NDSU Petrology 422 2018

Fire Creek Gold-Silver Mine, NV

By Sam Marolt

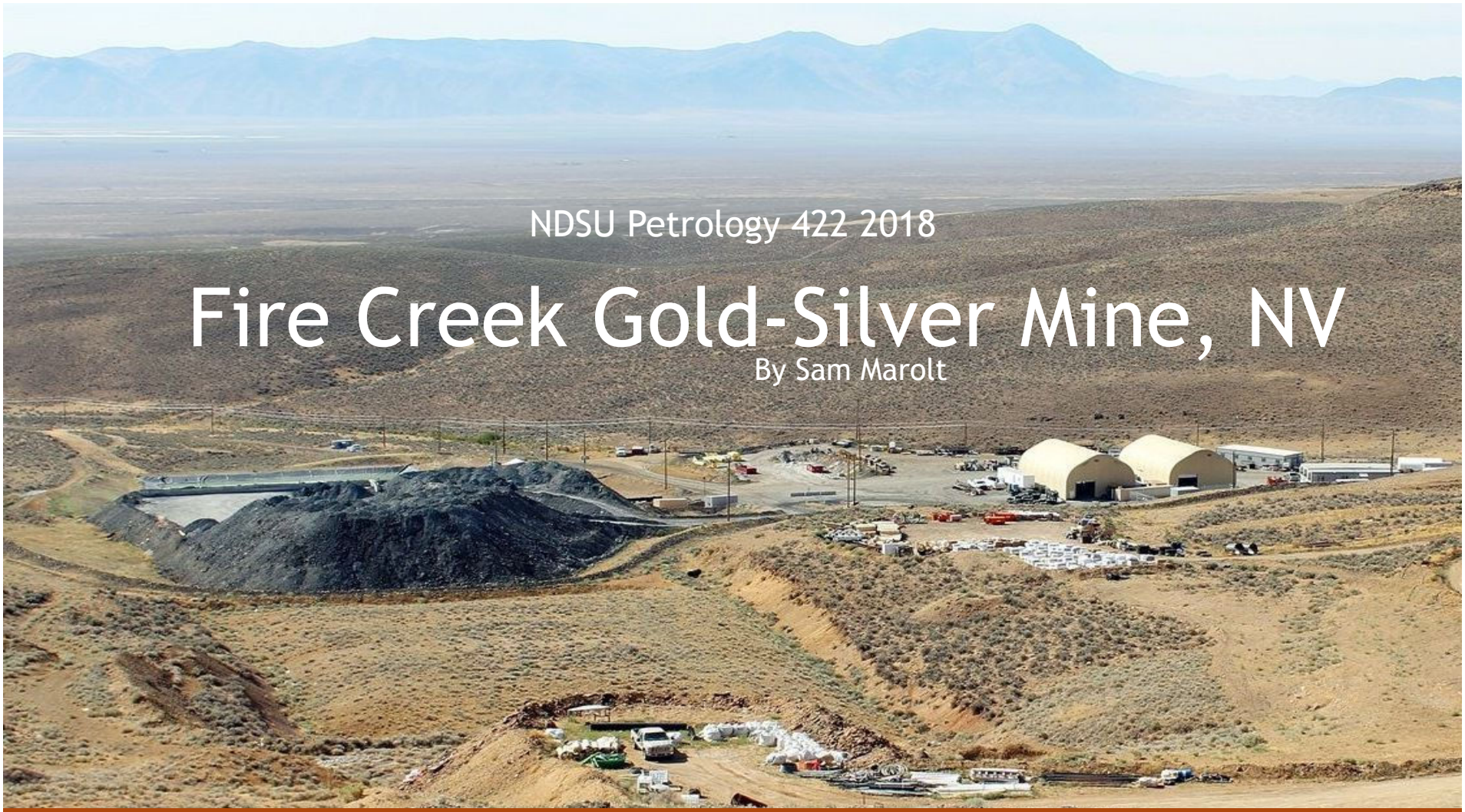
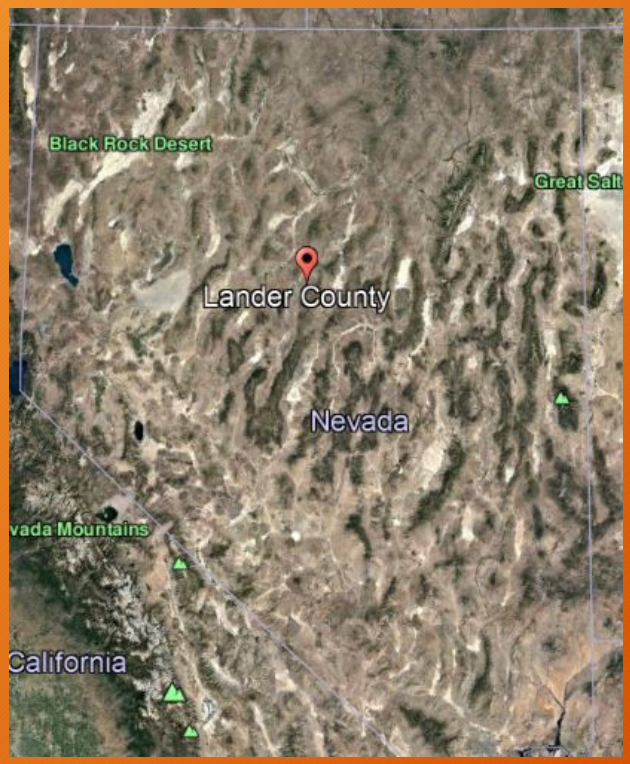


Photo from article “Comments sought on Fire Creek mitigation” by Elko Daily Free Press

Locality

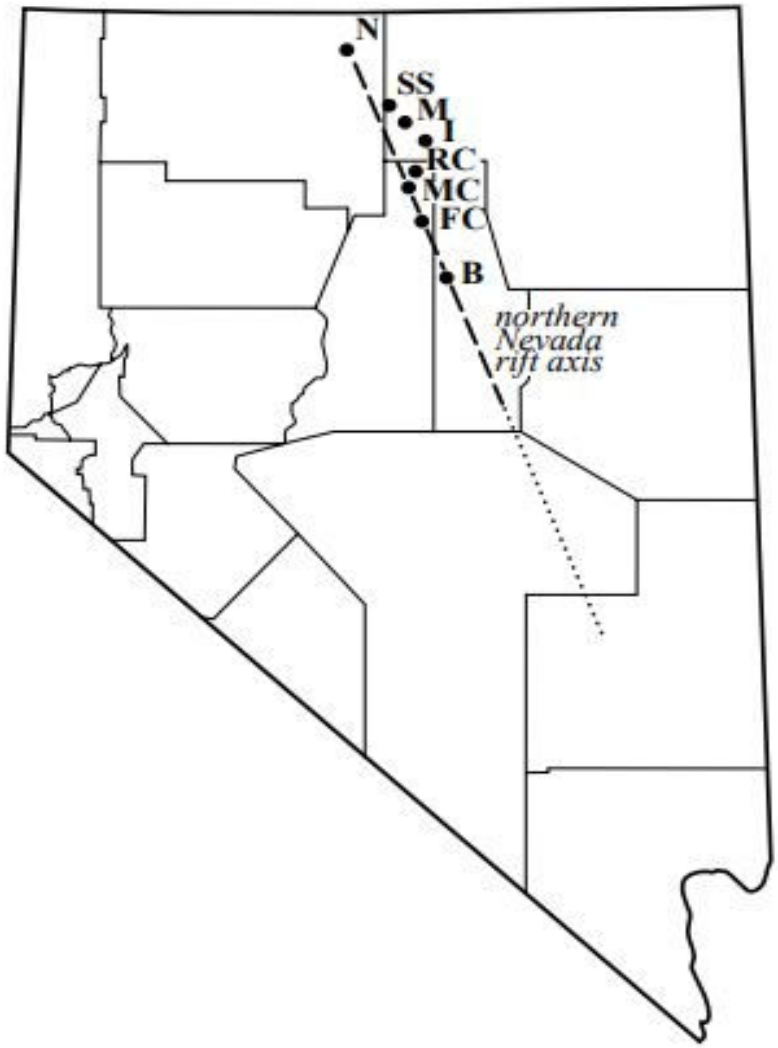


Images from Google Earth Pro

Northern Nevada Rift

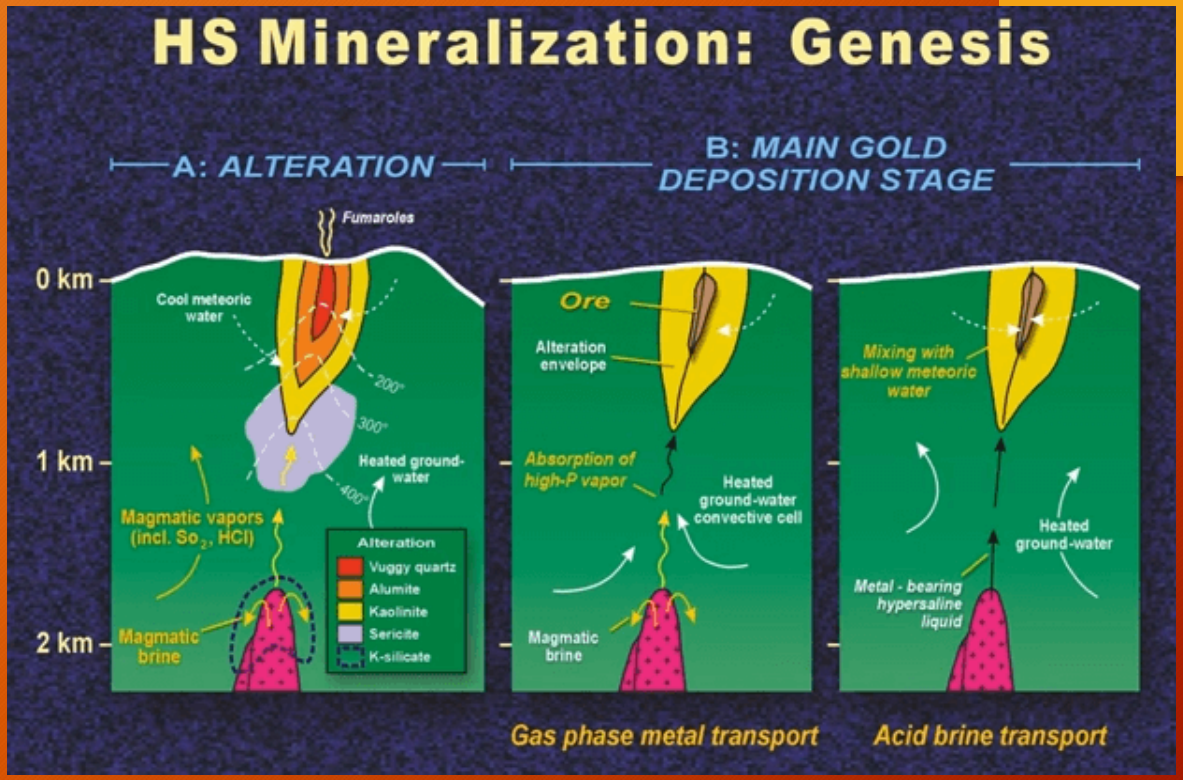
- Fracture system
- Reactivated when triple junction point moved northward
- Mix of basaltic, intermediate, and felsic magmas

(Wallace and John 1998)



Hydrothermal Solutions

- Vuggy quartz
- highly acidic saline fluids with $AuCl_2^-$
- Entrapped in gasses and transported as AuS
- Mixes with meteoric water
- Turns into Au(HS)
- Precipitates out

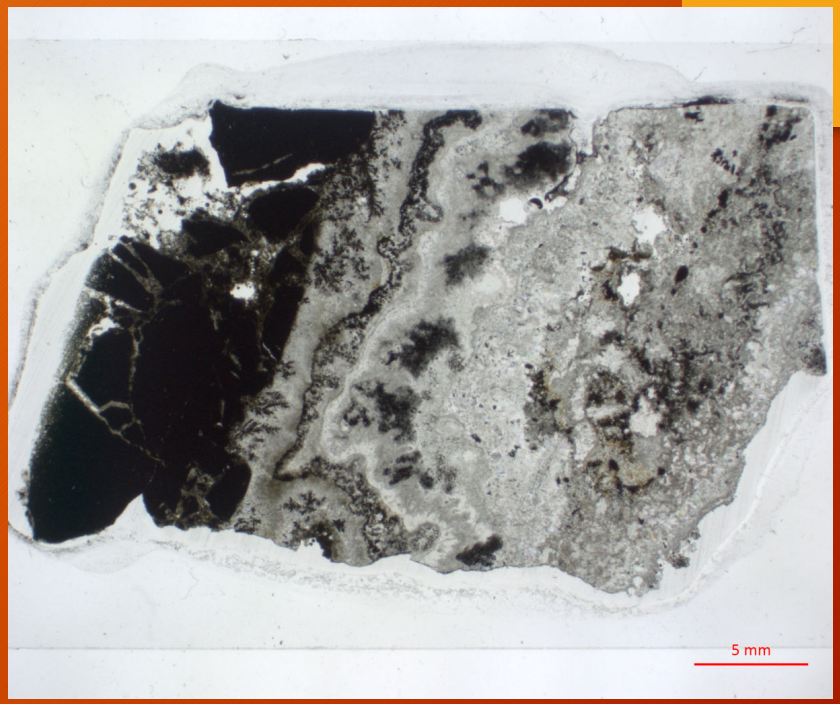


(After Arribas et al., 1995)

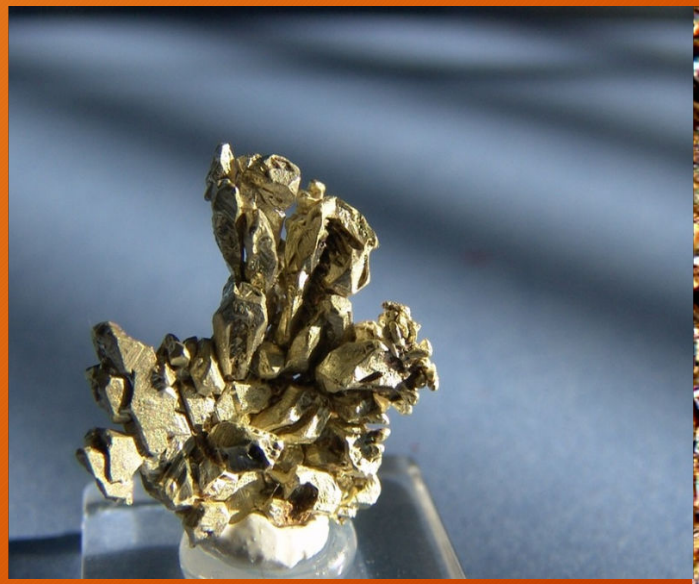
Methods

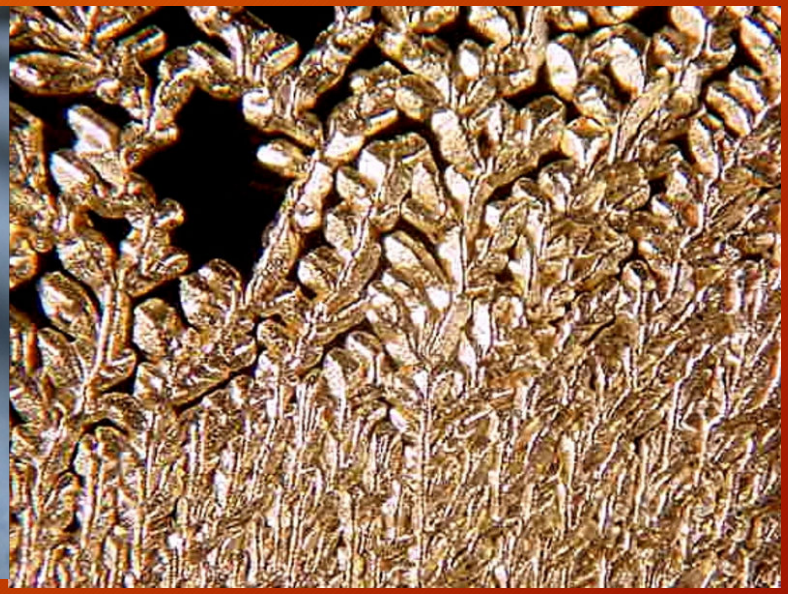
- Used the rock saw to make 2 billets
- Used epoxy mix to adhere the billets to the slide
- Grinded and polished sample down in the soils lab with the Buehler
- Polished one slide down to .25 microns with diamond grit
- Identified minerals under cross polarized light and reflected light
- Carbon coated the slide
- elemental analysis using JEOL JSM-6490LV SEM-EDS at the NDSU electron microscopy center (PIC)
- Compared the atom percents with the ideal percents


2 mm


5 mm

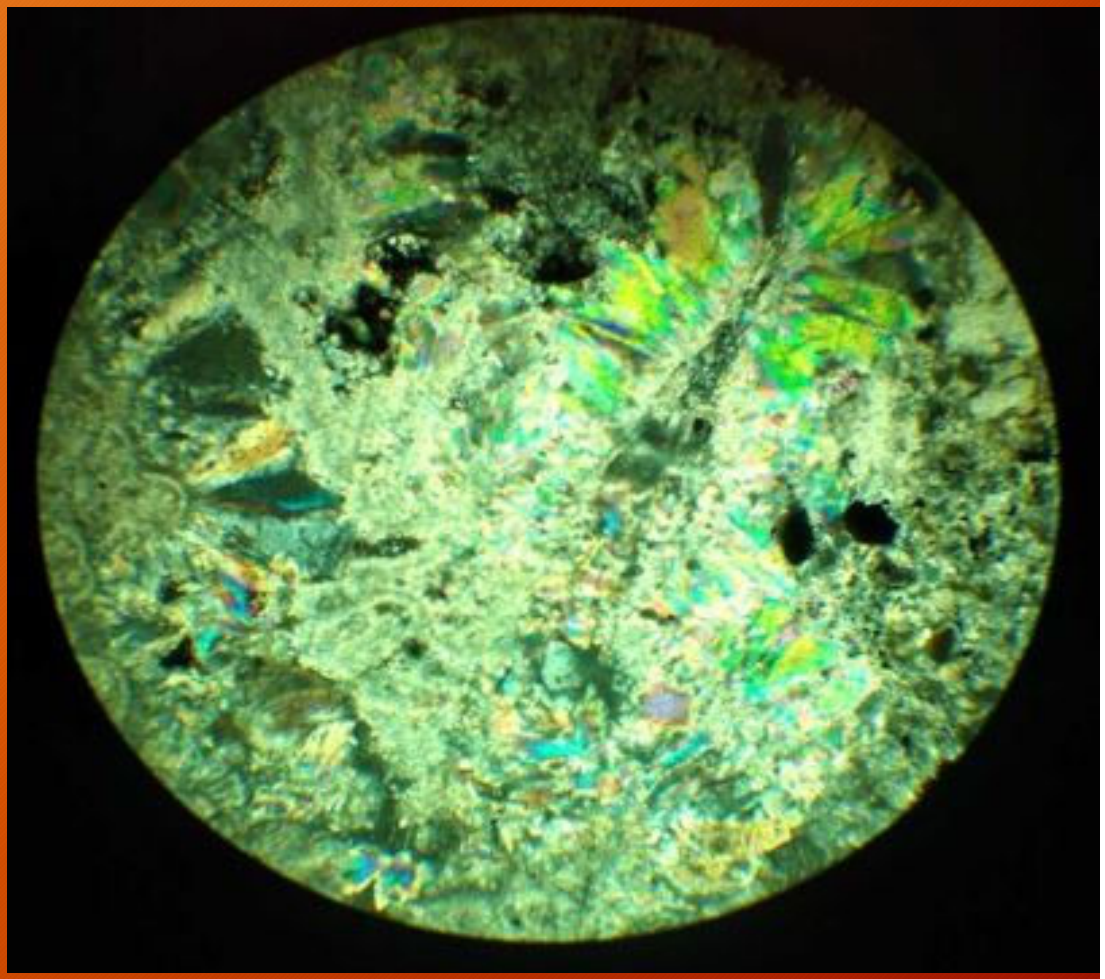
- Electrum is a gold silver alloy with at least 20% of gold or silver
- Commonly called by its most abundant element
- Malleable
- Pale Yellow streak
- No cleavage
- Metallic luster





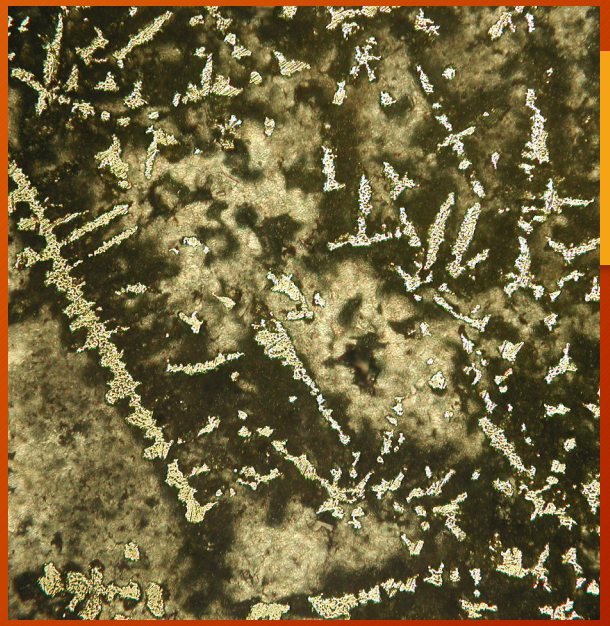
Mindat.org, tinuleo2004@yahoo.com (left) Michael Cline (right)

Microcrystalline
Quartz
Leica FOV 5mm XPL



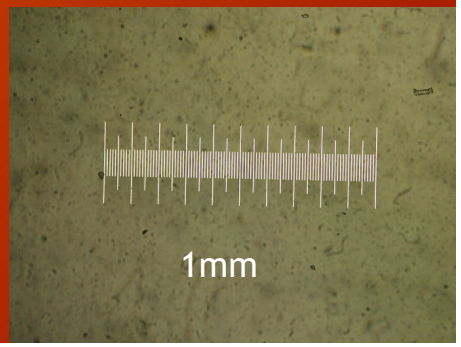
Reflected

Transmitted



Both

FOV: 1.5mm



Ore Texture

- Gold travels as a colloid in solution
- Decompresses and cooling allows colloids to aggregate in fluid
- Eventually falls out of solution and is deposited in dendritic textures. (Saunders and Schoenly 1994)

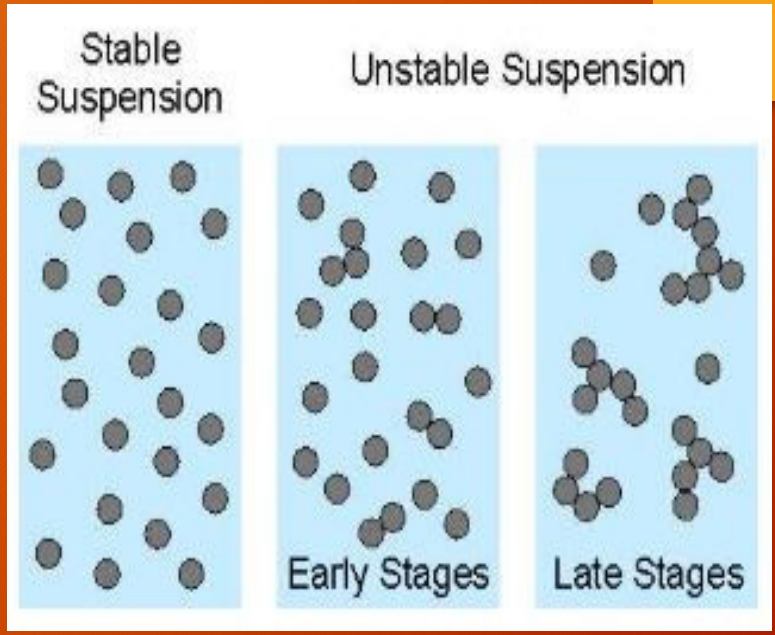
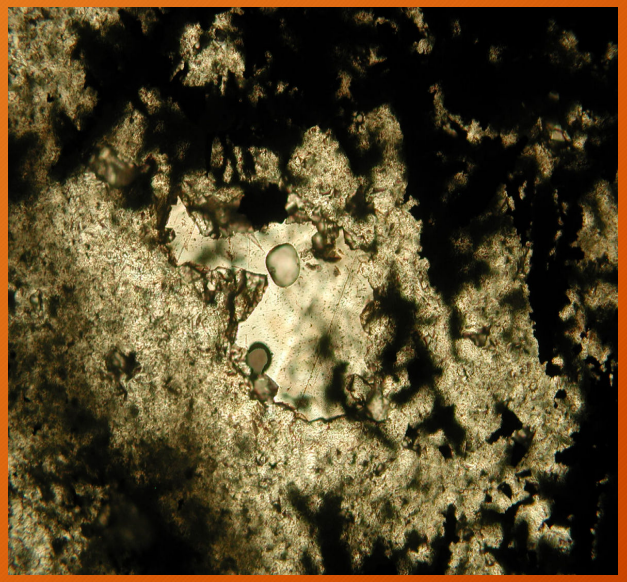


Figure from Laboratory of Colloid and Surface Chemistry (LCSC) University of Geneva

Reflected



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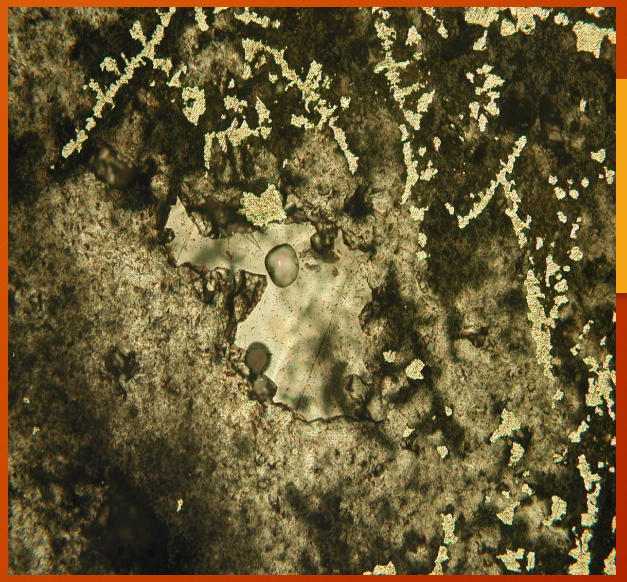
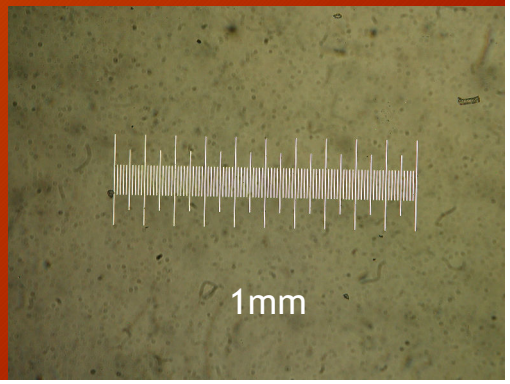
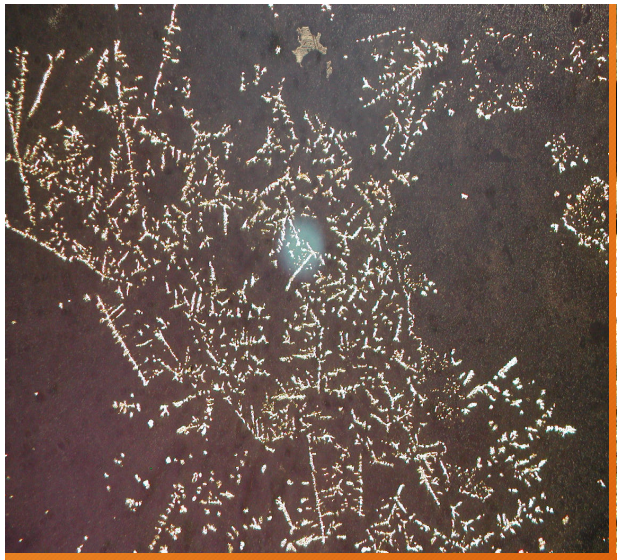


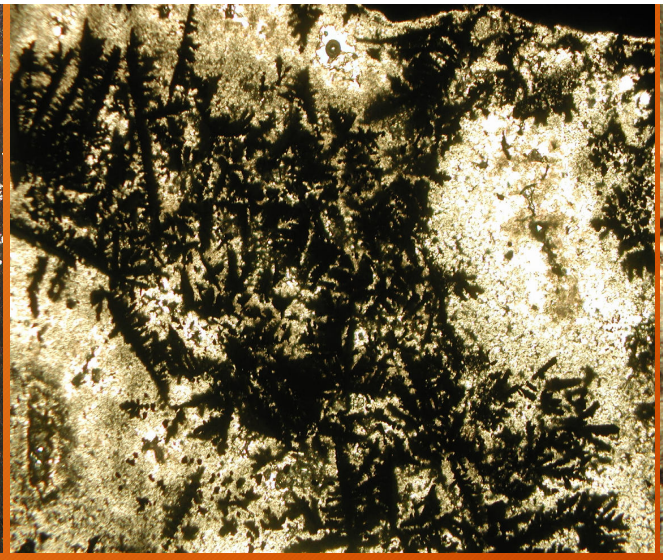
Both

FOV: 1.5mm

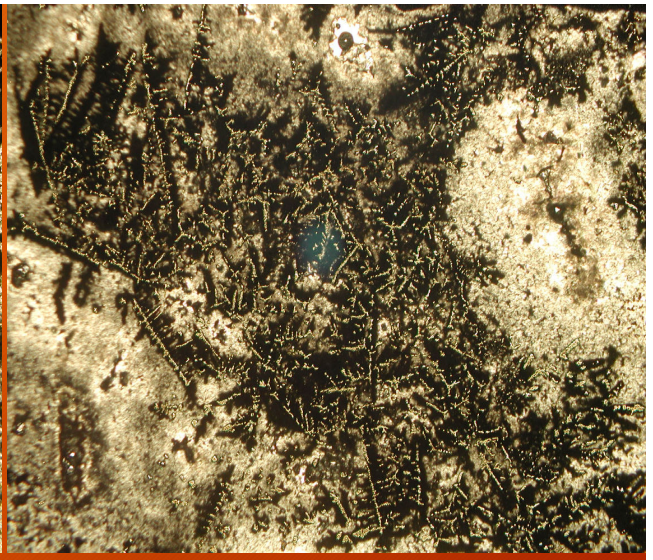




Reflected

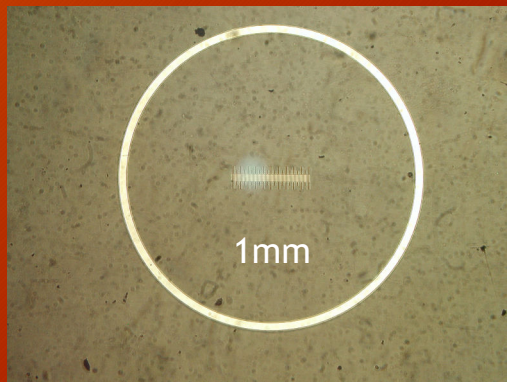


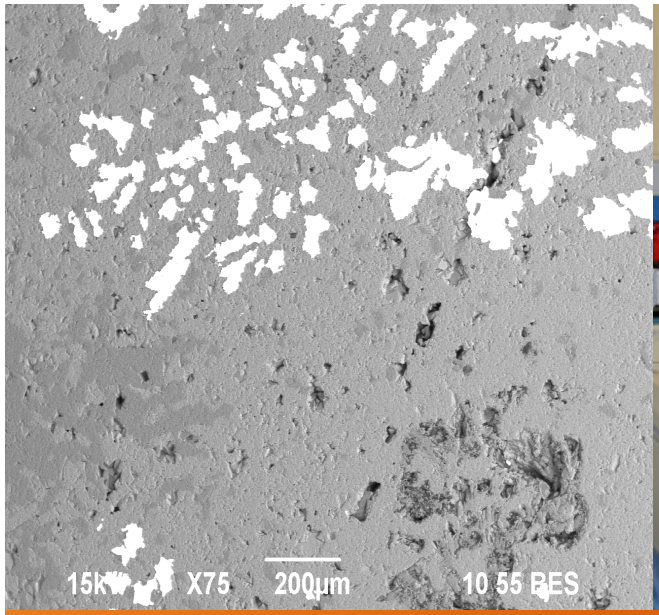
Transmitted

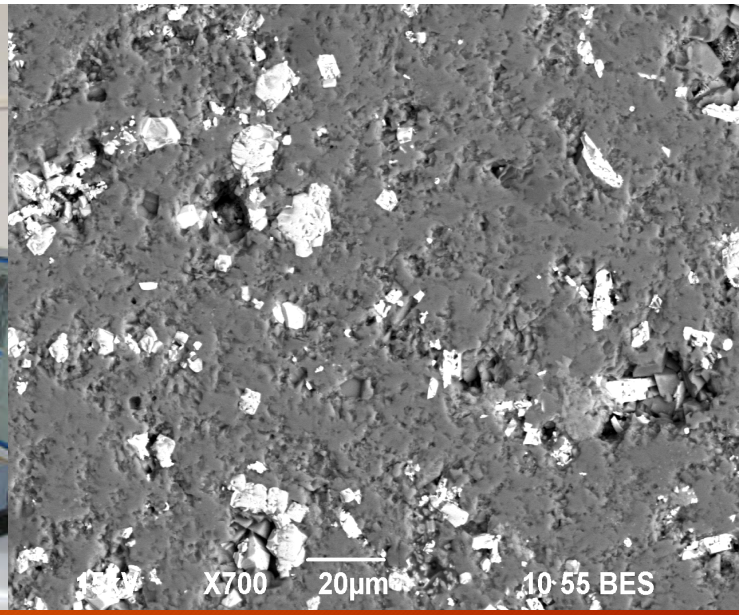


Both

FOV: 6.5mm



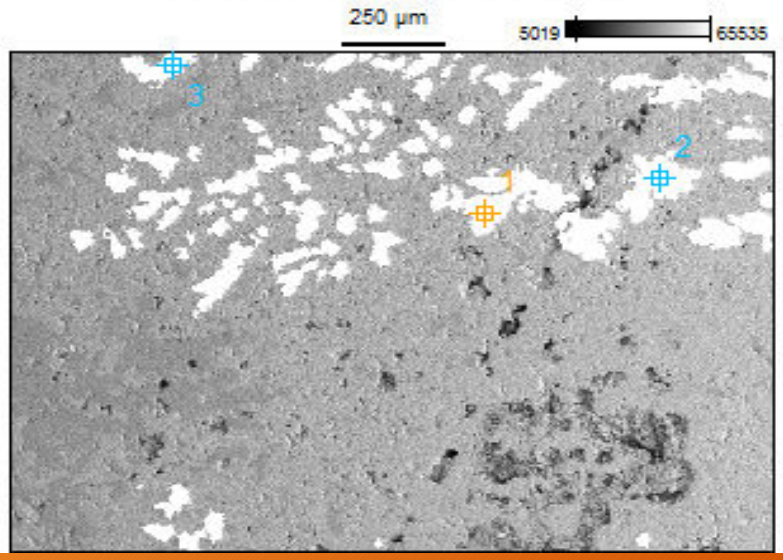




Polished samples were mounted conductive XYZ tape (Ted Pella Inc., Redding, California) and then coated with a conductive layer of carbon in a high-vacuum evaporative coater (Cressington 208c, Ted Pella Inc., Redding, California). Images were obtained with a JEOL JSM-6490LV scanning electron microscope operating at 15 kV (JEOL USA Inc., Peabody, Massachusetts).

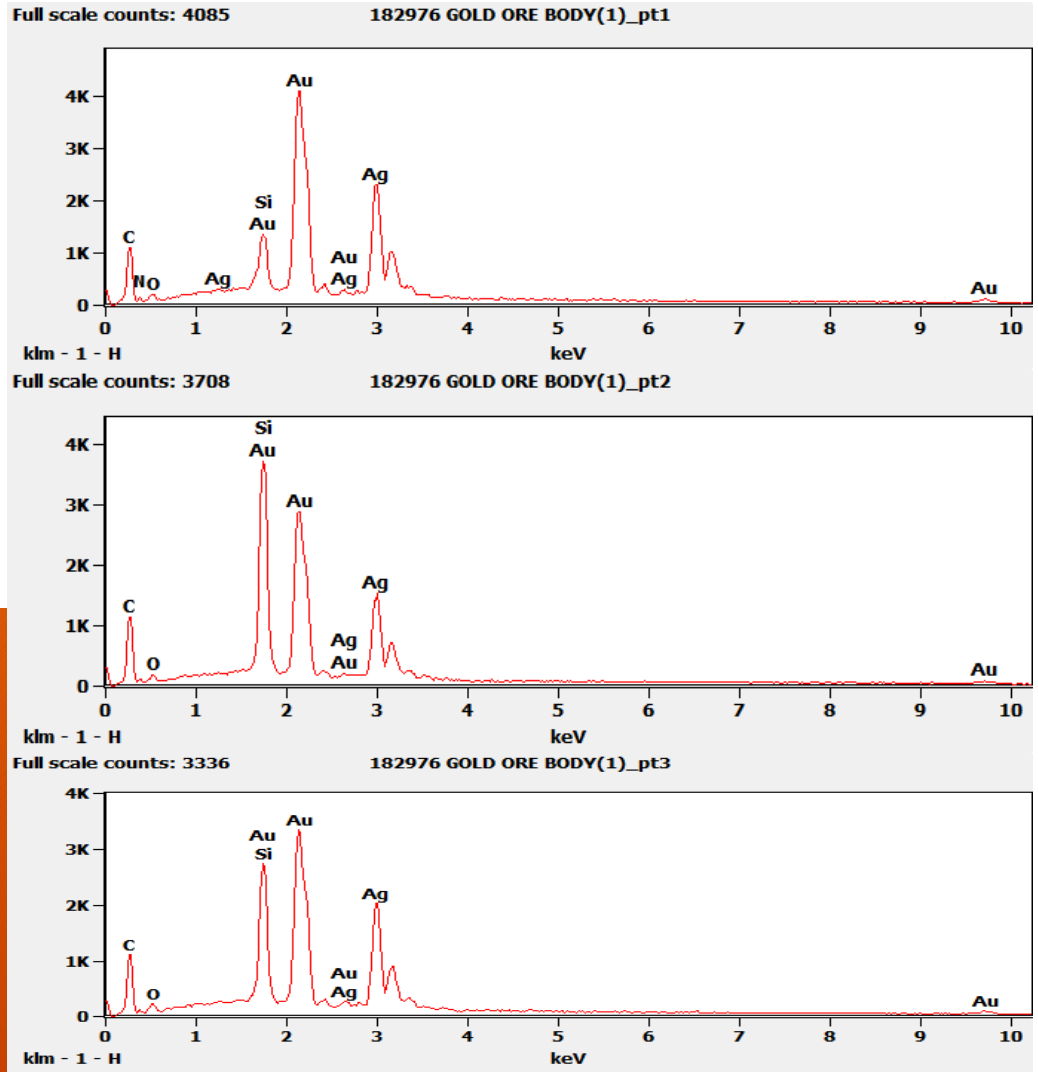
Acknowledgment given to the NDSU Electron Microscopy Center core facility.
This material is based upon work supported by the National Science Foundation under Grant No. 0619098 and 0923354.

182976 GOLD ORE BODY(1)

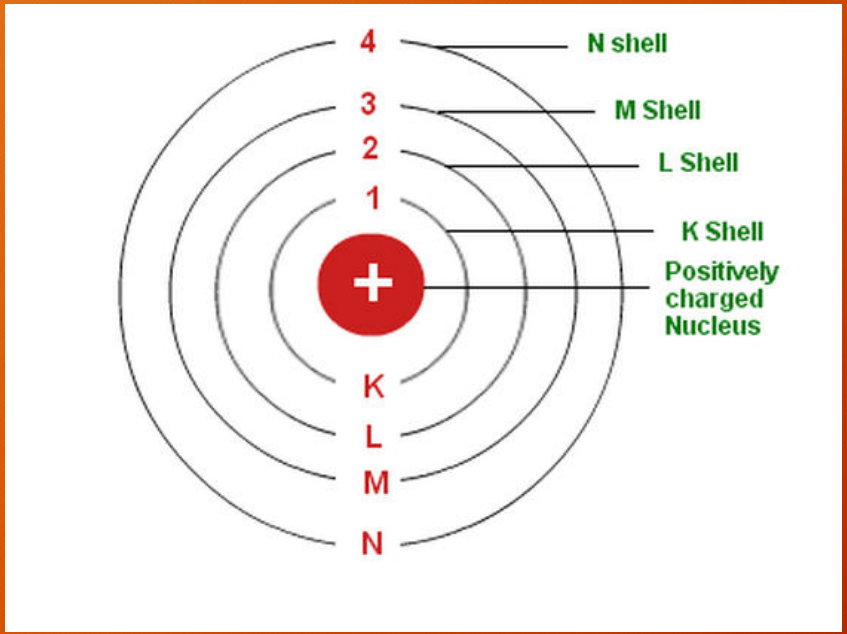


	1	2	3
Au-M	54.17	55.8	59.73
Ag-L	38.78	44.2	40.27

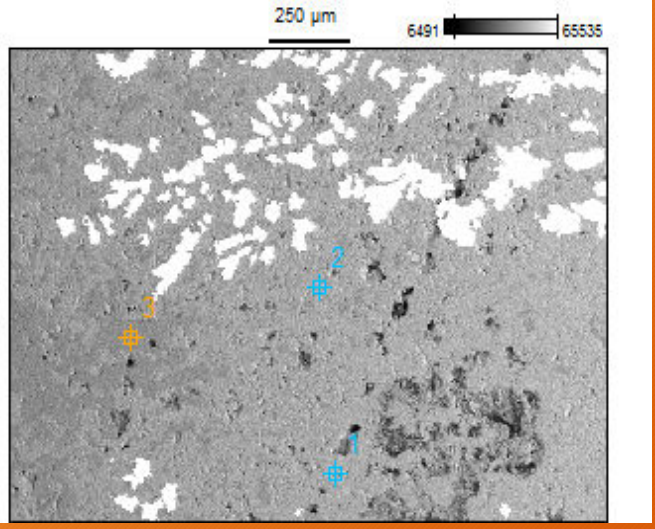
Image Name:	182976 GOLD ORE BODY(1)
Image Resolution:	512 by 384
Image Pixel Size:	3.54 µm
Acc. Voltage:	15.0 kV
Magnification:	75



- Higher the Atomic number the higher the chance of hitting a further out shell
- Gold = 79 protons
- Silver= 47 protons
- Oxygen= 8 protons

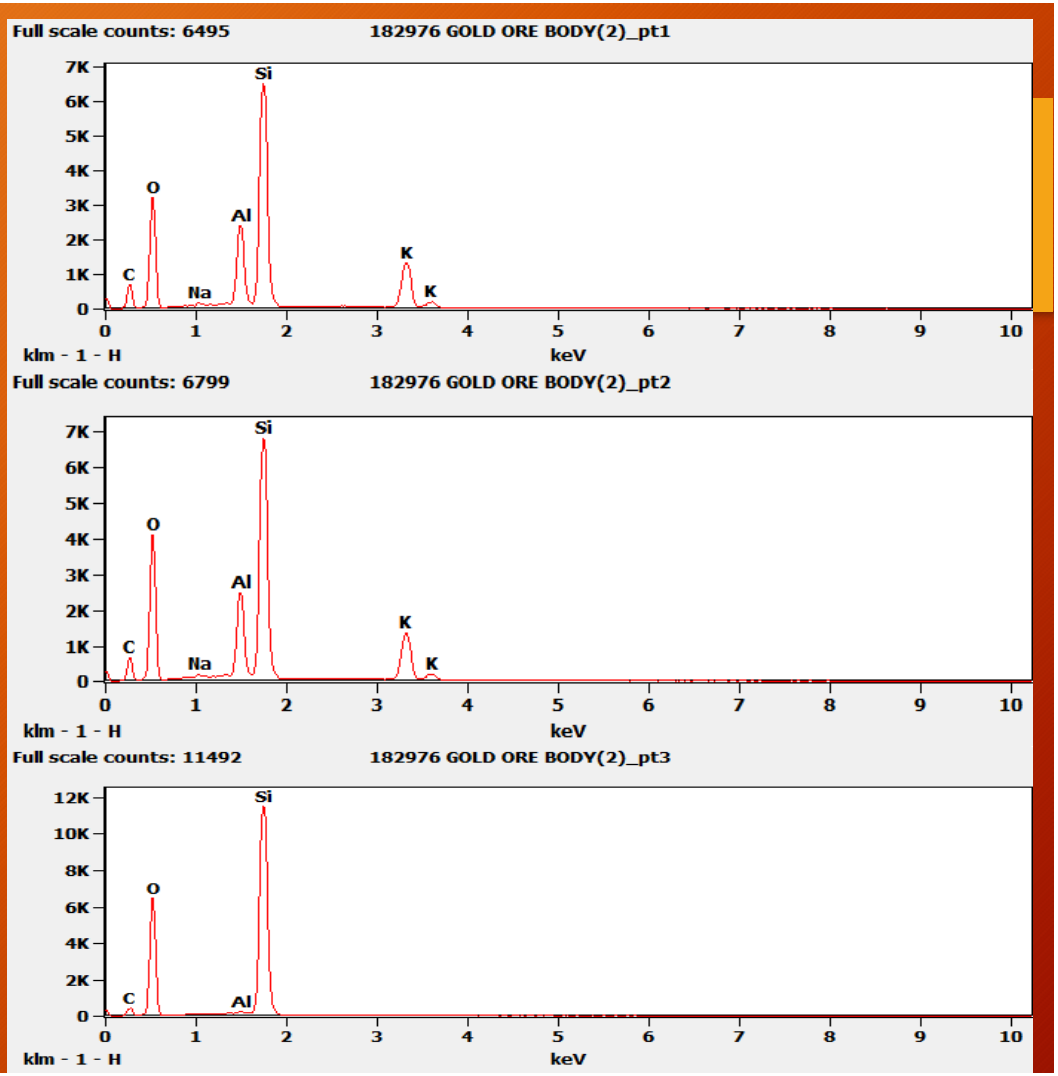


X-ray Compositional MicroAnalysis: EDS and WDS William Barker and John Fournelle from University of Wisconsin-Madison

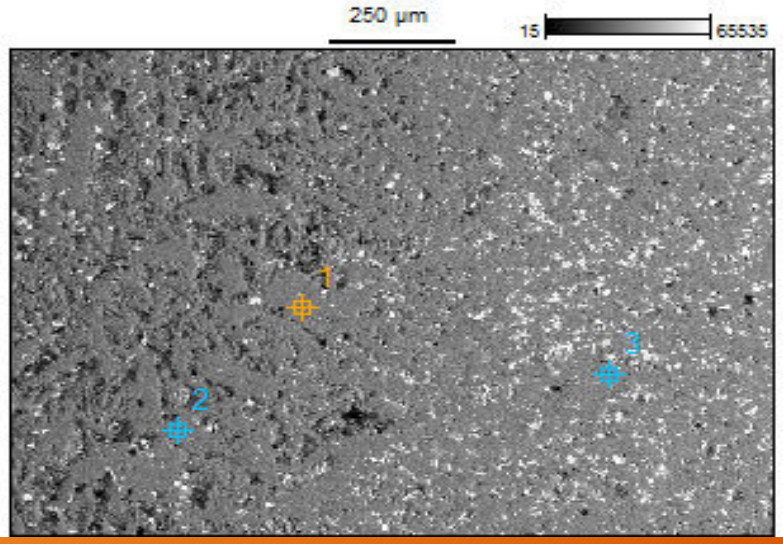


	1	2	3	Ideal Ratio for K- Spar $KAlSi_3O_8$	Ideal Ratio for Quartz (SiO_2)
O-K	56.95	59.99	65.09	61.54	66
Na-K	0.38	0.36		0	0
Al-K	8.19	7.62	0.17	7.69	0
Si-K	26.5	24.83	34.74	23.07	33
K-K	8.07	7.19		7.69	0

Image Name:	182976 GOLD ORE BODY(2)
Image Resolution:	512 by 384
Image Pixel Size:	3.54 µm
Acc. Voltage:	15.0 kV
Magnification:	75



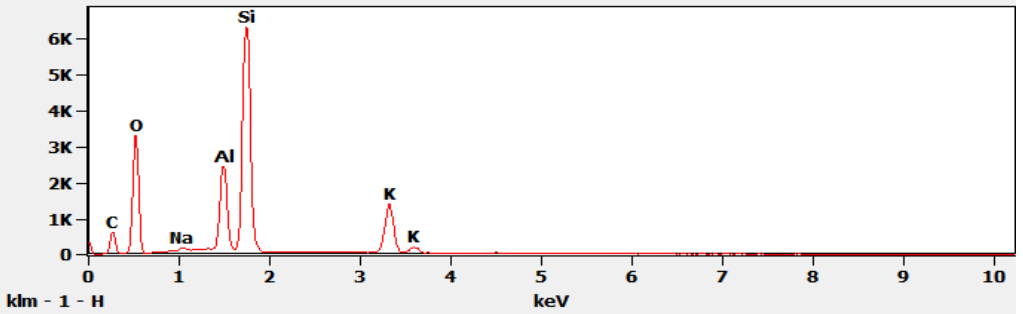
182976 GOLD ORE BODY(3)



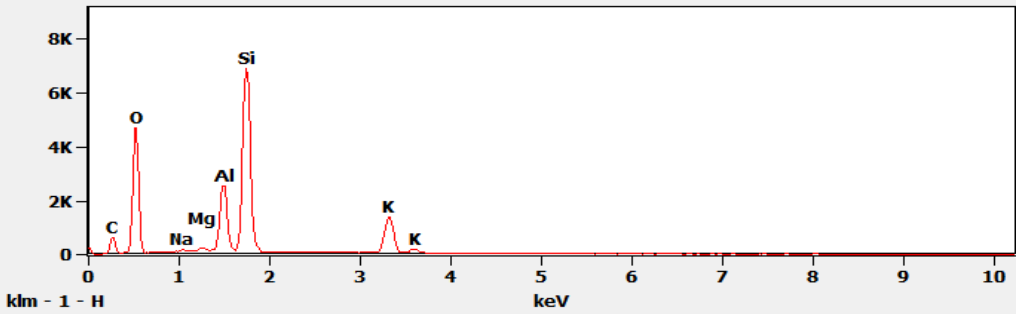
	1	2	3		Ideal Ratio for K- Spar $KAlSi_3O_8$
O-K	57.31	61.78	59.55		61.54
Na-K	0.39	0.35	0.57		0
Mg-K		0.35			0
Al-K	8.4	7.52	8.47		7.69
Si-K	36.38	23.42	27.23		23.07
K-K	7.63	6.57	4.18		7.69

Image Name:	182976 GOLD ORE BODY(3)
Image Resolution:	512 by 384
Image Pixel Size:	2.95 µm
Acc. Voltage:	15.0 kV
Magnification:	90

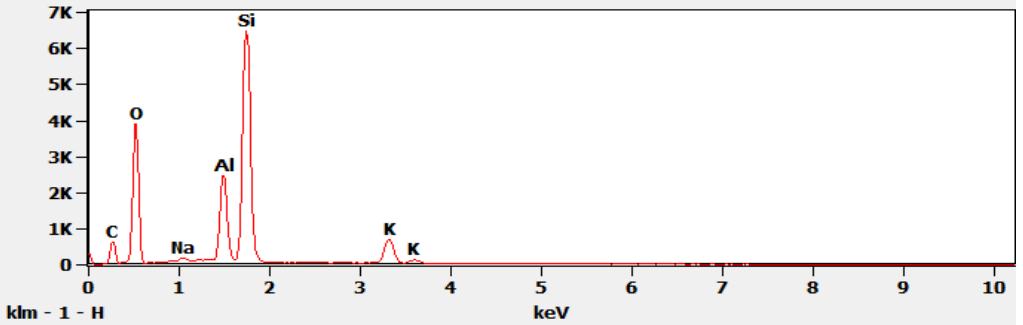
Full scale counts: 6300 182976 GOLD ORE BODY(3)_pt1



Full scale counts: 6891 182976 GOLD ORE BODY(3)_pt2



Full scale counts: 6460 182976 GOLD ORE BODY(3)_pt3

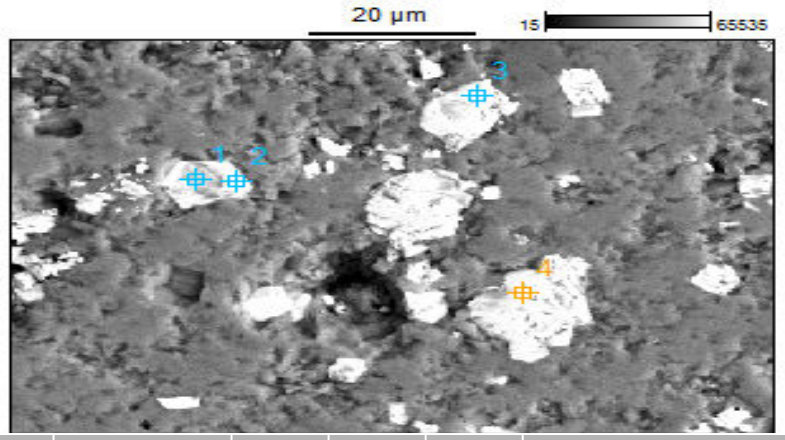


Adularia

- Potassium Feldspar that is altered by low temp typically found in a vug or vein.
- $KAlSi_3O_8$

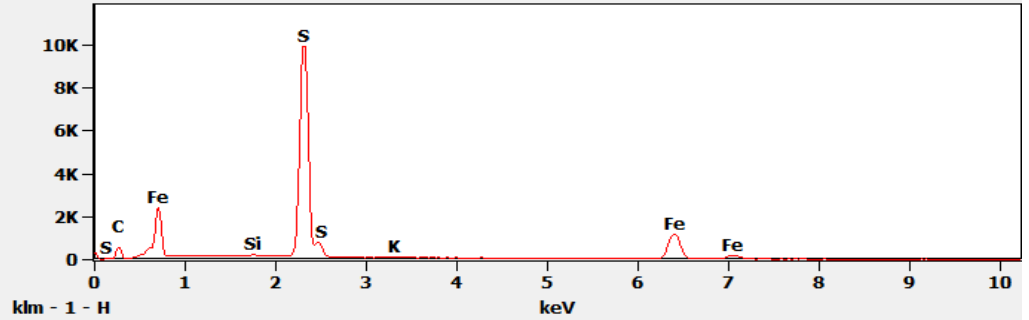
Mindat.org, Fraccaro (left) Enrico Bonacina (Right)

182976 GOLD ORE BODY(4)

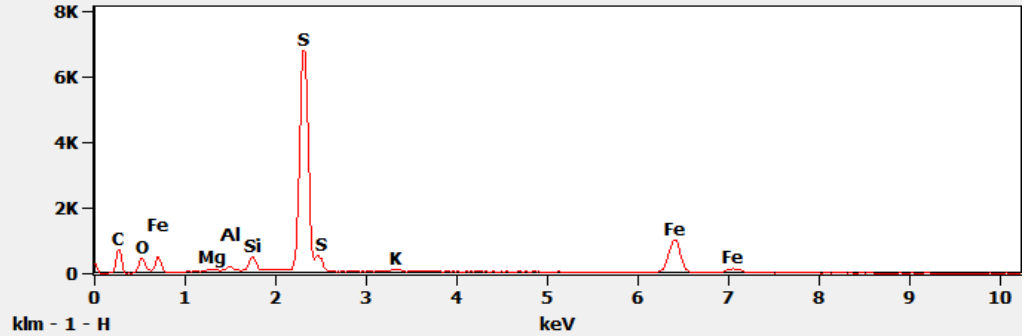


	1	2	3	4	Ideal Ratio for Pyrite (FeS_2)
O-K		16 (error)			0
Mg-K		0.14	0.31	0.2	0
Al-K		0.81			0
Si-K	0.36	2.7	0.75	0.52	0
S-K	66.71	49.35	66.06	65.86	66
K-K	0.19	0.64			0
Ca-K				0.35	0
Fe-K	32.74	30.36	32.88	33.06	33

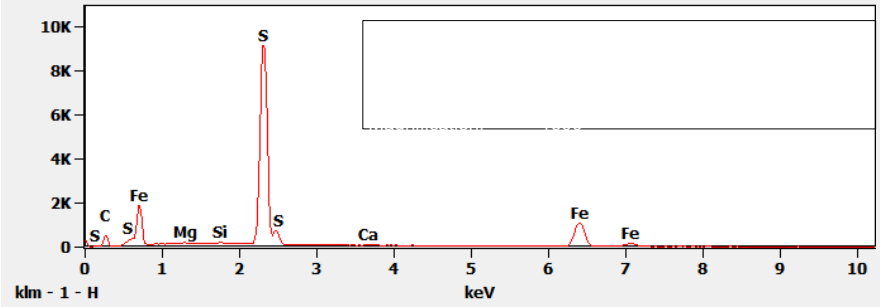
Full scale counts: 9896 182976 GOLD ORE BODY(4)_pt1



Full scale counts: 6802 182976 GOLD ORE BODY(4)_pt2



Full scale counts: 9133 182976 GOLD ORE BODY(4)_pt4



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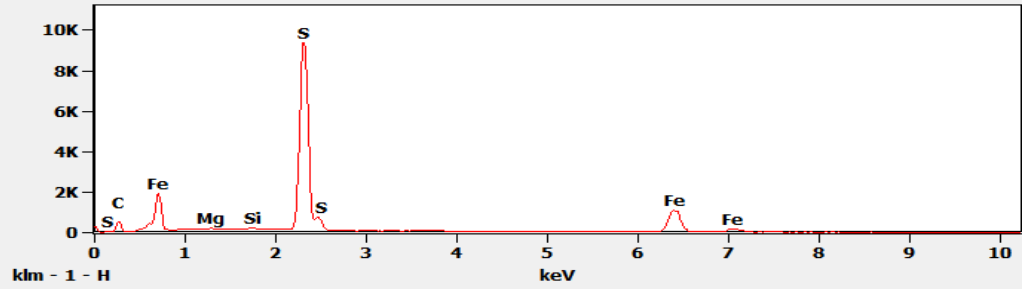

Conclusion

- Northern Nevada Rift caused expansion and magmatic bodies to form
- This allowed various elements to travel, mainly gold and silver
- Gold travelled as a colloid and formed dendritic patterns
- Used SEM data to identify minerals
- Adularia formed and Electrum deposited in vugs

Works Cited

Arribas, A., Hedenquist, J.W., Itaya, T., Okada, T., Concecion, R.A., Garcia, J.S. (1995) Contemporaneous formation of adjacent porphyry and epithermal Cu-Au deposits over 300 ka in northern Luzon, Philippines. Geology, 23, 337-40

Saunders, J.A., Schoenly, P.A., Boiling, colloid nucleation and aggradation, and the genesis of bonanza Au-Ag ores of the Sleeper deposit, Nevada: Mineralium Deposita v. 30, p. 199-210.

Wallace, A.R., John, D.A., New Studies of Tertiary Volcanic Rocks and Mineral Deposits, Northern Nevada Rift, USGS Open File Report 98-338, ch. 22, p. 264-278