Magmatic Volatiles

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Species that occur in a gaseous or supercritical fluid state at magmatic temperatures and pressures

These species are either dissolved in, or present in bubbles, in a magma.

The most abundant magmatic volatile phases are H_2O and CO_2

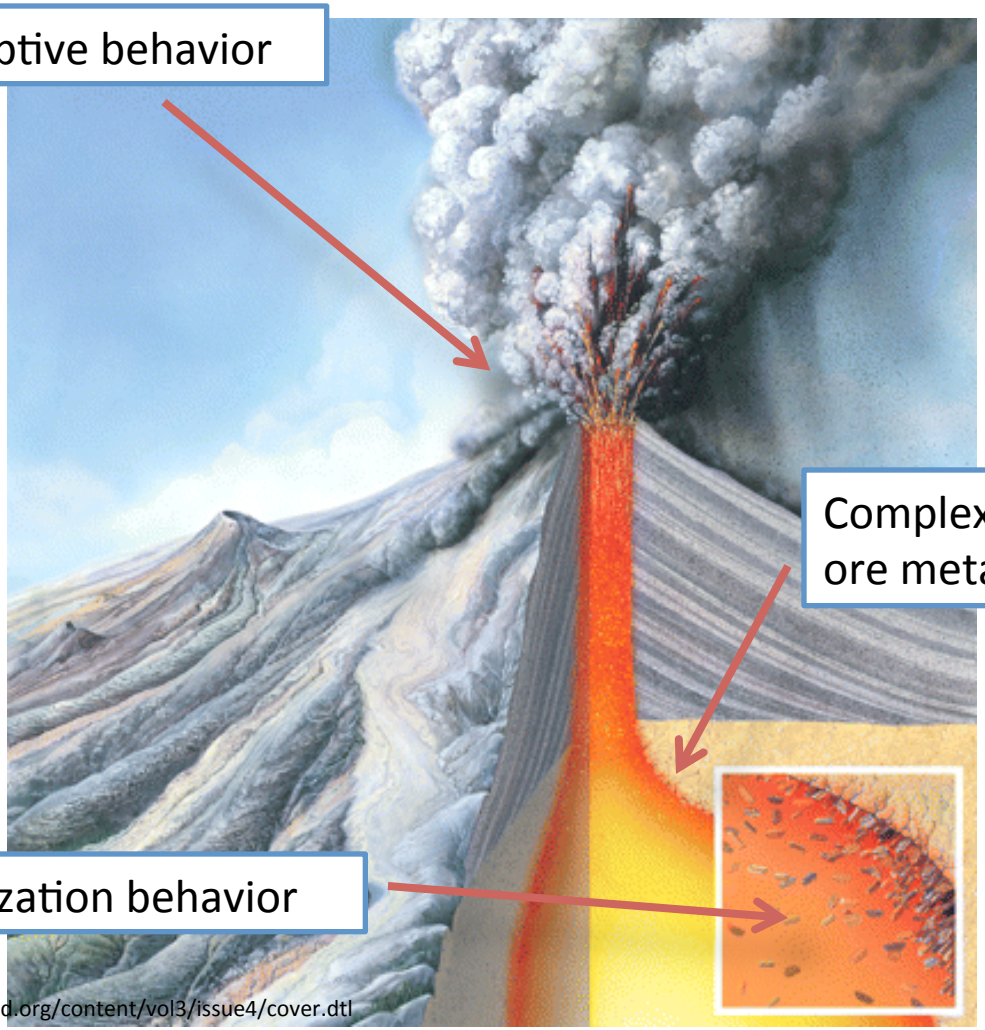
Other important volatile species include those composed of complexes of S (SO_2 and H_2S), Cl, and F.

Magmatic volatiles

H-O-C-S (+ Cl and F)

emitted as H_2O, CO_2, CO, HCl, HF, H_2S

Affect eruptive behavior



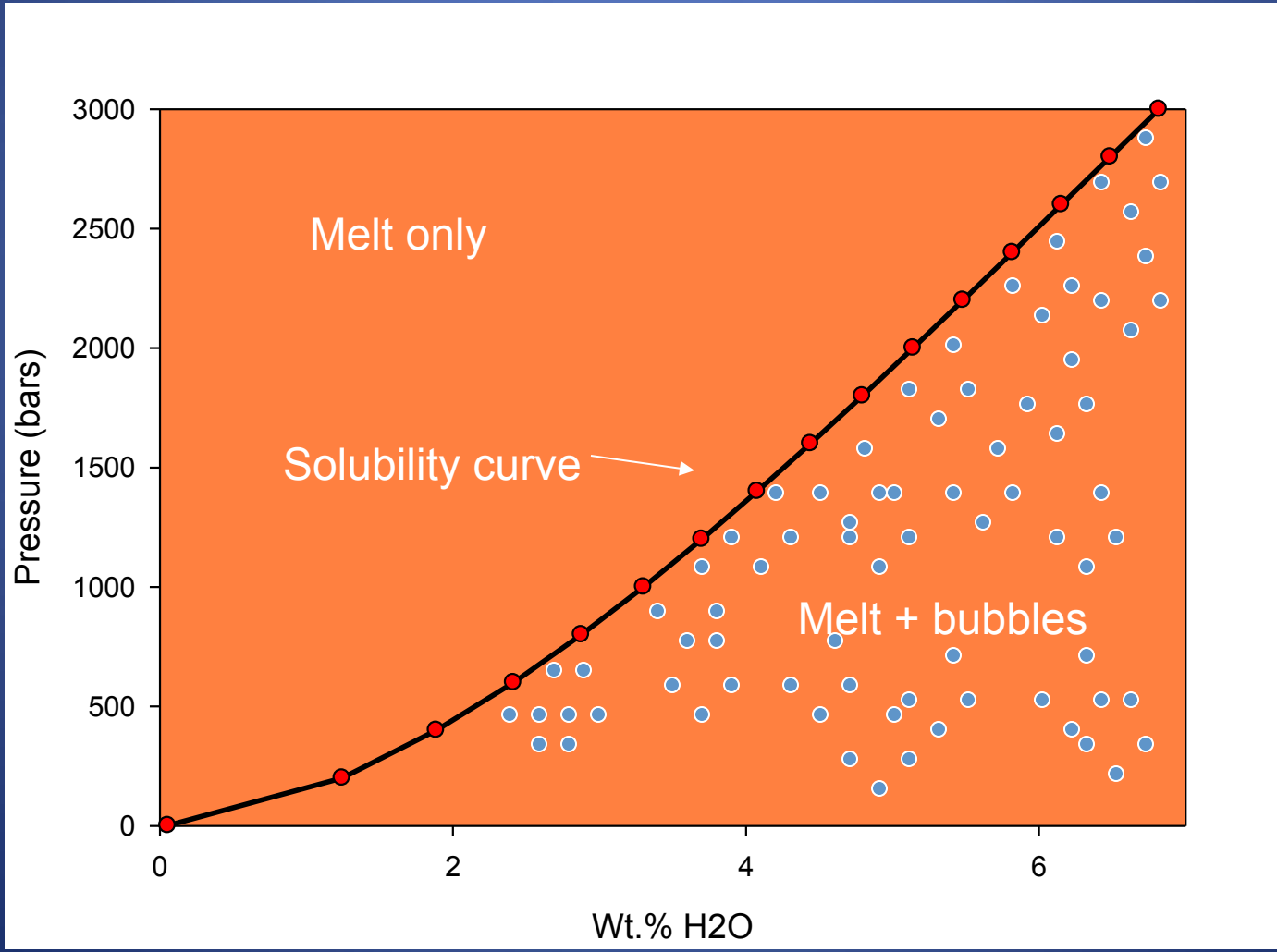
Complex and transport ore metals

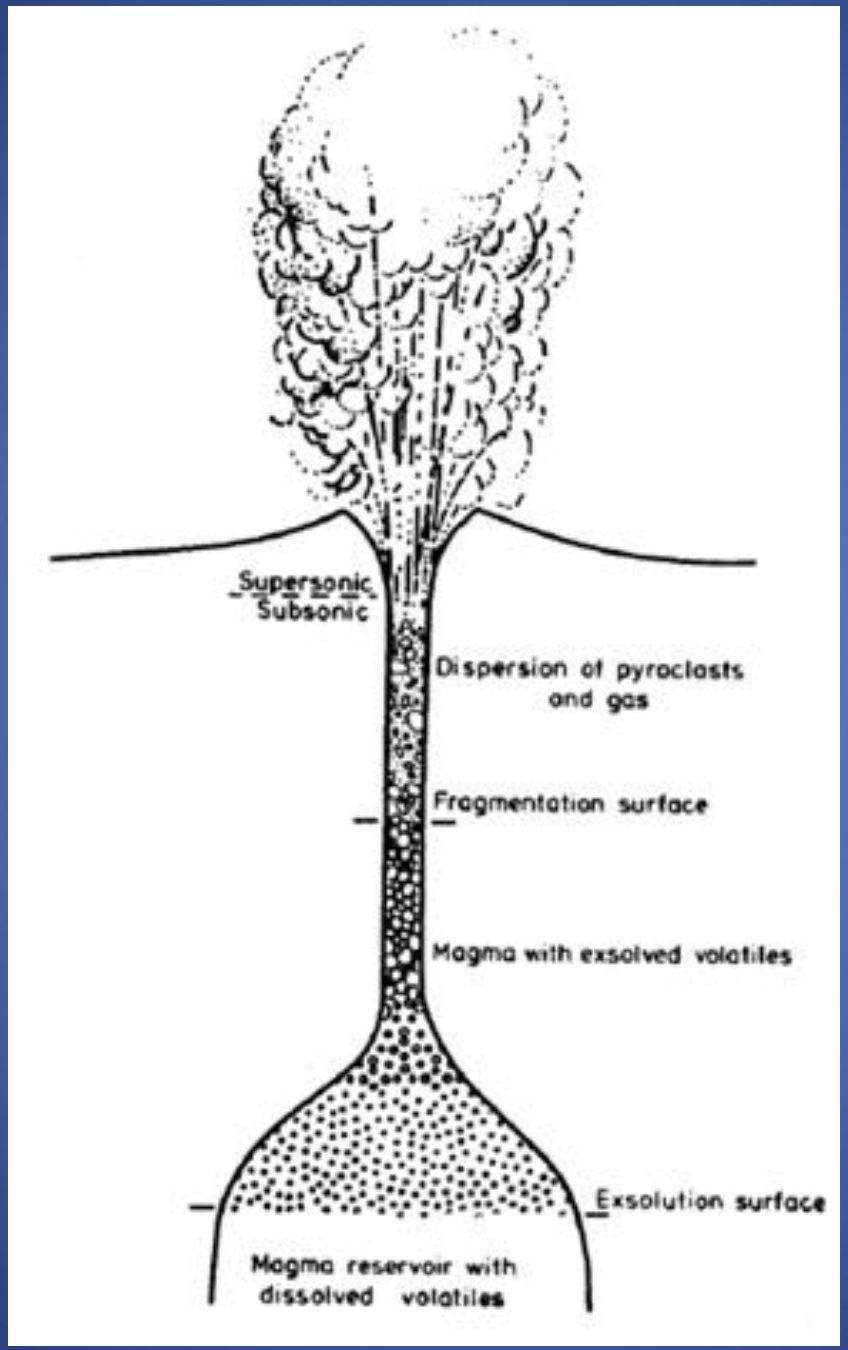
Affect crystallization behavior

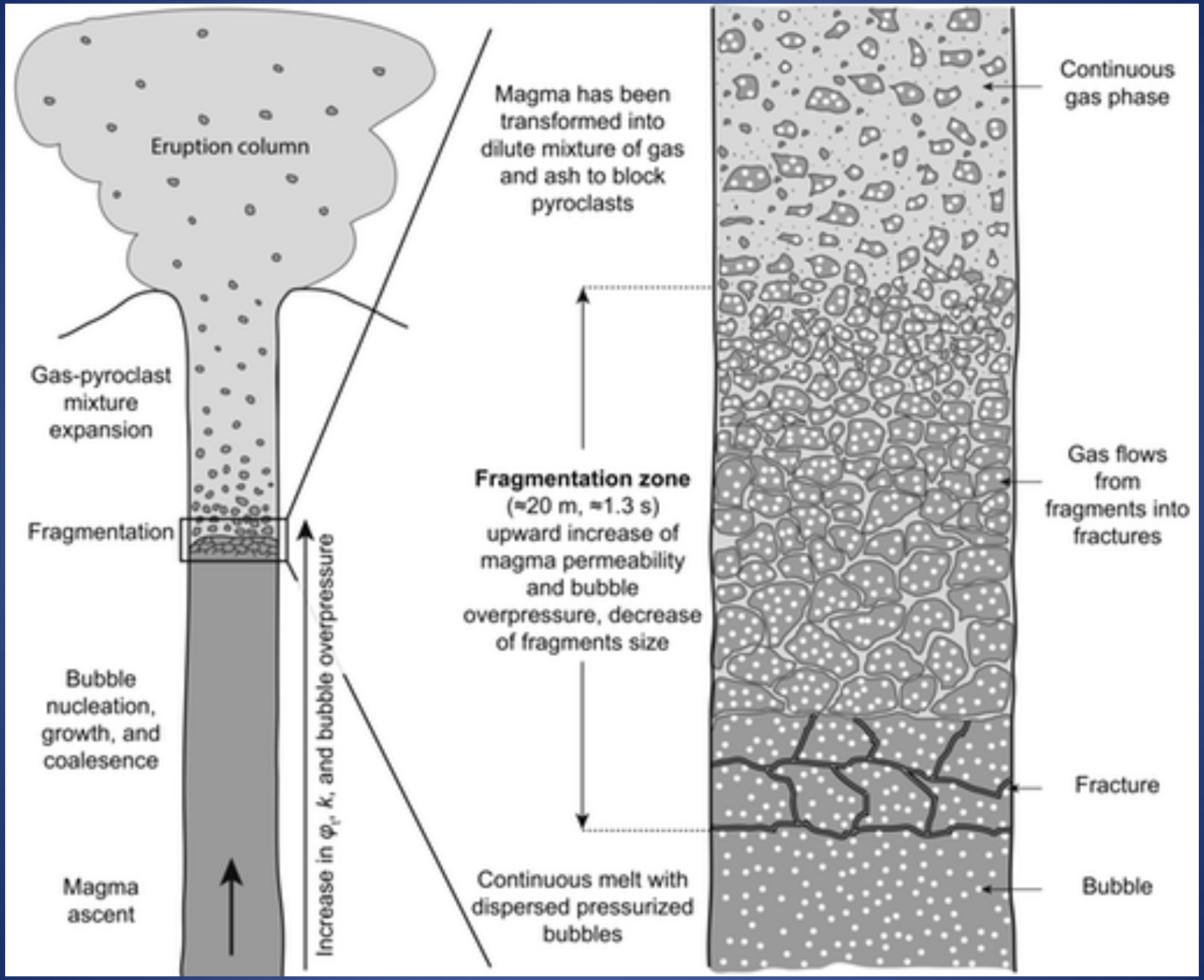
http://elements.geoscienceworld.org/content/vol3/issue4/cover.dtl

- **Solubility:** amount of a volatile species that can be dissolved in a melt at a given temperature and pressure.

  Solubility governs eruptive behavior, but degassing behavior can be difficult to track directly because of the dynamic nature of volcanic eruptions.



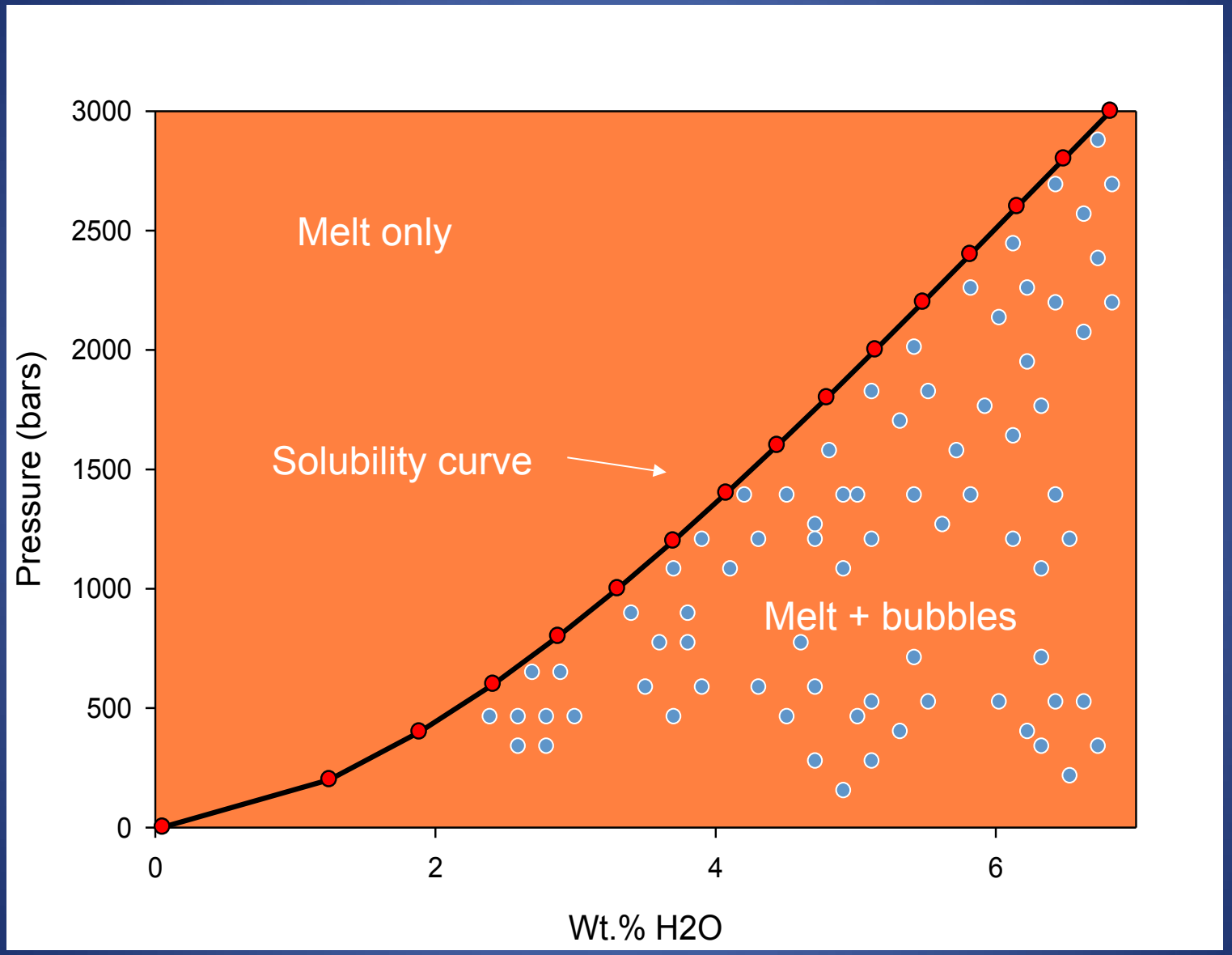

Supersonic
Subsonic
Dispersion of pyroclasts and gas
Fragmentation surface
Magma with exsolved volatiles
Exsolution surface
Magma reservoir with dissolved volatiles

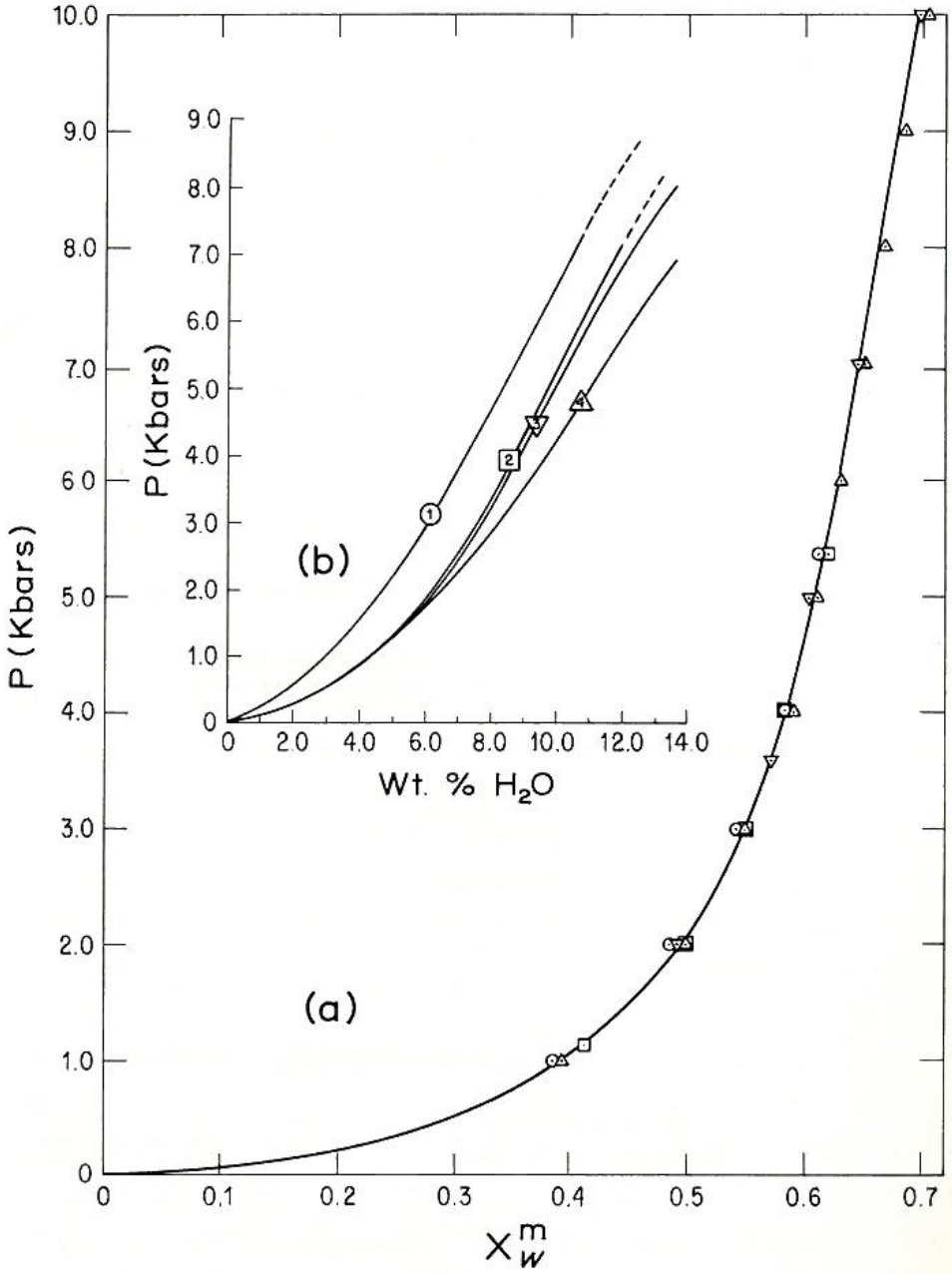


http://pages.uoregon.edu/tgiachet/research/magma-degassing.html

https://www.wired.com/2013/11/eruption-at-sinabung-intensifies/

How do volatiles dissolve in melt?

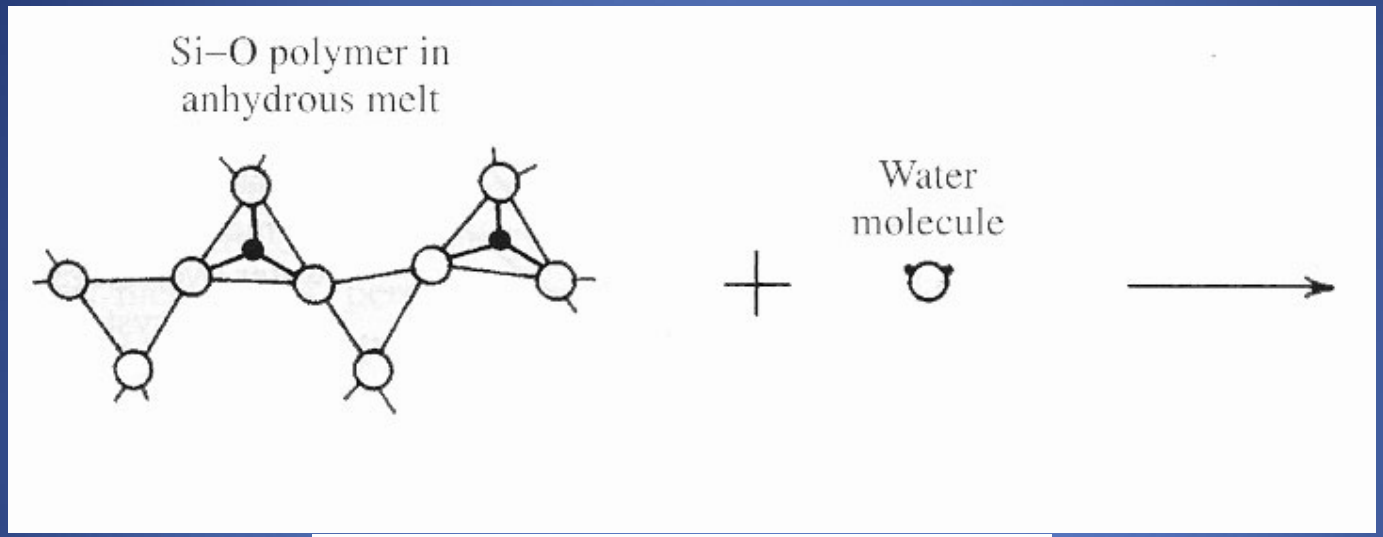


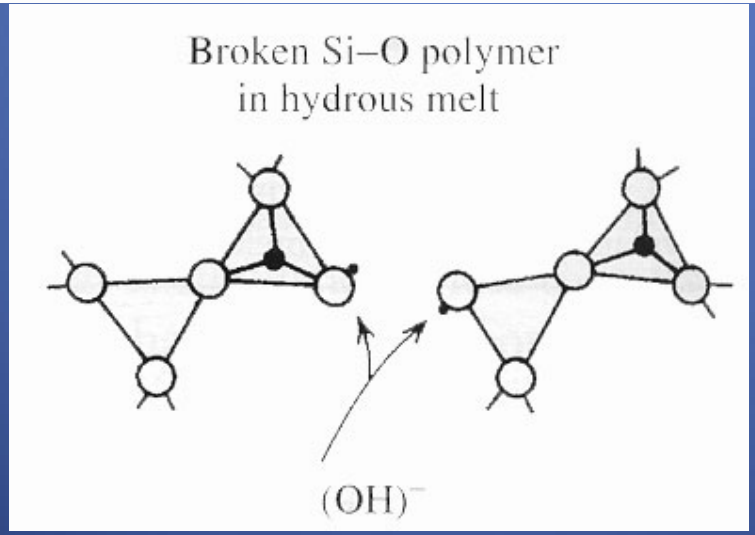


Strong effect on melt viscosity

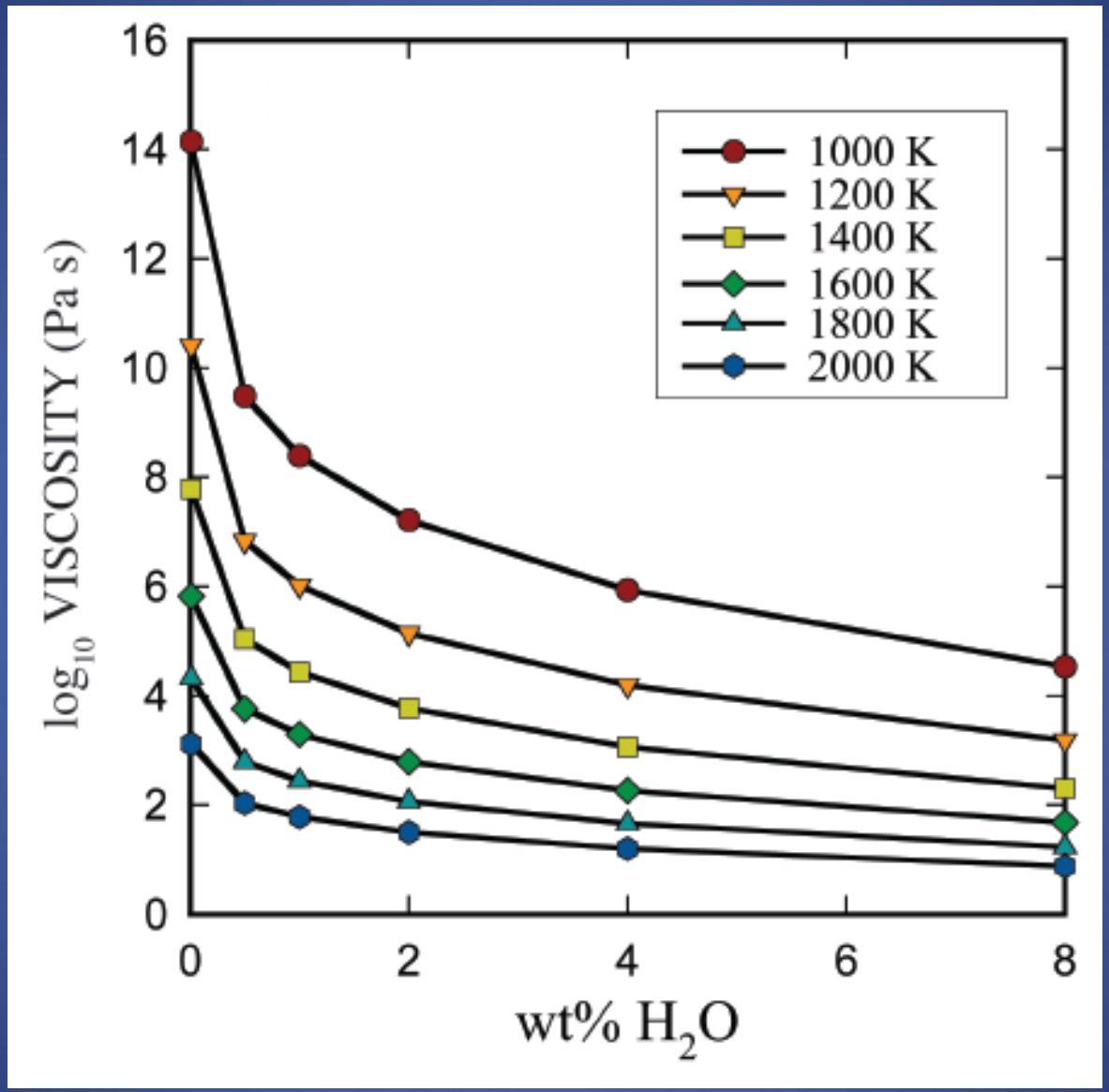
From Burnham, 1979

One mechanism of H_2O solubility



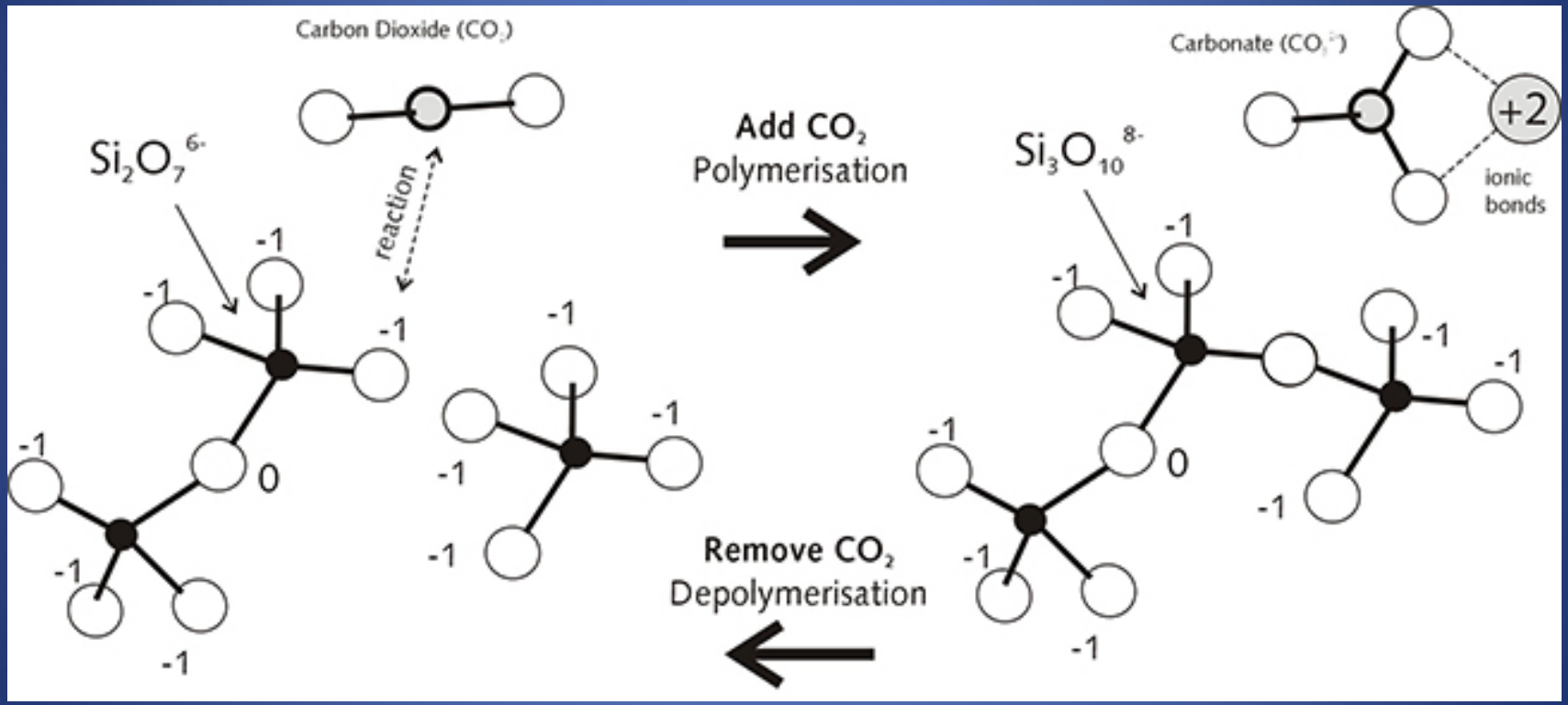


Strong effect on melt viscosity

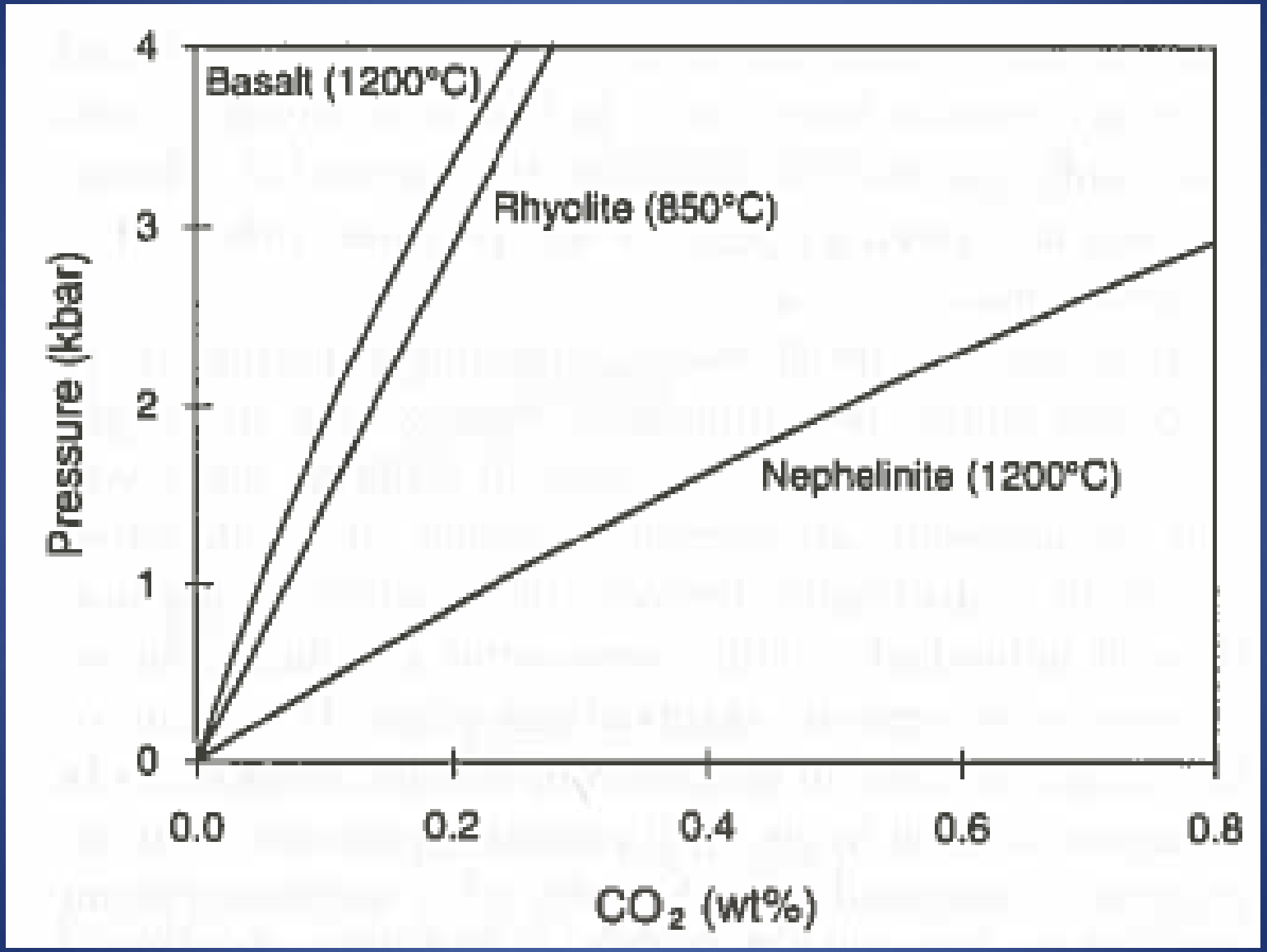


From Dingwell, 2006

CO_2 solubility has the opposite effect on melt viscosity than H_2O



http://www.alexstrekeisen.it/english/vulc/index.php



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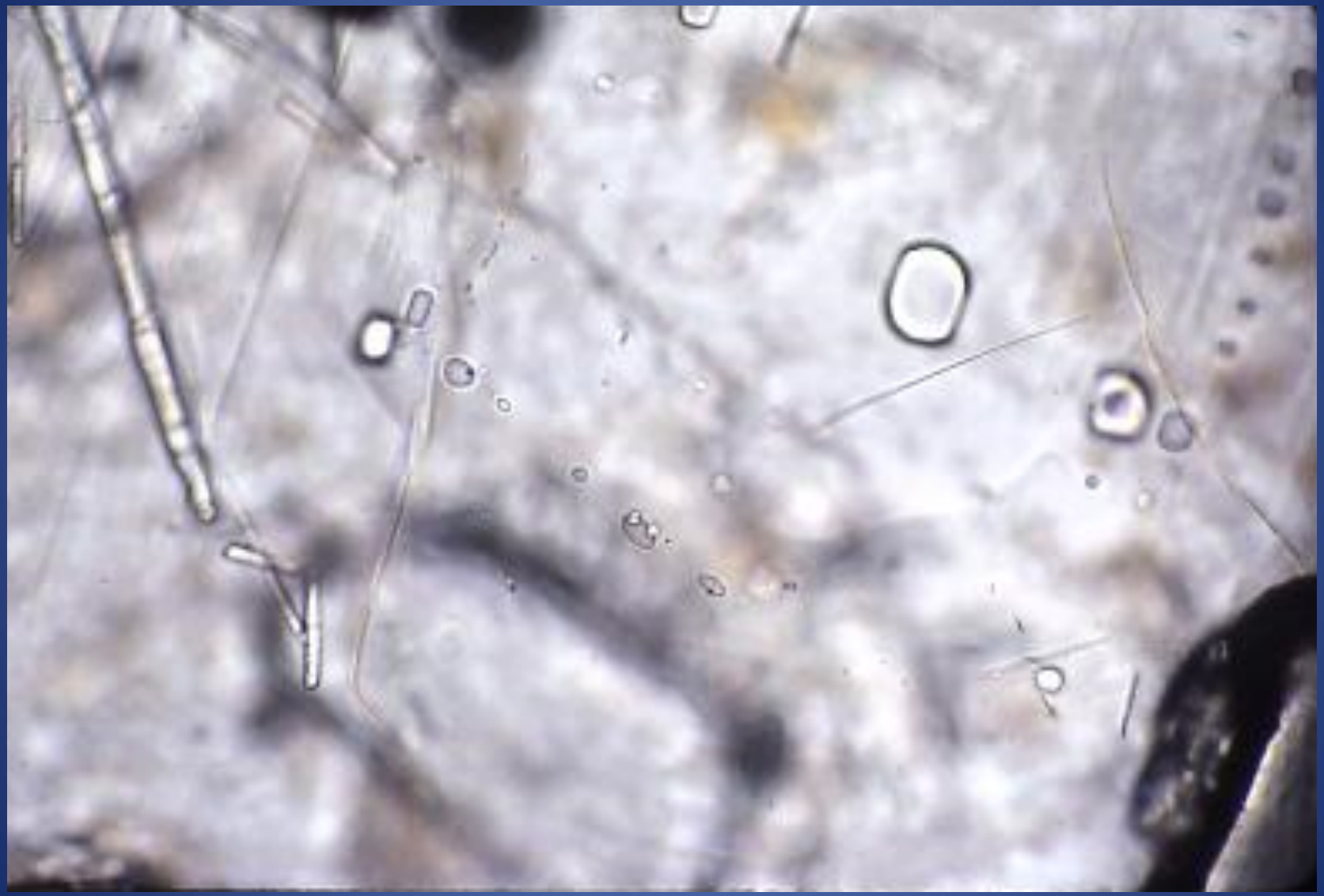
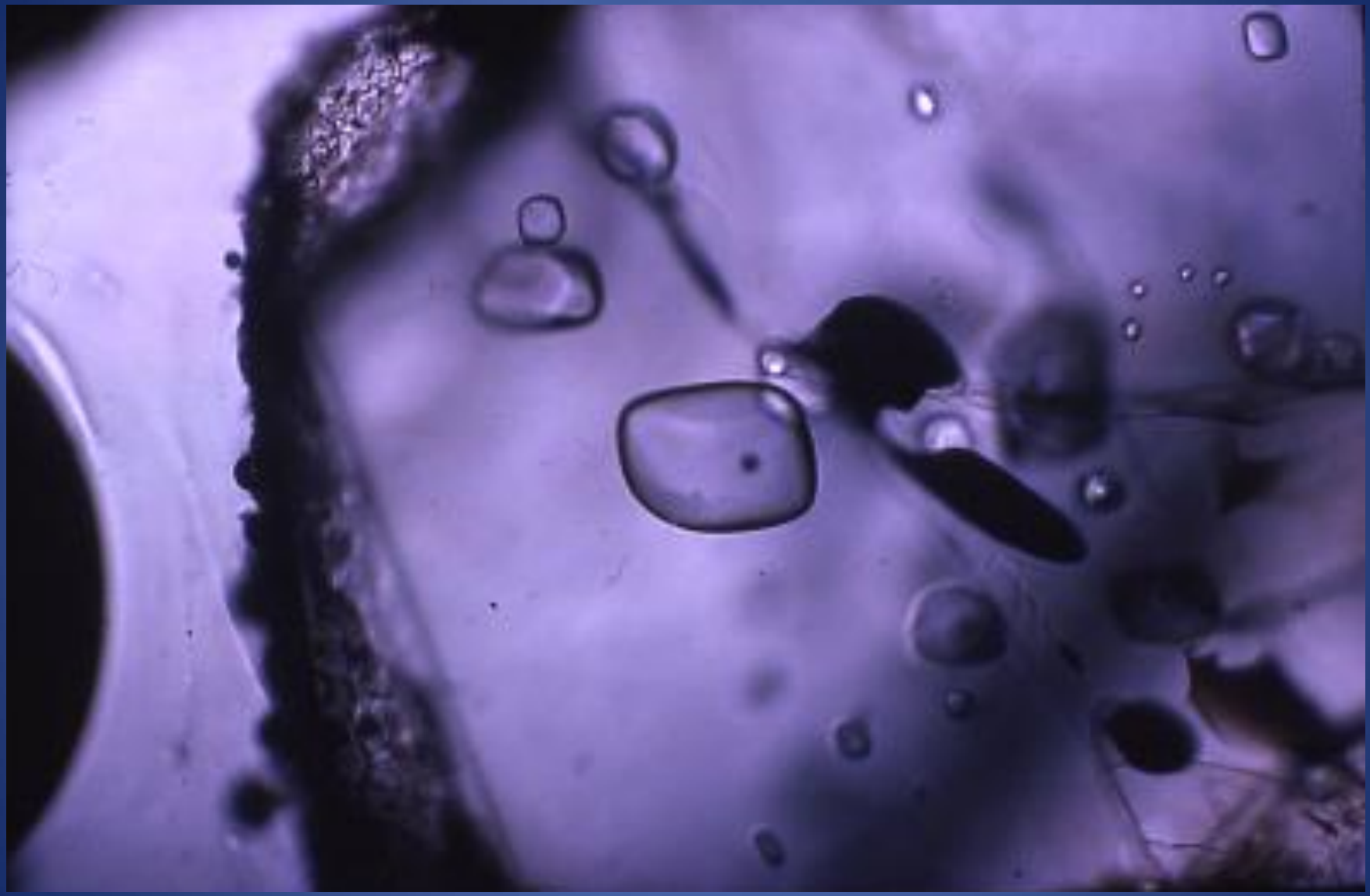
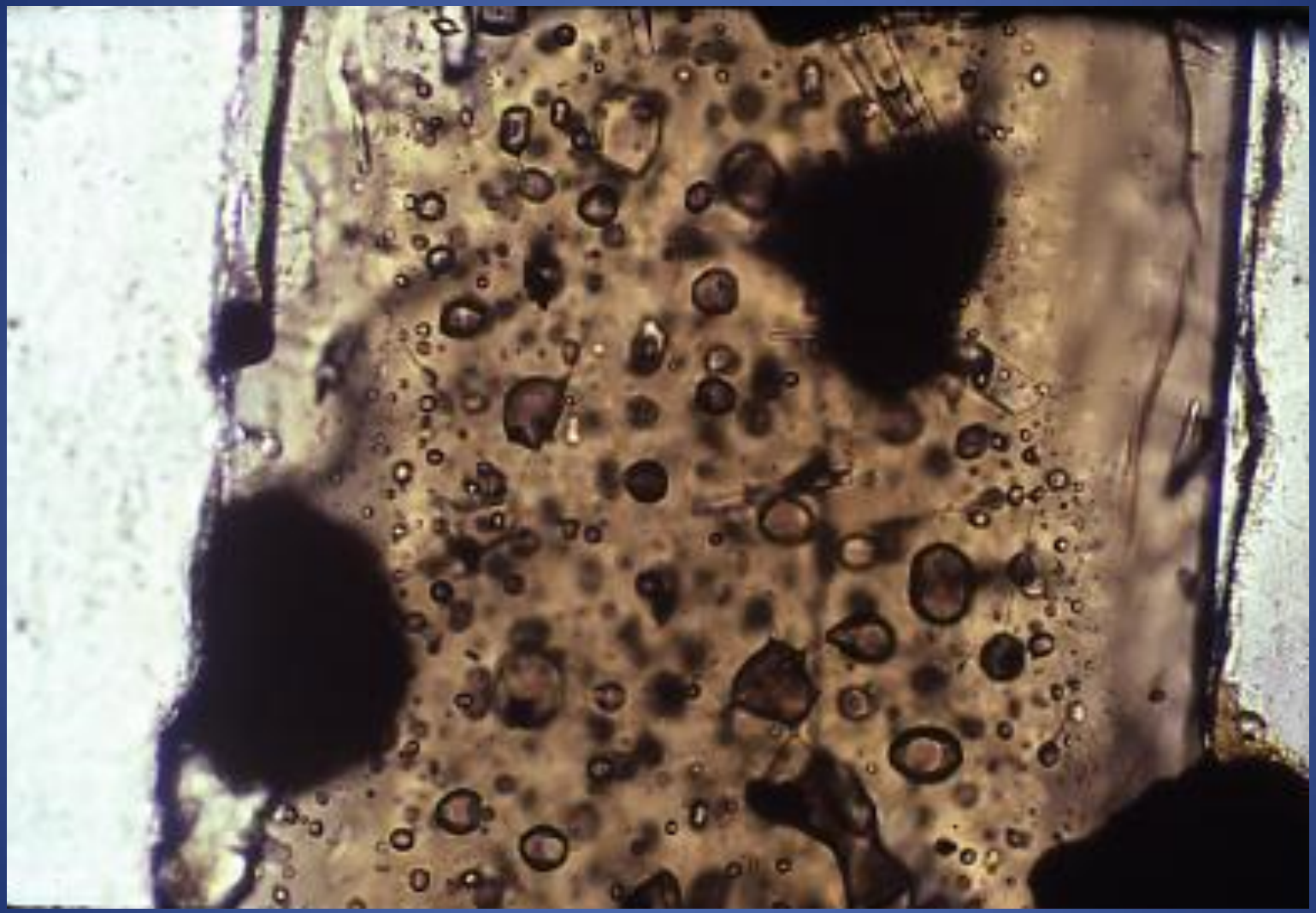
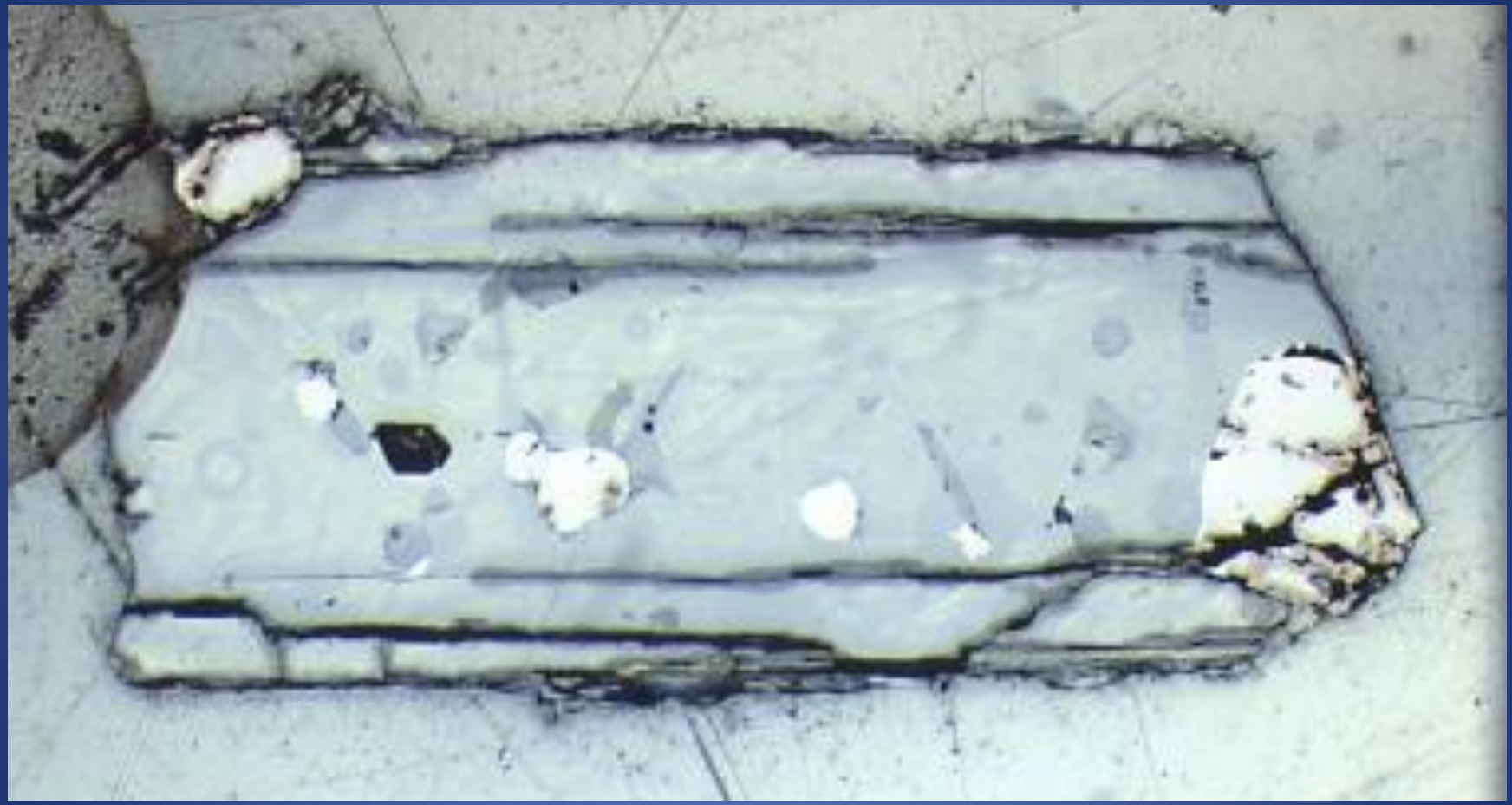
Determining pre-eruptive volatiles content and composition in magmas

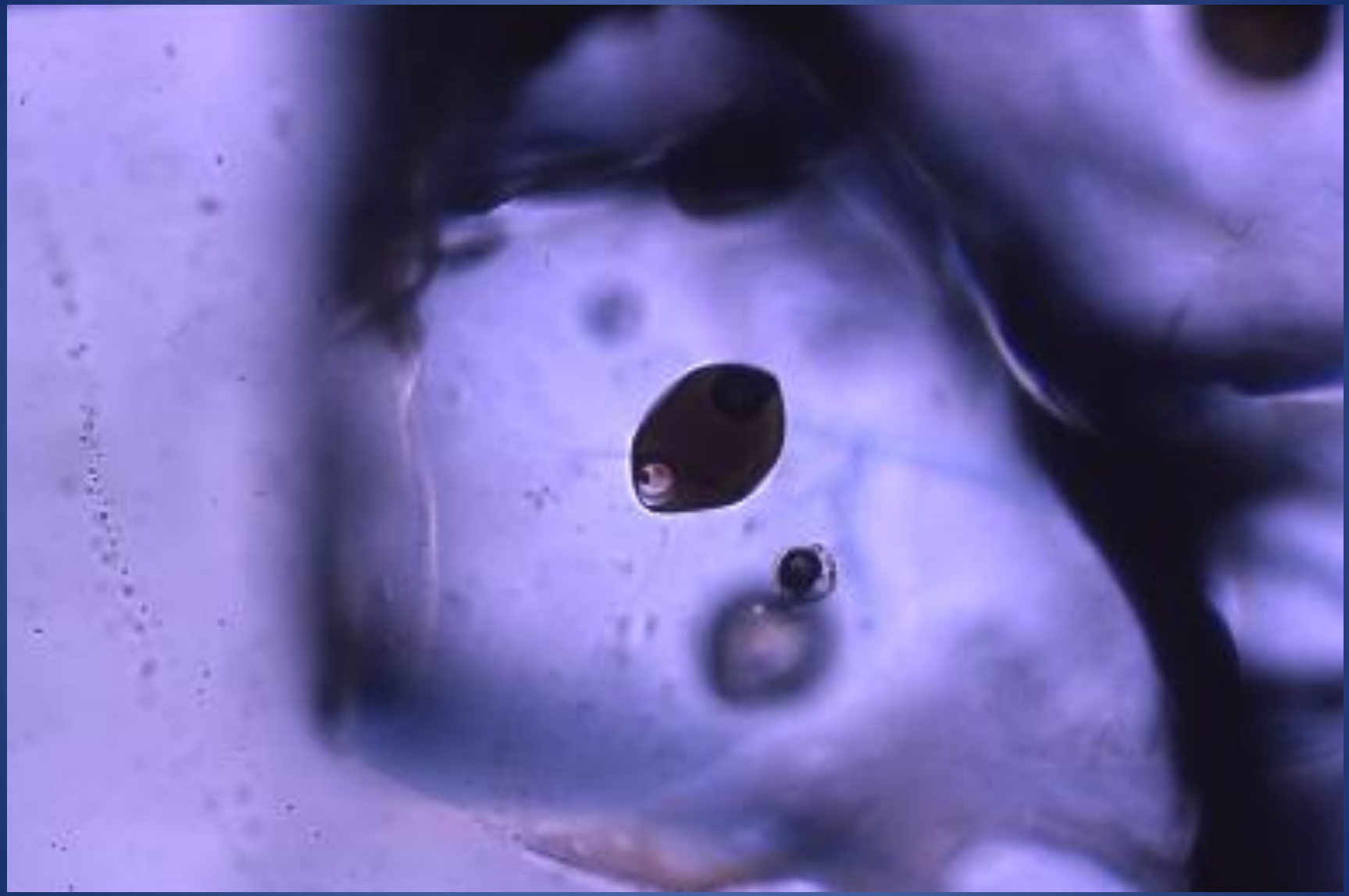
- Volcanic glass (MI/obsidian/pillow glass)
- Experimental determinations
- Thermodynamics

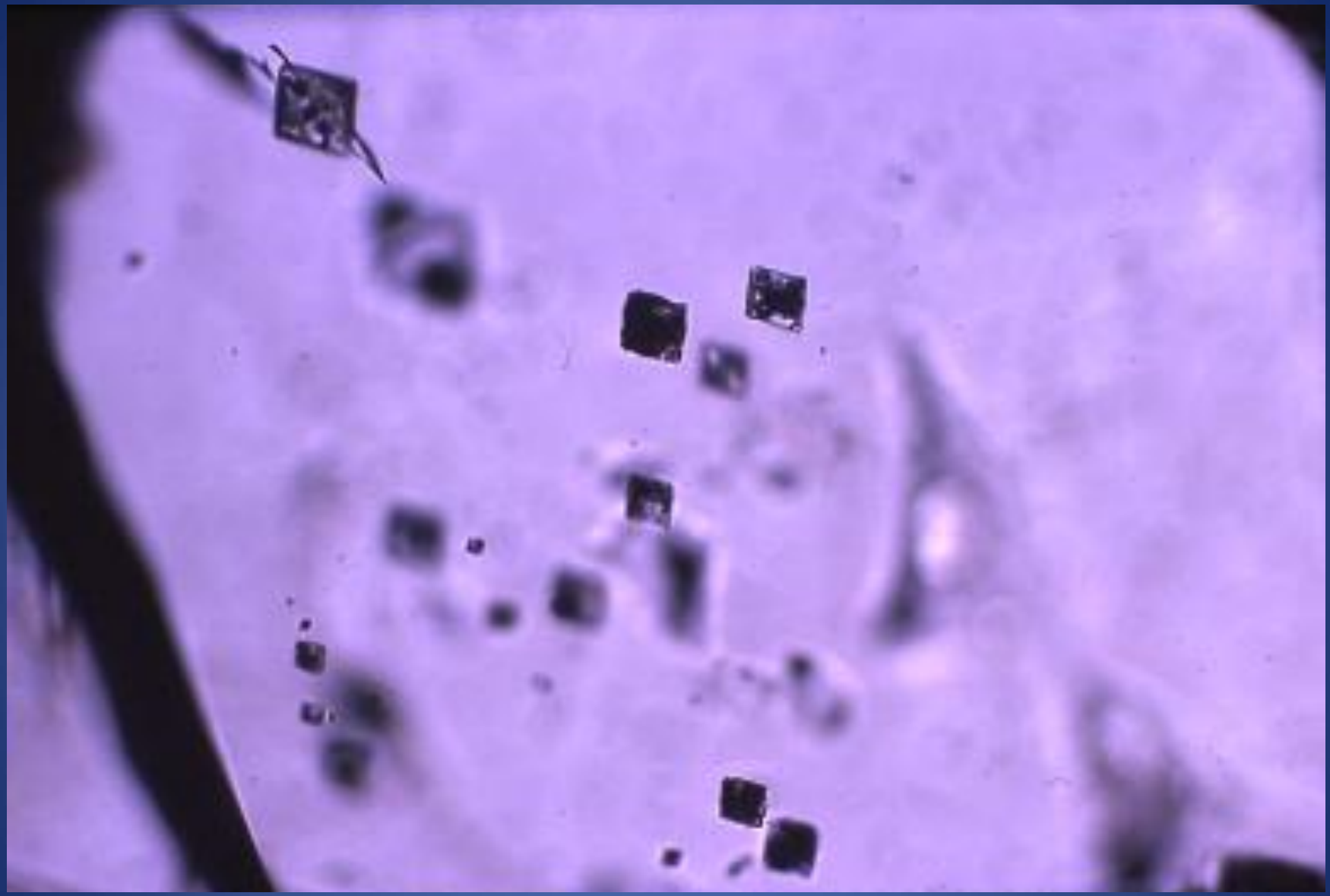


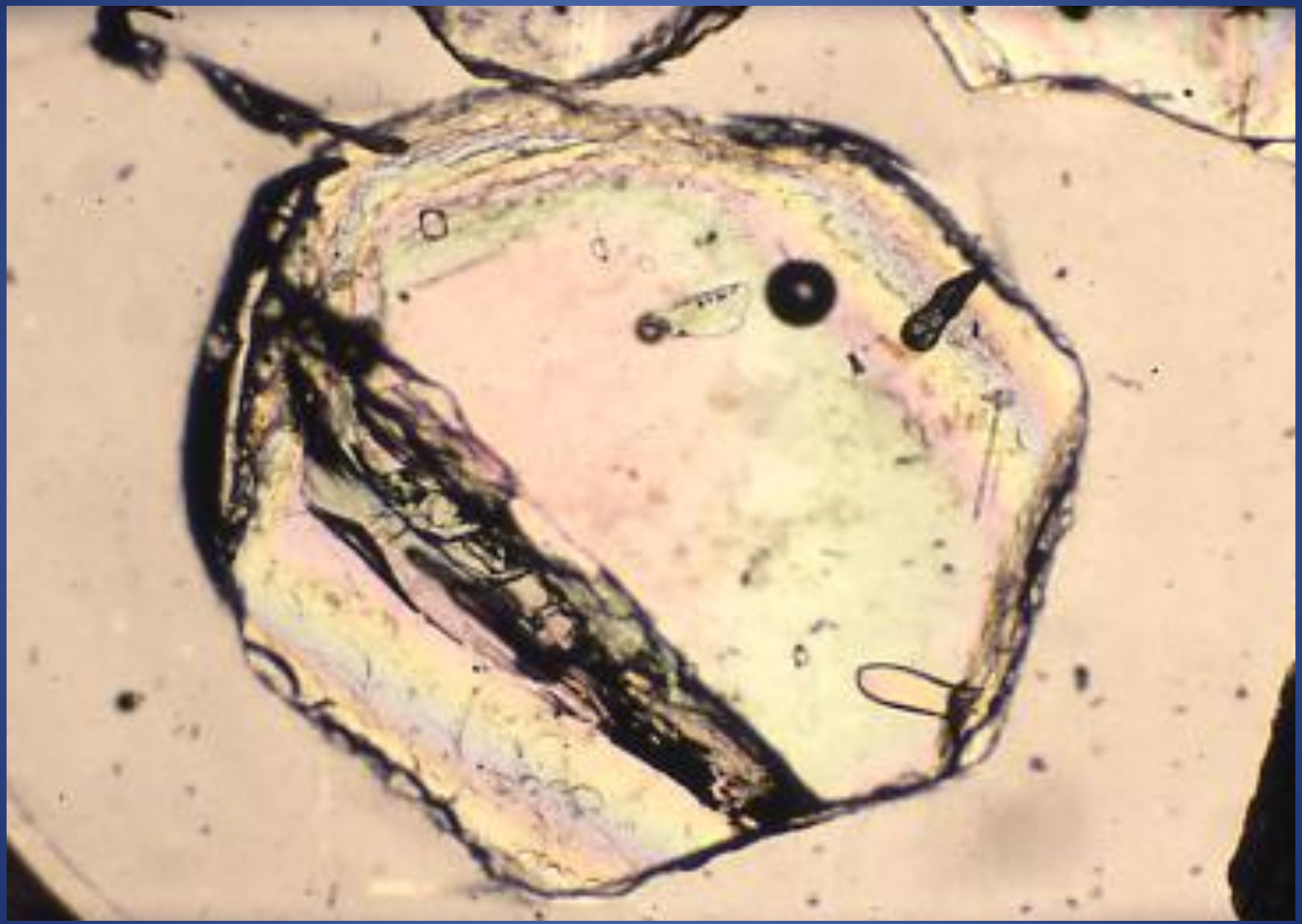




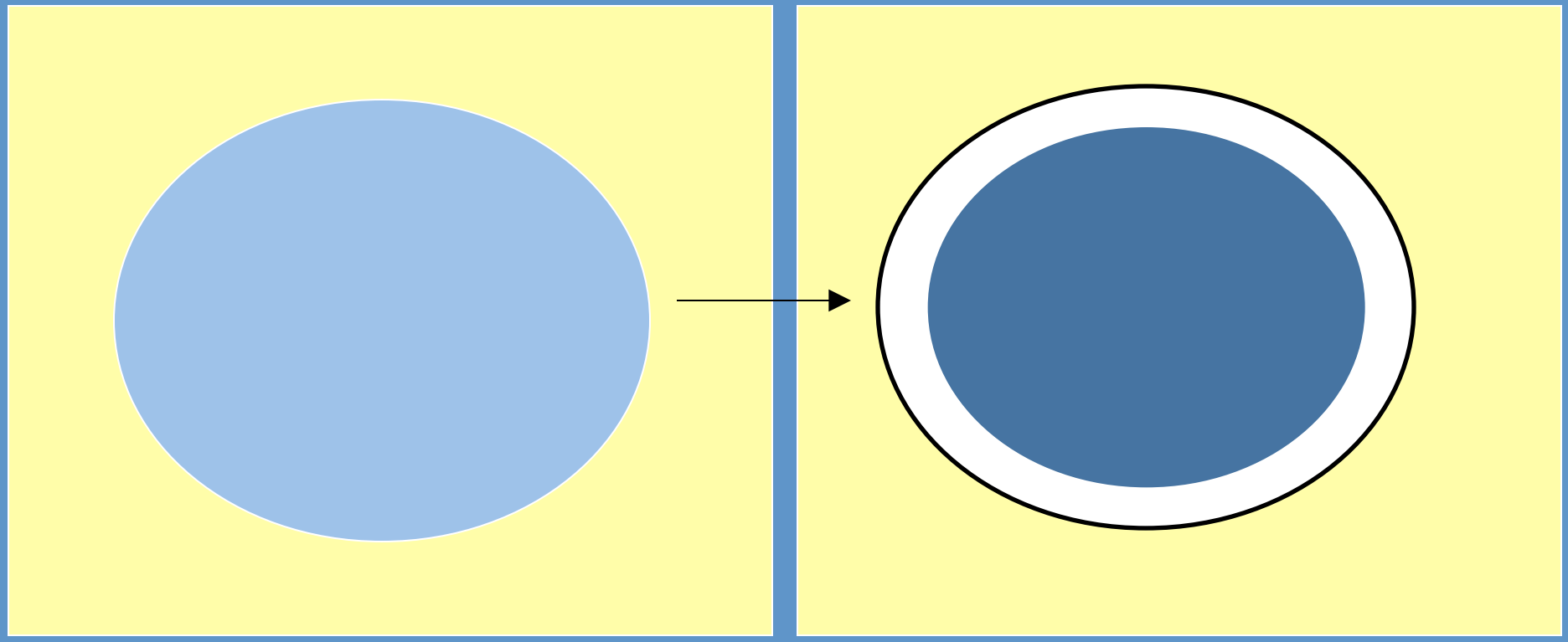


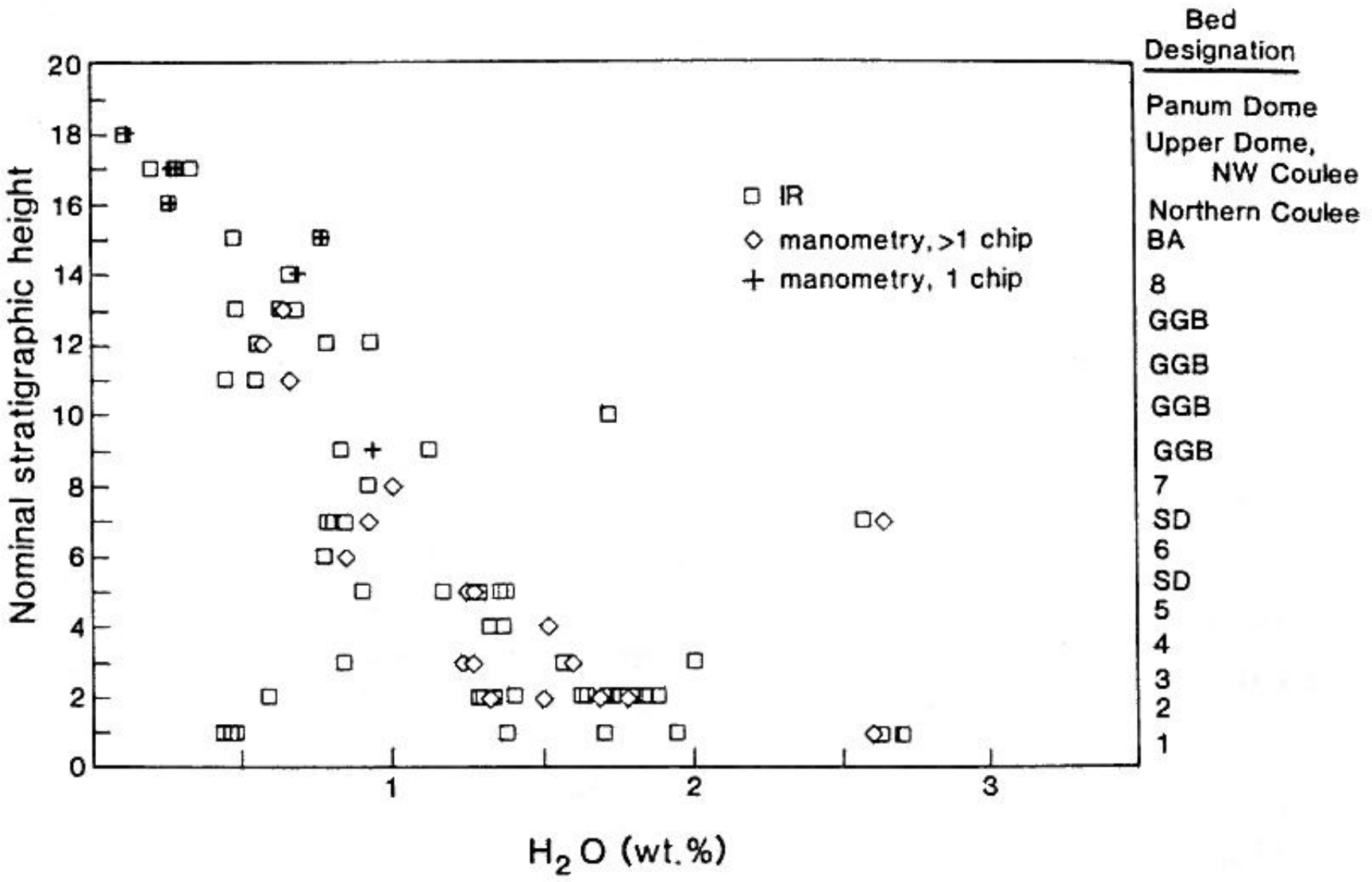






Post entrapment crystallization

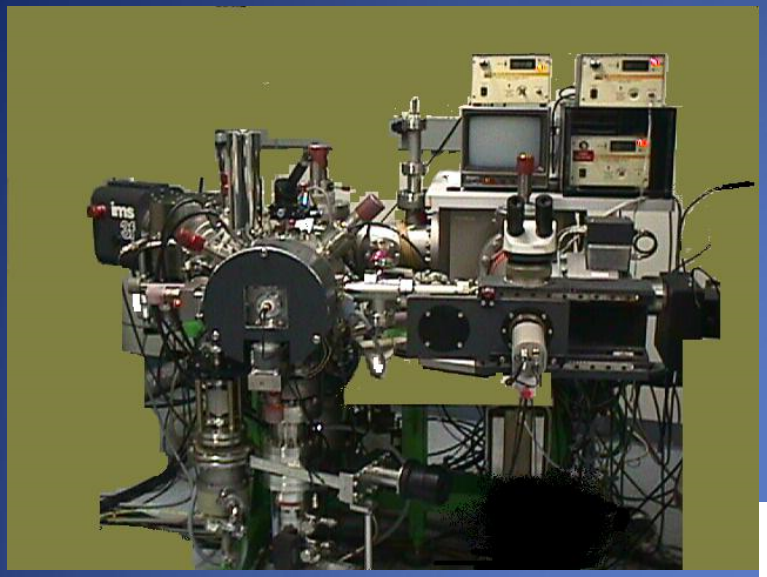




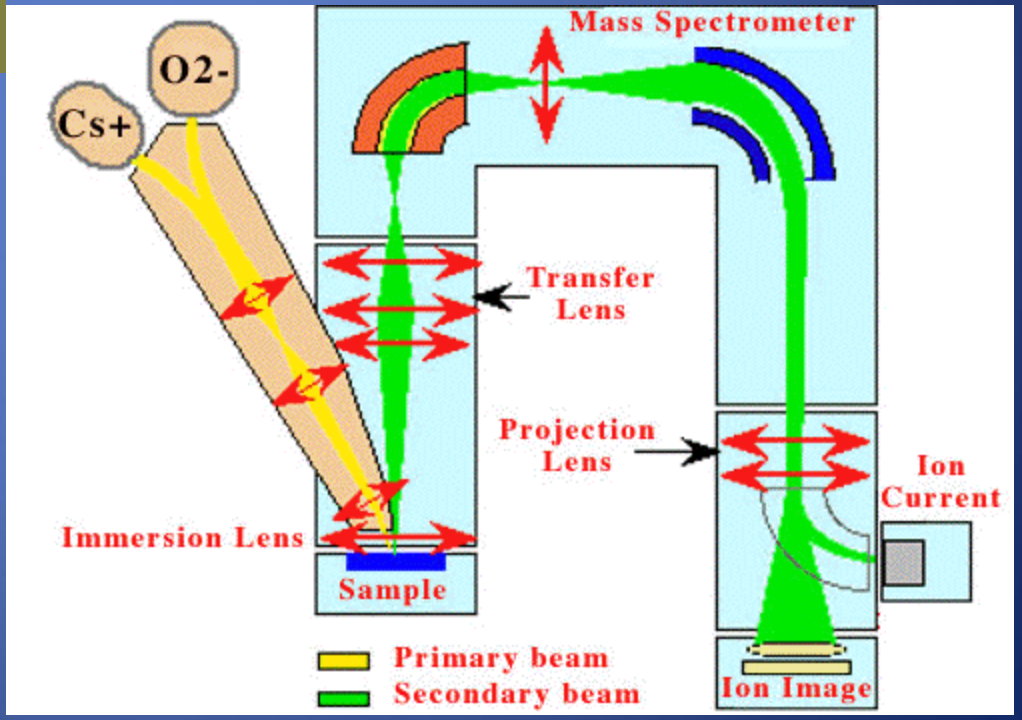
Newman et al., 1988

Electron microprobe

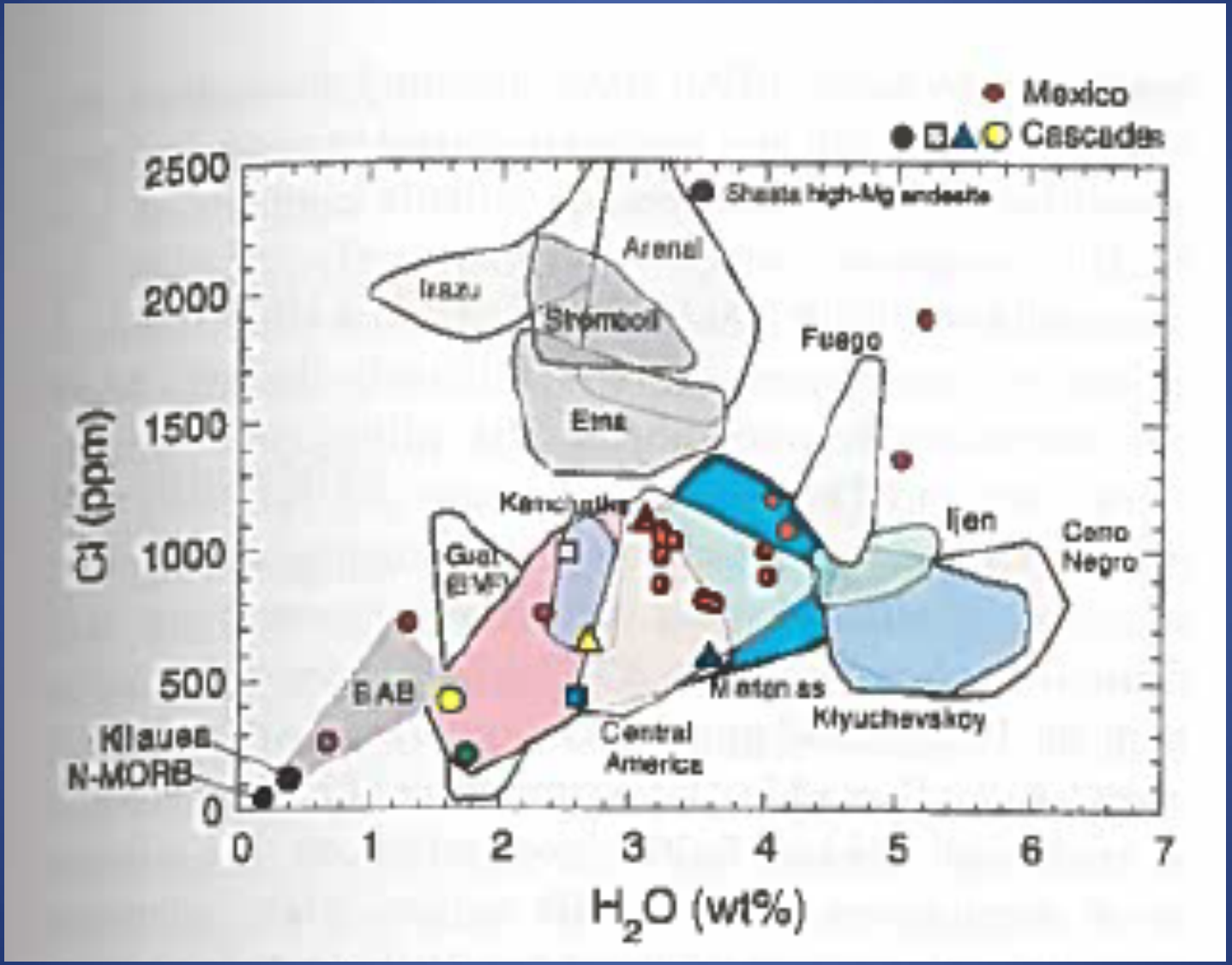
basantic ash	P2O5	SiO2	SO2	TiO2	Al2O3	MgO	CaO	MnO	FeO	Na2O	K2O	F	Cl
MBI1-R16-4-01	2.06	44.62	0.14	4.59	15.74	3.98	9.05	0.24	11.74	5.41	1.96	0.36	0.09
MBI1-R16-4-02	1.82	44.67	0.17	4.41	15.87	4.17	9.00	0.24	11.55	5.84	1.96	0.21	0.10
MBI1-R16-4-03	1.90	44.79	0.13	4.31	15.85	4.10	8.94	0.21	11.60	5.81	1.88	0.37	0.09



Secondary Ion Mass Spectrometry (SIMS)



Water and Cl contents of basalts



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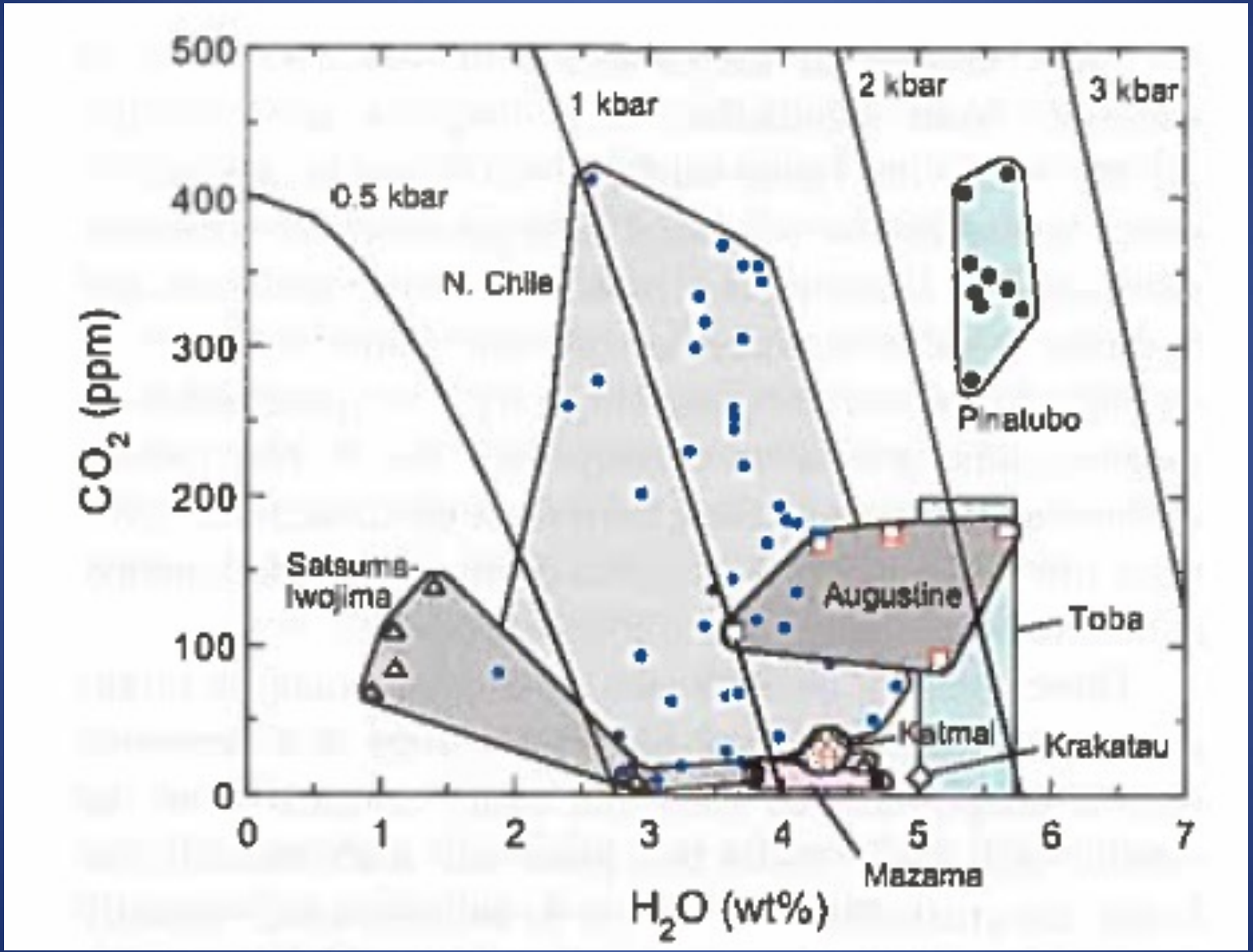
Water and CO2 contents of subduction related rhyolites and dacites



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