Chemical Investigation of the Roof Strike Rock

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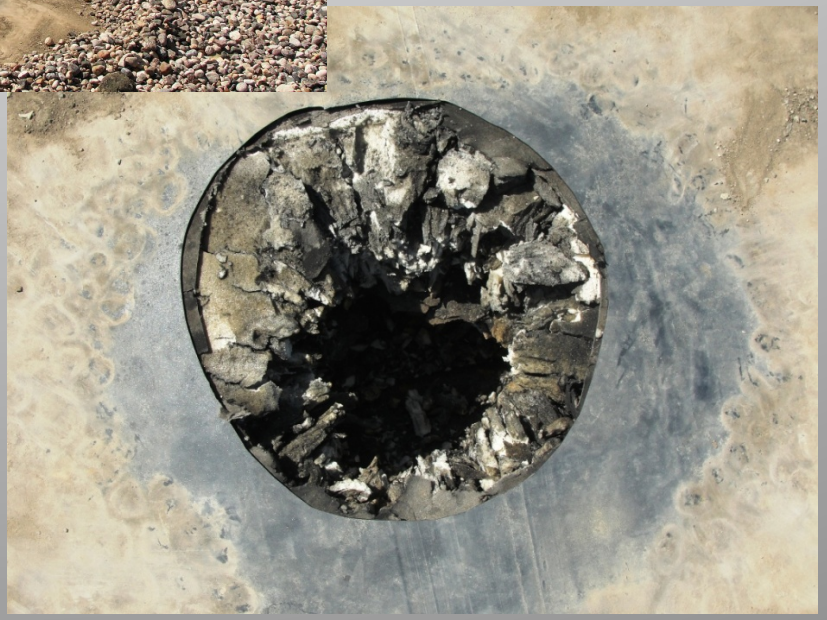
NDSU Petrology 422

Outline

- Hand sample analysis
- Thin section analysis
- XRD results
- Mineral background
- Formation processes
- Localities of sample

The Mysterious Hole in the Roof of Infinity Windows

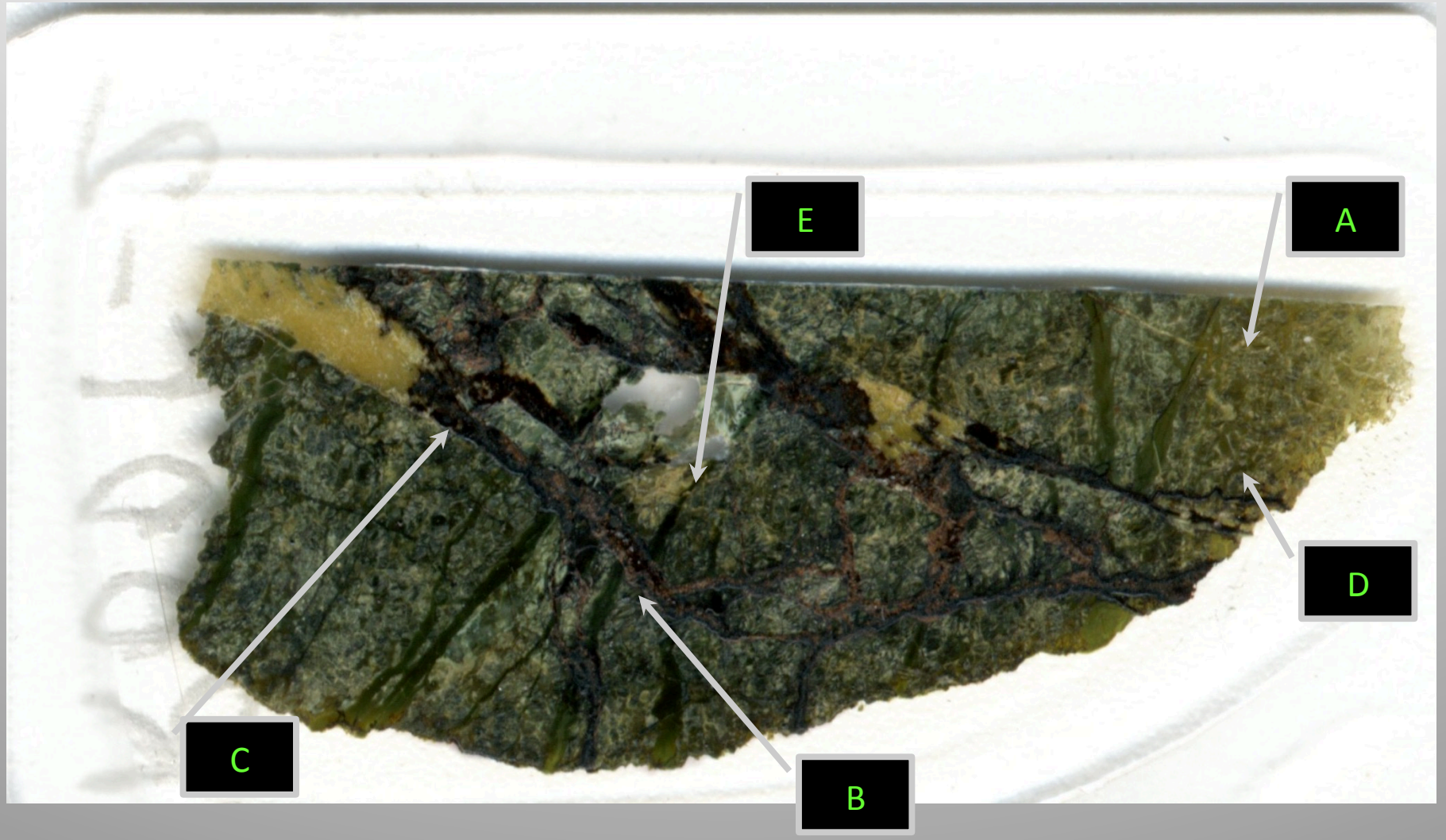


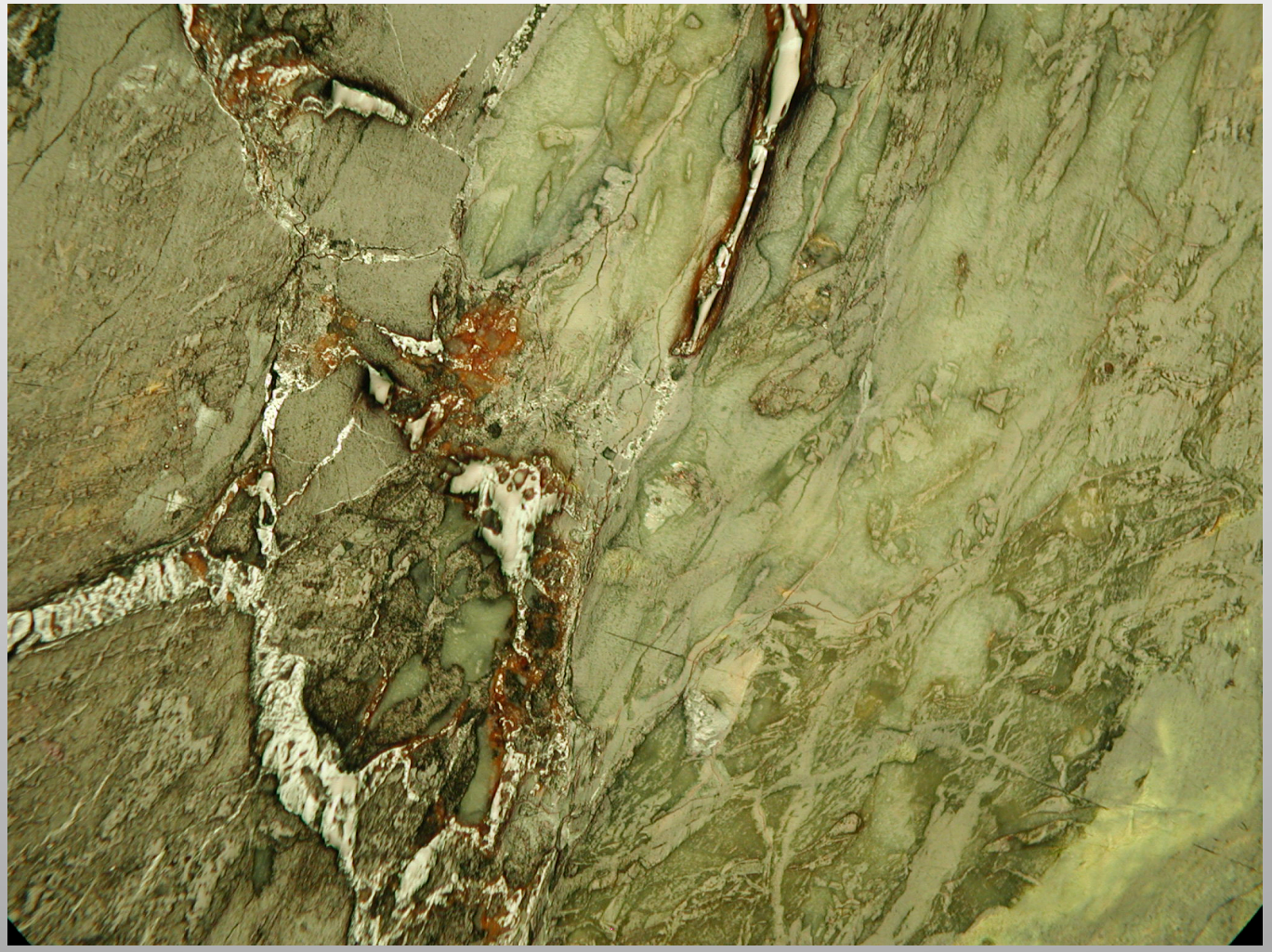
Hand sample analysis

- Clay-like odor
- A main green rock with major silicate veins of lt. Brown color and minor black oxide veins
- 1.5 kg Weight in Air
- .85 kg Weight in Water
- Specific Gravity of 2.31
- Green portions are soft, a fingernail can scratch

Chemical Analysis

The Thin Section





10X, XPL, (B), Transmitted Light
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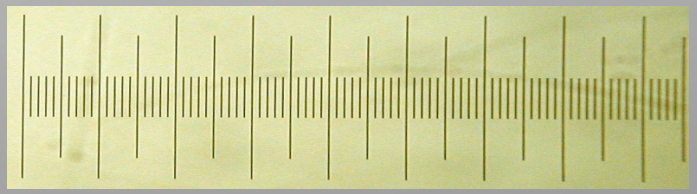

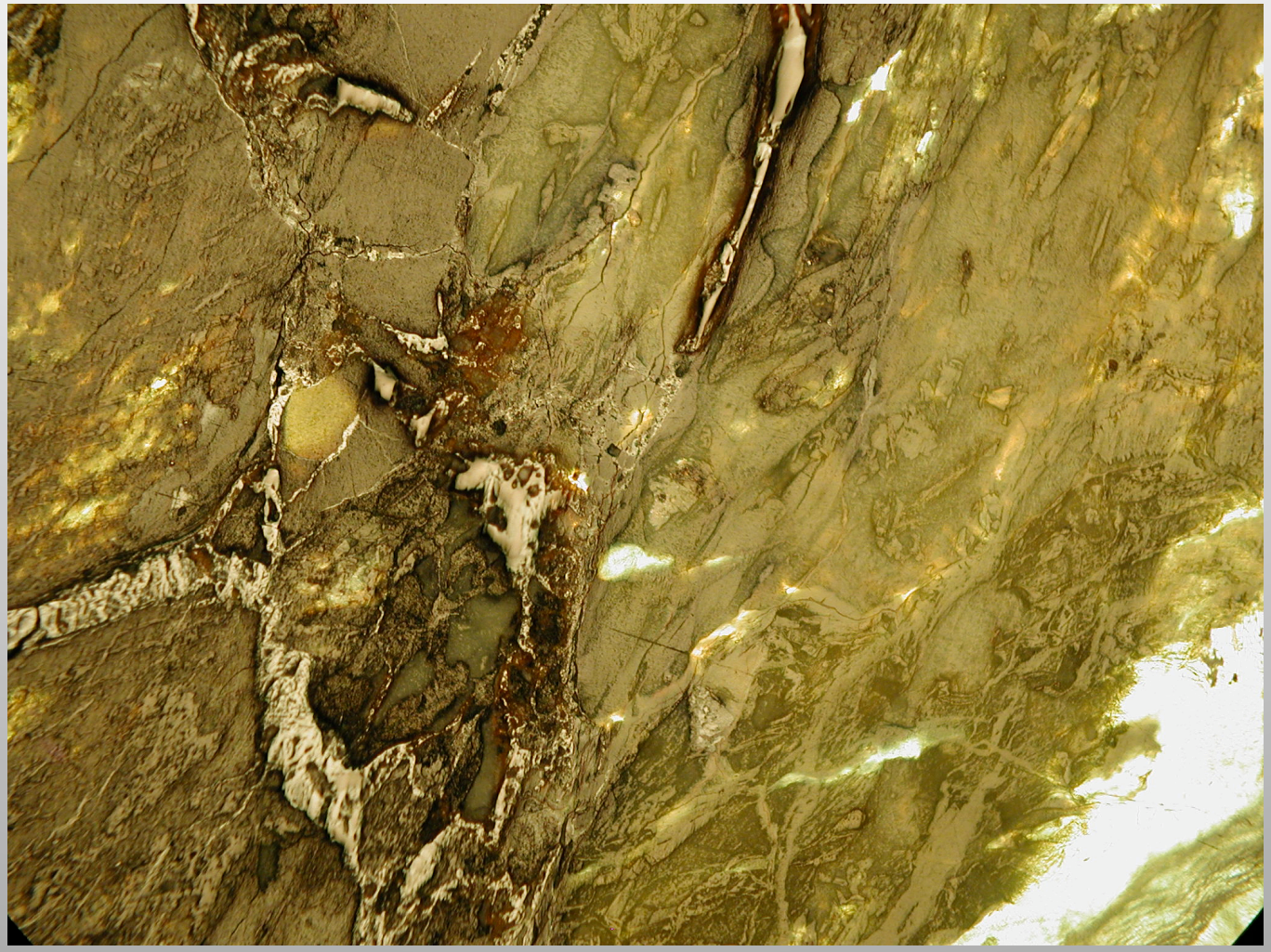

10X, PPL, (B), Transmitted Light
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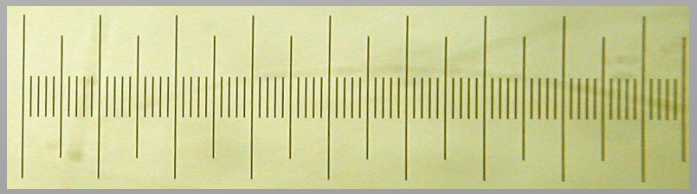

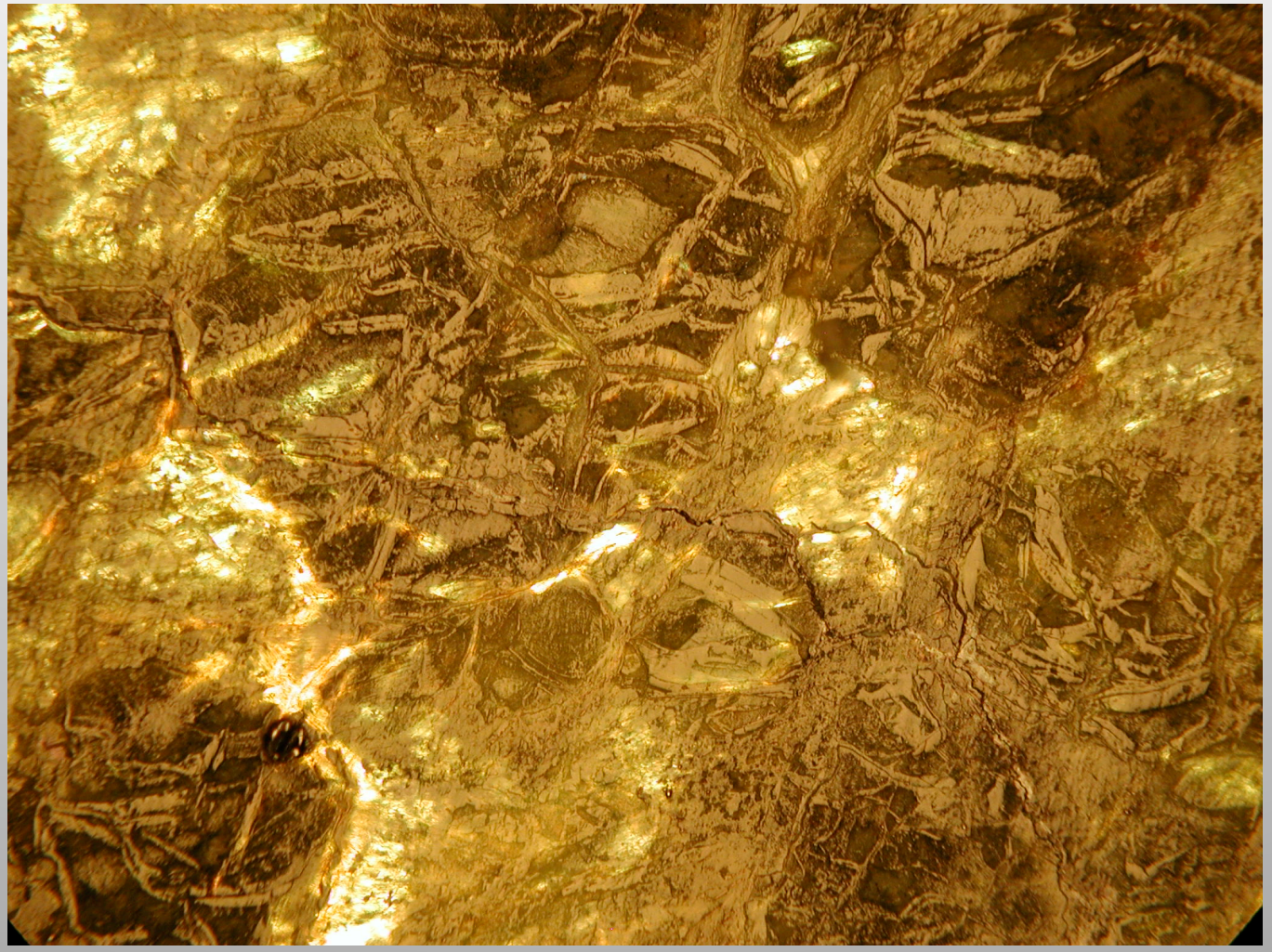

10X, PPL, (C), Transmitted Light
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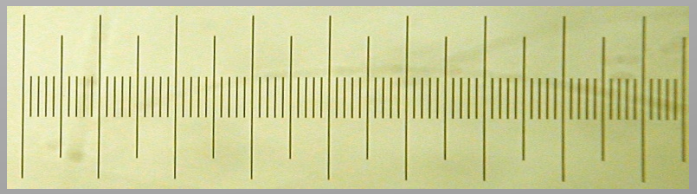

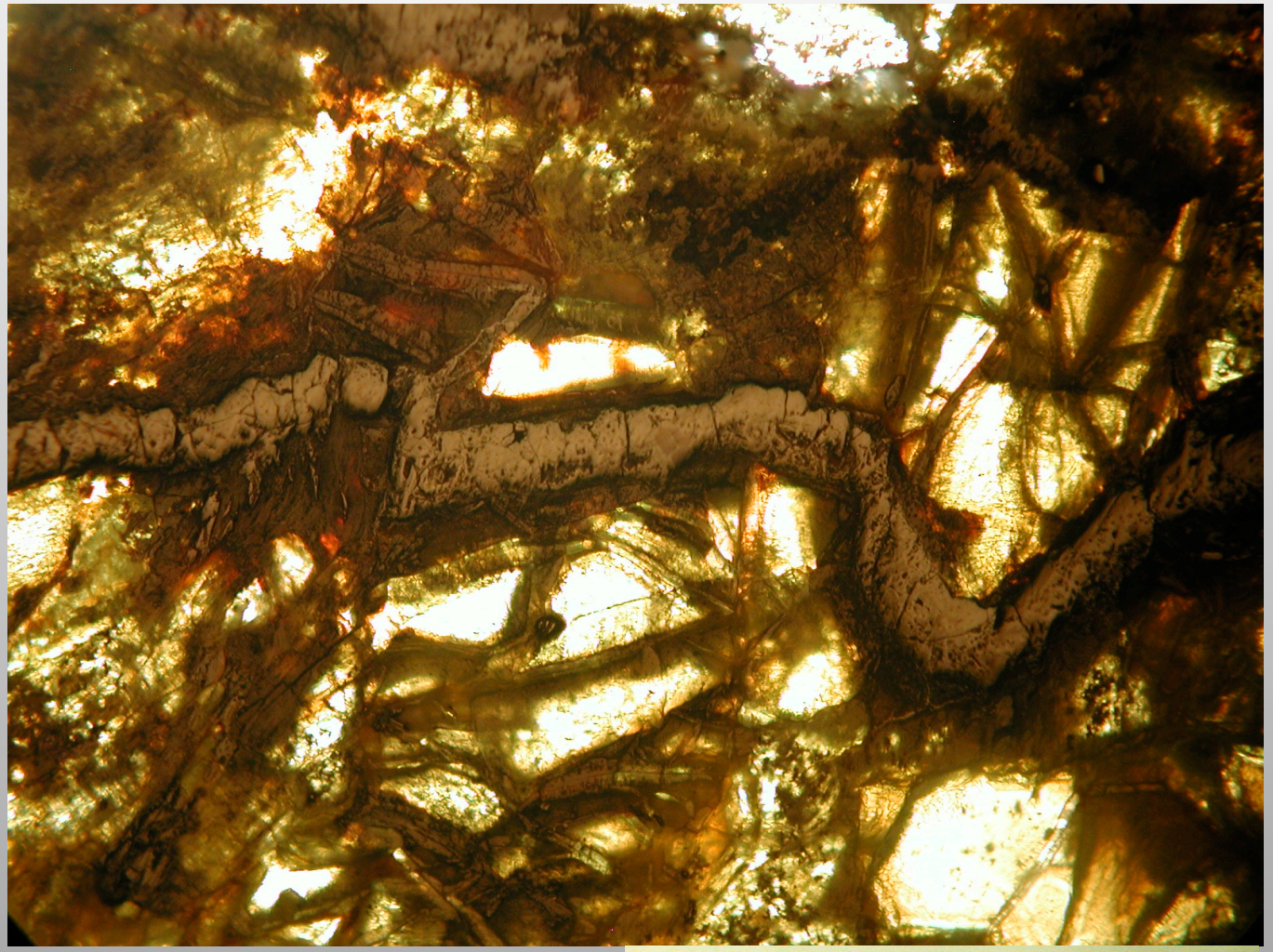

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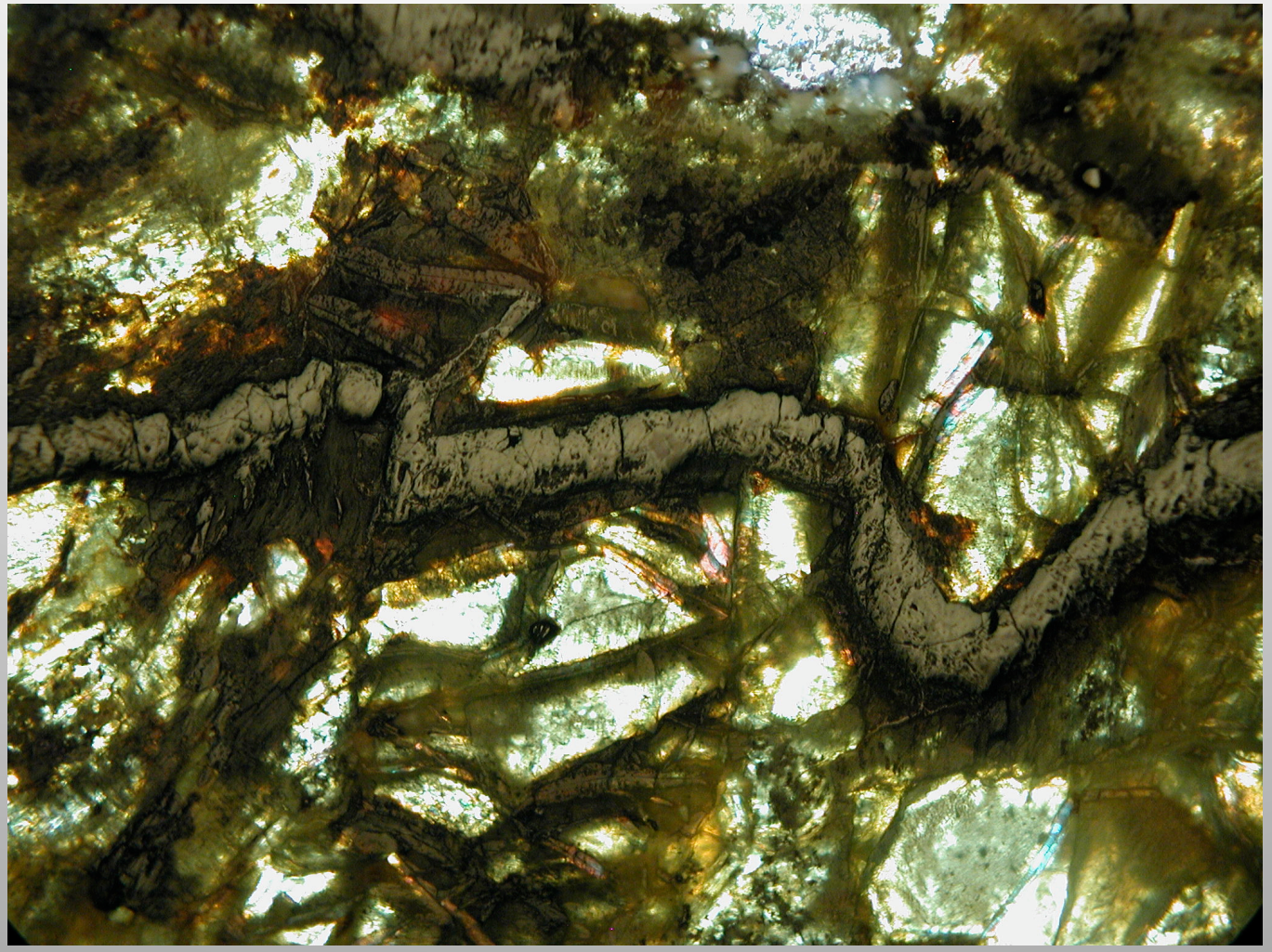
P4230013



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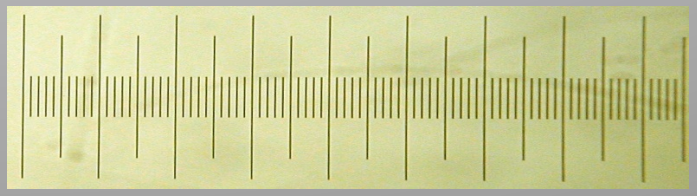
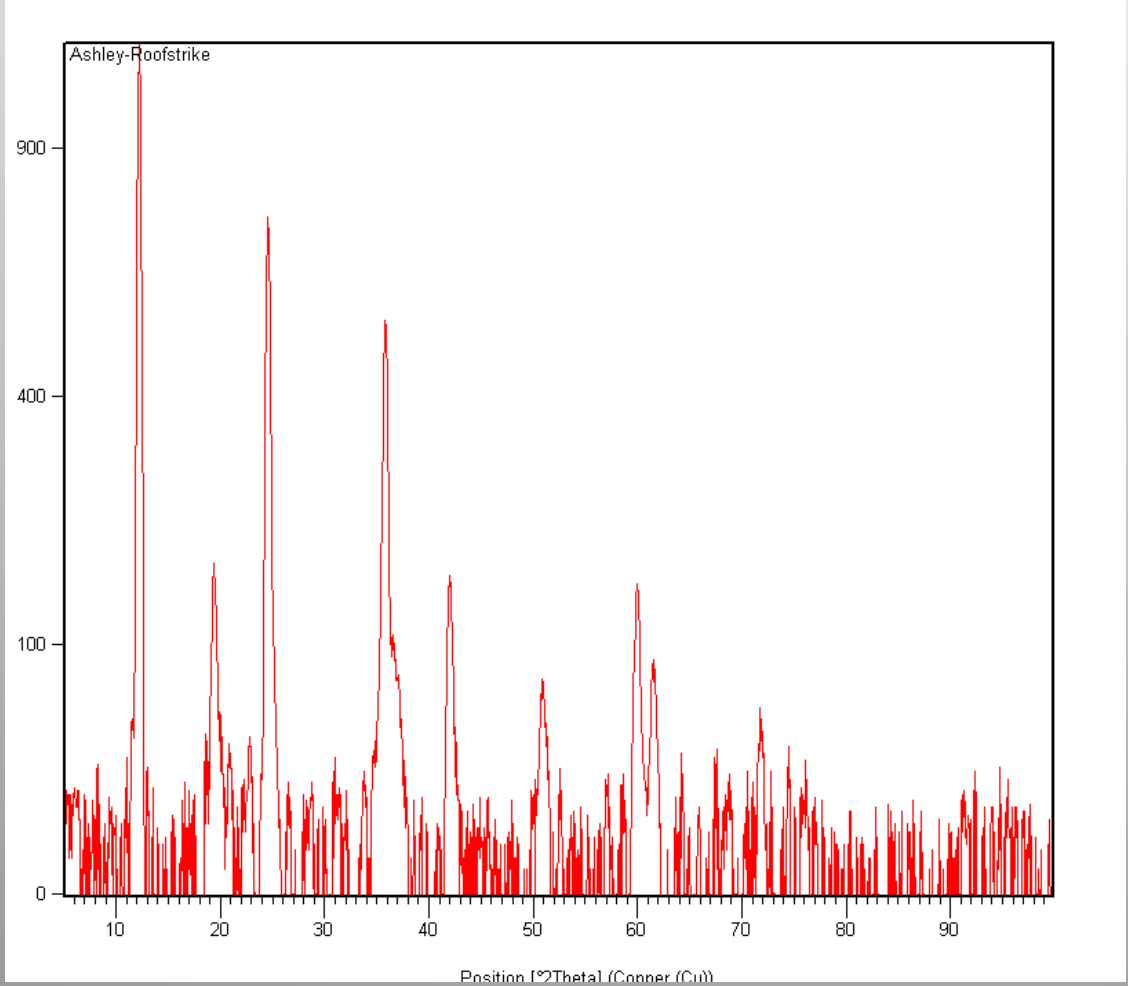
P4230014

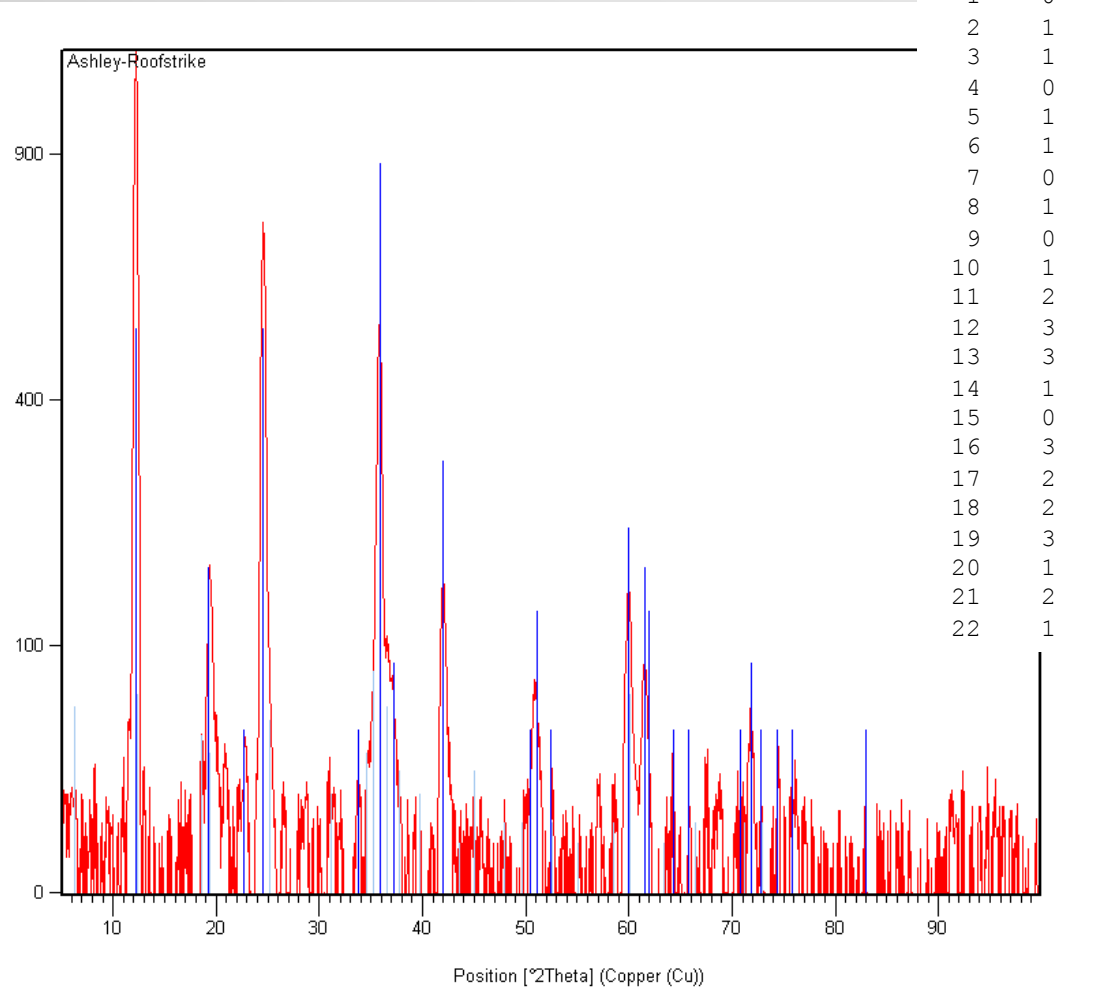


XRD Results



No.	Pos. [°2Th.]	d-spacing [Å]	Matched
1	6.2376	14.15812	FALSE
2	9.3152	9.48632	FALSE
3	12.2481	7.22053	TRUE
4	18.569	4.77448	FALSE
5	19.3051	4.59405	TRUE
6	24.5467	3.62364	TRUE
7	26.6881	3.33755	FALSE
8	28.6847	3.10961	FALSE
9	31.5212	2.83596	FALSE
10	33.6296	2.66283	TRUE
11	35.8609	2.50209	TRUE
12	42.0288	2.14806	TRUE
13	50.9105	1.7922	TRUE
14	59.9937	1.54074	TRUE
15	61.5095	1.50636	TRUE
16	64.0997	1.4516	TRUE
17	65.8234	1.4177	TRUE
18	71.9307	1.3116	TRUE
19	74.265	1.27605	TRUE
20	75.6267	1.25642	TRUE
21	76.0523	1.25044	TRUE
22	93.7536	1.05537	FALSE

Lizardite Comparison



No.	h	k	l	d [A]	2Theta[deg]	I [%]
1	0	0	1	7.25000	12.198	60.0
2	1	0	0	4.61000	19.238	20.0
3	1	0	1	3.91000	22.724	5.0
4	0	0	2	3.62000	24.572	60.0
5	1	1	0	2.65500	33.732	5.0
6	1	1	1	2.50300	35.847	100.0
7	0	0	3	2.41500	37.201	10.0
8	1	1	2	2.14800	42.030	35.0
9	0	0	4	1.80700	50.464	5.0
10	1	1	3	1.78800	51.039	15.0
11	2	1	0	1.74400	52.423	5.0
12	3	0	0	1.54100	59.983	25.0
13	3	0	1	1.50700	61.481	20.0
14	1	1	4	1.49600	61.982	15.0
15	0	0	5	1.44800	64.278	5.0
16	3	0	2	1.41800	65.808	5.0
17	2	2	0	1.32900	70.846	5.0
18	2	2	1	1.31200	71.906	10.0
19	3	0	3	1.29900	72.740	5.0
20	1	1	5	1.27400	74.405	5.0
21	2	2	2	1.25400	75.798	5.0
22	1	0	6	1.16300	82.957	5.0

Lizardite Physical Properties

(Mindat, 2012)

- $Mg_3Si_2O_5(OH)_4$
- Hardness: 2.5
- Streak: White
- Density: 2.57
- Hexagonal
- Perfect Cleavage: {001}

Crystallographic Structure

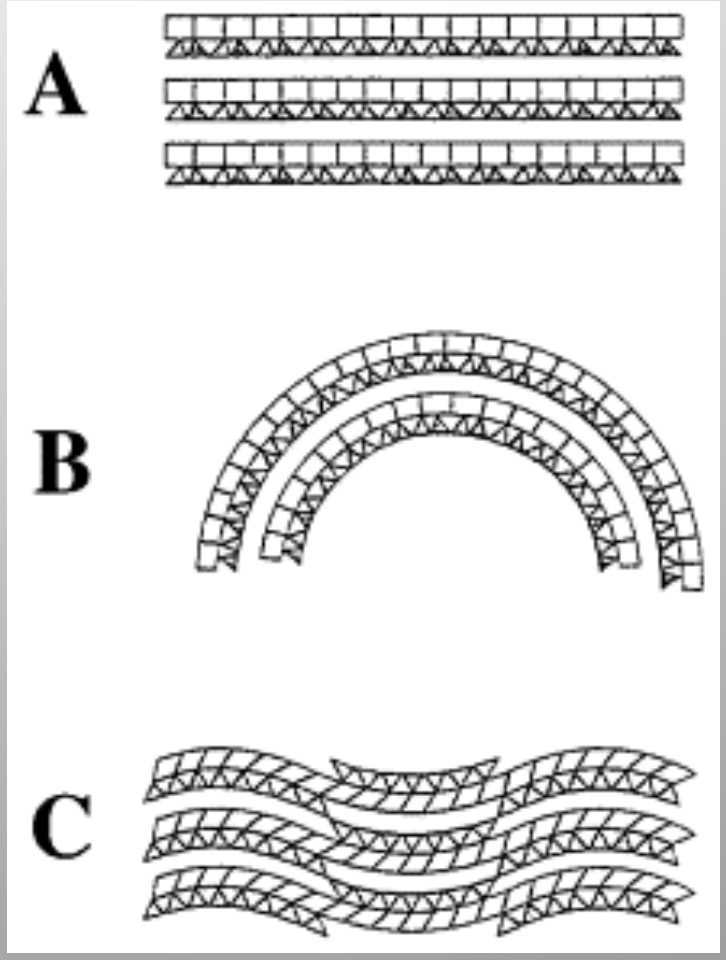
Phyllosilicate

Dioctahedral Equivalent

- **Kaolinite**

Member of the Serpentine Group

- **Polymorhps**
  - **Chrysotile (B)**
  - **Antigorite (C)**



(Mével, 2003)

A Secondary Mineral

- Results from a hydrothermal metamorphic activity on the parent rock
- Parent rock often is Peridotite, an ultra-mafic rock loaded with Olivine, Pyroxene, and <45% Si.
- Multiple chemical reaction paths available

Chemical equations

Serpentine from Olivine

1a) $3Fe_2SiO_4 + 3H_2O \rightarrow 2Fe_3O_4 + 3SiO_2 + 2H_2$

Fa + water → magnetite + silica + hydrogen

1b) $3Mg_2SiO_4 + SiO_2 + 4H_2O \rightarrow 2Mg_3Si_2O_5(OH)_4$

Fo + silica + water → serpentine

2) $2Mg_2SiO_4 + 3H_2O \rightarrow Mg_3Si_2O_5(OH)_4 + Mg(OH)_2$

Fo + water → serpentine + brucite

Serpentine from Pyroxene

3) $2H_2O + 3MgSiO_3 \rightarrow Mg_3Si_2O_5(OH)_4 + SiO_2$

water + En → serpentine + aqueous silica

4a) $3MgSiO_3 + SiO_2 + H_2O \rightarrow Mg_3Si_4O_{10}(OH)_2$

En + aqueous silica + water → talc

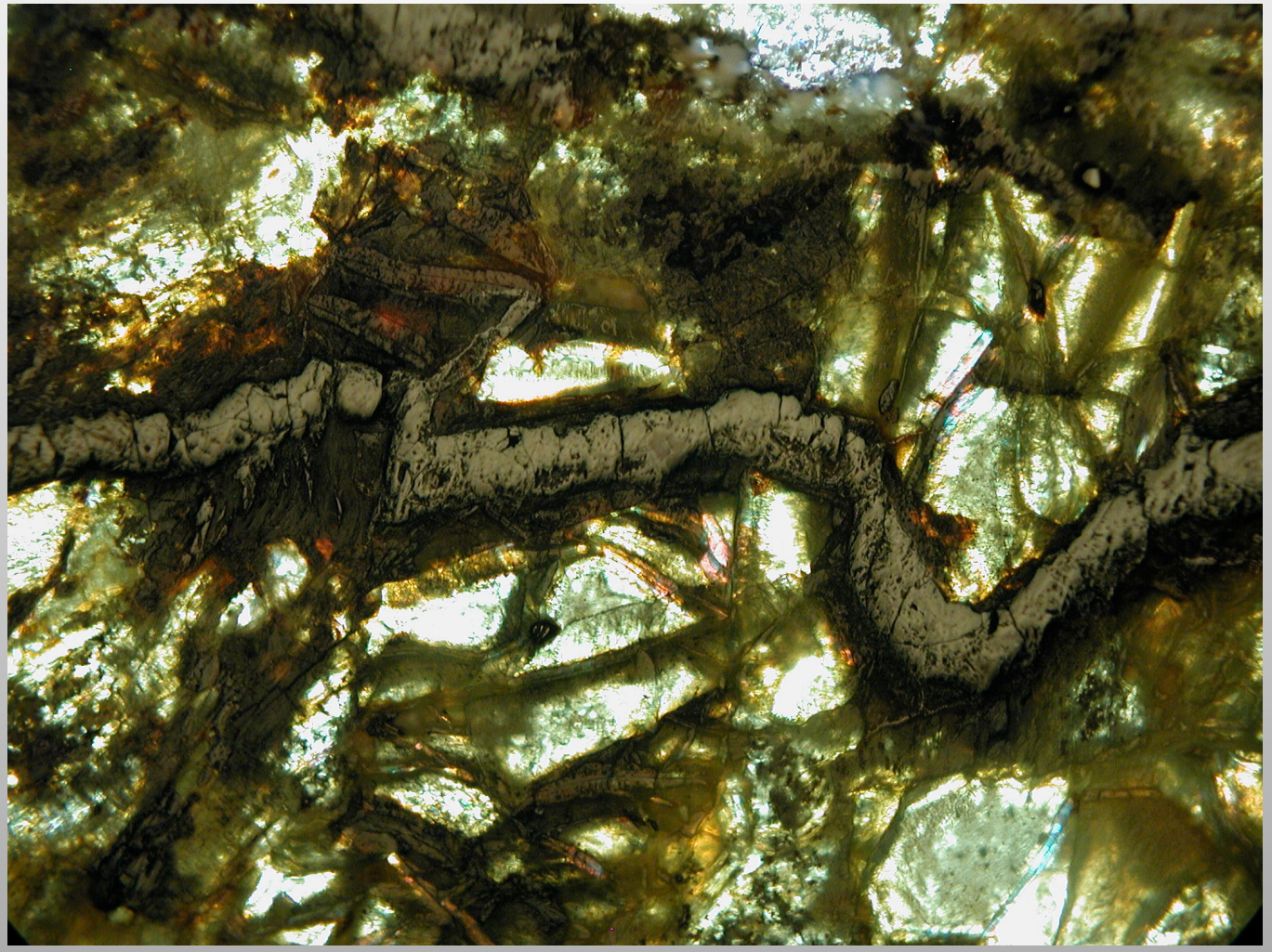
4b) $Mg_3Si_4O_{10}(OH)_2 + H_20 \rightarrow Mg_3Si_2O_5(OH)_4 + 2SiO_2$

talc + water → serpentine + aqueous silica

Comparison

Oxide	Our Samples Mol. Proportion	Ideal Mol. Proportion	Deviation
MgO	35.20%	43.63%	8.43%
SiO_2	43.14%	43.46%	.32%
H	No Data	13%	No Data

- Our sample contained 15.89% Fe_2O_3
- XRF values normalized to 100%
- Ideal Mol. Proportion from Webmineral.com



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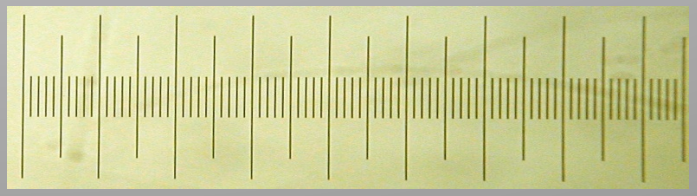
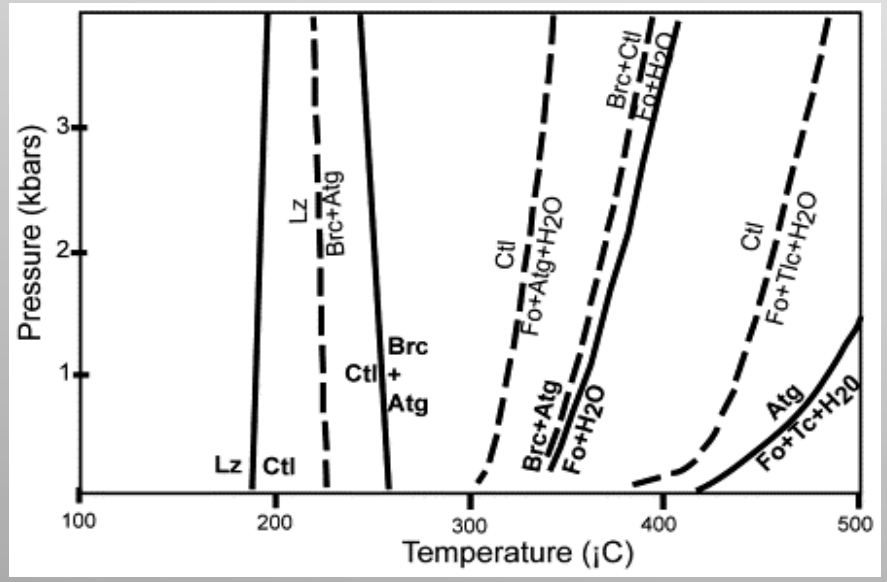
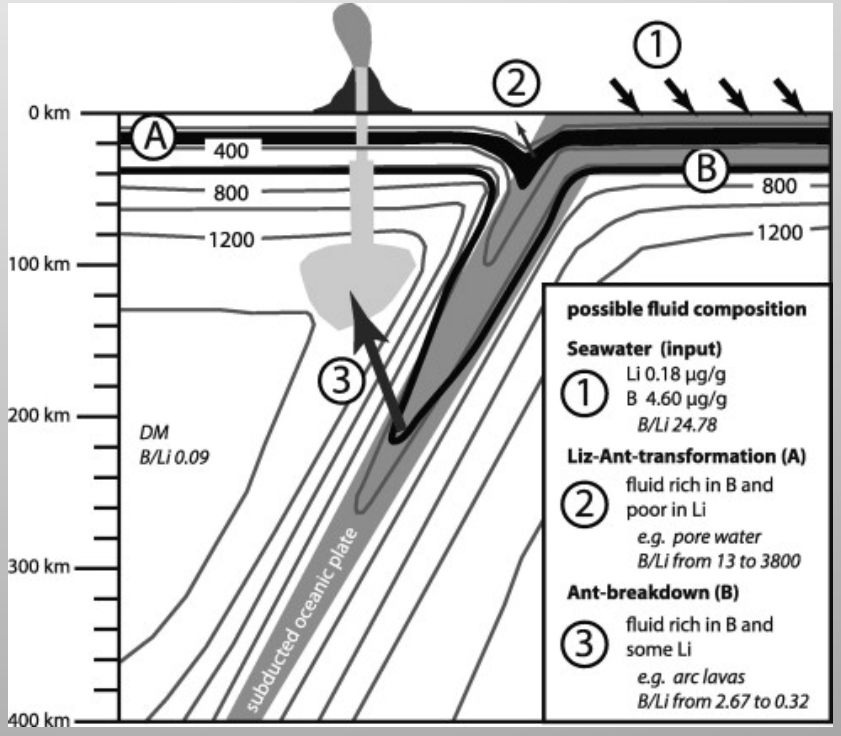


Where Do We Find It?



(Mével, 2003)



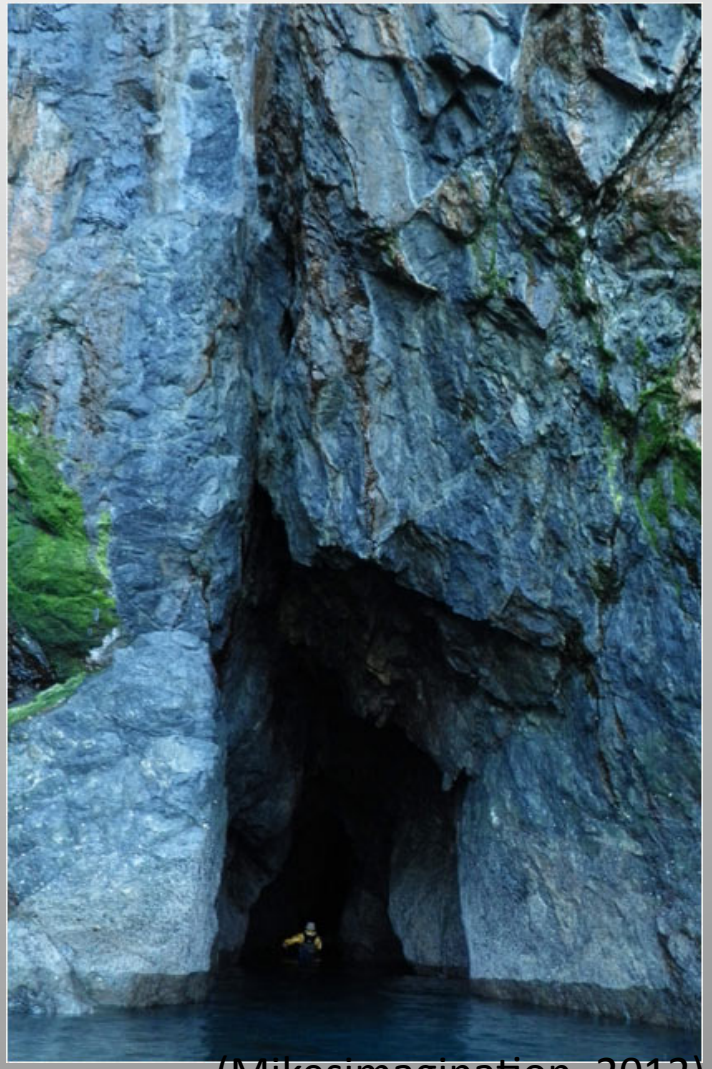
(Vils et al., 2011)

Lizard Peninsula

The Lizard Complex of Cornwall, England

Exposed Ophiloite

(Cornwall, 2012)



(Mikesimagination, 2012)

Major Lizardite Outcrops

(Mindat, 2012)

Conclusions

- The green portion is a mono-mineral composition – Lizardite
- This is not a meteorite
- The rock was most likely formed from the serpentinization of peridotites (rarer alternative options exist)
- The rock that punctured the roof has siliceous veins stabilizing an otherwise structurally weak composition

- **Speculation #1** : The rock was dropped from an aircraft. Accident? Intentional prank? Bombing Mission?
- **Speculation #2** : If not for the siliceous veins, this rock would have disintegrated on impact with the roof

References

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