Earth Science Exchange at PCSHS Loei
Geology Related

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Classification of Rocks

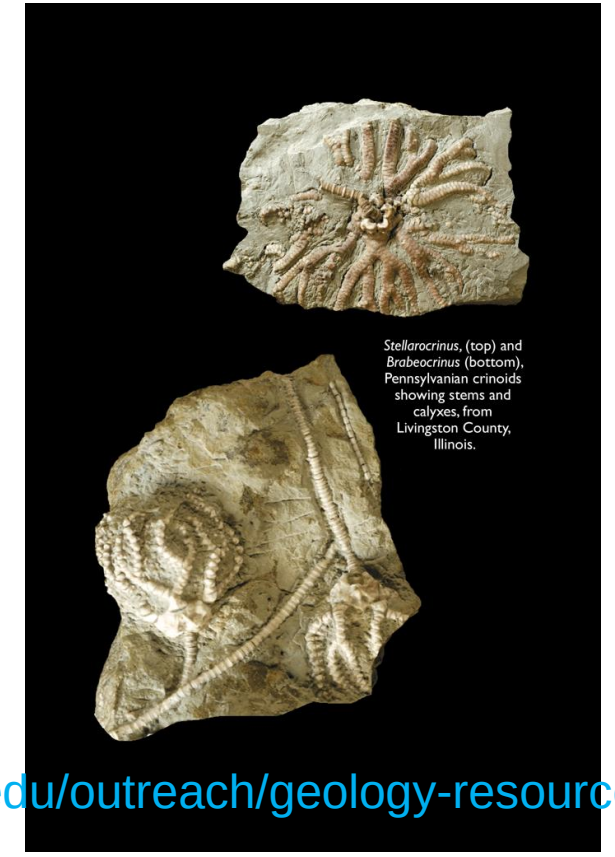
- Igneous Rocks
- Sedimentary Rocks
- Metamorphic Rock

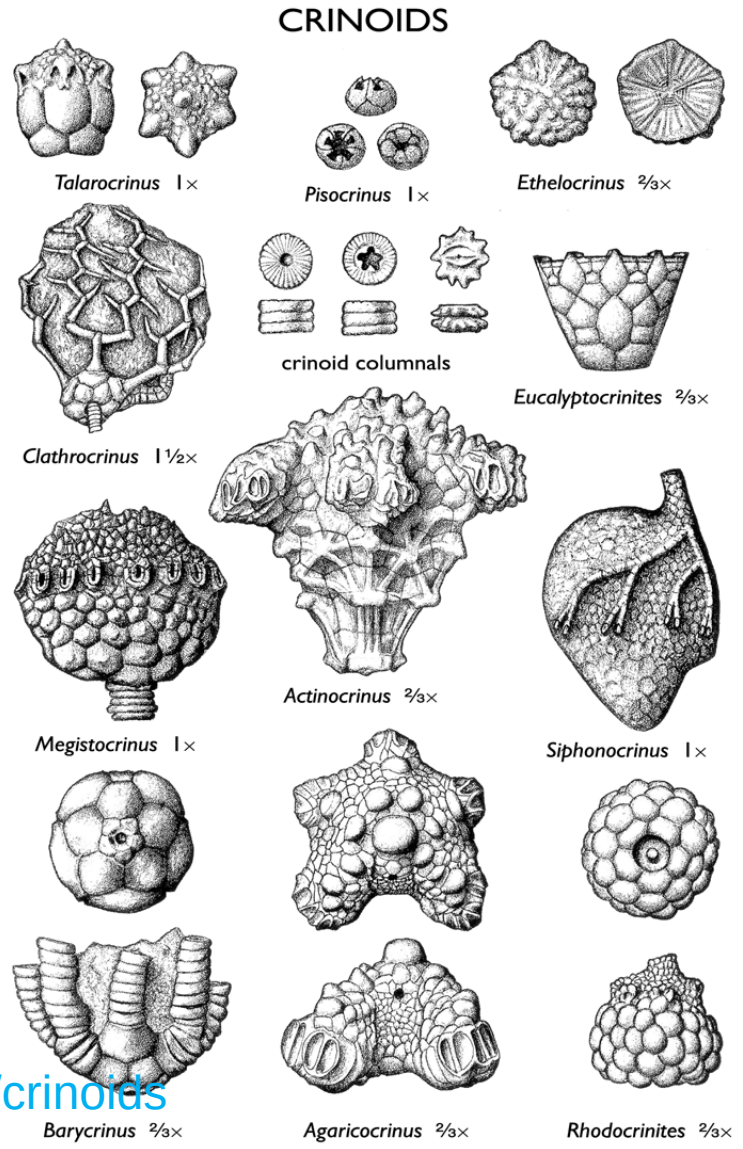
->Some figures are not used in my lecture

Fossils of the Loei campus

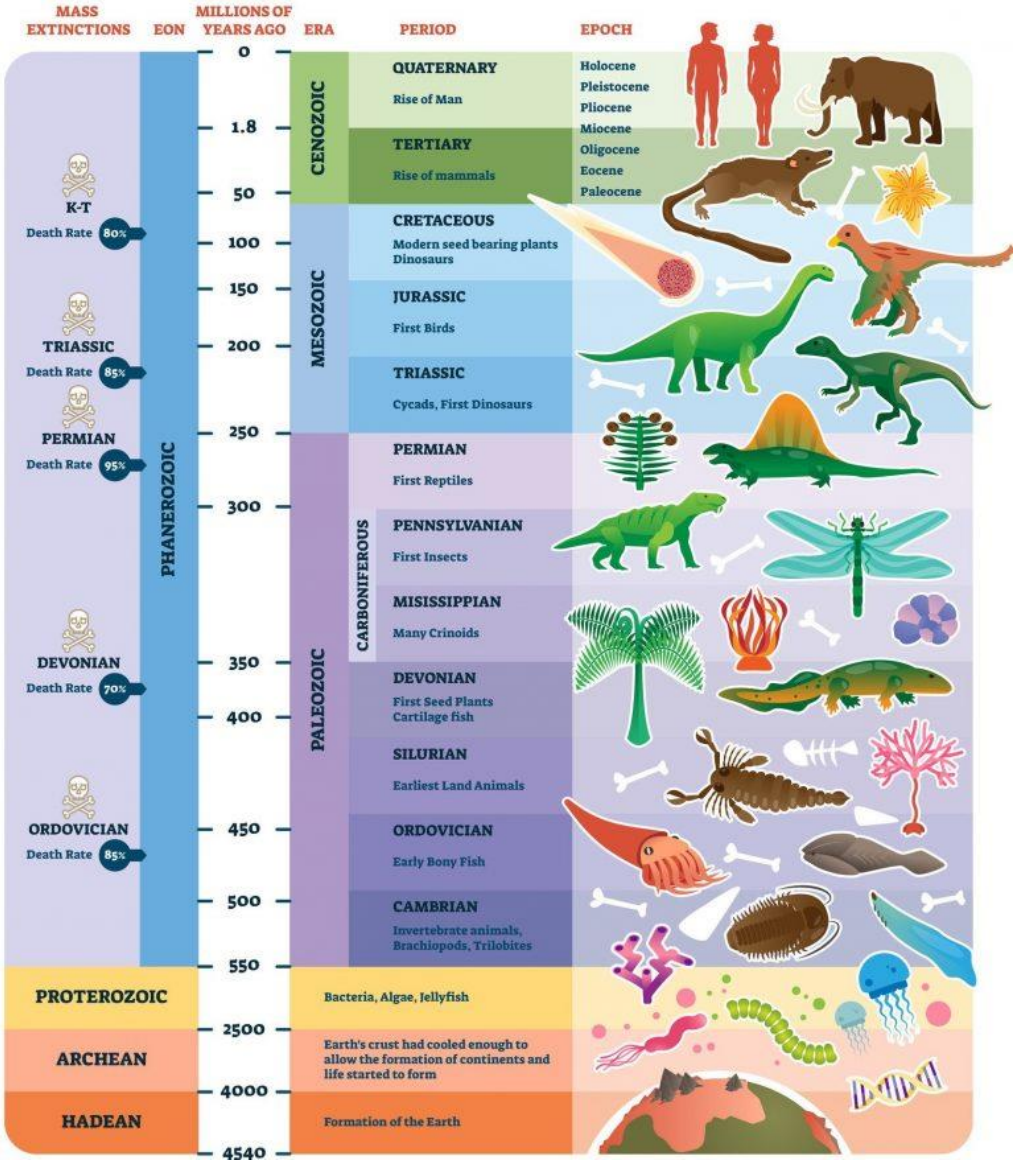
Crinoid

Fusulina





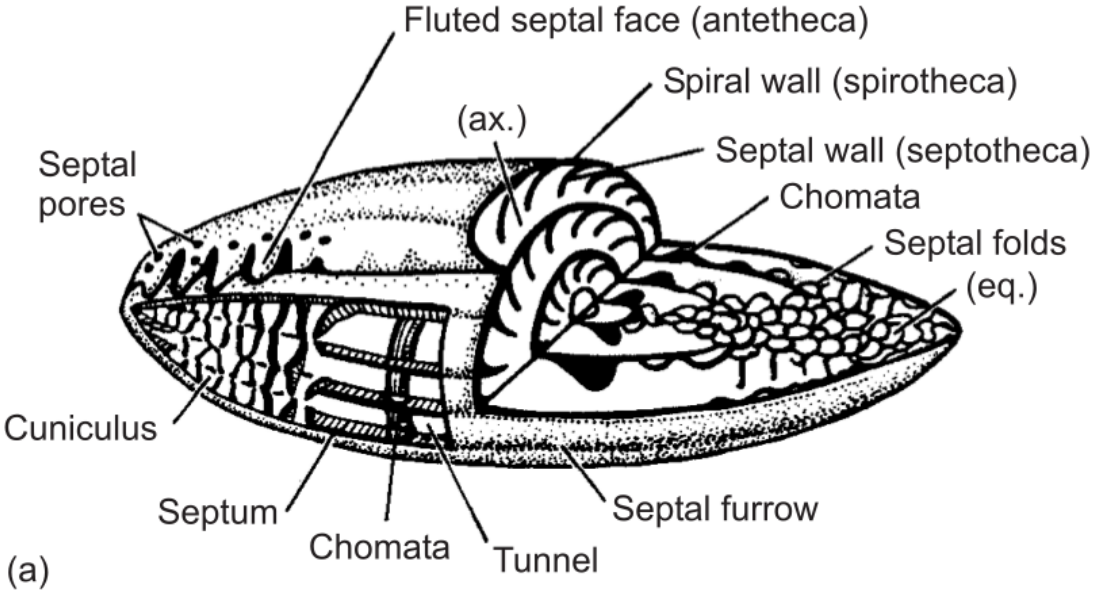
https://isgs.illinois.edu/outreach/geology-resources/crinoids

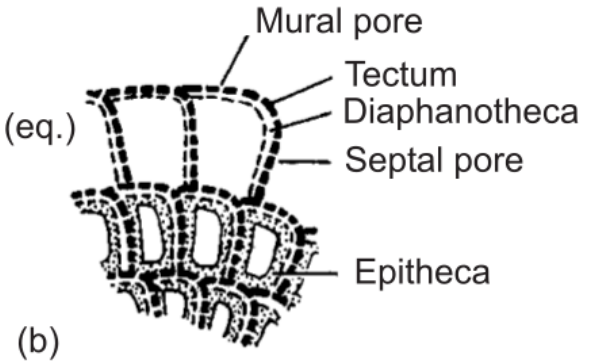


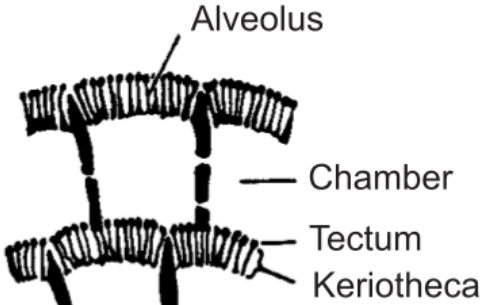
Carboniferous to Permian

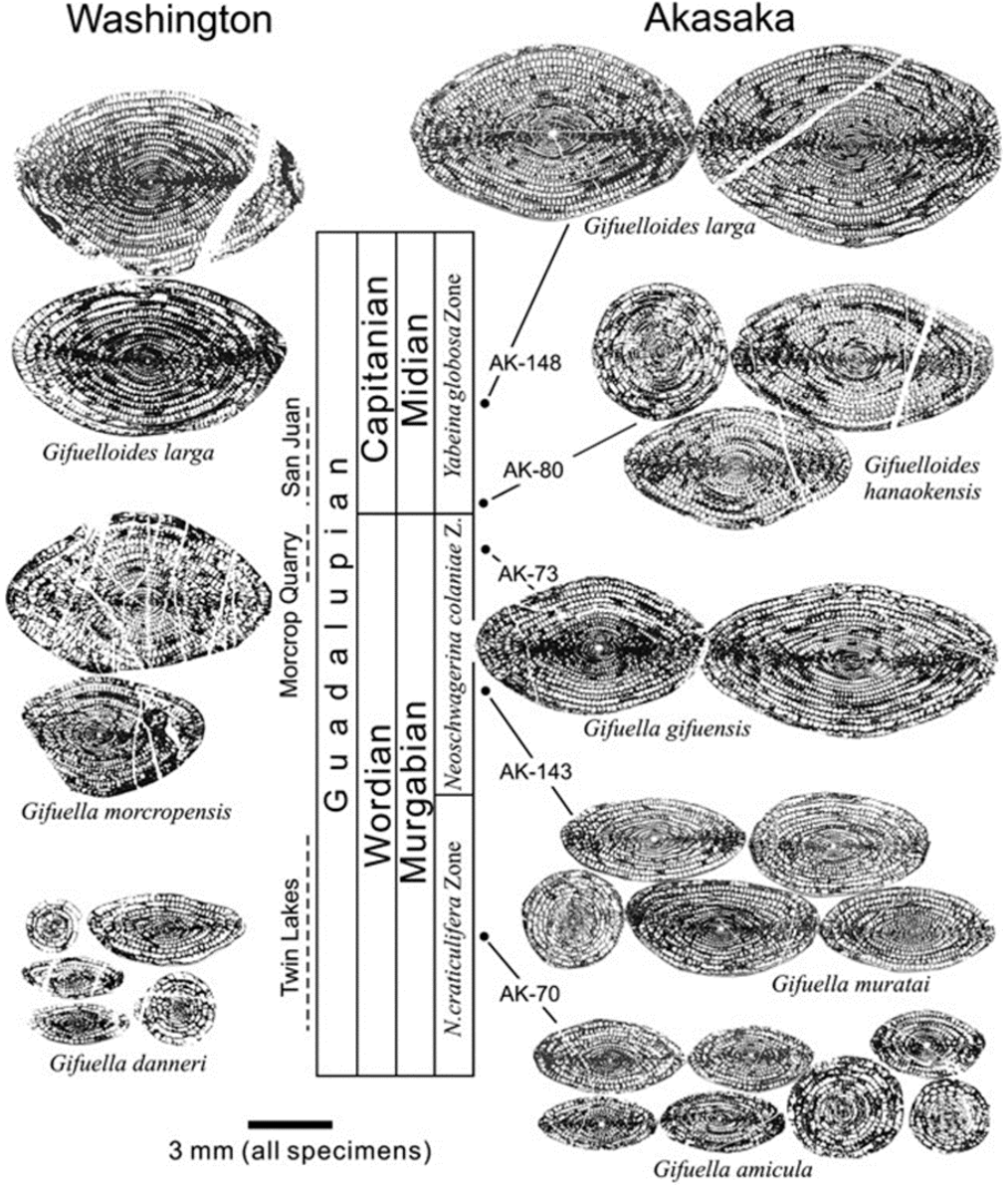
Loei Limestone

Fusulina inner structure
A kind of plankton








Washington
Akasaka
Gifuelloides larga
Gifuelloides larga
AK-148
AK-80
Gifuelloides hanaokensis
AK-73
Gifuella gifuensis
AK-143
Gifuella muratai
AK-70
Gifuella amicula
Gifuella morcropensis
Gifuella danneri
San Juan
Morcrop Quarry
Twin Lakes
Guadalupian
Capitanian
Wordian
Midian
Murgabian
Yabeina globosa Zone
Neoschwagerina colaniae Z.
N.craticulifera Zone
3 mm (all specimens)

How to identify igneous rocks

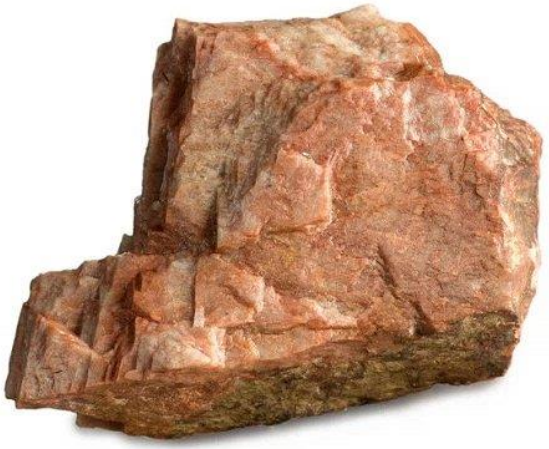
- Minerals and texture by “Naked eye (Loupe)”
- Minerals and texture by **Polarized microscope**
- Analyze by XRD or EPMA (Chemical comp.)


Volcanic Rocks
Basalt
Andesite
Rhyolite
Plutonic Rock
Gabbro
Diorite
Granite

Rock-Forming Minerals: Seven Sisters!!

Quartz

SiO_2



Potassium Feldspar

$KAlSi_3O_8$

Plagioclase Feldspar

$NaAlSi_3O_8$ - $CaAl_2Si_2O_8$

https://tesep.org.au/student-online-resources/rock-forming-minerals.html

Biotite

$(Mg,Fe,K,Al)Si_3O_{10}(OH)_2$

Amphibole

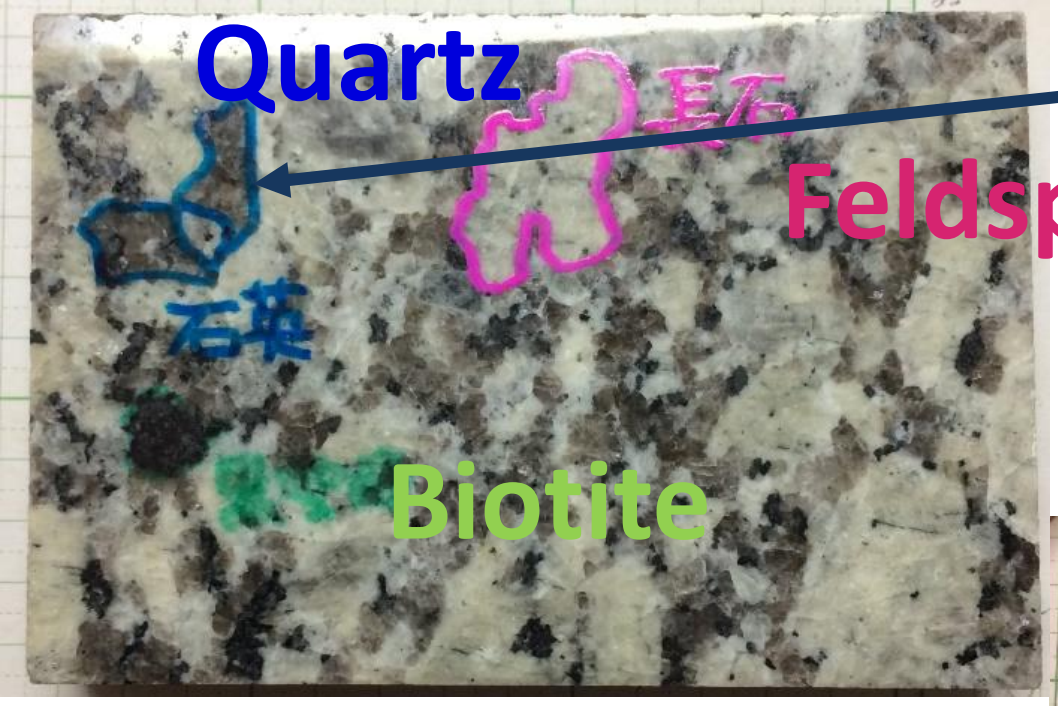
$(Mg,Fe,Ca,Na)Si_8O_{22}(OH)_2$

Pyroxene

$(Mg,Fe,Ca,Al)SiO_3$

Olivine

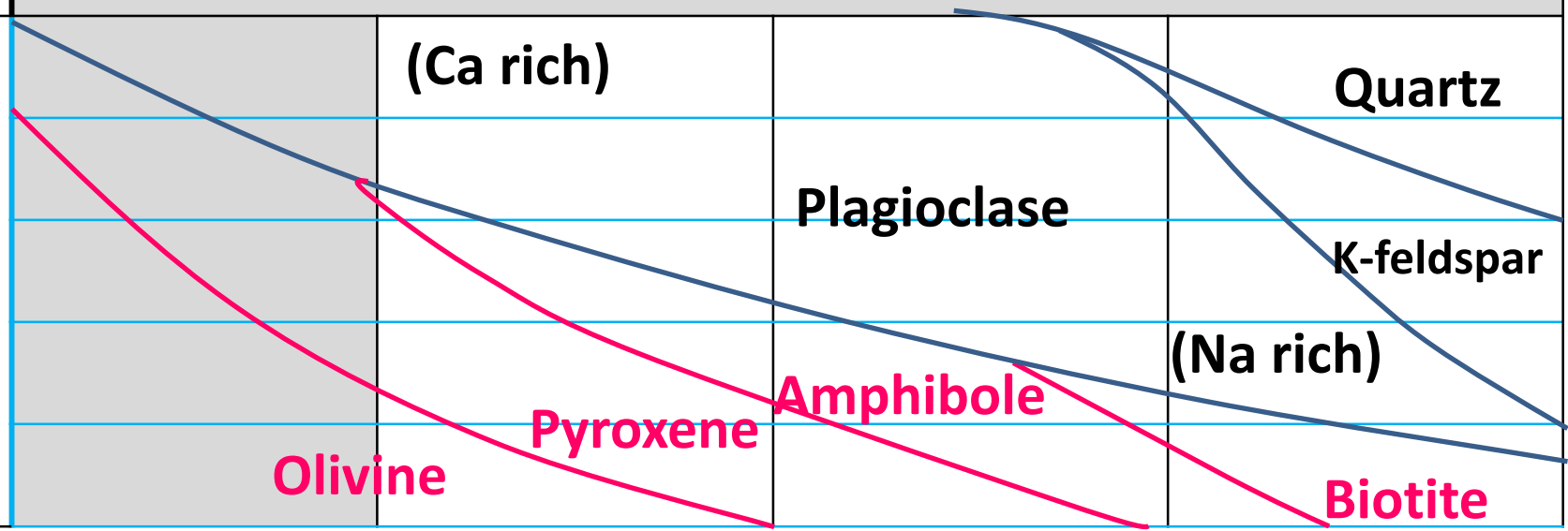
$(Mg,Fe)_2SiO_4$



Quartz looks dark due to transparency.
Lay penetrate inside.

Igneous Rock table (Y.Okamoto2018)

Volcanic Rock (Aphanitic Tex.)	Komatiite	**Basalt**	**Andesite**	**Rhyolite**
Plutonic Rock (Phaneritic Tex.)	Peridotite	**Gabbro**	**Diorite**	**Granite**
SiO_2(wt%)	Ultra Basic	Basic	Mid	Acid
		45 52 66		
Major Rock forming minerals (Vol%)				



• Polarized Microscope

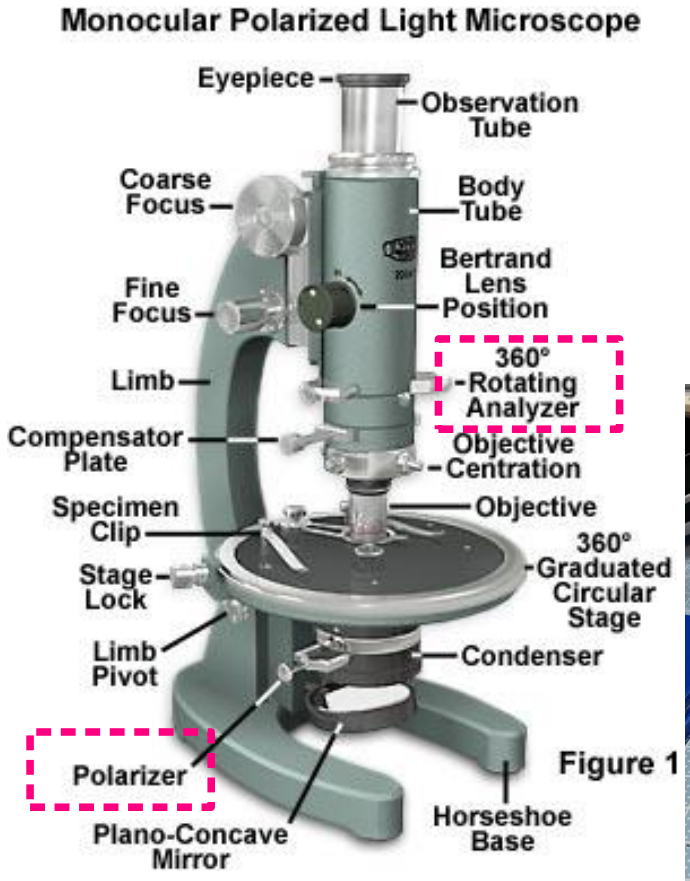


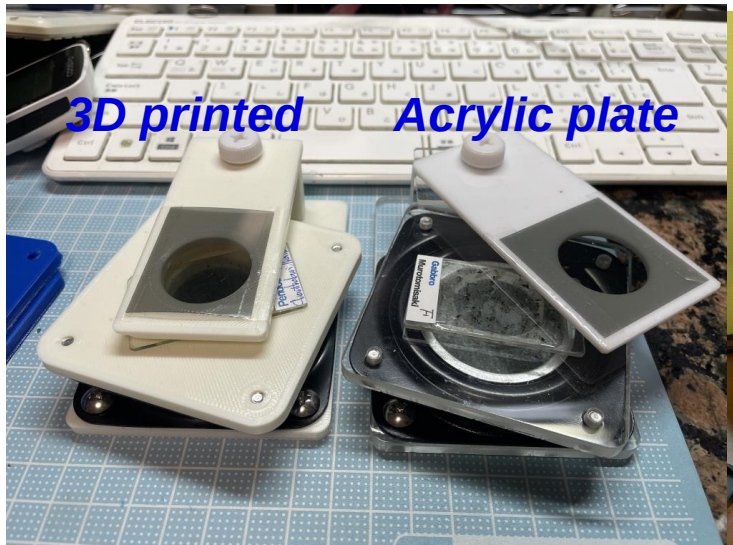
Figure 1

https://www.olympus-lifescience.com/

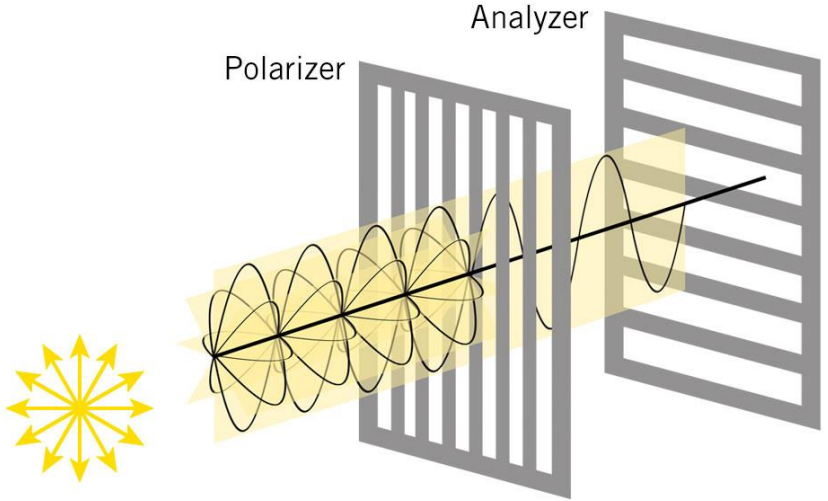
- Normal microscope or USB mscp.

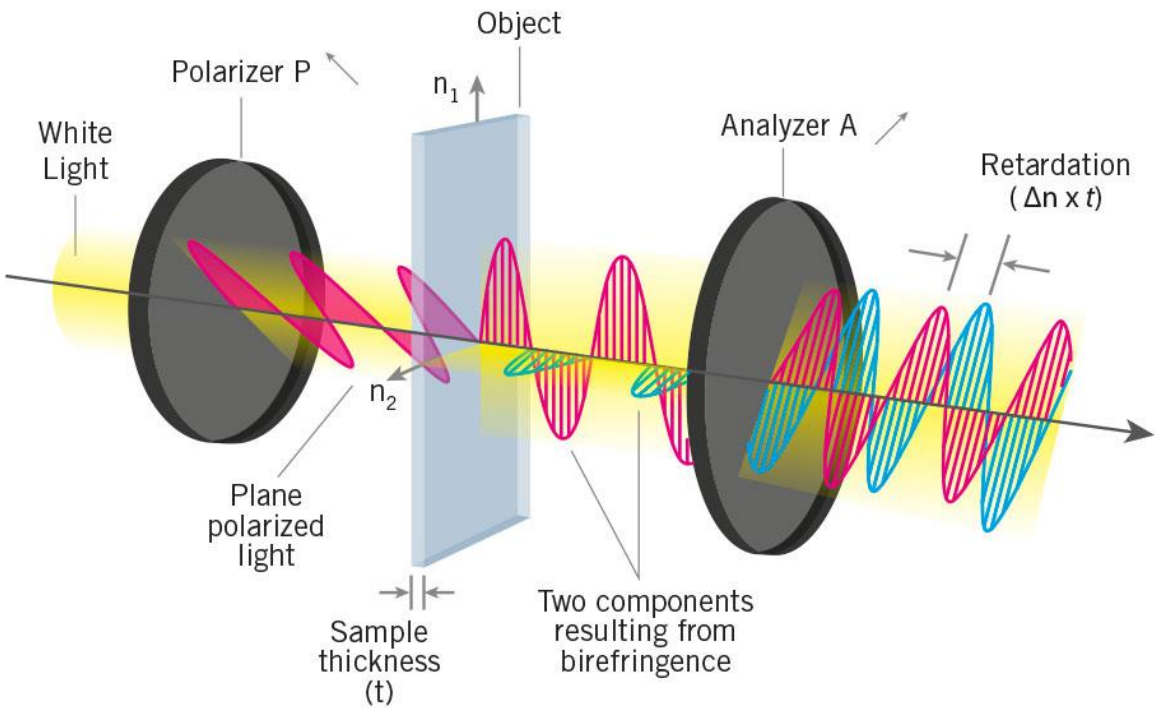
  + Polarized filter + additional parts

- My polarizing unit!

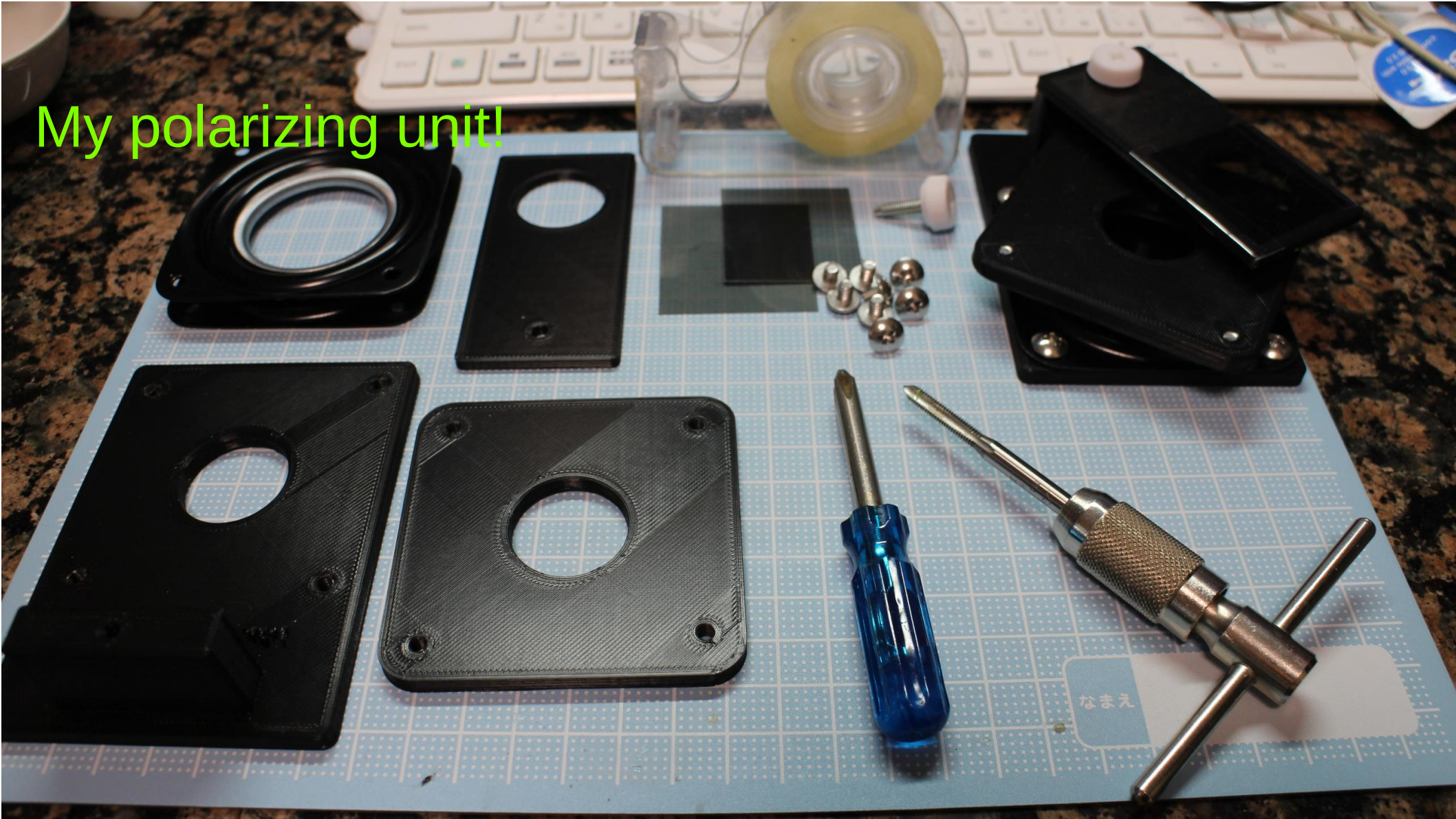


Polarized light and other physics





Images are from https://moticeurope.blogspot.com/


My polarizing unit!

How to make thin-sections Part 1

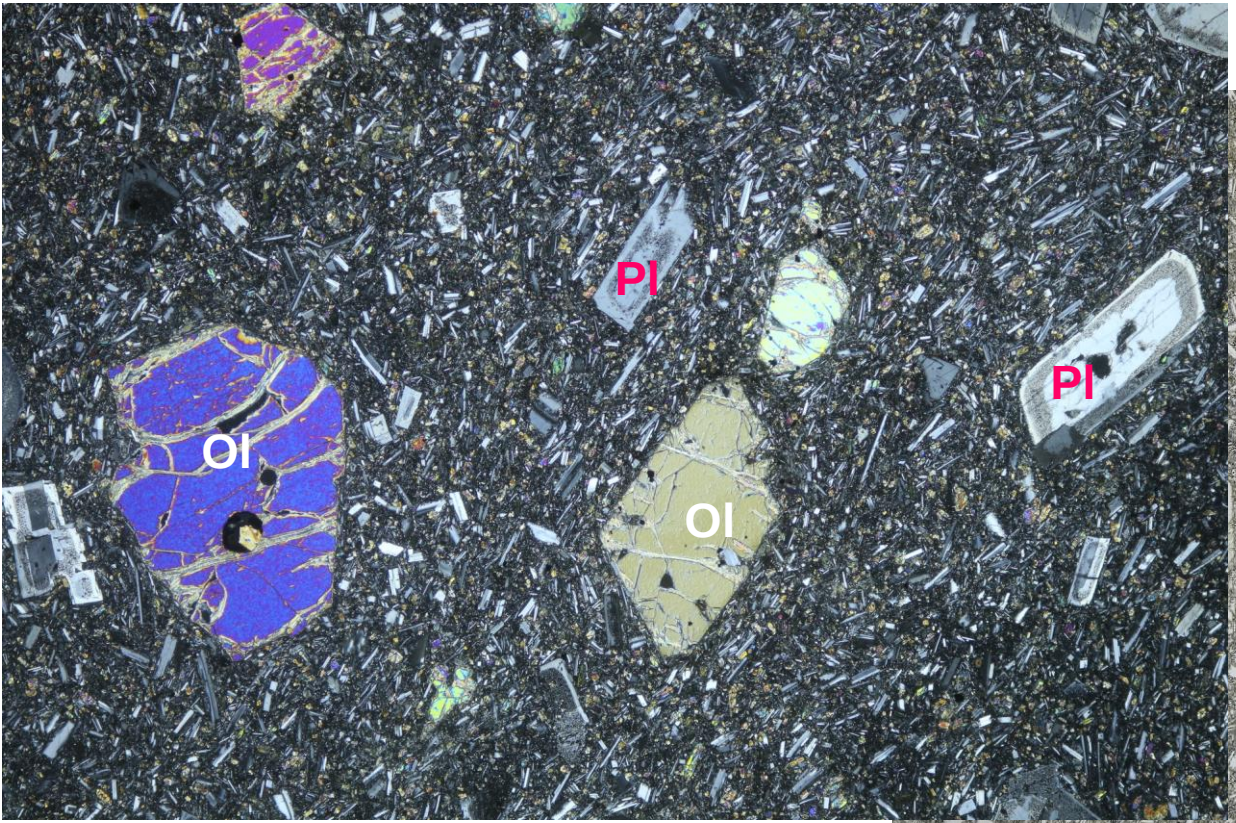
https://youtu.be/ViijnnHxqls

How to make thin-sections Part 2

https://youtu.be/TGRfYrV_D5E

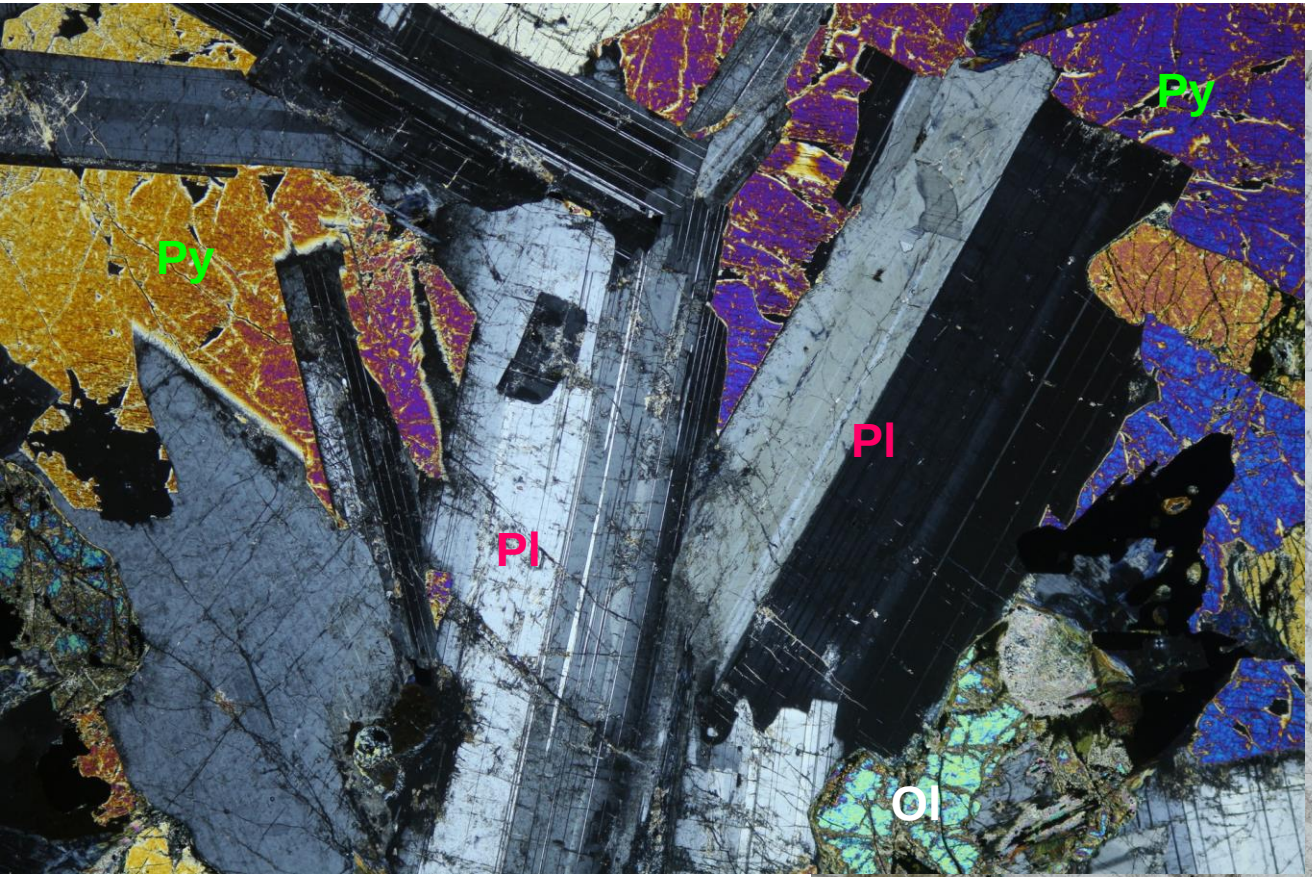
Observation of Basalt at Chausuyama, Matsue Japan

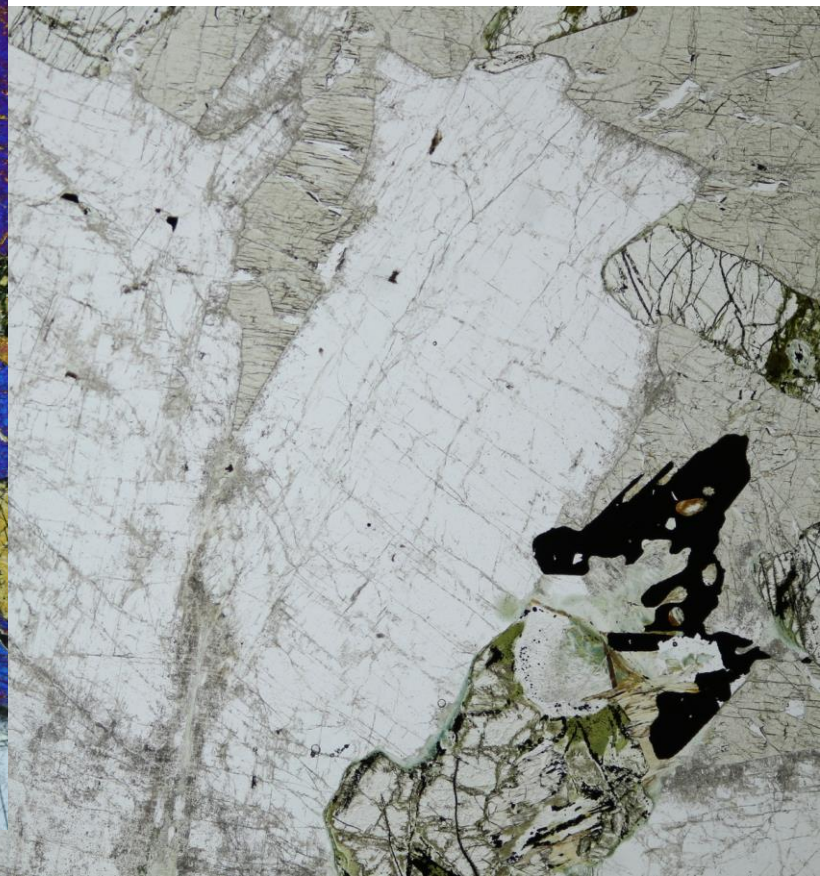
Ol: Olivine
Pl: Plageoclase



Observation of Gabbro at Murotomisaki, Kohchi Japan

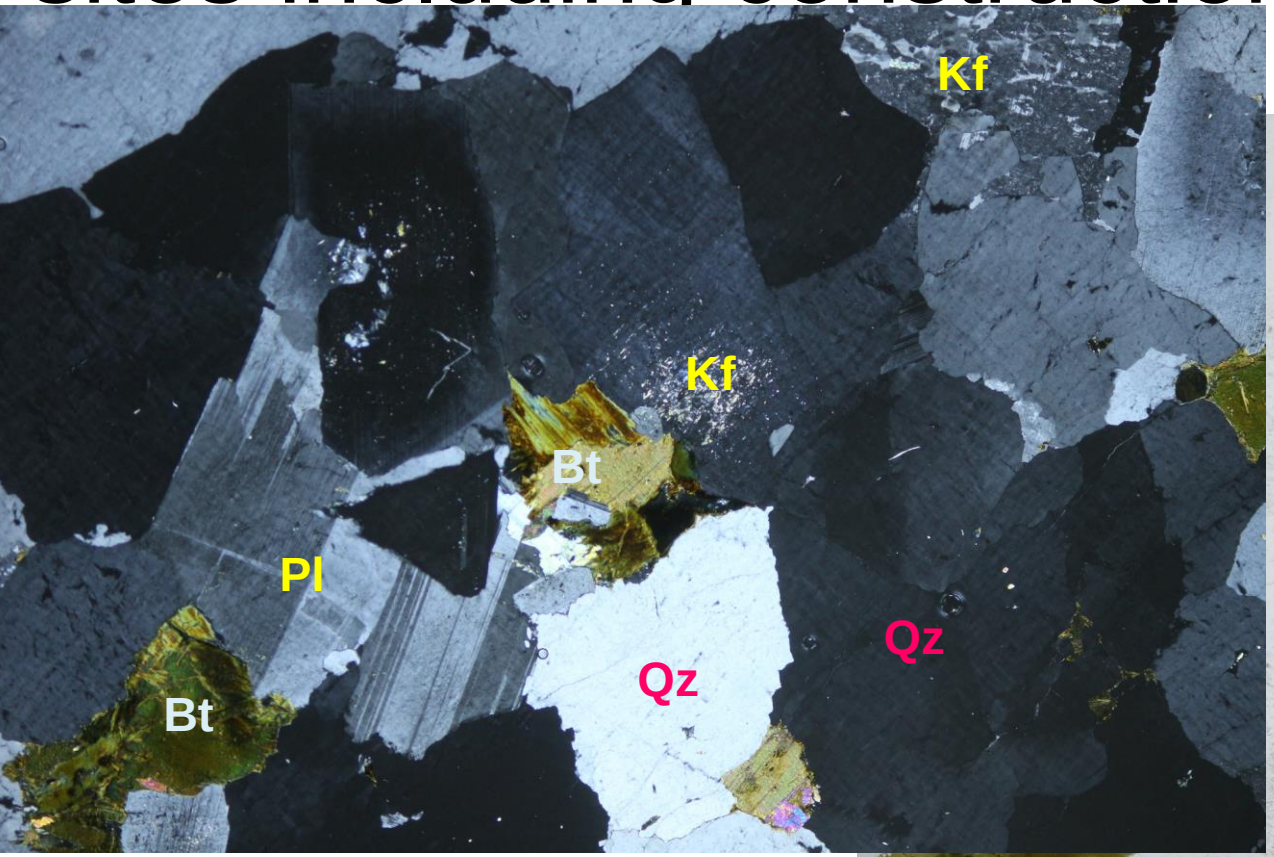
Ol: Olivine
Py: Pyroxene
Pl: Plageoclase

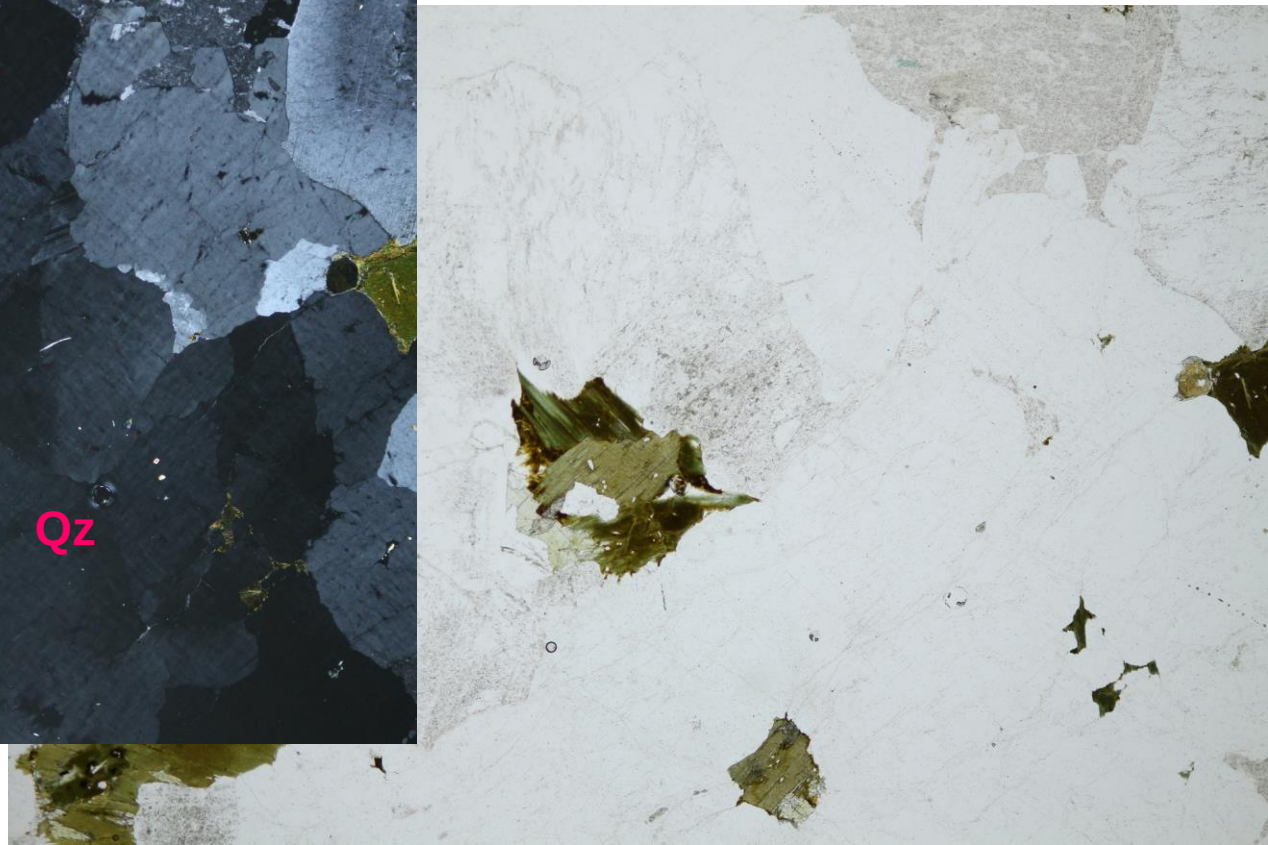




Observation of Granite at various sites including construction stones

Qz: Quartz
Kf: K-Felspar
Pl: Plageoclase
Bt: Biotite



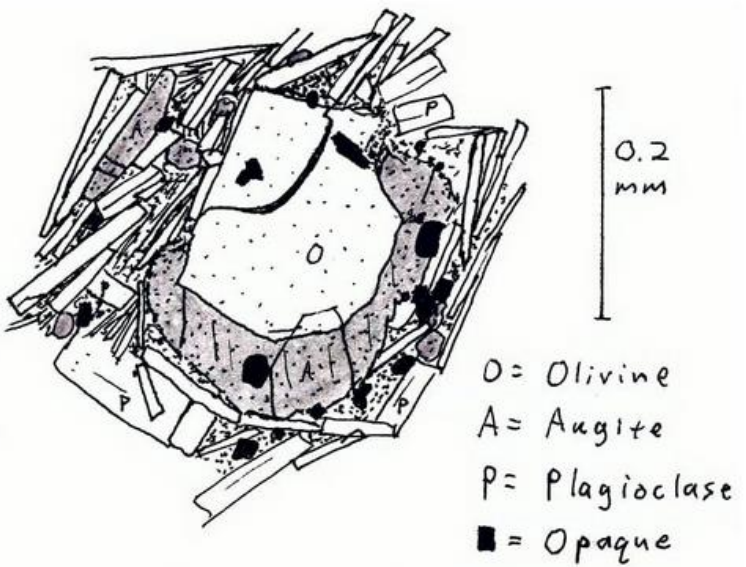


How to sketch

- Only draw the profile lines and structures
- Do not need painting
- Write features, mineral names, etc. in a callout

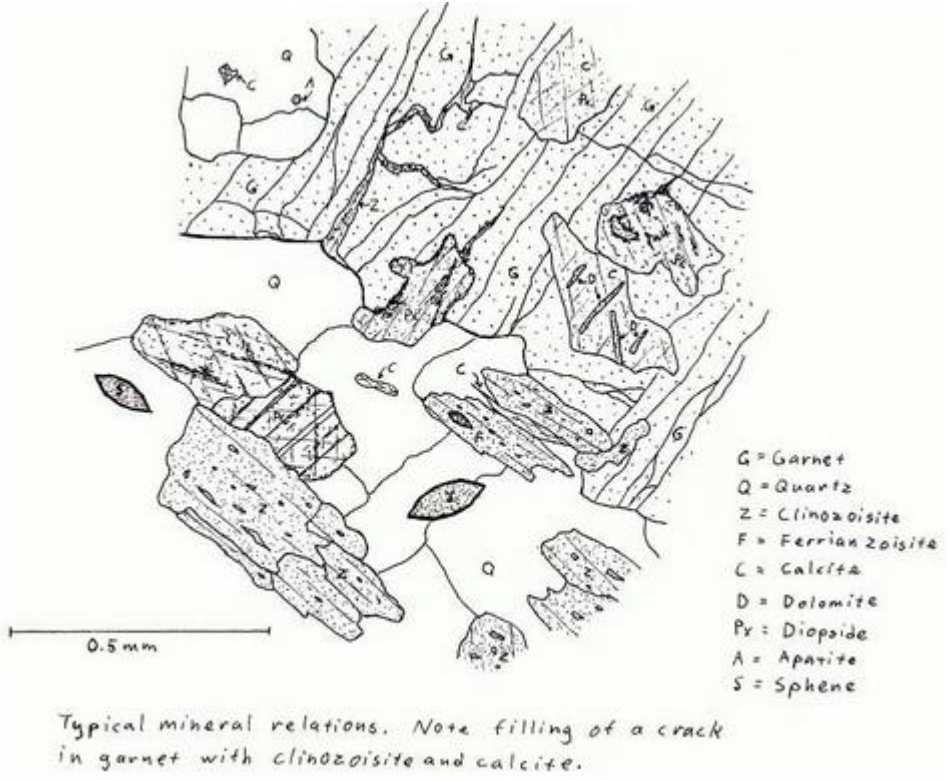
Some beautiful sketch examples 1

https://muse.union.edu/hollochk/kurt-hollocher/petrology/the-almost-forgotten-art-of-hand-drawings-in-petrology/



Typical mineral relations, Olivine phenocryst rimmed by augite.

Hawaii alkali basalt.

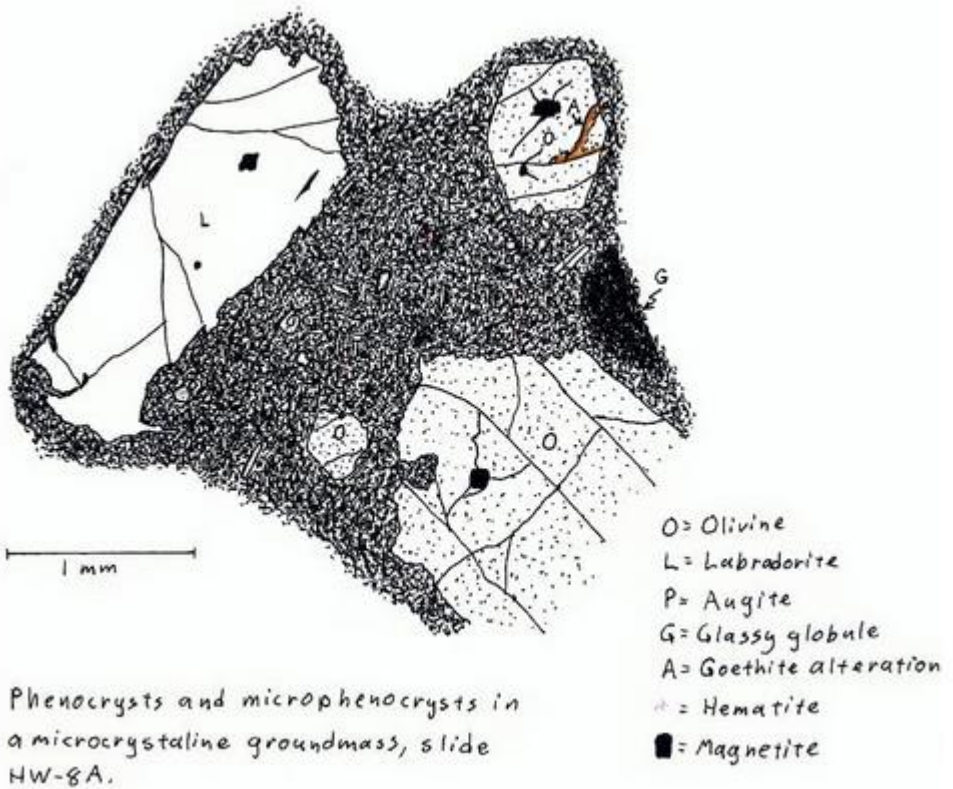


Typical mineral relations. Note filling of a crack in garnet with clinozoisite and calcite.

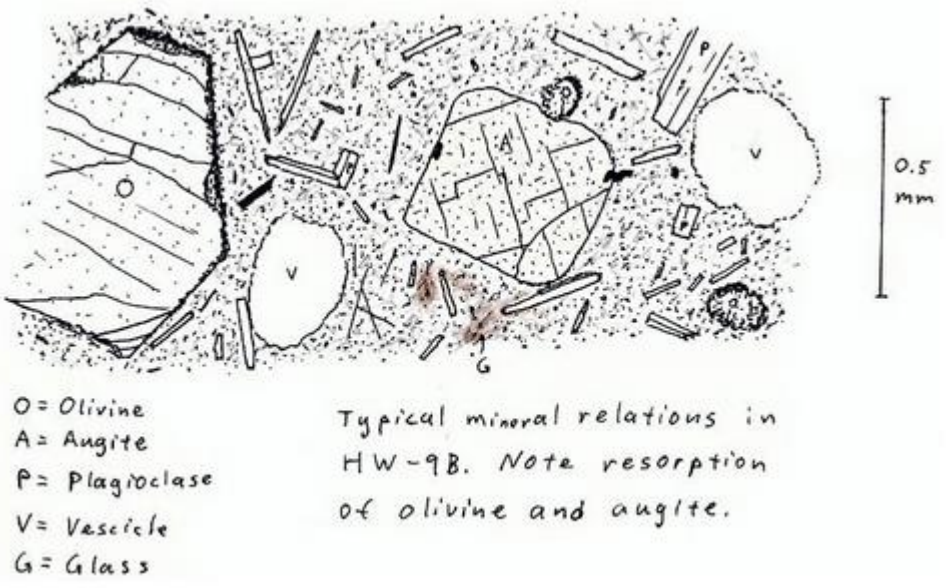
Amphibolite facies calc-silicate rock. Not very colorful, except in cross-polarized light.

Some beautiful sketch examples 2

https://muse.union.edu/hollochk/kurt-hollocher/petrology/the-almost-forgotten-art-of-hand-drawings-in-petrology/



Phenocrysts and microphenocrysts in a microcrystaline groundmass, slide HW-8A.

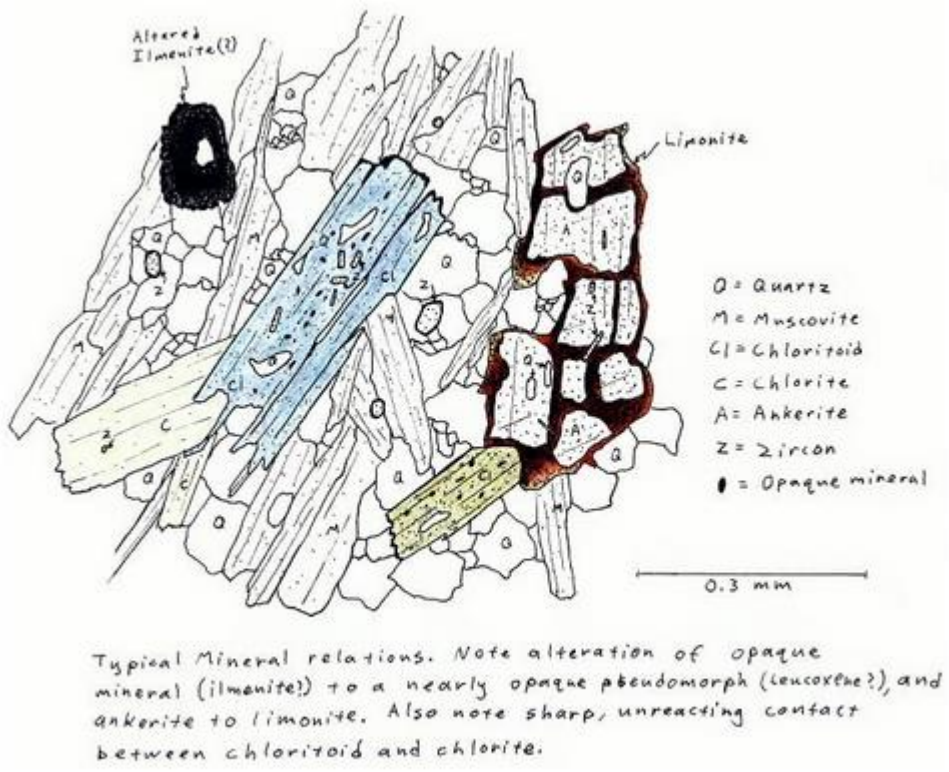


Typical mineral relations in HW-9B. Note resorption of olivine and augite.

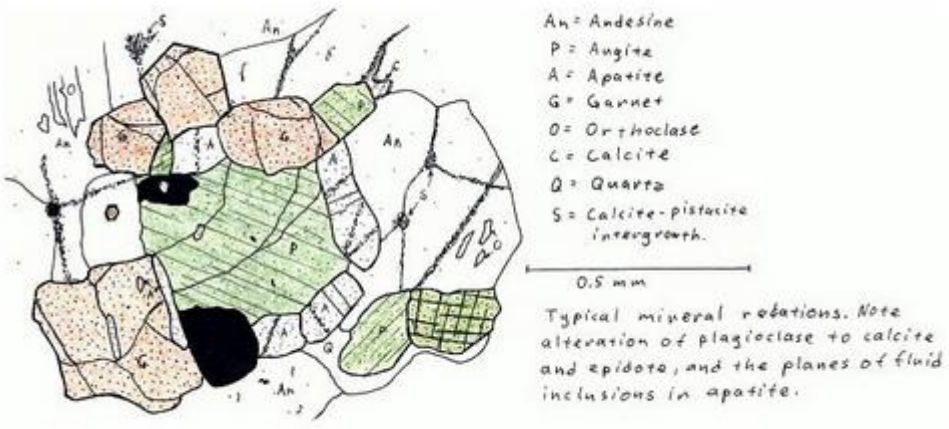
Hawaii olivine basalt.

Some beautiful sketch examples 3

https://muse.union.edu/hollochk/kurt-hollocher/petrology/the-almost-forgotten-art-of-hand-drawings-in-petrology/



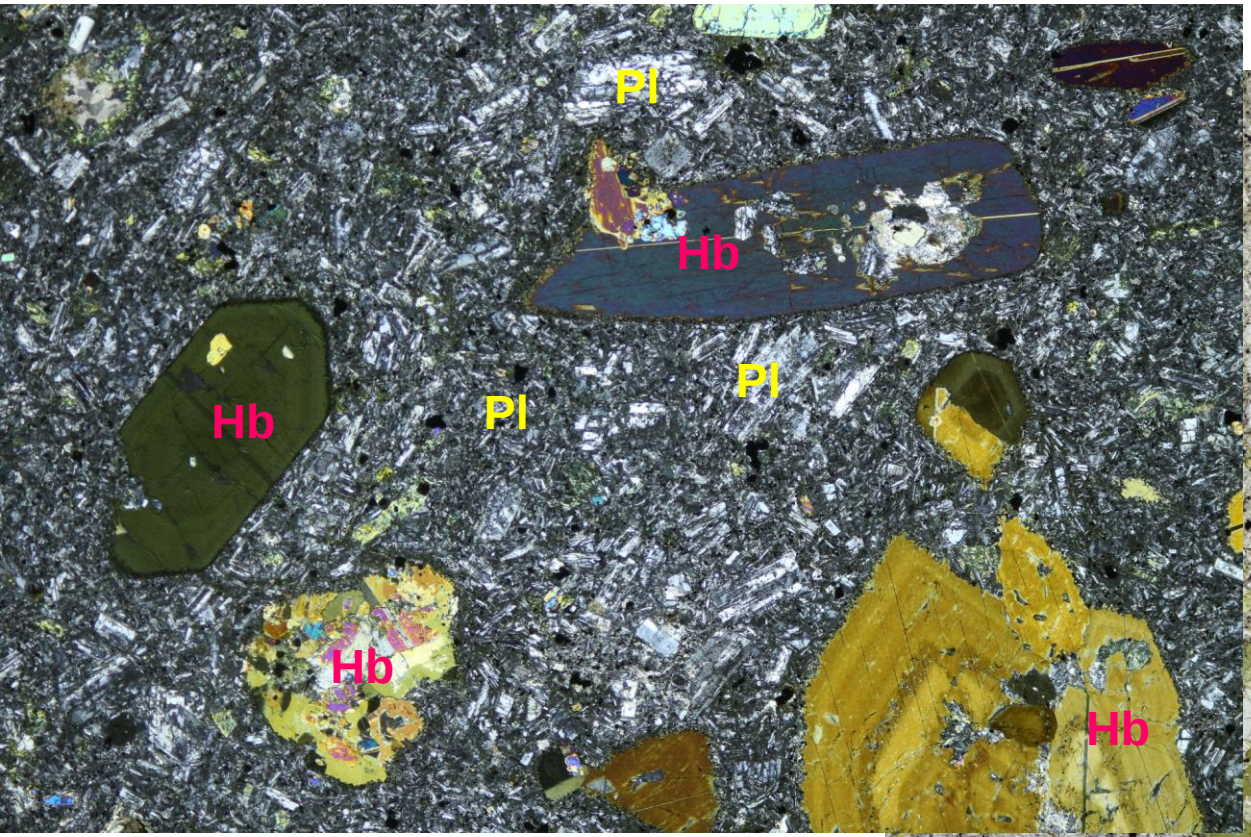
CHL. Greenschist facies chloritoid-chlorite-muscovite schist.

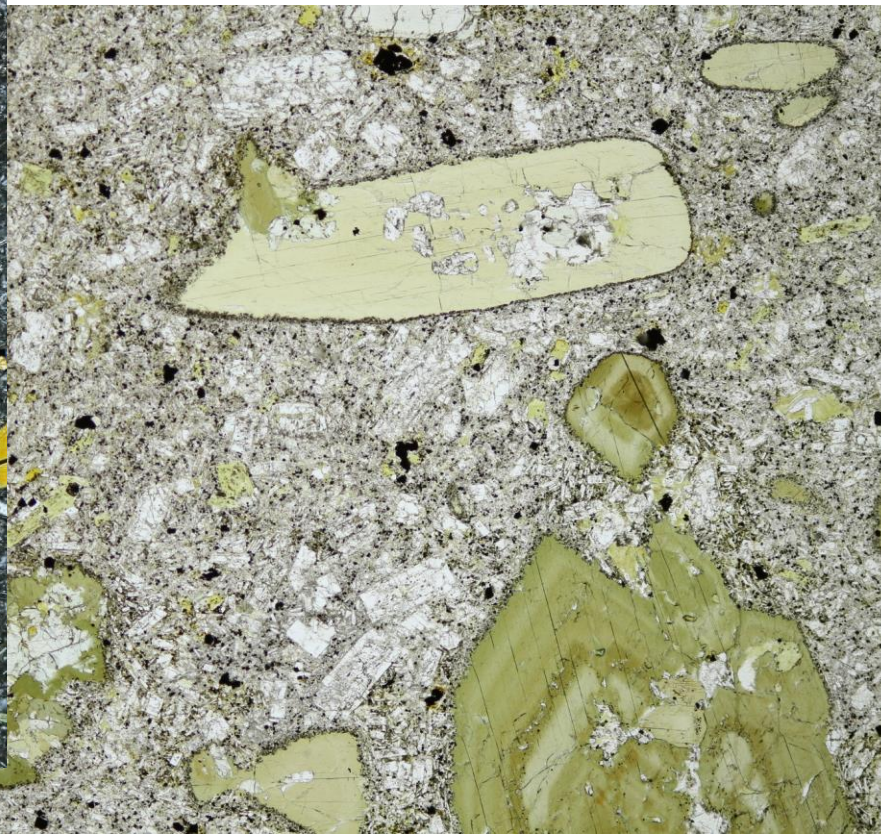


Elizabethtown, NY. Two-pyroxene granulite (only one pyroxene illustrated here).

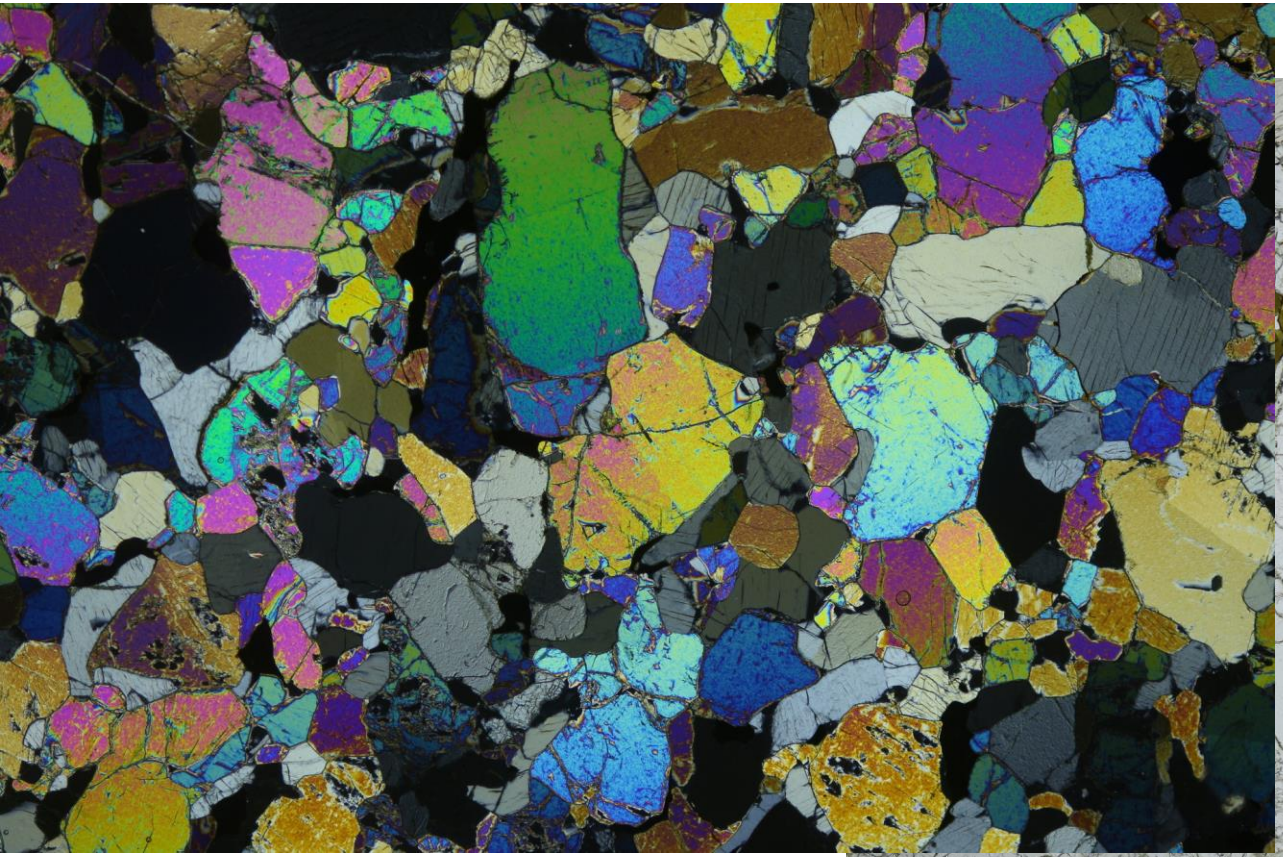
Observation of Diabase at Miyamacho, Fukui Japan

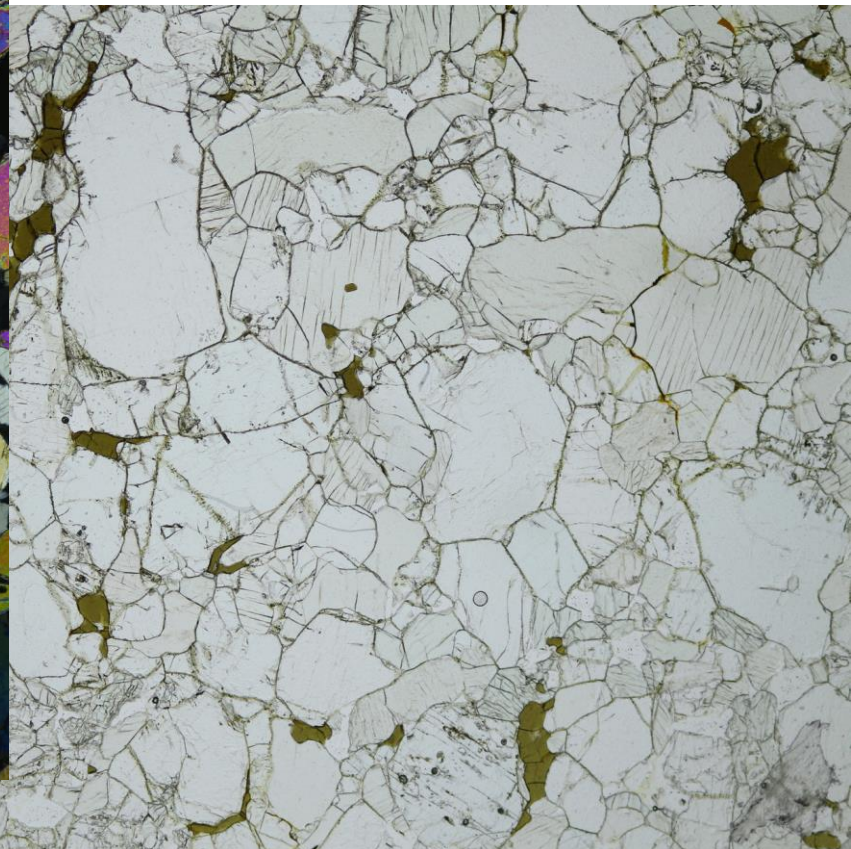
Hb: Hornblende
Pl: Plageoclase

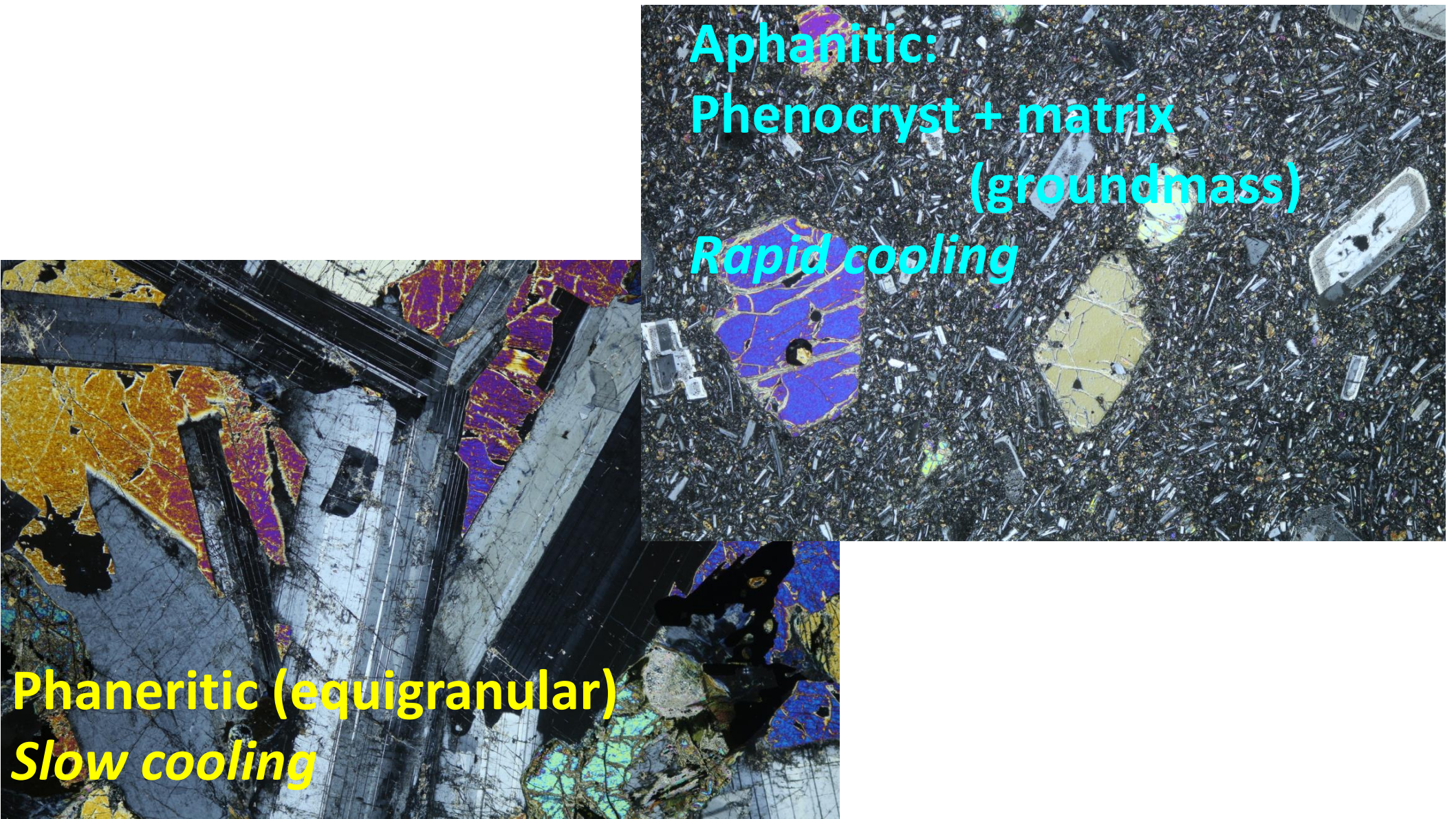




Observation of Peridotite at Chanthaburi, Thailand

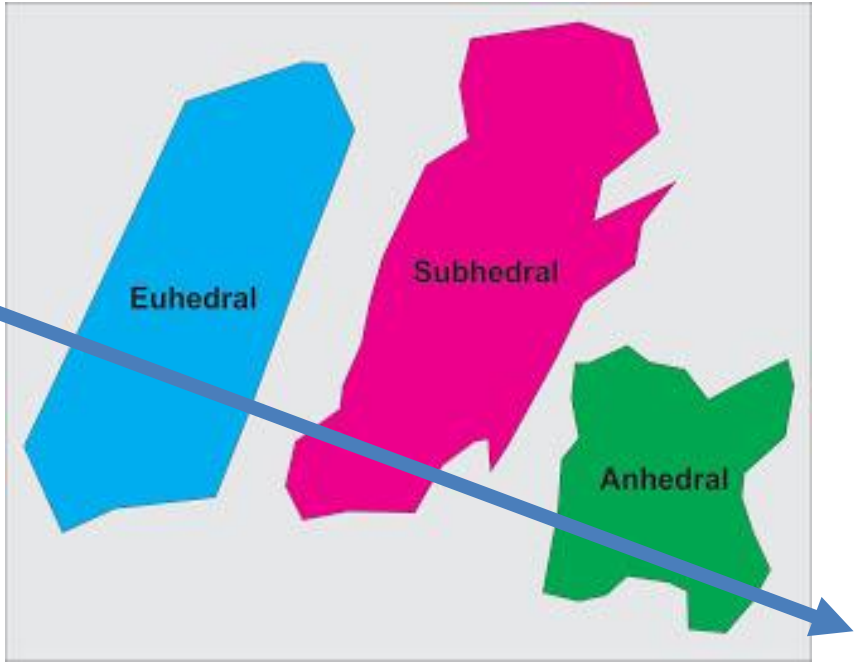





Aphanitic:
Phenocryst + matrix
(groundmass)
Rapid cooling
Phaneritic (equigranular)
Slow cooling

Minerals under Polar-microscope Part1

- Texture: volcanic (fine) or plutonic (coarse)
- Profile of minerals



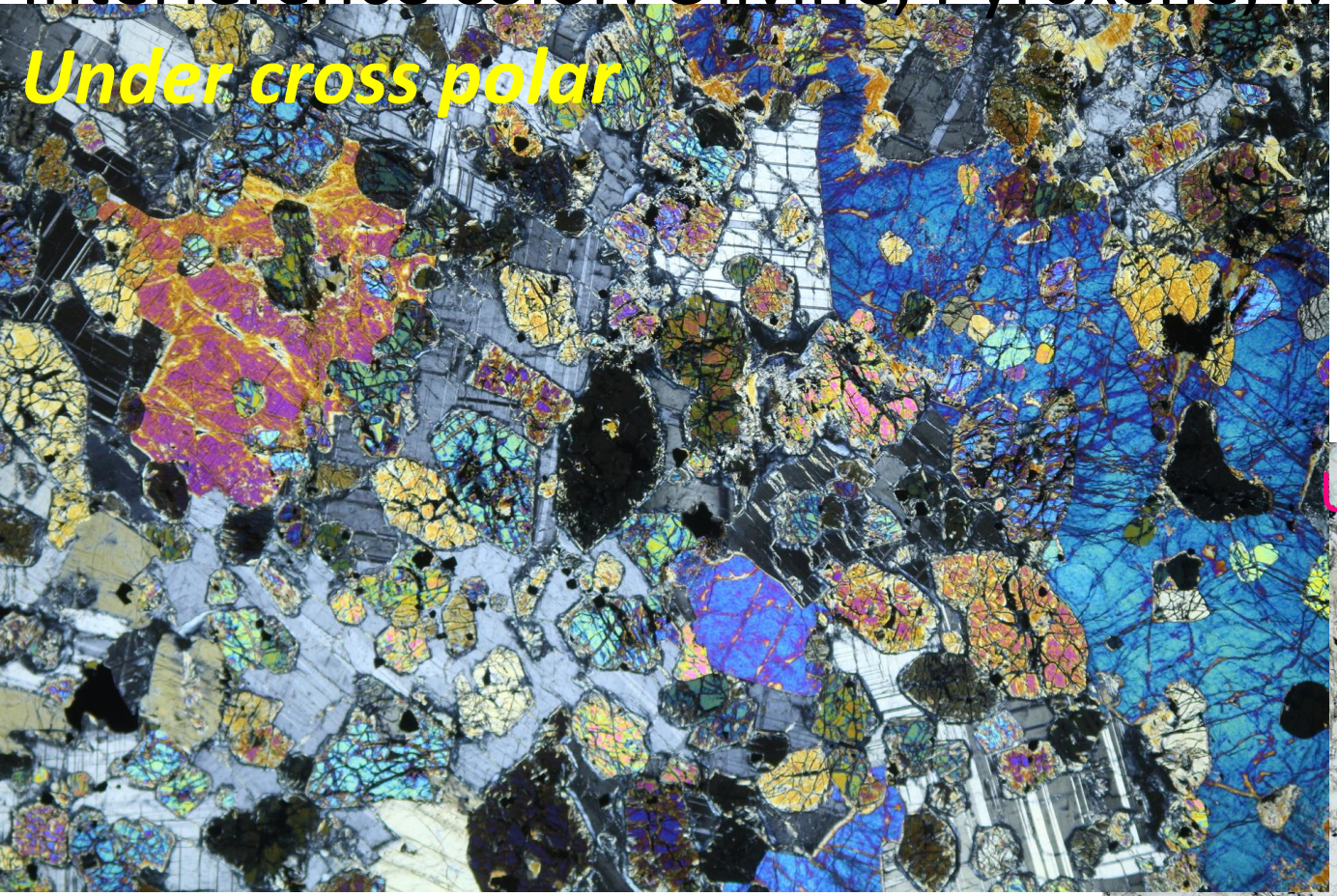
https://ilmubatugeologi.blogspot.com/2015/05/deskripsi-batuan-beku.html

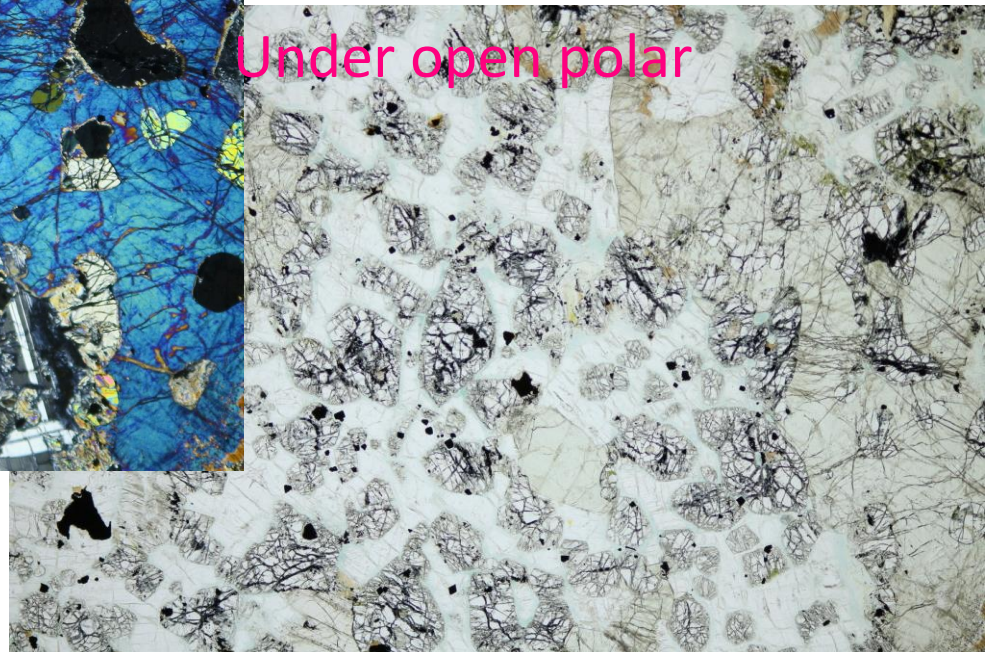
- Euhedral
- Subhedral
- Anhedral

Minerals under Polar-microscope Part2

- Refraction index (Becke line): Olivine, Pyroxene,
- Garnet,
- Cleavages: Plagioclase, Biotite, Hornblende
- Pleochroism(Open): Biotite, Hornblende
- Interference color(Cross): Olivine, Pyroxene, , Muscobite
- No light (Cross)→ Garnet, Glass, opaque minerals

Interference color: Olivine, Pyroxene, Muscobite





Part 2:

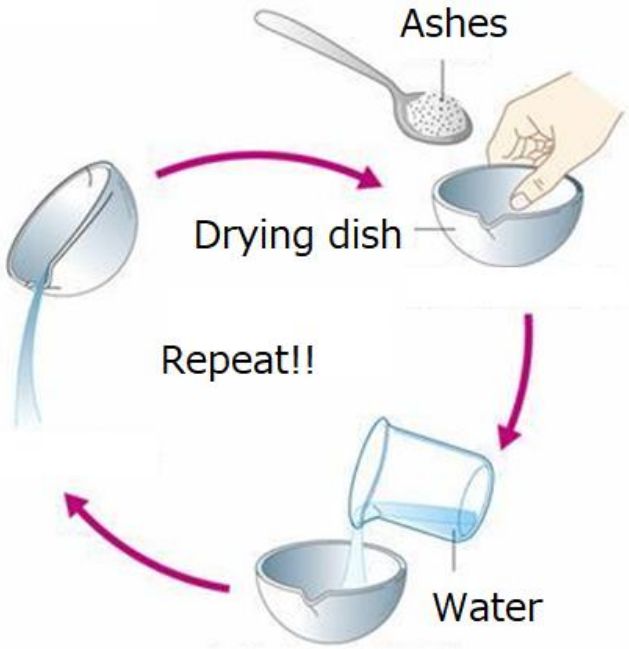
Volcanic ash (Garden soil) observation

Volcanic ash (Garden soil) observation

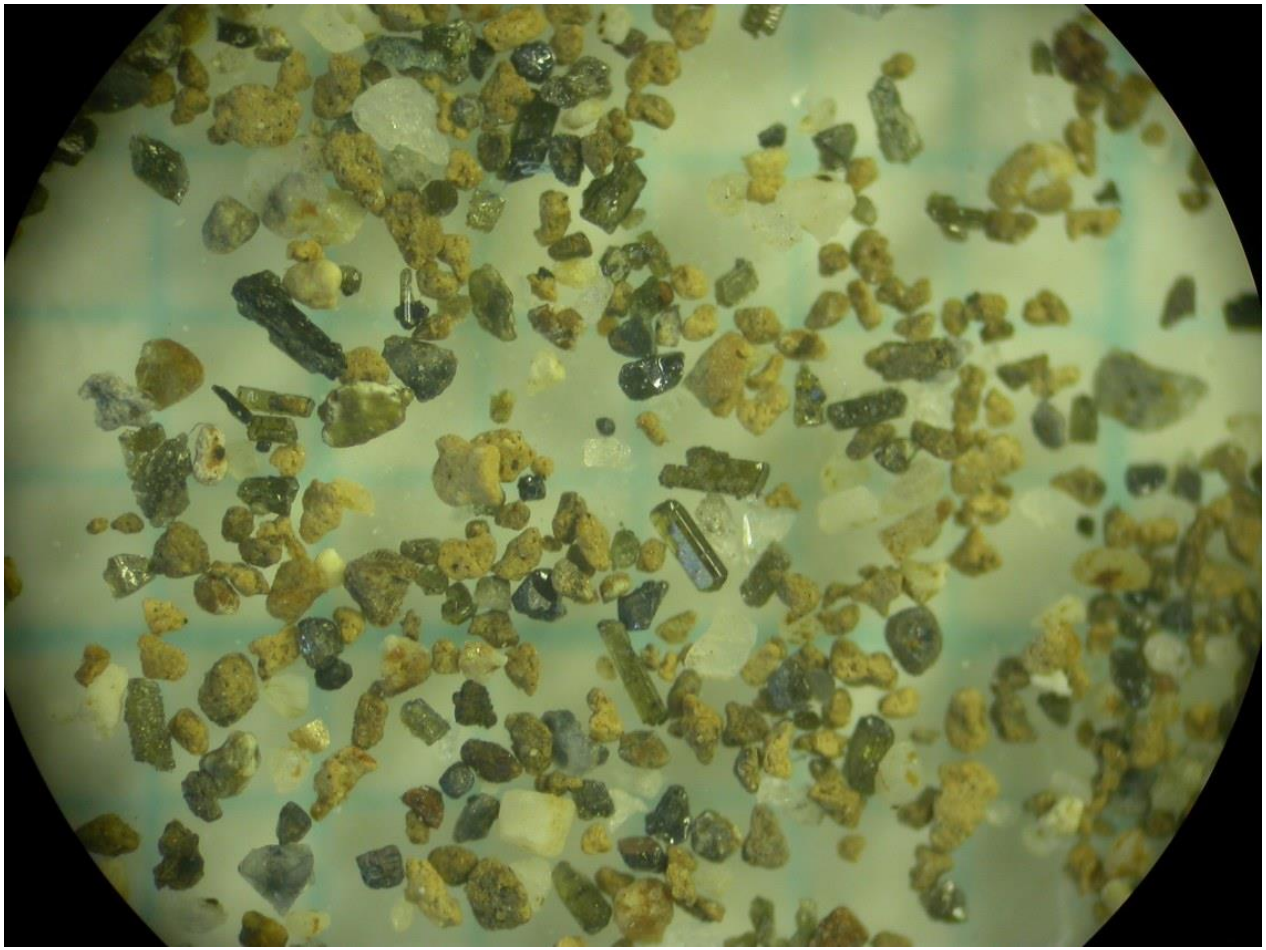
Wash up dirty soils

Preparation of volcanic ashes and soils for microscope observation

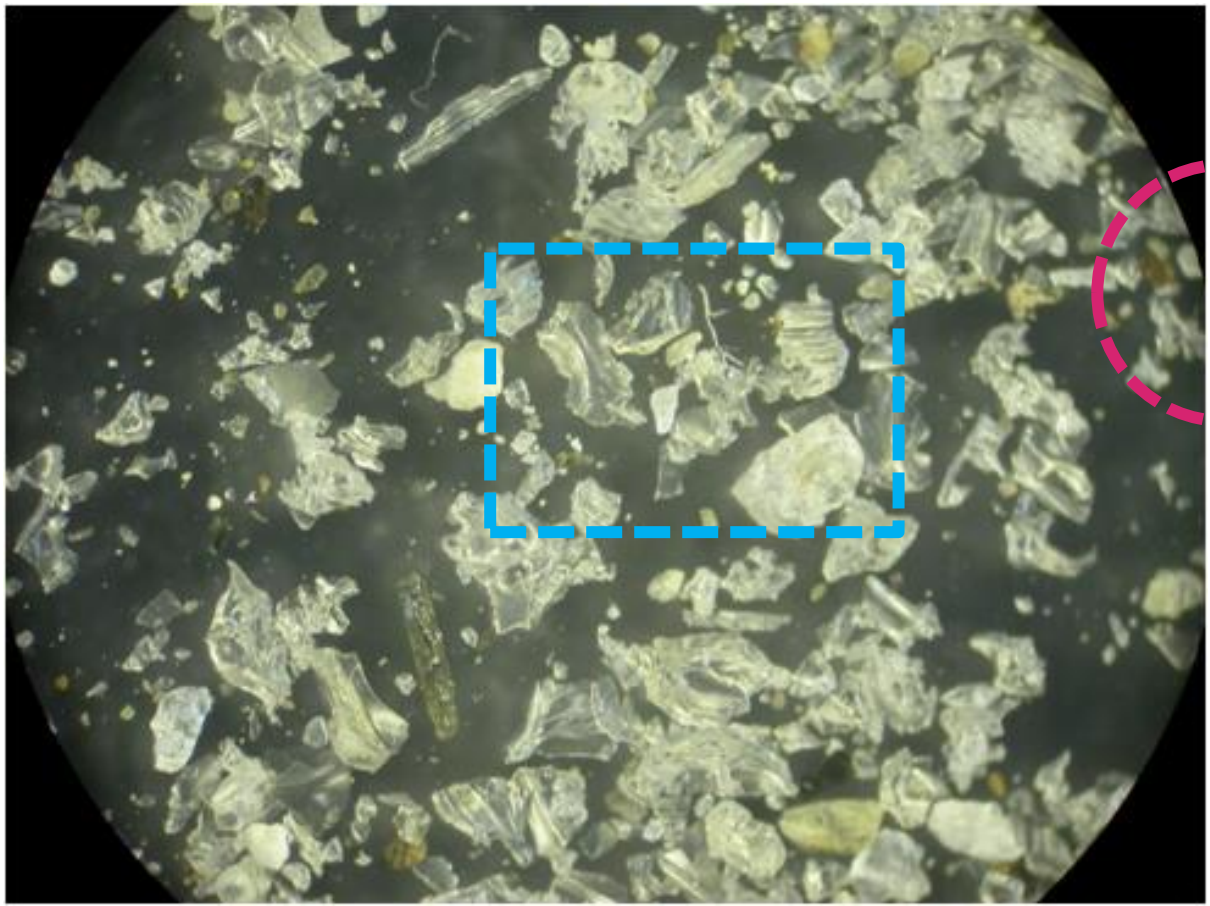
Squash using
Ball of a thumb

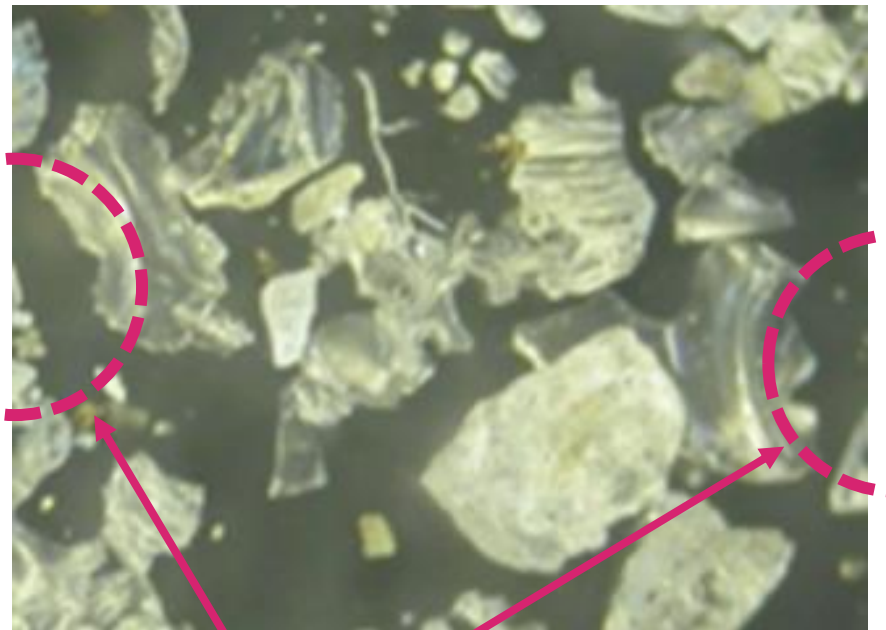


<Akatama-tsuchi: Kanto Roam> purchased from DIY shop as a plant soil Hyperion augite, hornblende, magnetite, rock fragments (background blueline: 1mm span, view area 8mm)



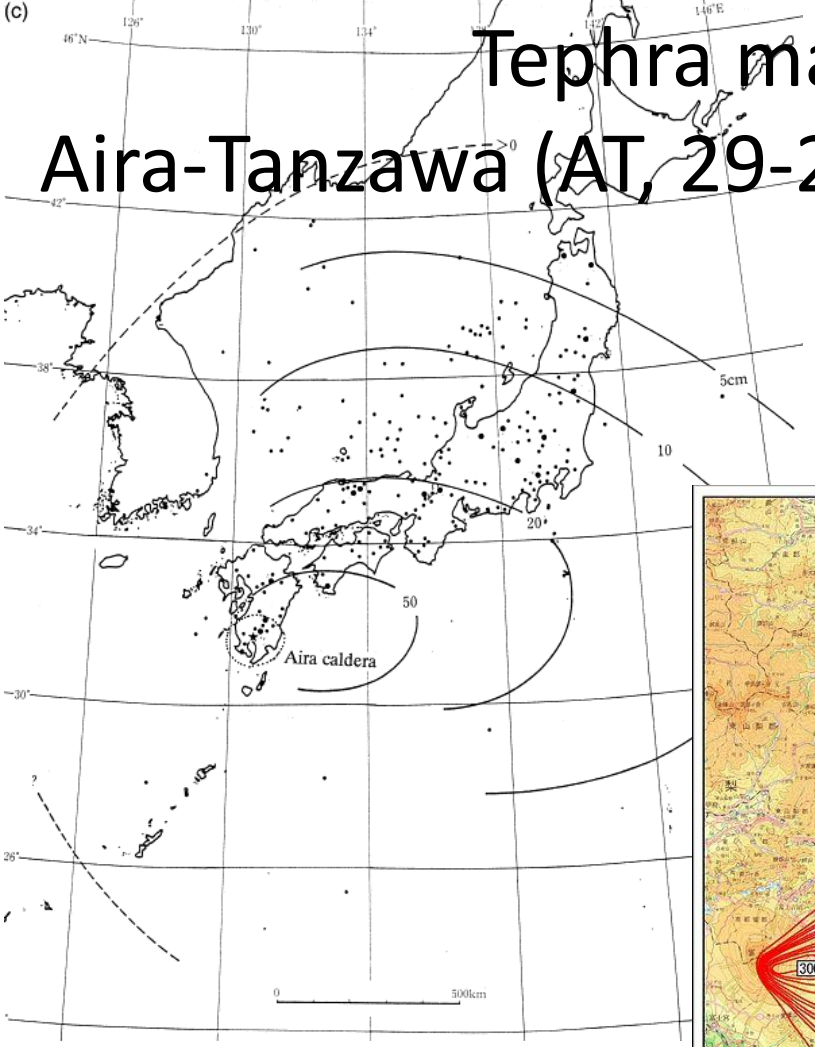
<Aura-Tanzawa volcanic ash: **AT volcanic ash**> in Mt.Aso Kumamoto Pref. Japan (same scale) Bubble walls of **volcanic glass** are significant. The expansion of this ash covers the large area of western Japan and Honsyu even northern end of Amomori. Important key bed of 2.5Ma. and is called a typical distal tephra.

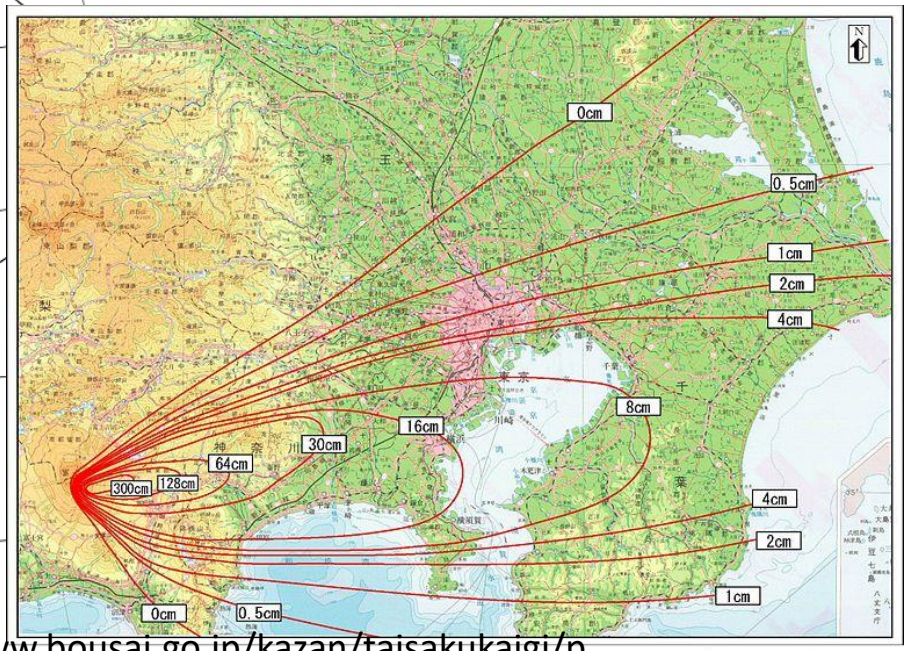




Air bubble ->
“Bubble wall” structure

Tephra map in Japan
Aira-Tanzawa (AT, 29-26ka) & Mt. Fuji (1707)

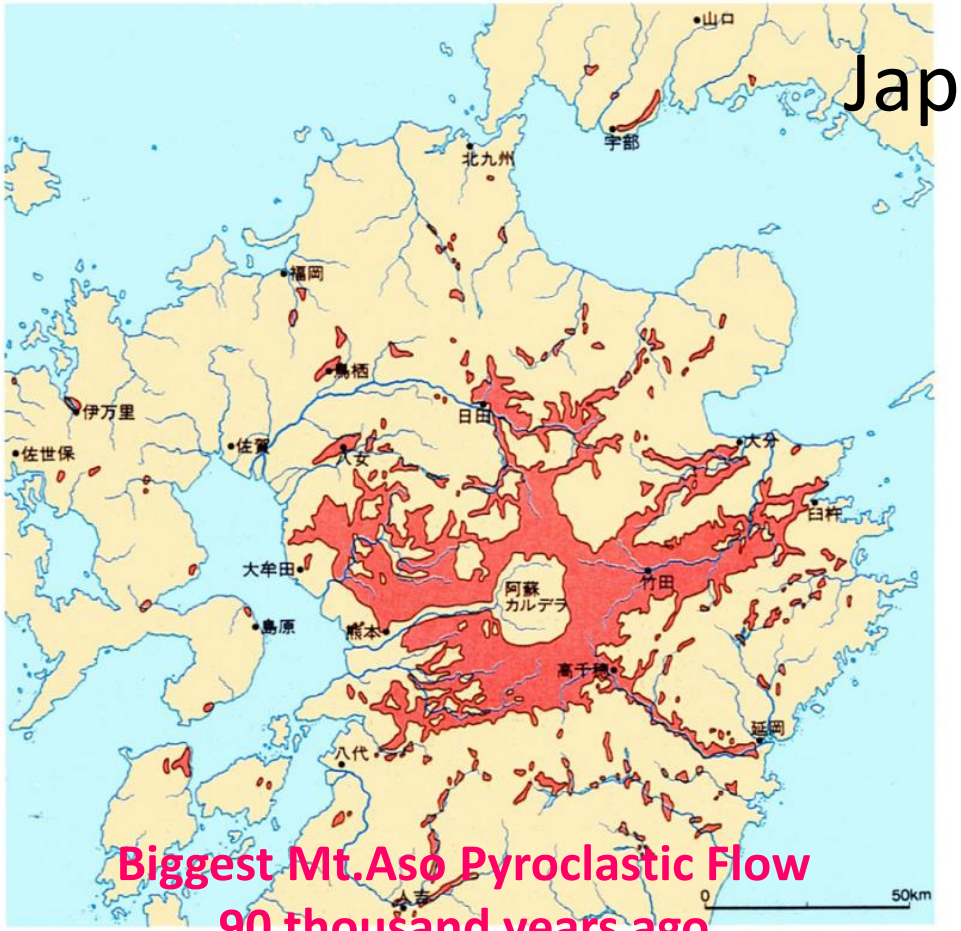




http://www.bousai.go.jp/kazan/taisakukaigi/pdf/dai1kai/20150904siryo2.pdf

Akahoya Tuff（7300 ya） in Mt.Aso

Japan had some huge size volcanic eruptions in the past!



Biggest Mt.Aso Pyroclastic Flow
90 thousand years ago

【図3】阿蘇4噴火の火砕流の分布

出典：大木・小林,「日本の火山」1987より

http://bunarinn.lolipop.jp/bunarinn.lolipop/bunarintokodaisi/kitaminaminojilyounonn/marukihune/5/kaidokikankiyo.html

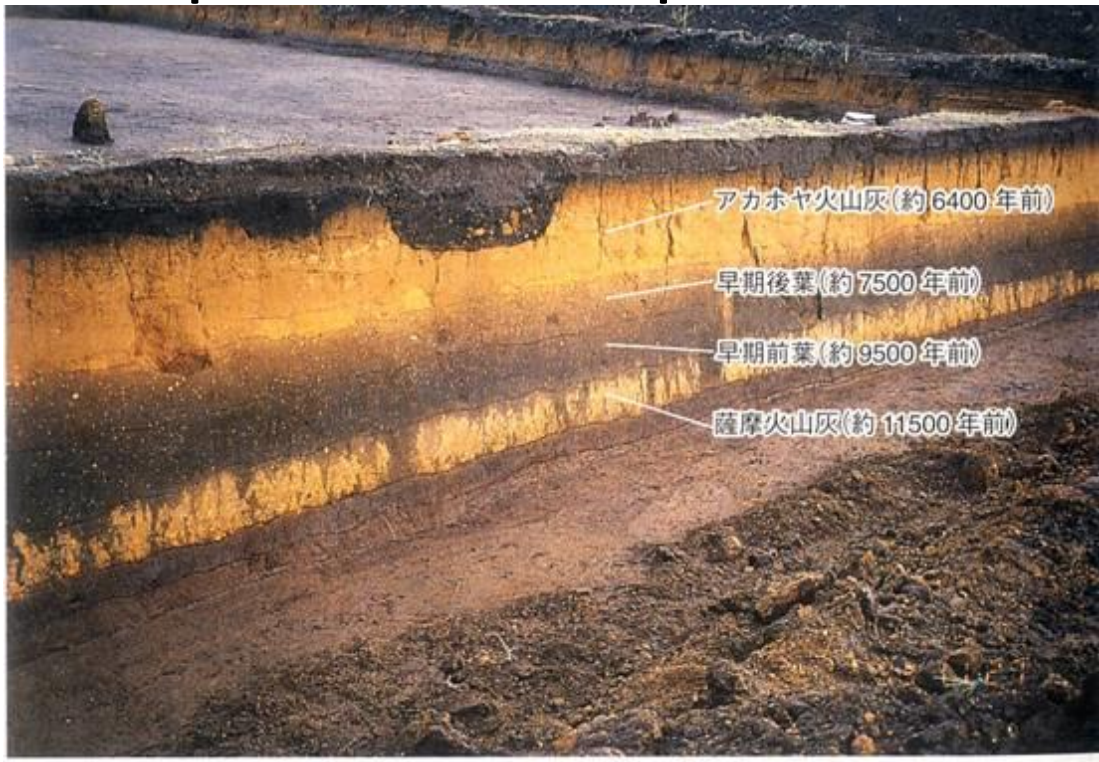
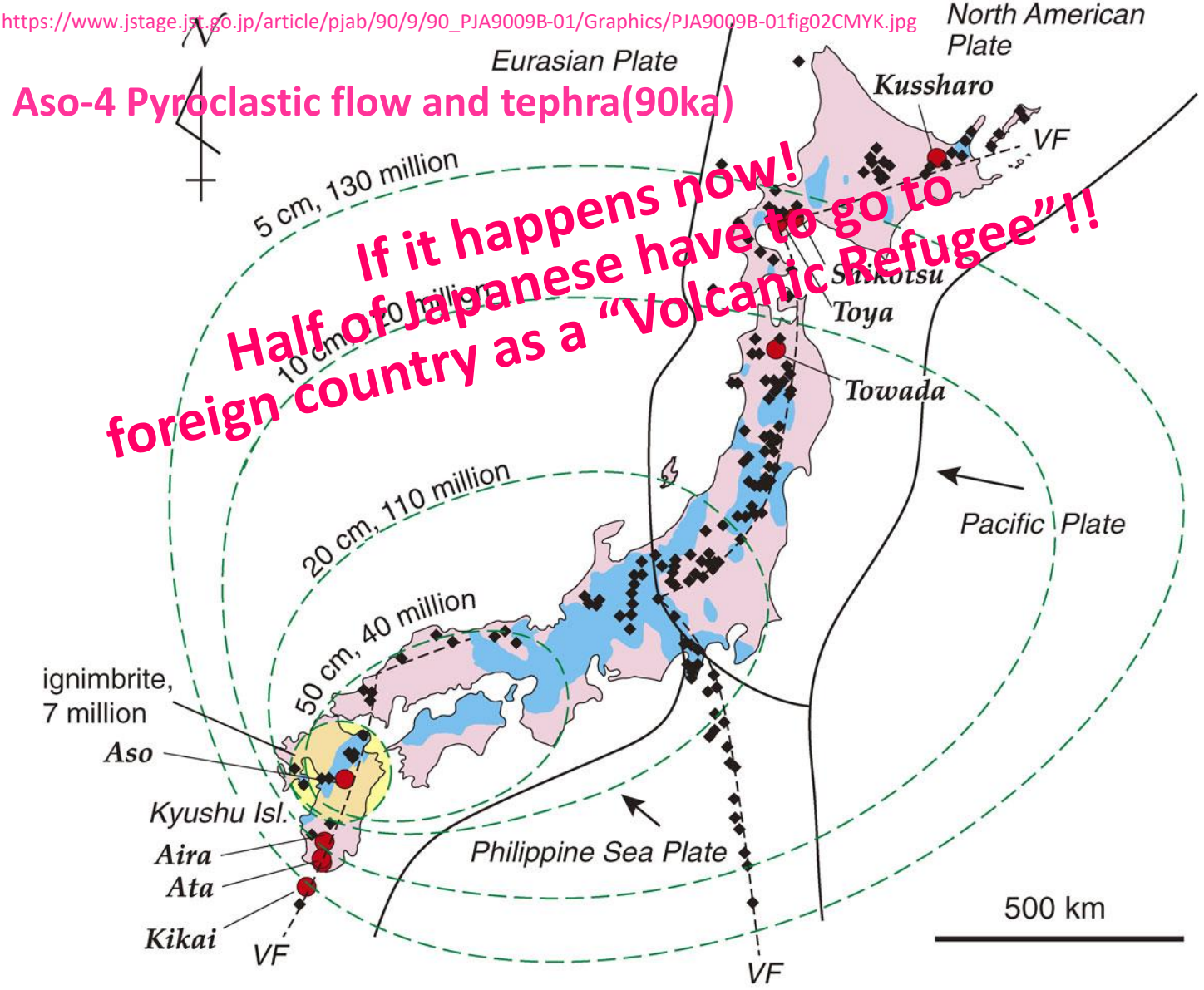
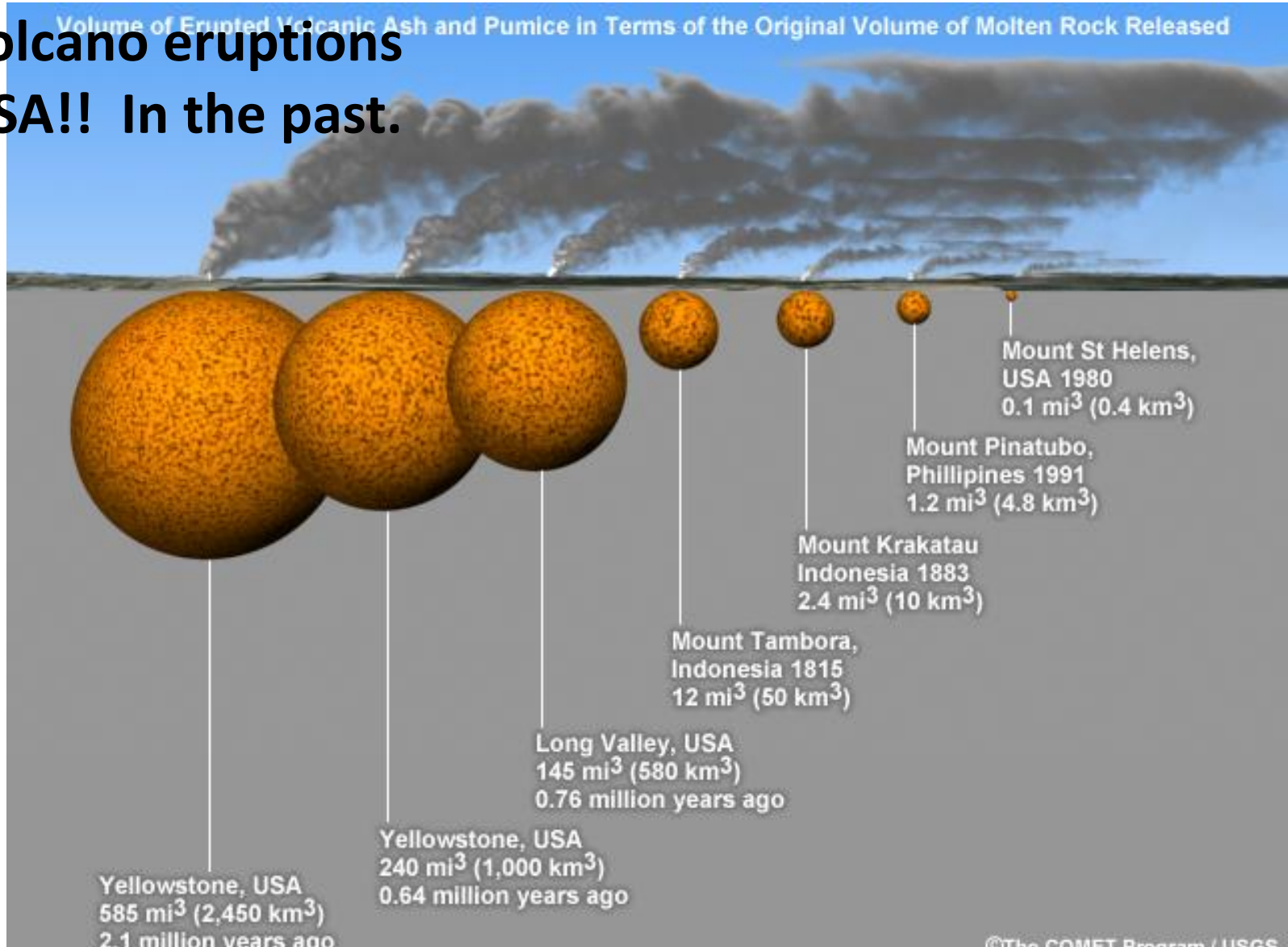


図17 ● 上野原遺跡の地層写真
上野原遺跡ではアカホヤ火山灰（5層）と薩摩火山灰（10層）の間に、縄文時代早期後葉と前葉の2文化層が発見されている。薩摩火山灰（10層）以下の生活は確認されていない。

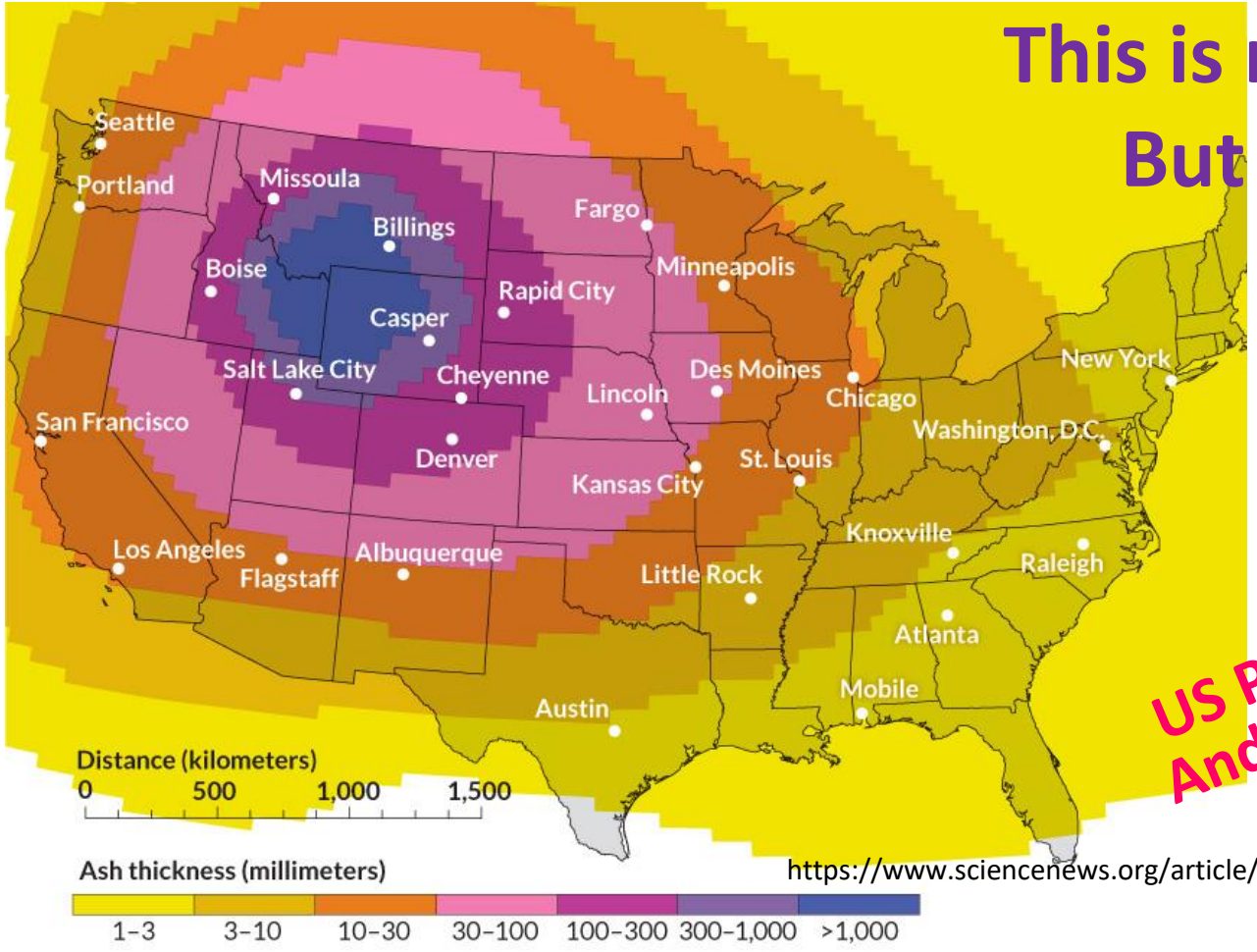
https://www.jstage.jst.go.jp/article/pjab/90/9/90_PJA9009B-01/Graphics/PJA9009B-01fig02CMYK.jpg



Most of huge volcano eruptions happened in USA!! In the past.



If it happens; A half of Americans become "Volcanic refugee"!!

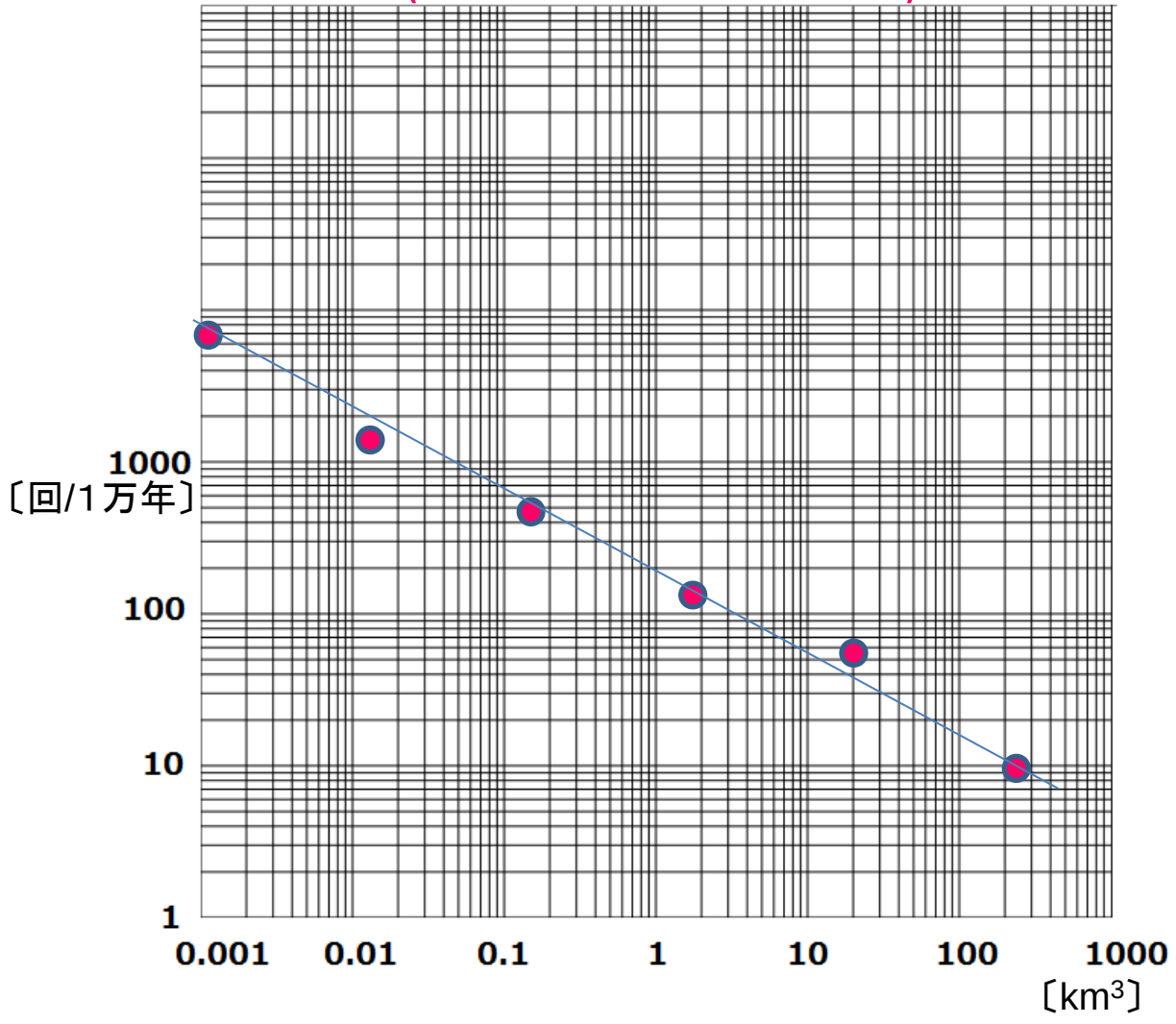


This is not a scientific fiction
But a geological fact!!

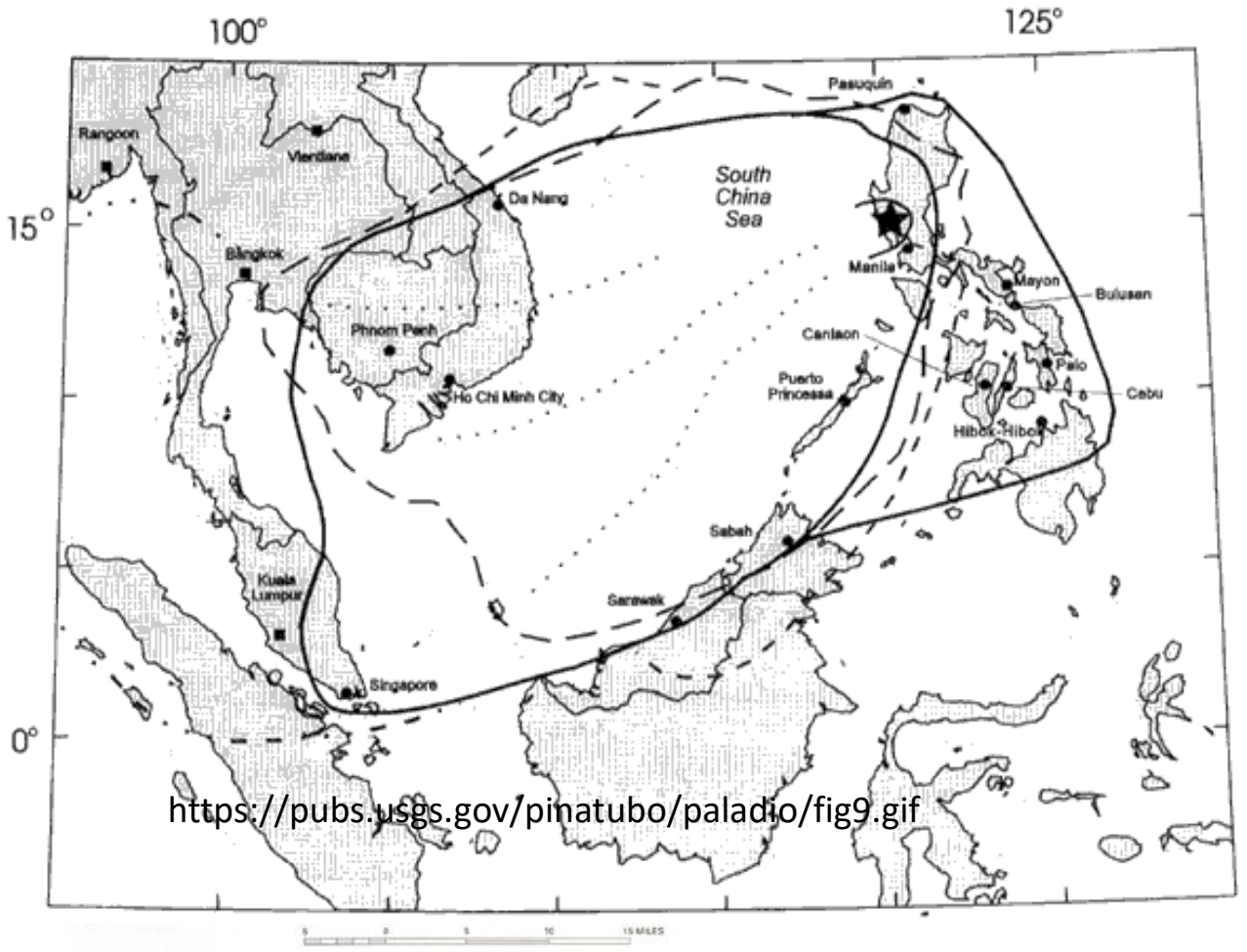
US President has to ask to Mexico And Canada; Acceptance of them!!

https://www.sciencenews.org/article/supervolcano-blast-would-blanket-us-ash

Frequency vs. size of eruptions (Smithsonian Institution)



I suppose in your country some volcanic ash layers are found!



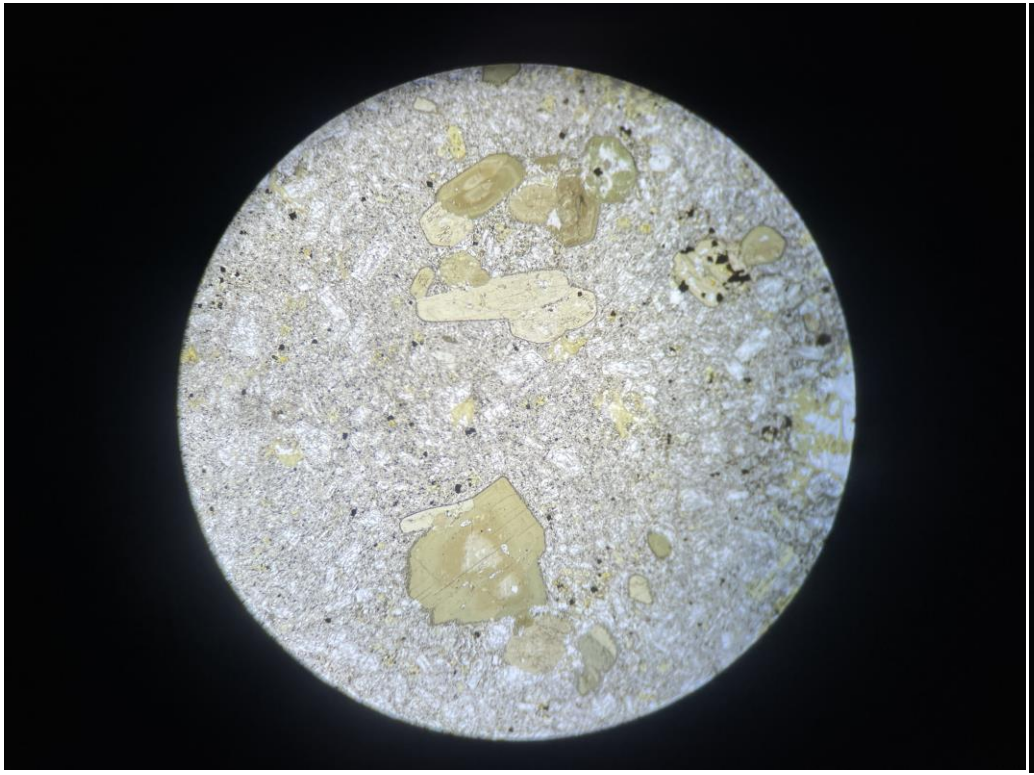
https://pubs.usgs.gov/pinatubo/paladio/fig9.gif

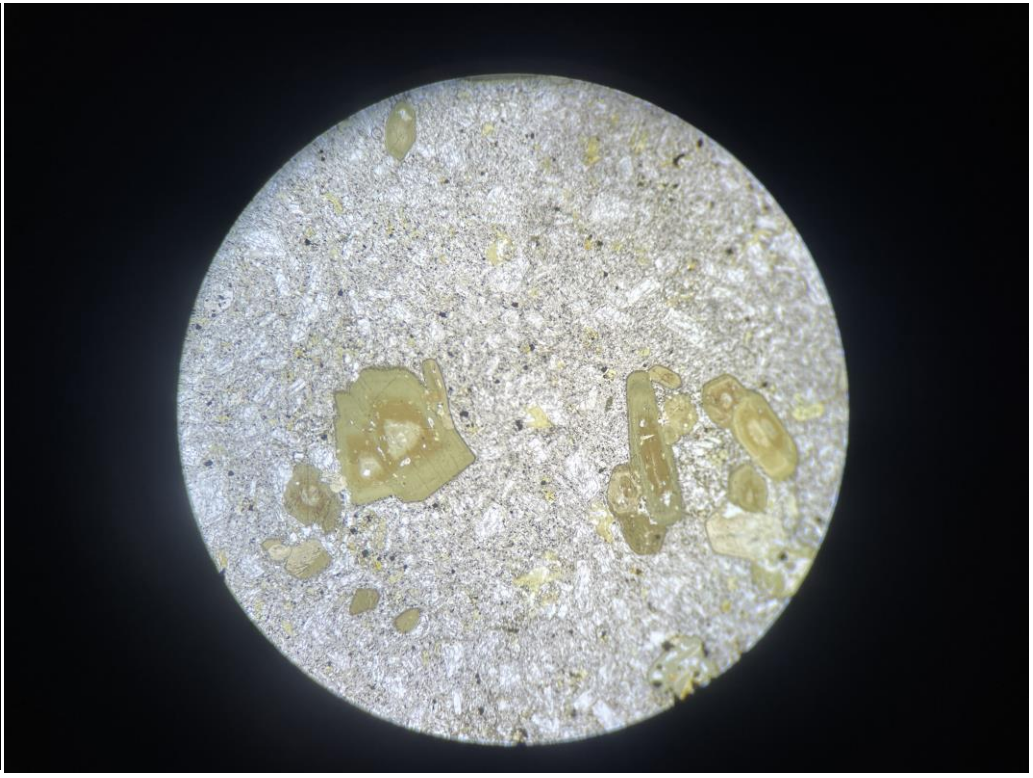
Figure 7. Distribution of tephra-fall deposits of the climatic eruption of June 15 (phase VI of Wolfe and Hoblitt, this volume), layer C, and locations of sections (triangles) sampled for grain-size and component data. KAK is location of section sketched in figure 1. Isopachs are in centimeters; sources of data as in figure 3, but open circles show total thickness of section (in centimeters), which may also include layers A and (or) B.

Umbal&Rodolfo,1996)

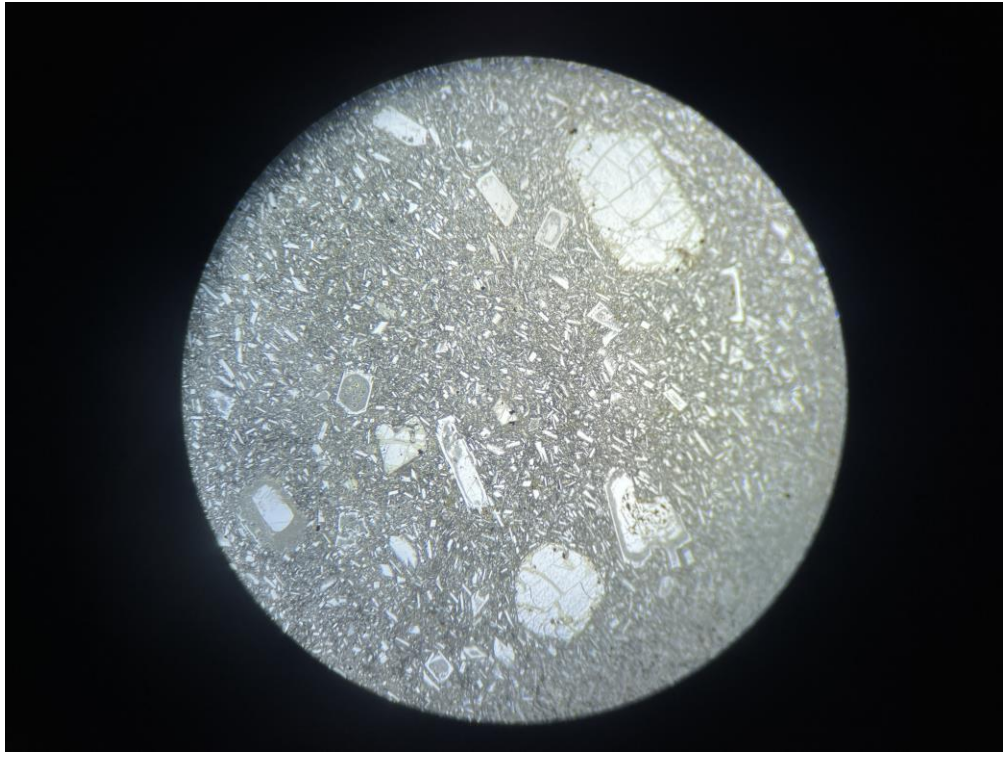
Mineral characteristics in thin-section

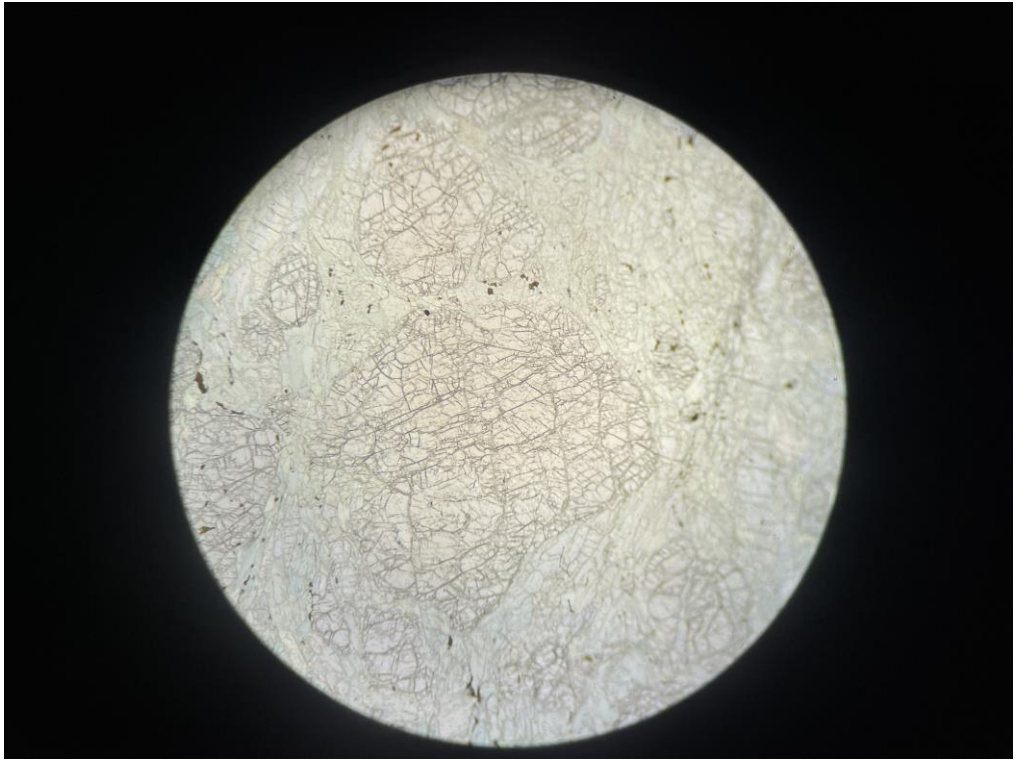
Pleochroism (Open polar): Biotite, **Hornblende**





Refraction index (Open polar): **Olivine,** Pyroxene, **Garnet**



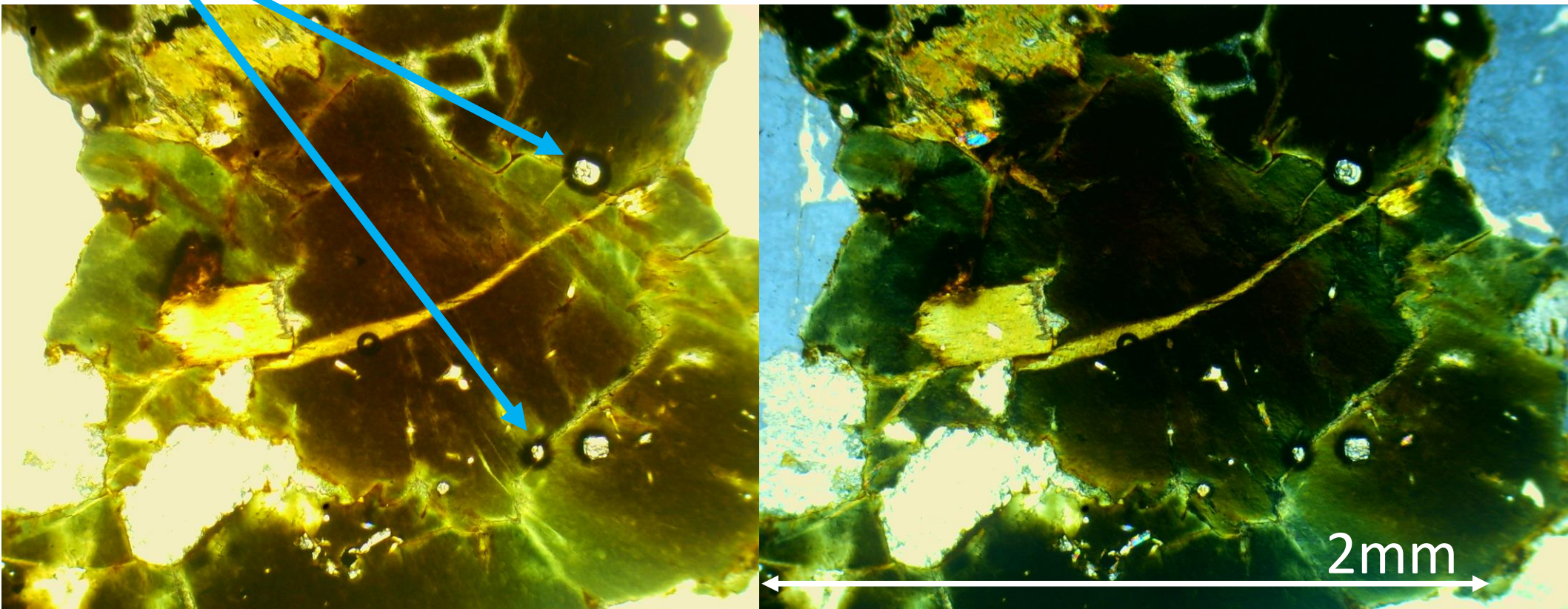


Yet another mineral

They can not show in the lecture.

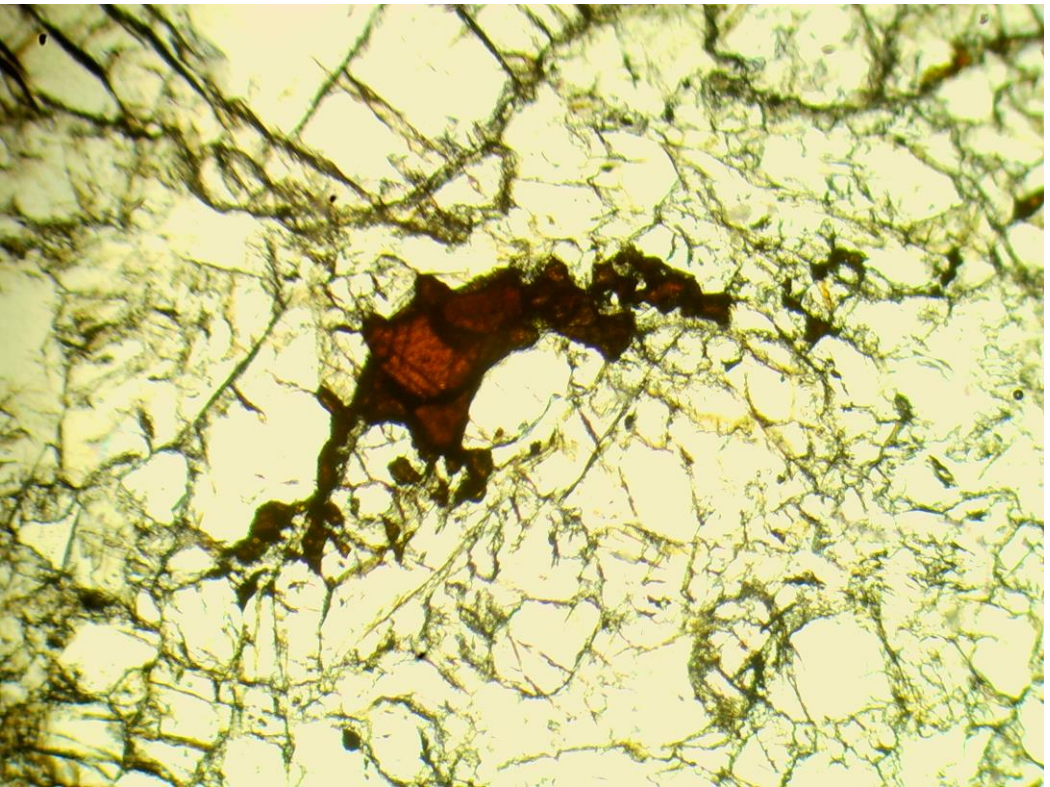
Yet another tiny minerals

Zircon in Biotite (Radiation halo)



Yet another tiny minerals

Rutile in Eclogite

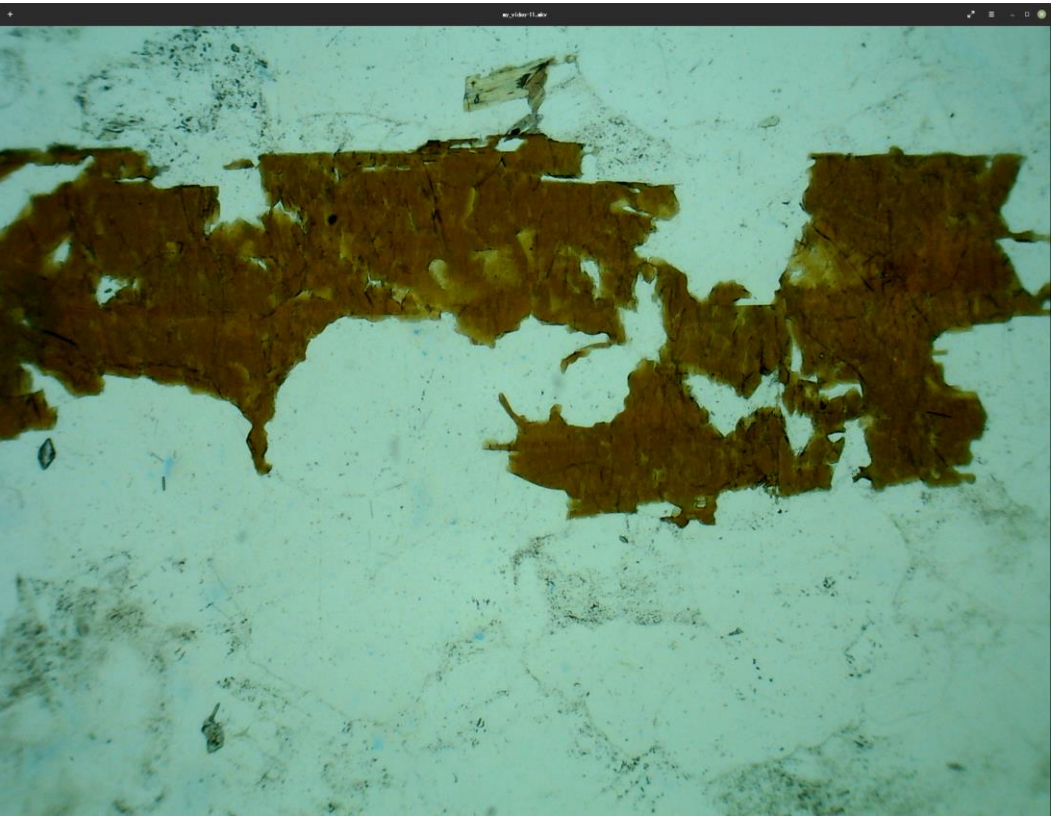


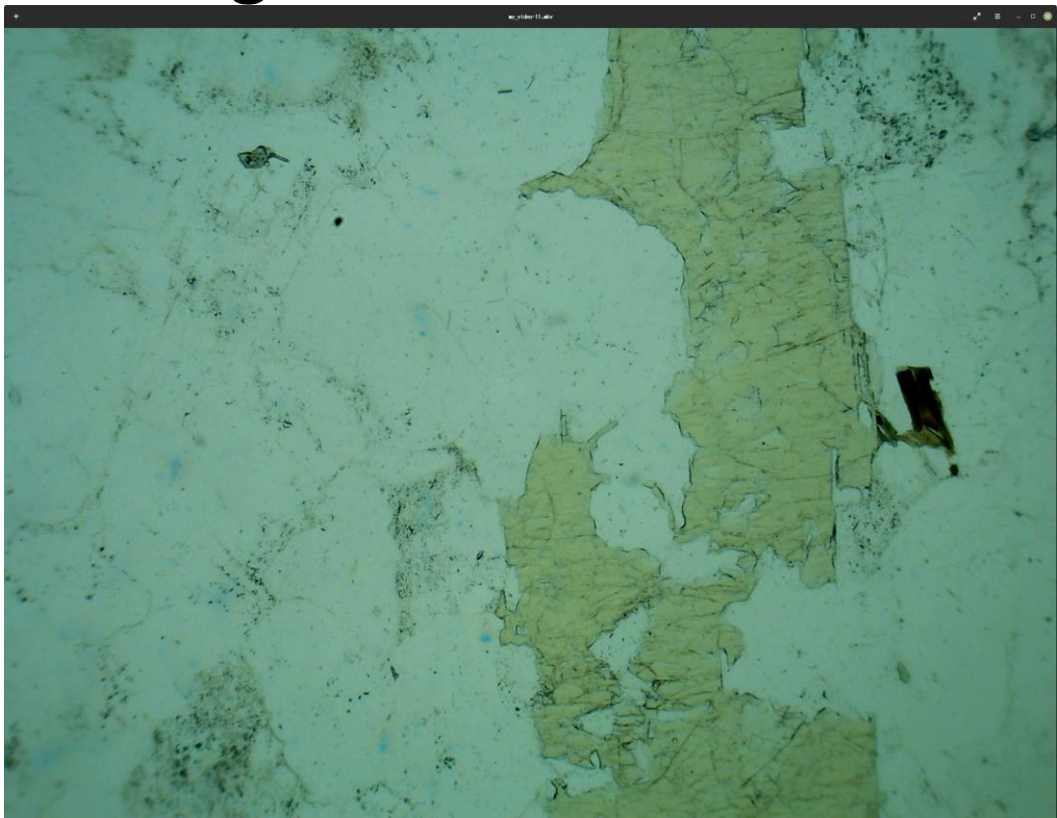
Spinel in Gabbro

Other minerals

Tourmaline Granite

Dark ⟷ Light





Other minerals

Muscovite in Schist

Zoisite in Schist