Welcome to 3.091

Lecture 33

December 4, 2009

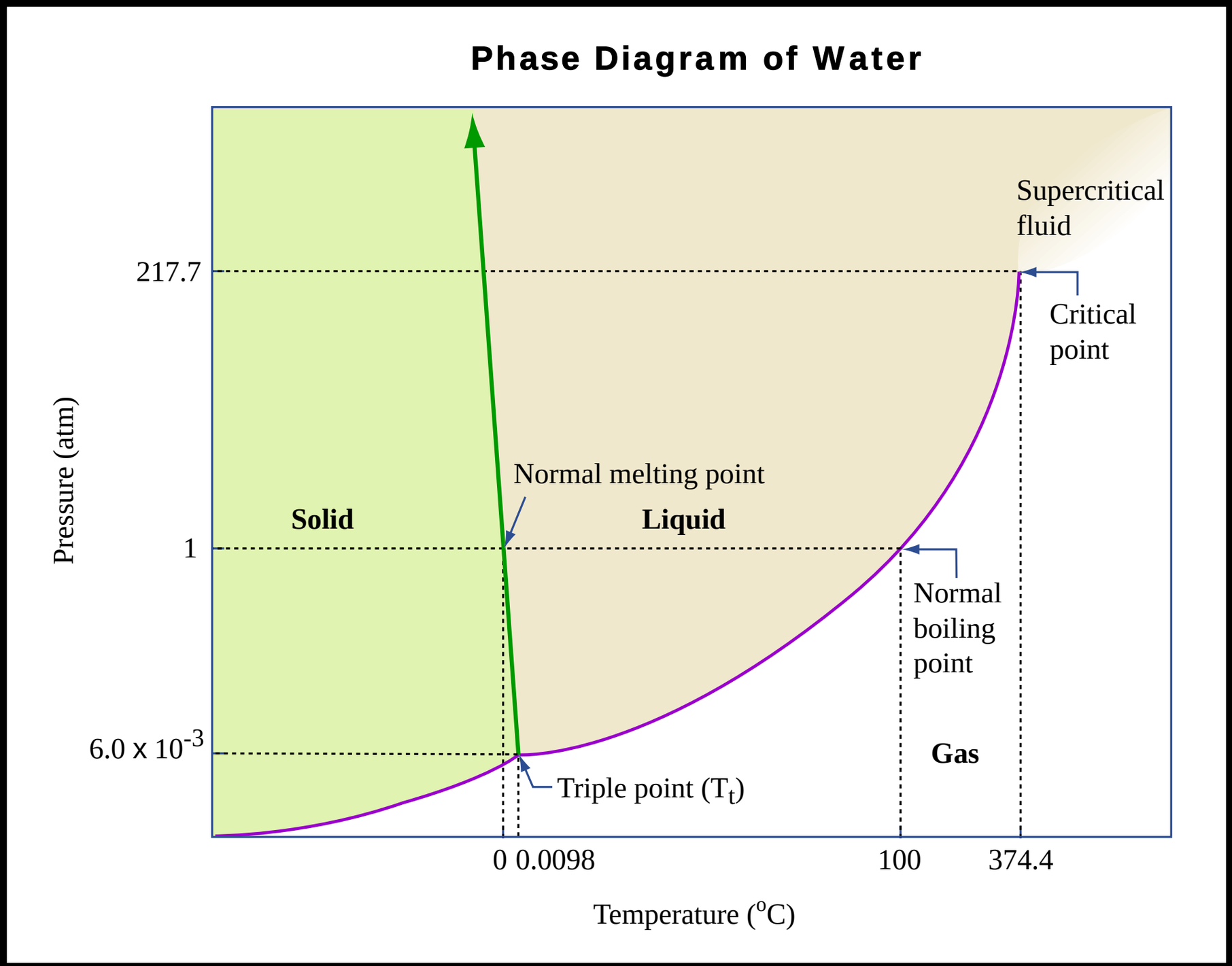
Unary Phase Diagrams

Courtesy of WoofBC on Flickr.

snowflake obsidian:

black glassy phase + white xtalline phase

SiO_2 - MgO - Fe_3O_4



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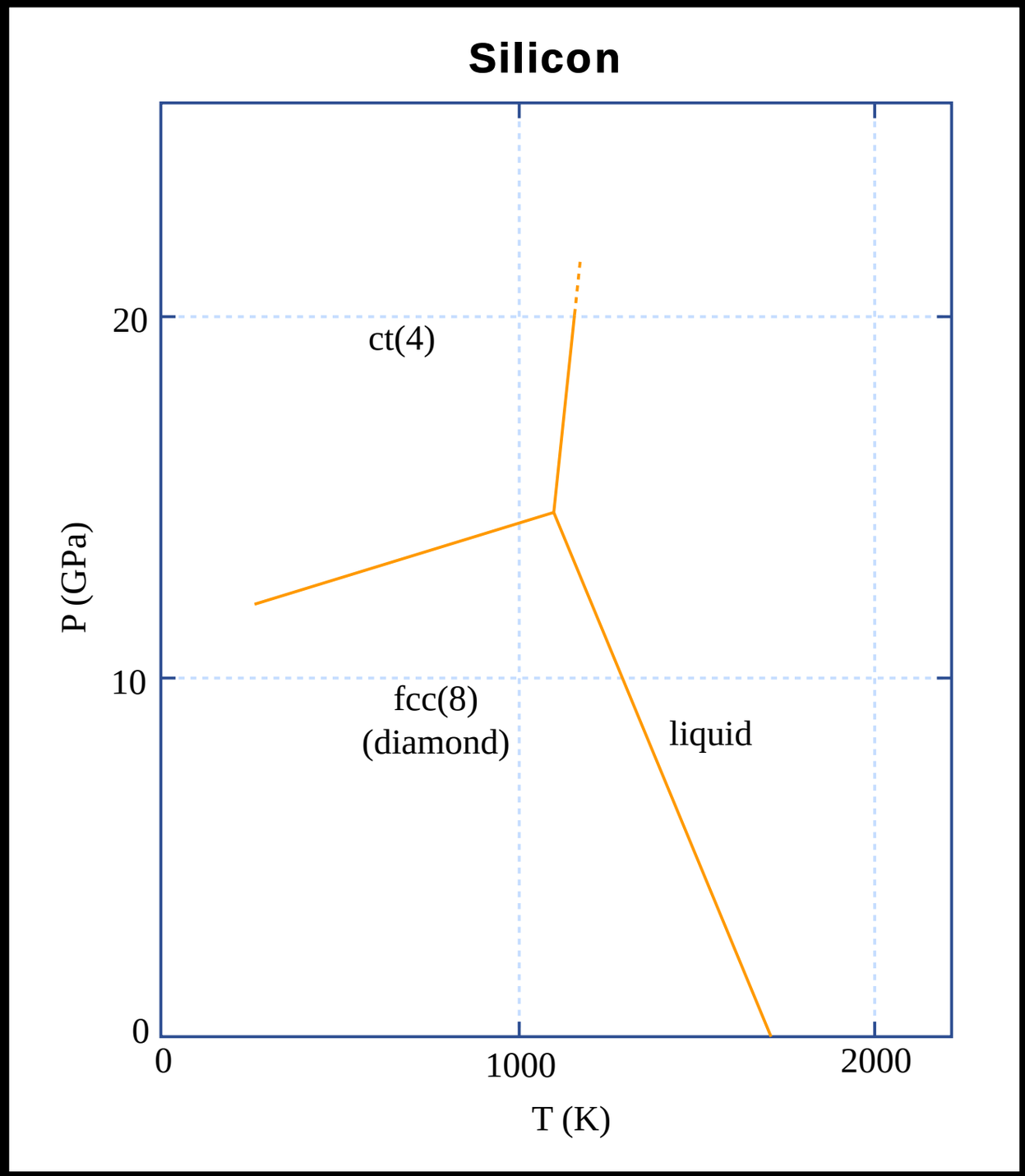

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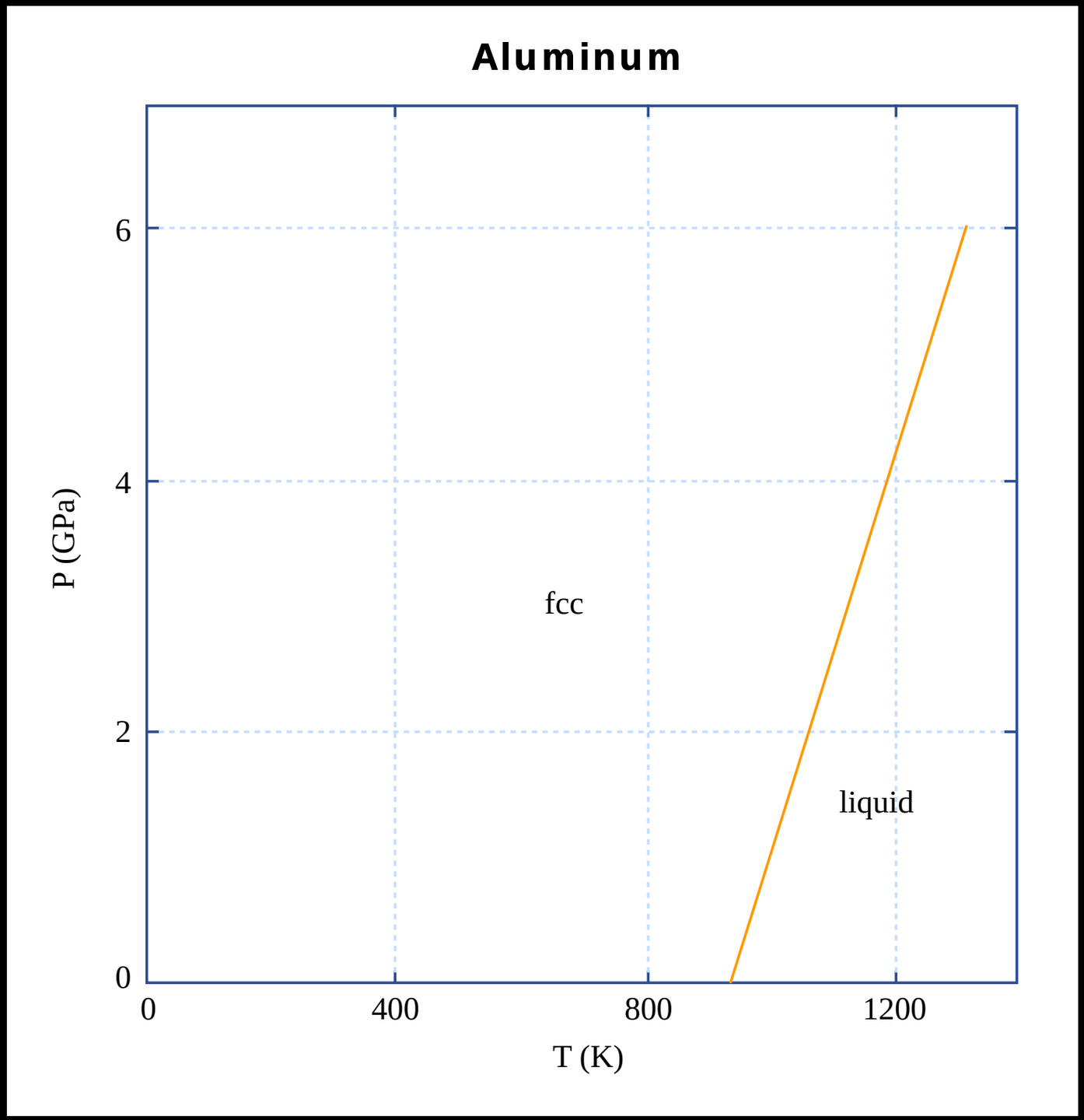
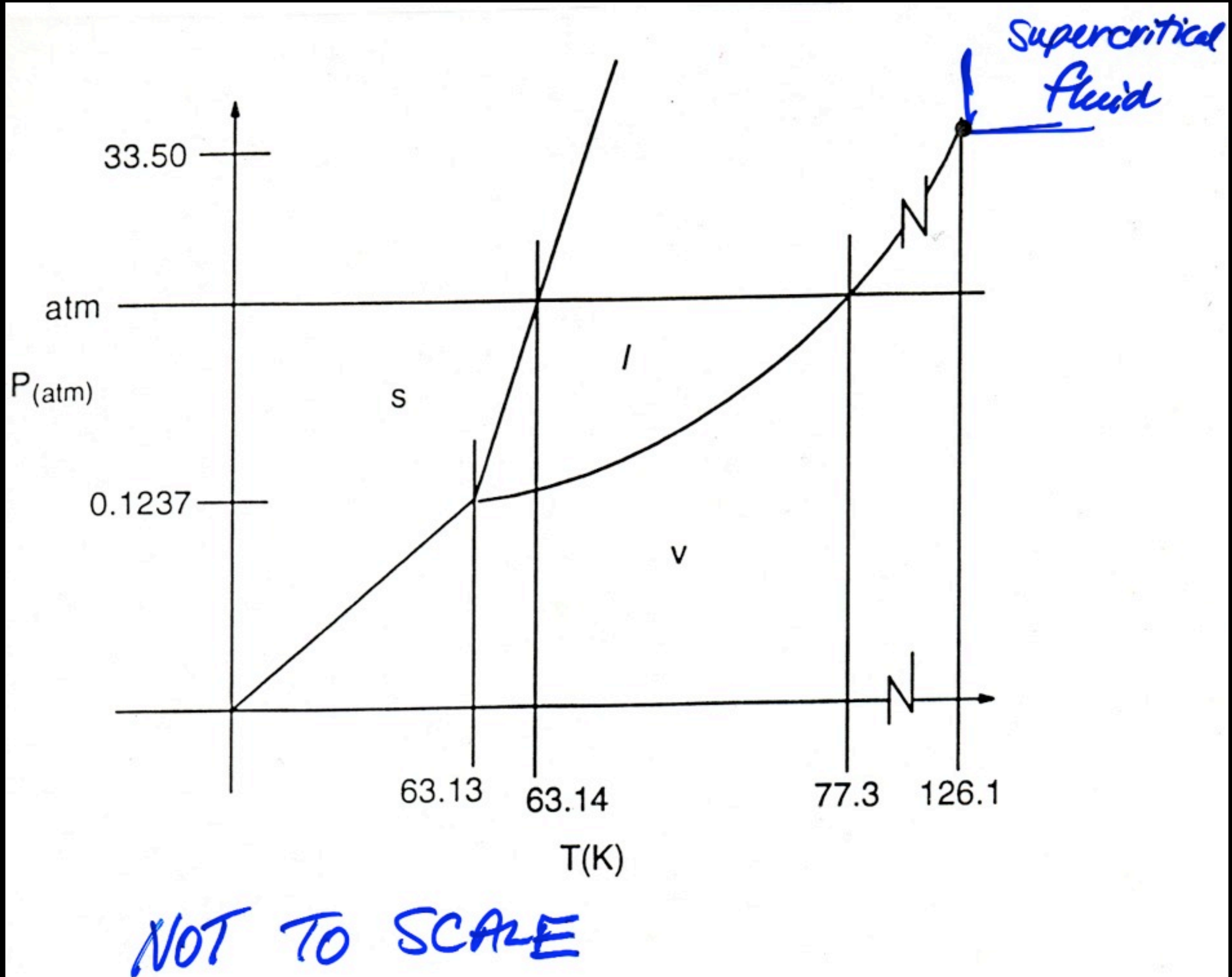
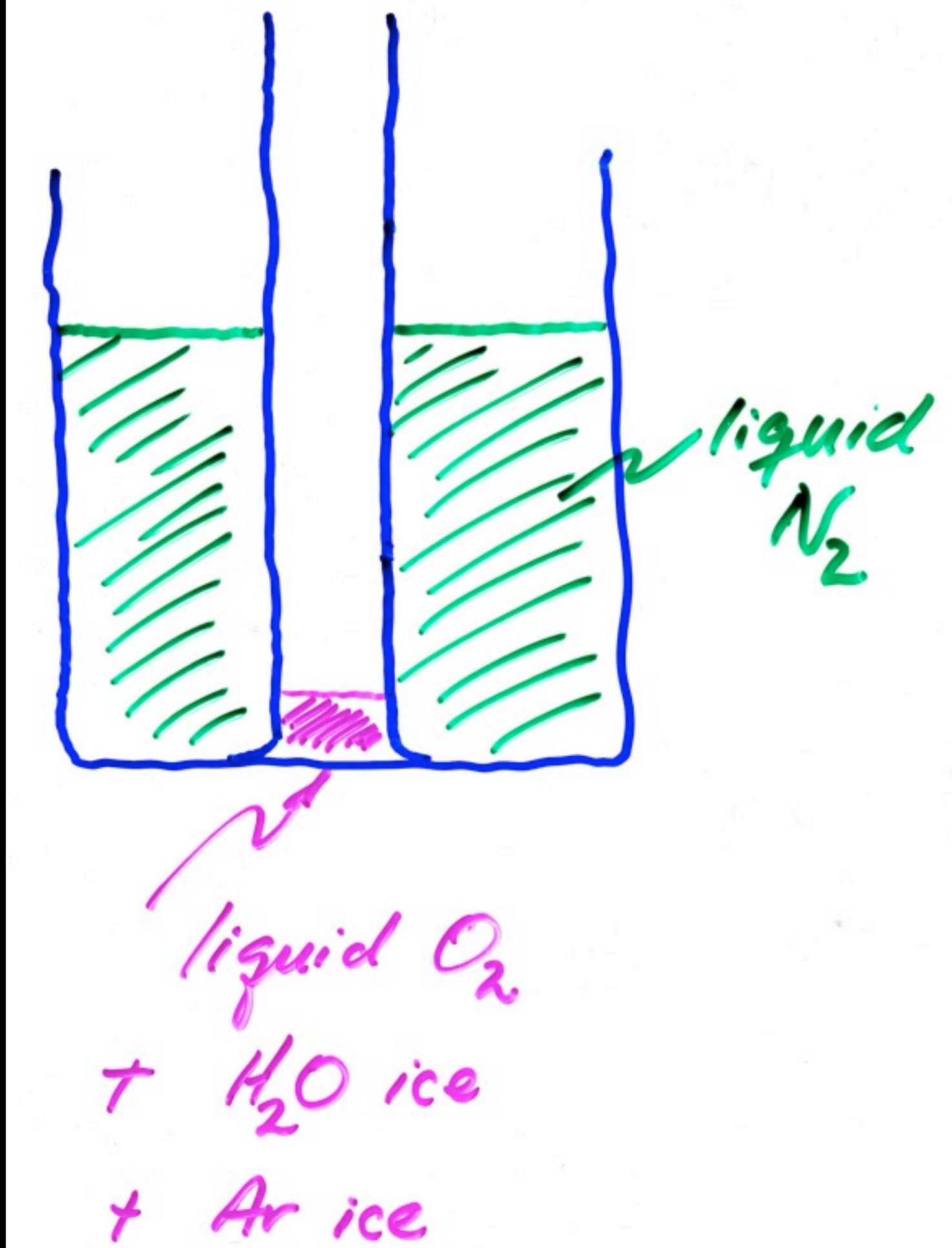



Supercritical fluid
33.50
atm
$P_{(atm)}$
0.1237
s
l
v
63.13
63.14
77.3
126.1
T(K)

NOT TO SCALE

Professor Sadoway's lab coat
is from MAISON DUTECH:
it's French!

	m.p. (K)	b.p. (K)
oxygen	55	90
argon	84	87
nitrogen	63	77



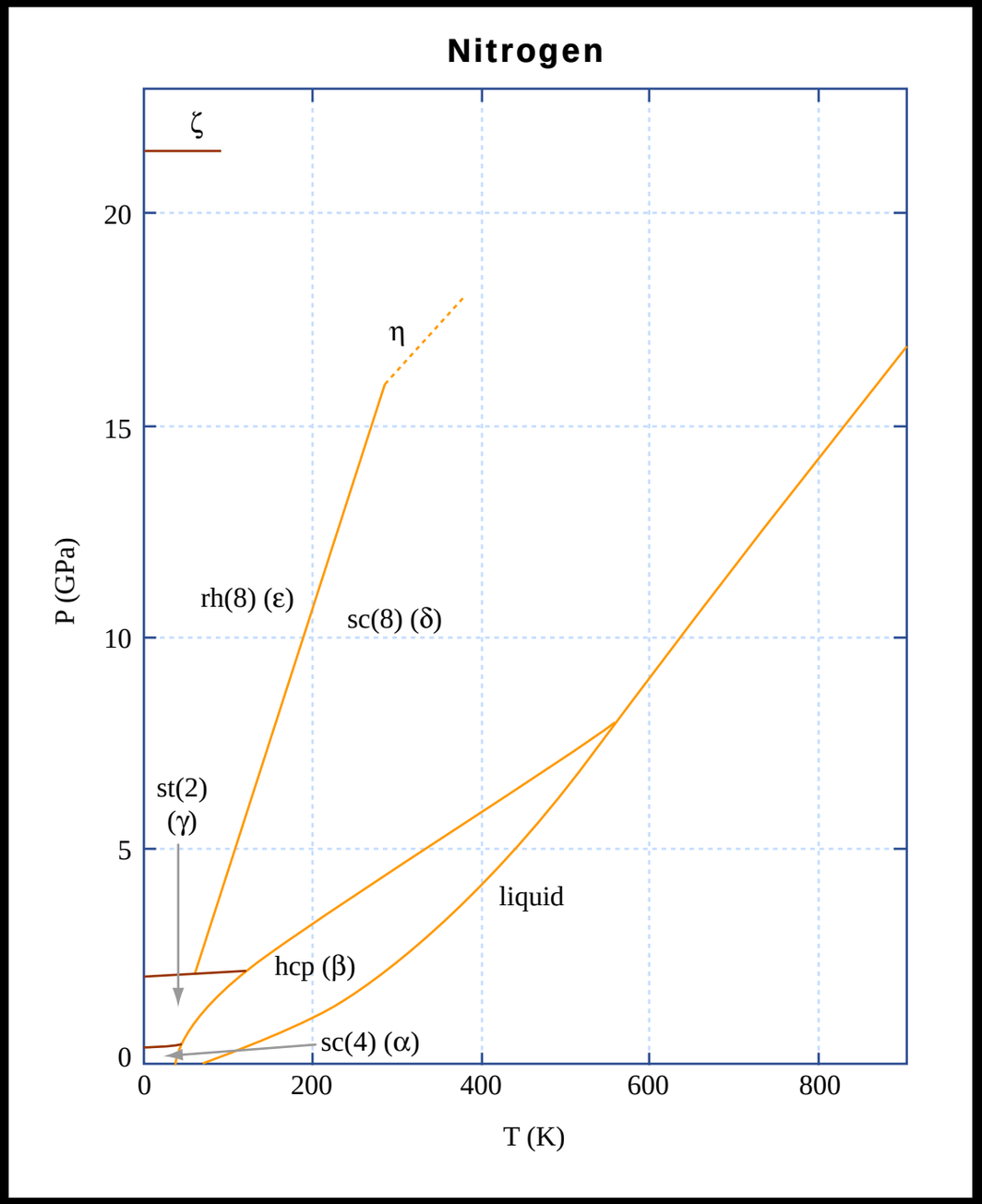
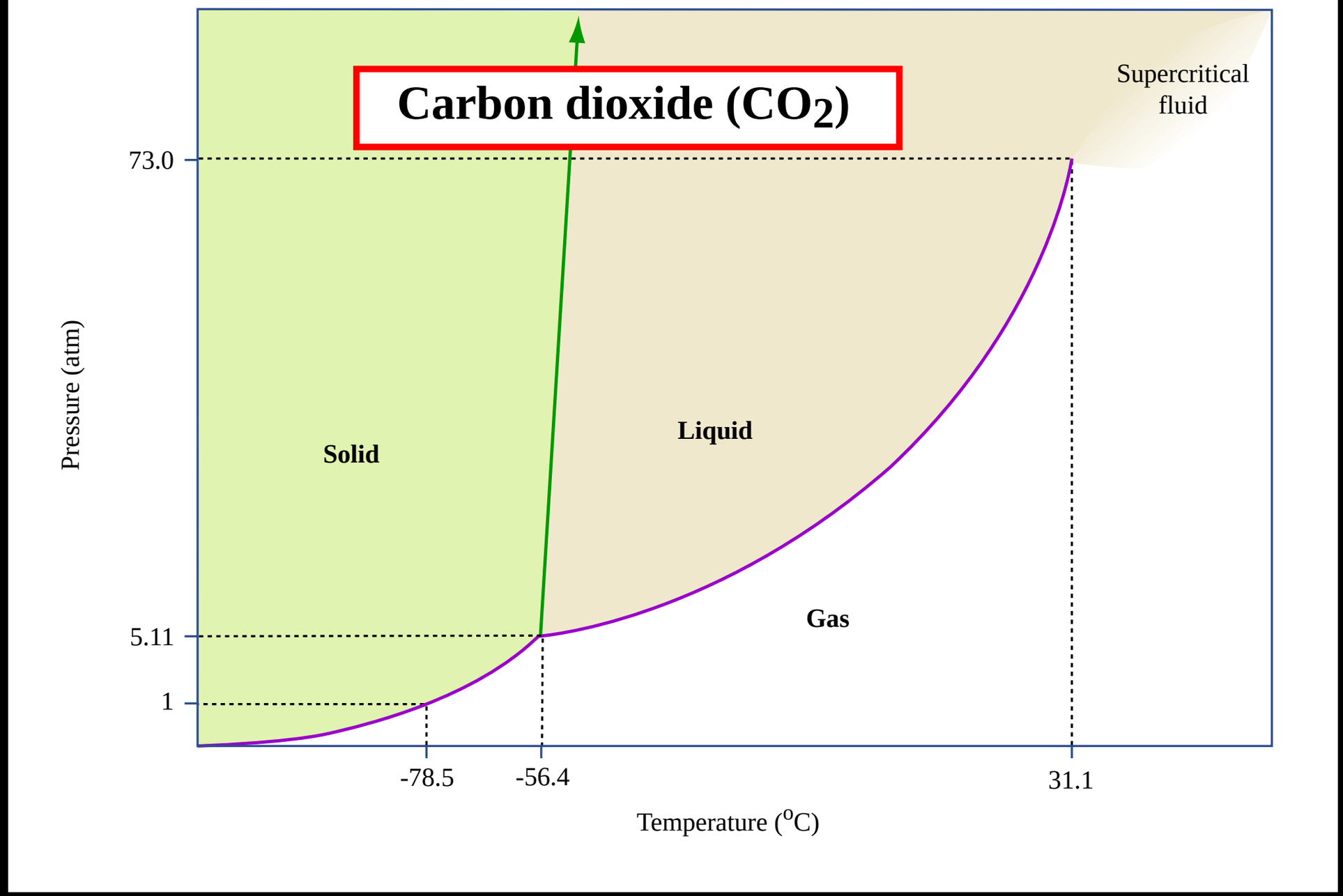


Image by MIT OpenCourseWare.

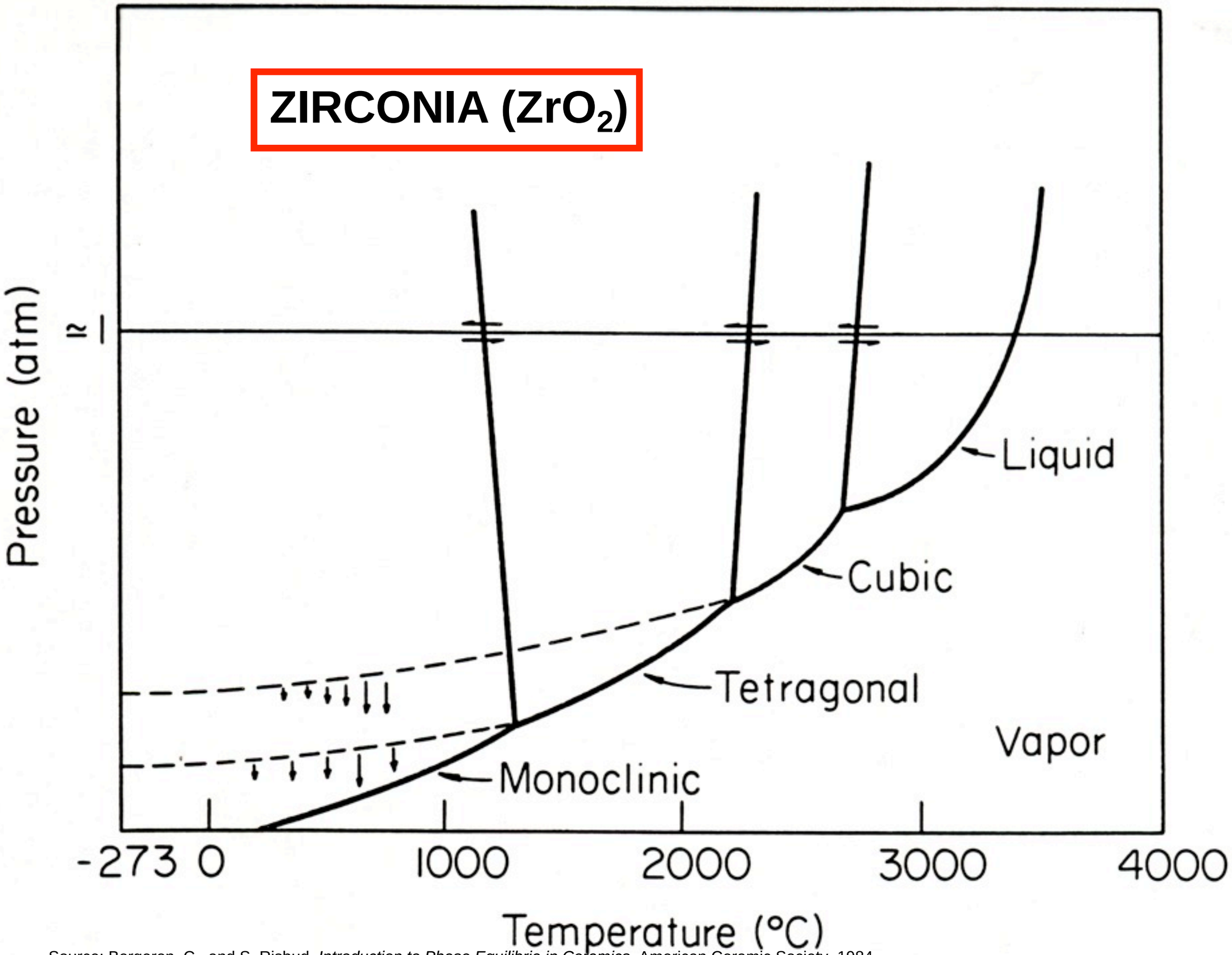
polymorphs: different atomic arrangements at constant composition

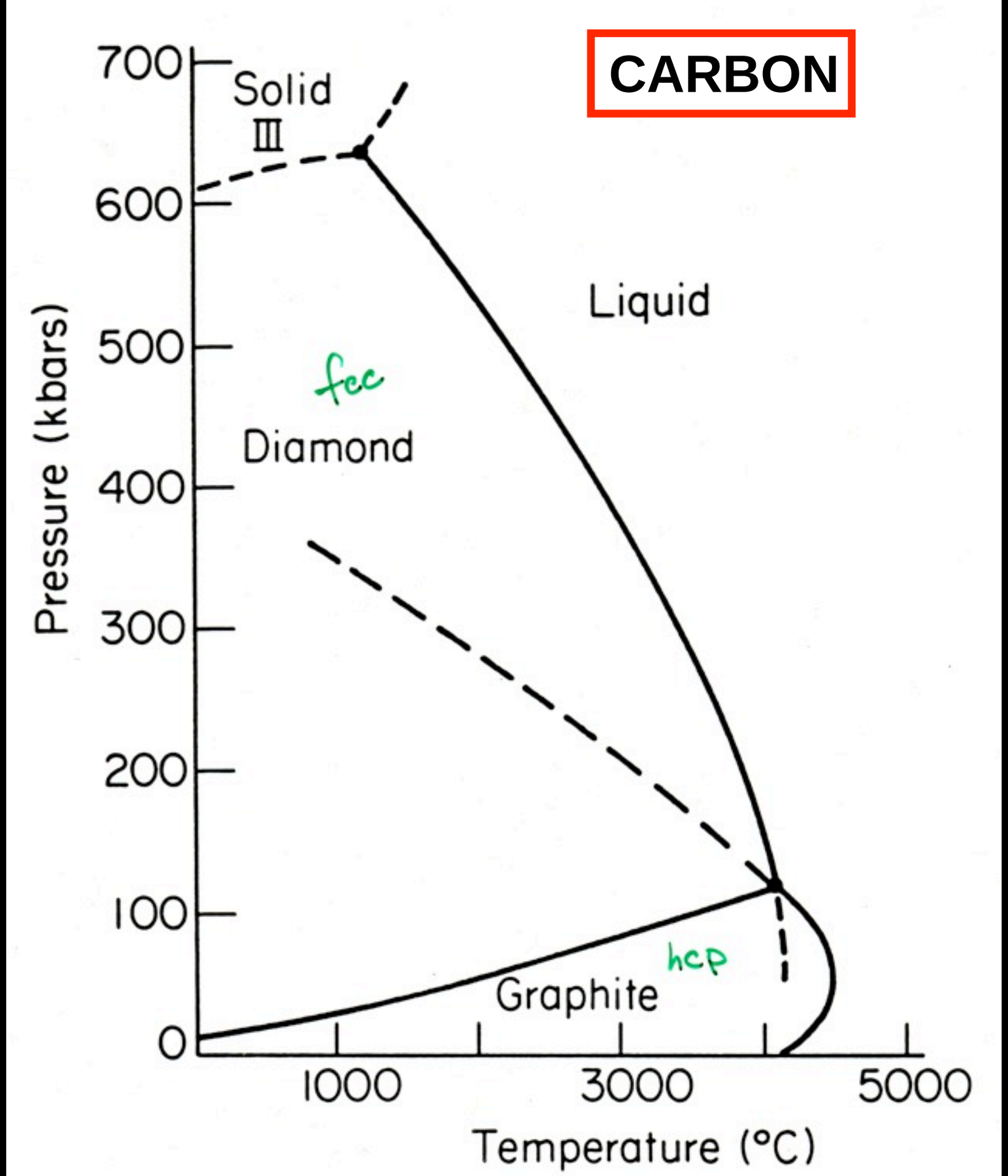
1 atm = 101325 Pa = 0.1 MPa = 14.7 psi = 1 bar

☞ 1 GPa = 10,000 atm



ZIRCONIA (ZrO_2)





RAPID COMMUNICATIONS

PHYSICAL REVIEW B VOLUME 48, NUMBER 18 1 NOVEMBER 1993-II

Rapid Communications

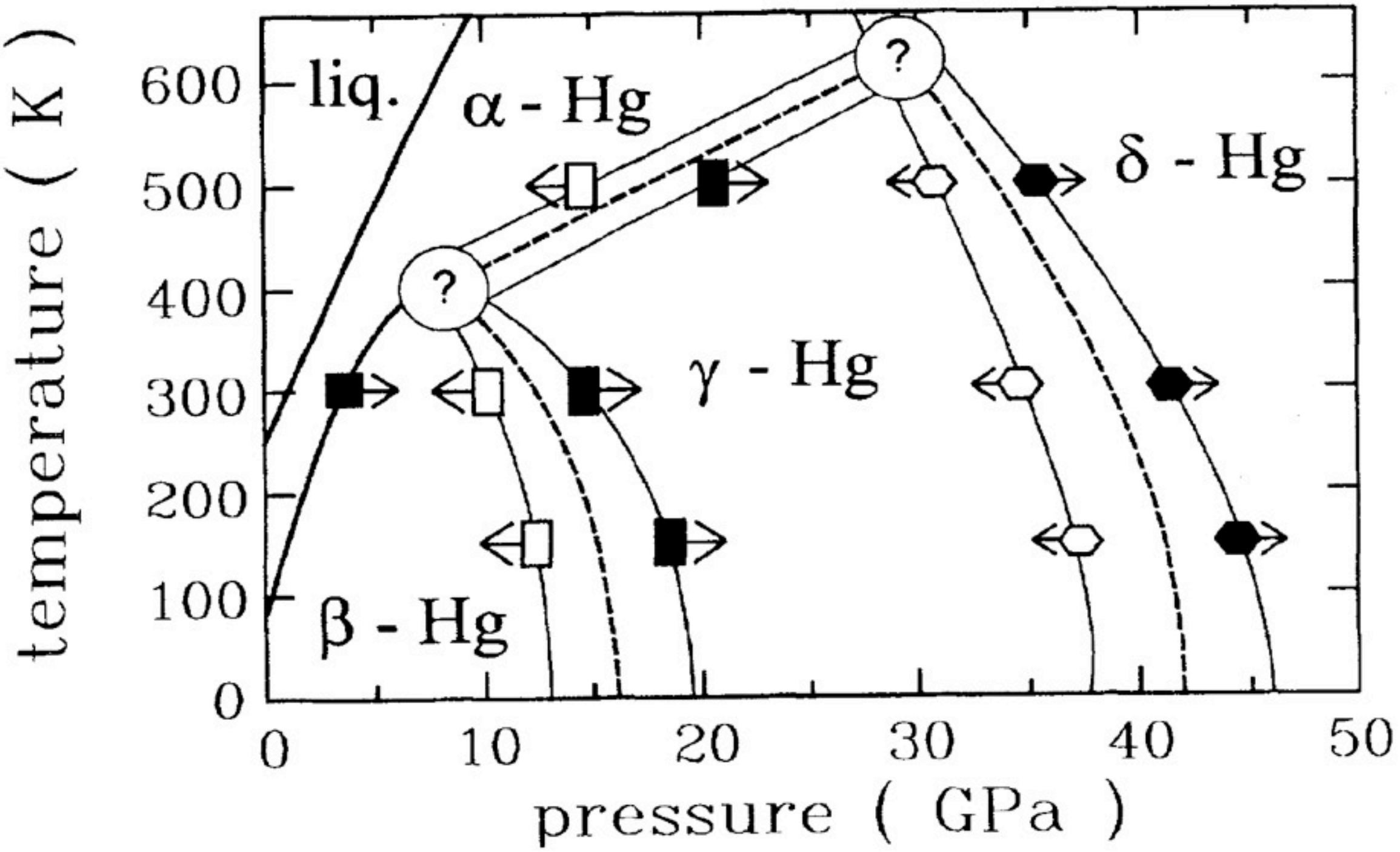
Rapid Communications are intended for the accelerated publication of important new results and are therefore given priority treatment both in the editorial office and in production. A Rapid Communication in **Physical Review B** *should be no longer than four printed pages and must be accompanied by an abstract. Page proofs are sent to authors.*

Phase diagram for mercury up to 67 GPa and 500 K

Olaf Schulte and Wilfried B. Holzapfel
Universität Gesamthochschule Paderborn, 33095 Paderborn, Germany
(Received 23 July 1993; revised manuscript received 7 September 1993)

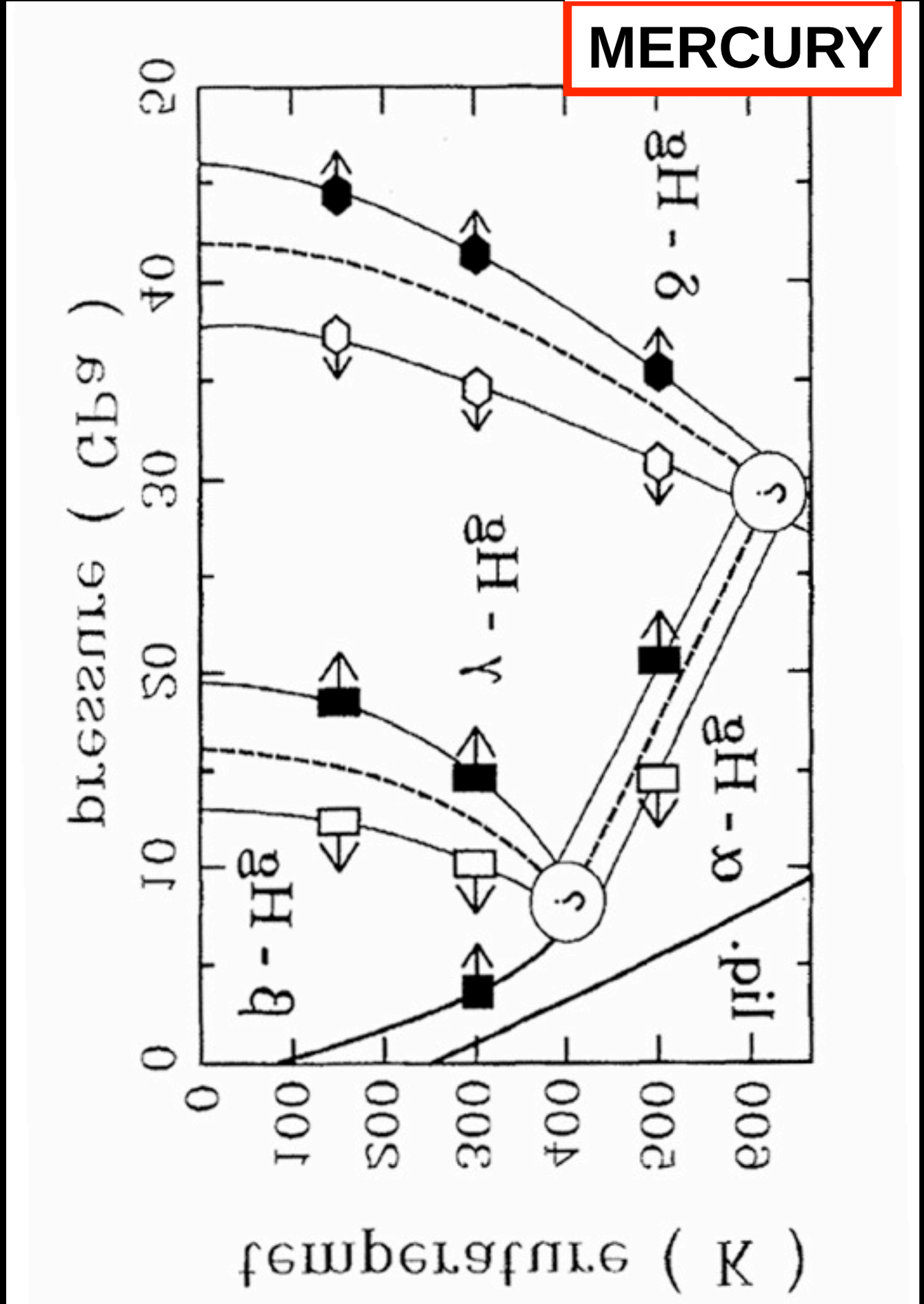
The pressure-temperature phase diagram for mercury is determined using energy-dispersive x-ray diffraction and a diamond anvil cell. In addition to the well-known structures of Hg, one new modification was found to be stable in the present experimental region. An orthorhombic lattice with four atoms in the unit cell represents all the experimental data for this new phase. The locations of the phase boundaries between the different phases α-β-γ-δ are determined for the extended p-T region. Furthermore, the parameters of the equations of state of the different phases are evaluated.

MERCURY



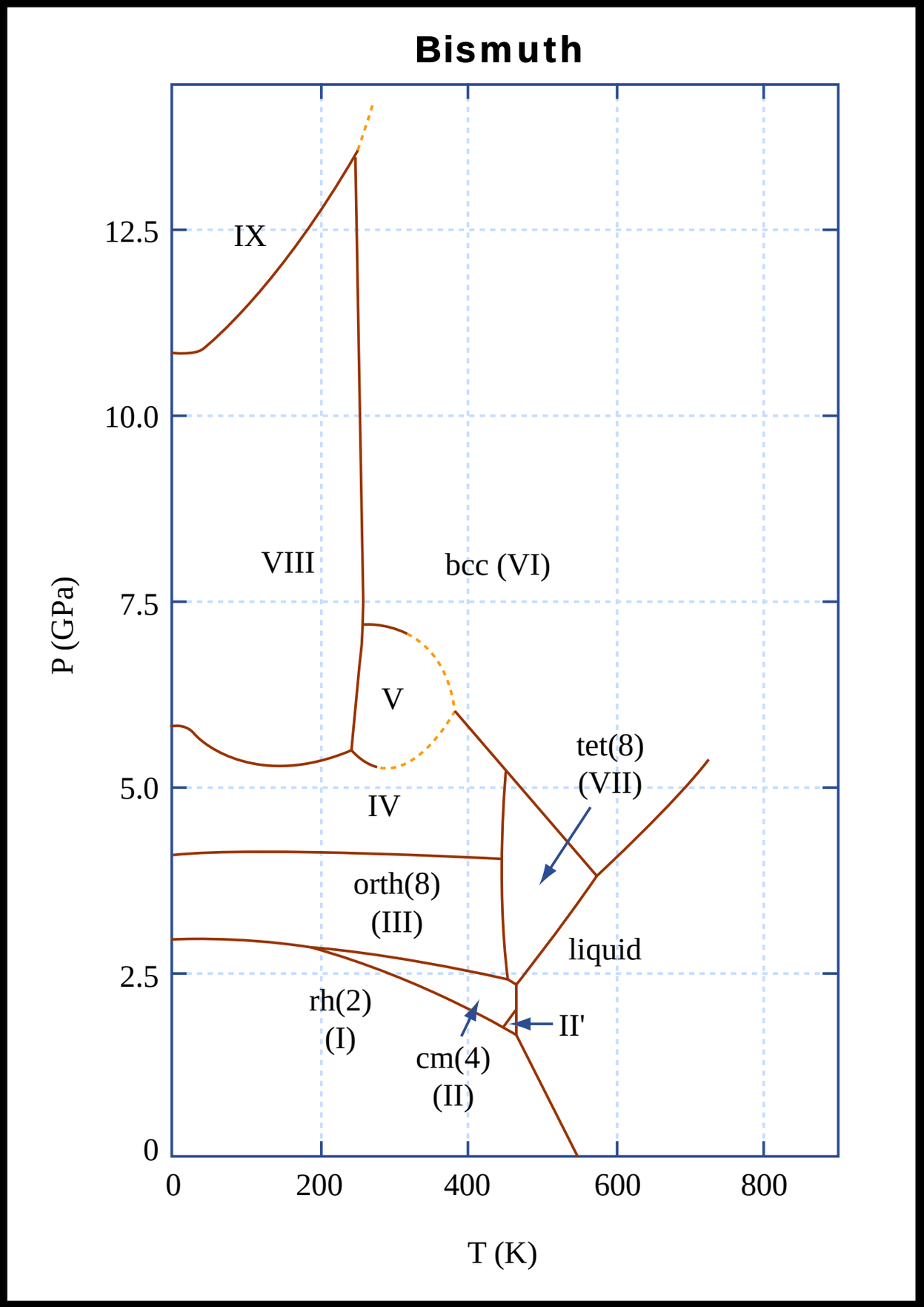
Source: Schulte, O., and W. B. Holzapfel. "Phase diagram for mercury up to 67 GPa and 500 K." *Phys Rev B* 48 (1993); 14009-14012.

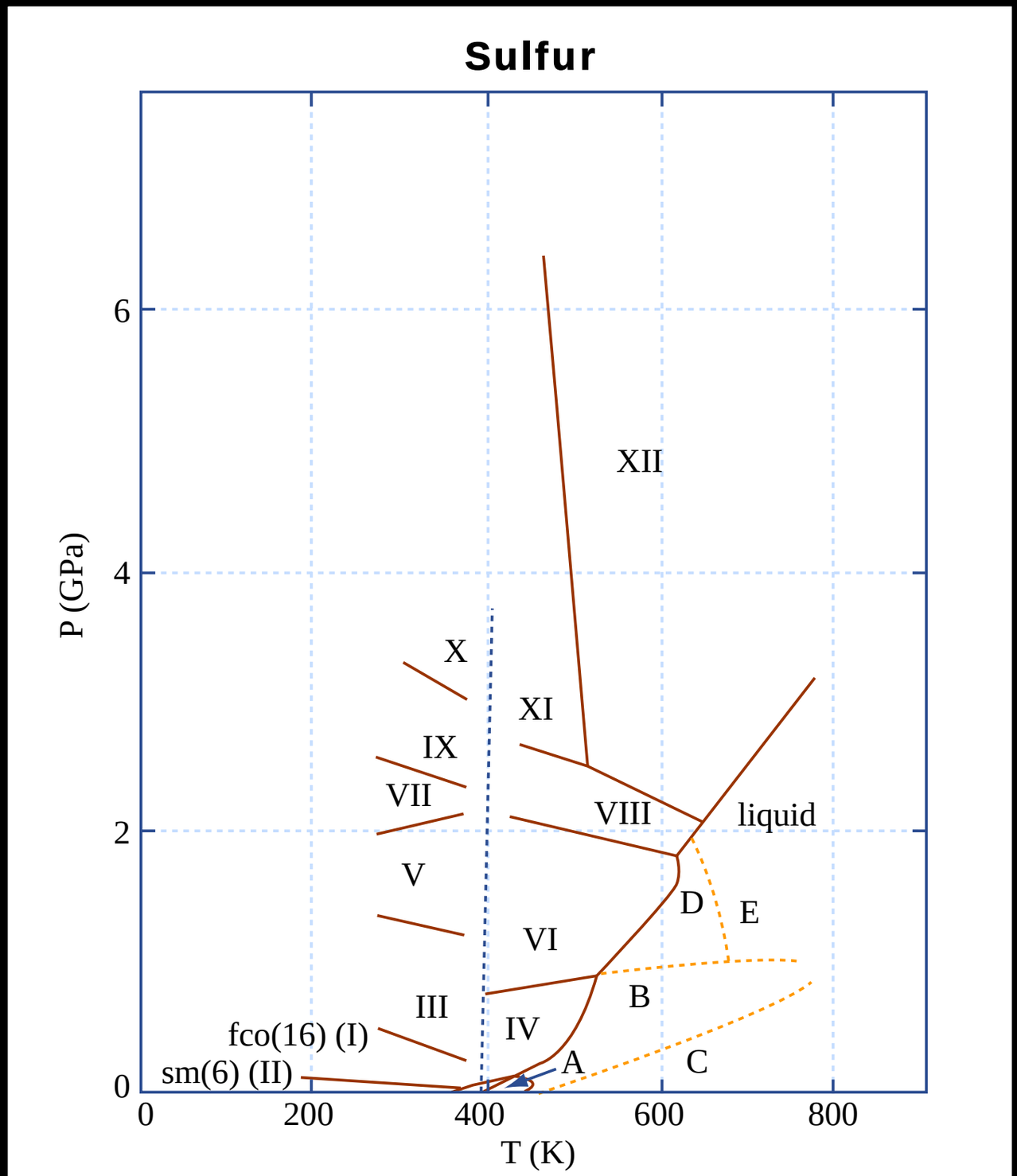
MERCURY



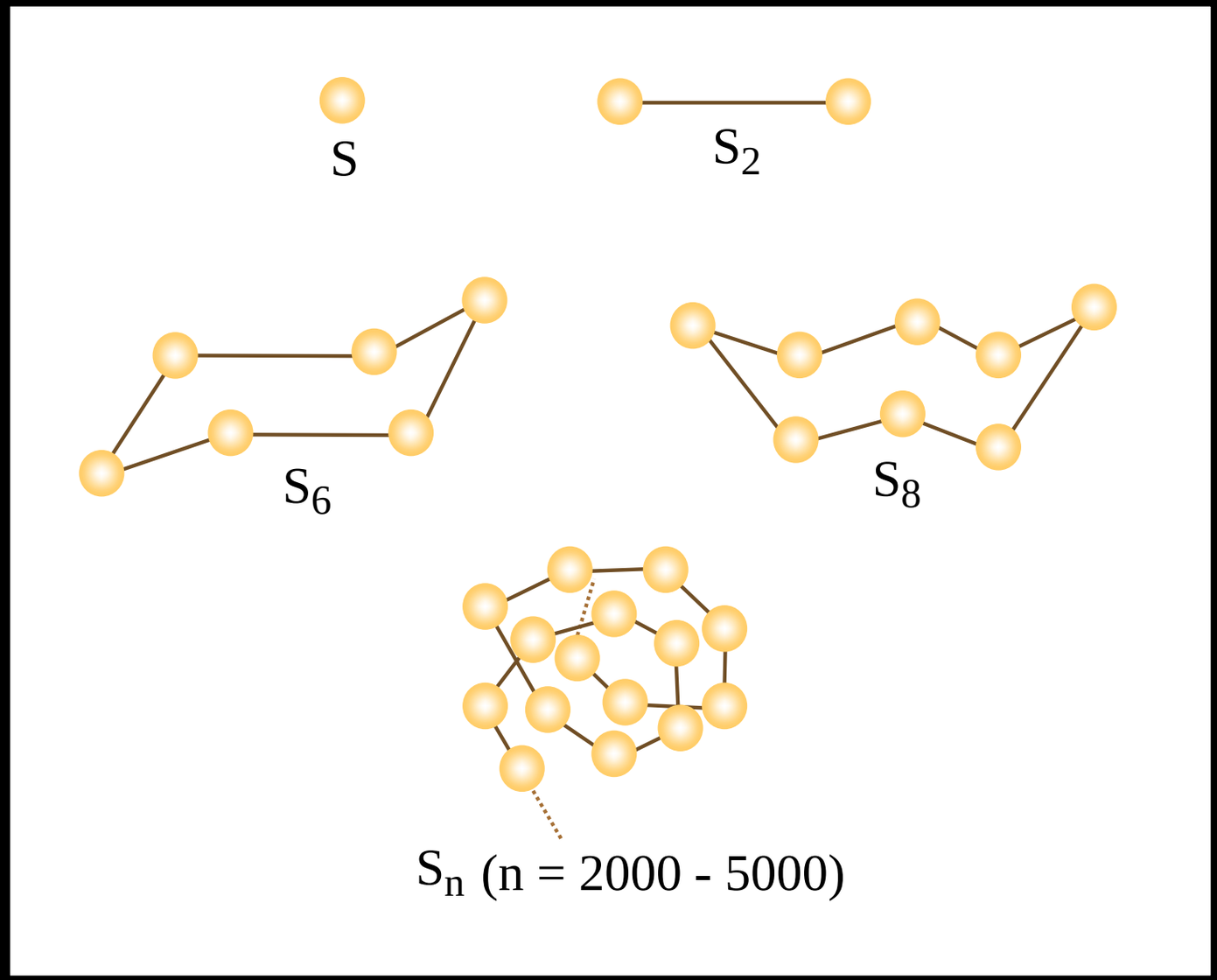
Source: Schulte, O., and W. B. Holzapfel. "Phase Diagram for Mercury up to 67 GPa and 500 K." *Phys Rev B* 48 (1993); 14009-14012.

Calder – Miró
Mercury Fountain
in honor of the miners of Almaden
Miro Museum, Barcelona, Spain





allotropes of sulfur



allotropes: forms of an element differing in bonding and molecular structure, e.g., O_2 and O_3 are allotropes of oxygen

polymorphs of sulfur

α = β at 95.5°C

rhombic

monoclinic

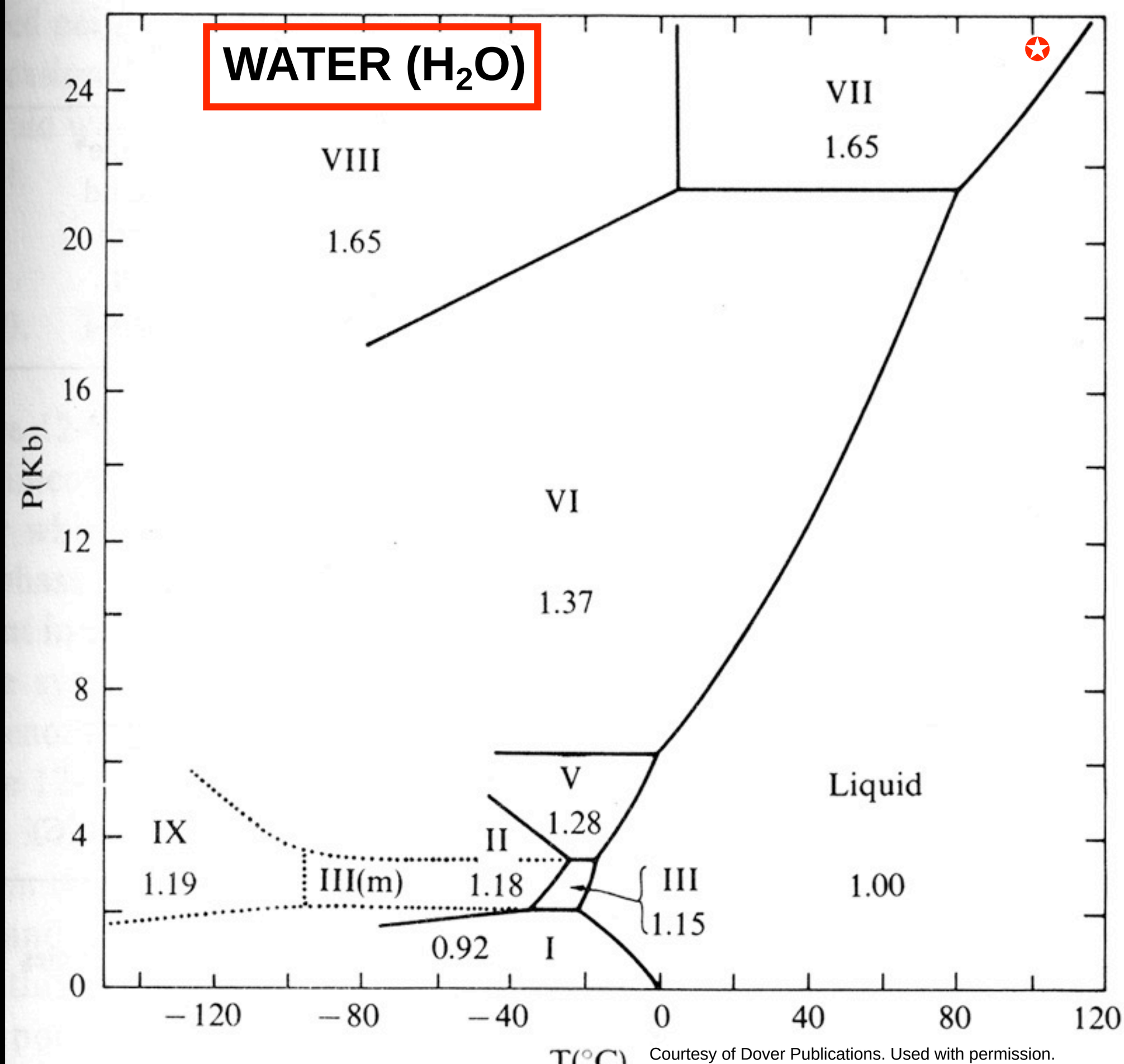
Image sources: Left, public domain. Right, courtesy of fluor_dooublet on Flickr.

$\beta = \lambda$ at 119°C

$\lambda = \mu$ at 160°C

forming “plastic” sulfur,
i.e., amorphous

WATER (H_2O)



✪ ice VII
100°C
25 kbar

decaffeinating coffee

- use a process called ***solvent extraction***
- historically the solvent was CH_2Cl_2
- today, green beans soaked in CO_2 at 90°C and ≈200 atm.

- caffeine conc. drops from the normal 1-3% to ≈0.02%
- reduce *T* & *P* to exceed K_{sp}
  - ☞caffeine precipitates out of solution
- recycle the CO_2

3.091SC Introduction to Solid State Chemistry

Fall 2009