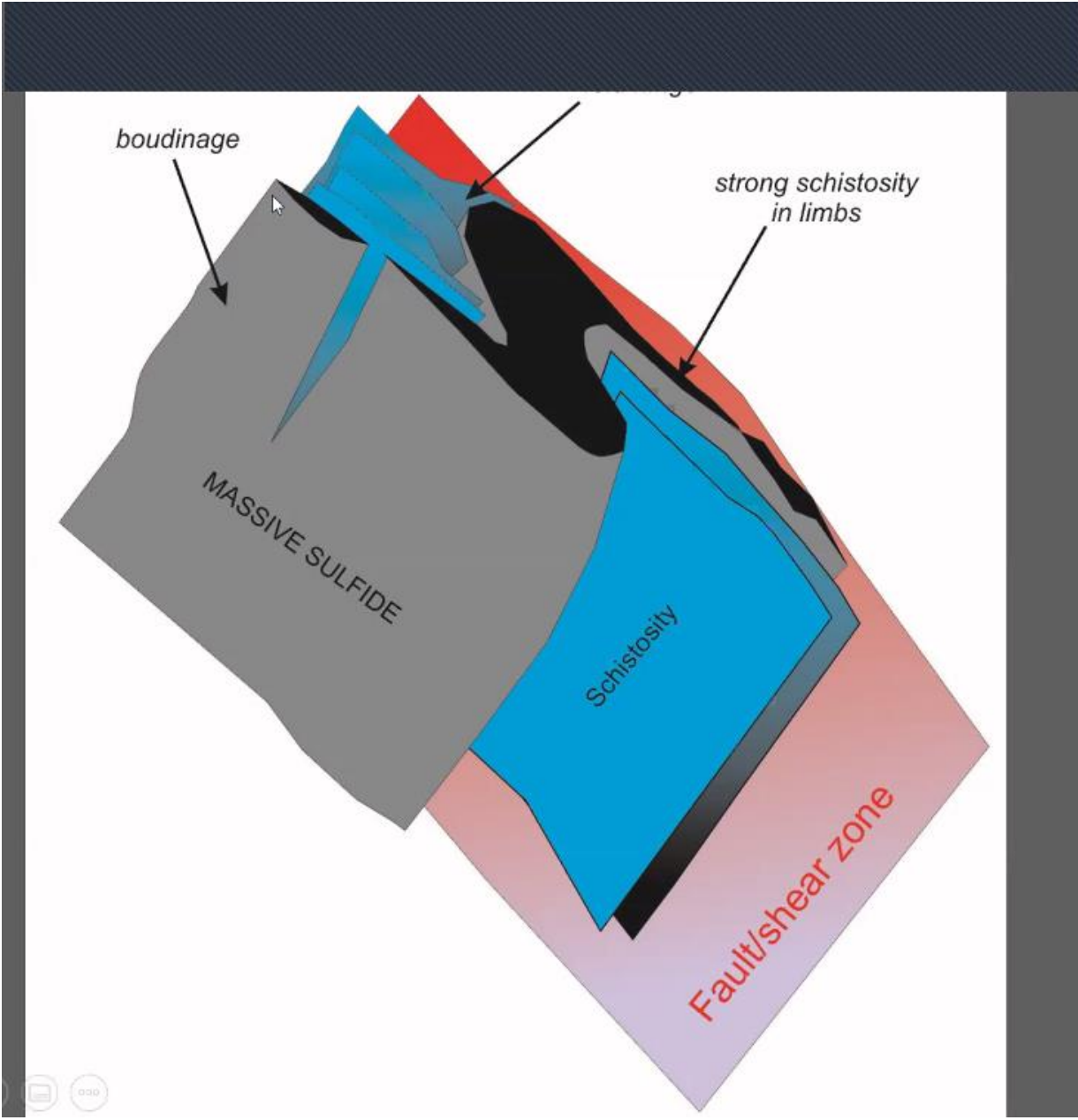
# Tubeworms and chimney fragments







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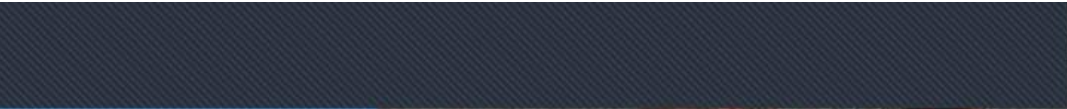
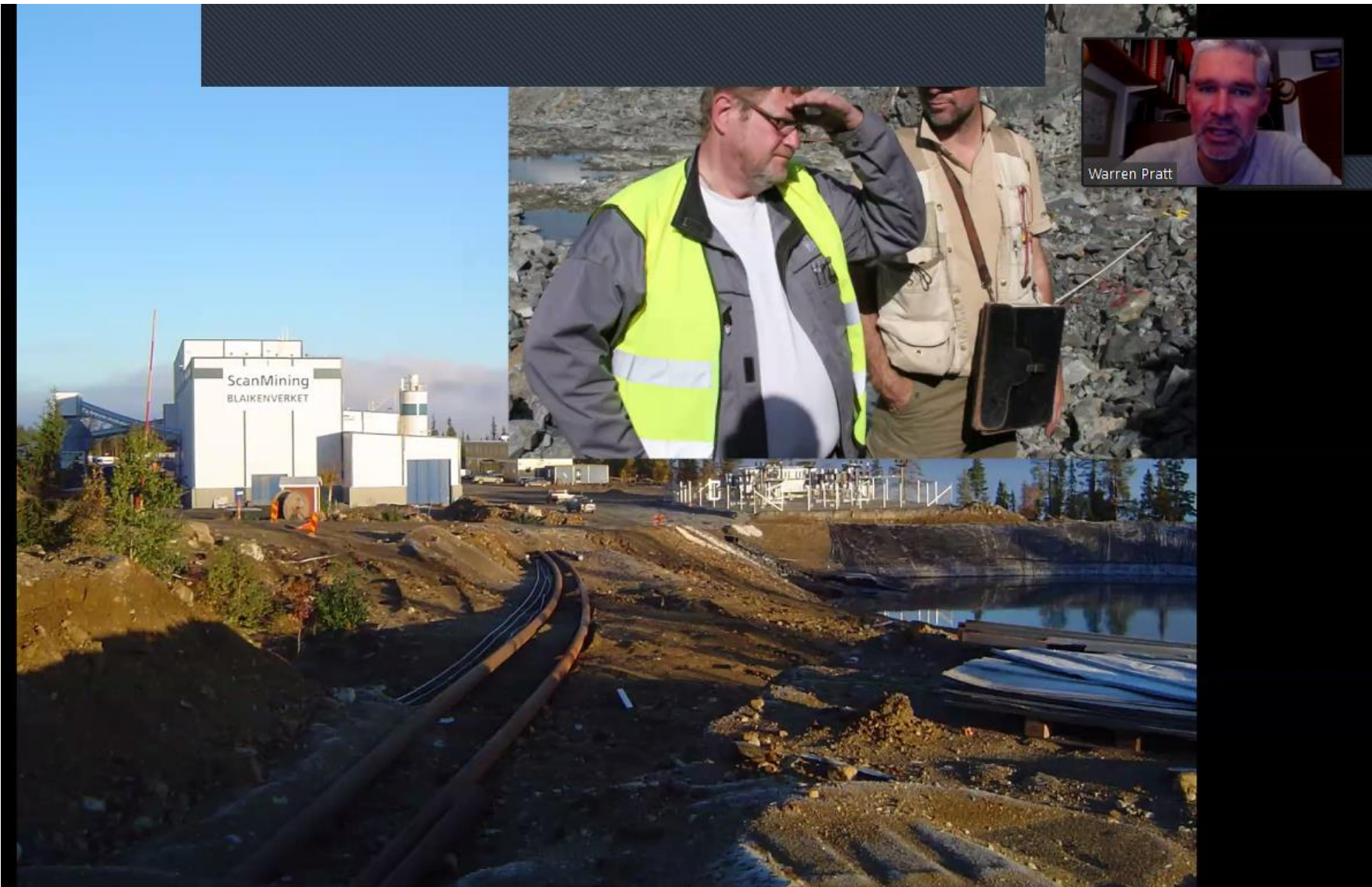


Gold can be 'nuggety'. This can make resource calculations very difficult. These type of mines tend to have little or no 'reserves'. Hand-to-mouth existence. The mill is always hungry.

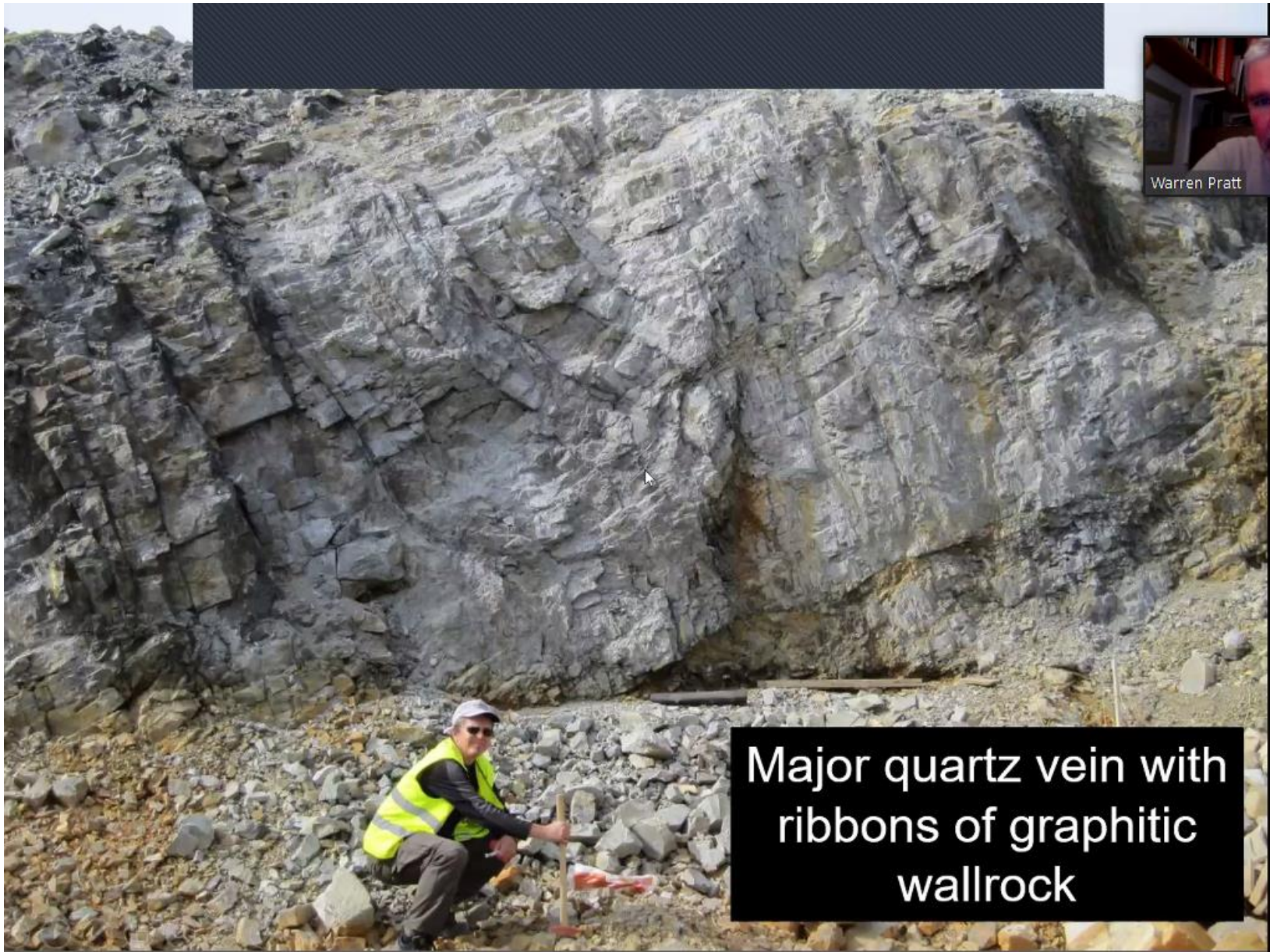
Poor downhole surveys.

Search directions in the resource model (which feeds back to a bad geological model).





ScanMining  
BLAIKENVERKET



Major quartz vein with  
ribbons of graphitic  
wallrock



# CONCLUSIONS

- USE THE TECH/SOFTWARE
- FOCUS ON WHAT IS RELEVANT
- AND NEVER FORGET MAPPING.....





Warren Pratt



Pratt



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