# Development of a CsCl pressure standard and its use in testing a series of multi-anvil cells (the COMPRES assemblies)

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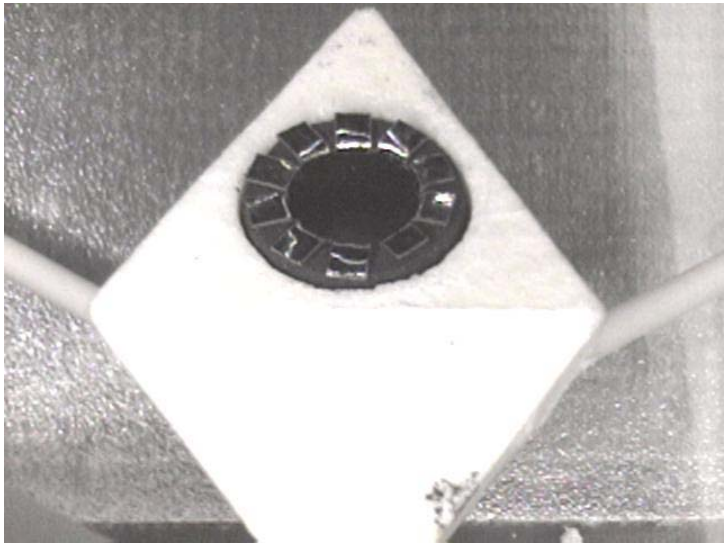
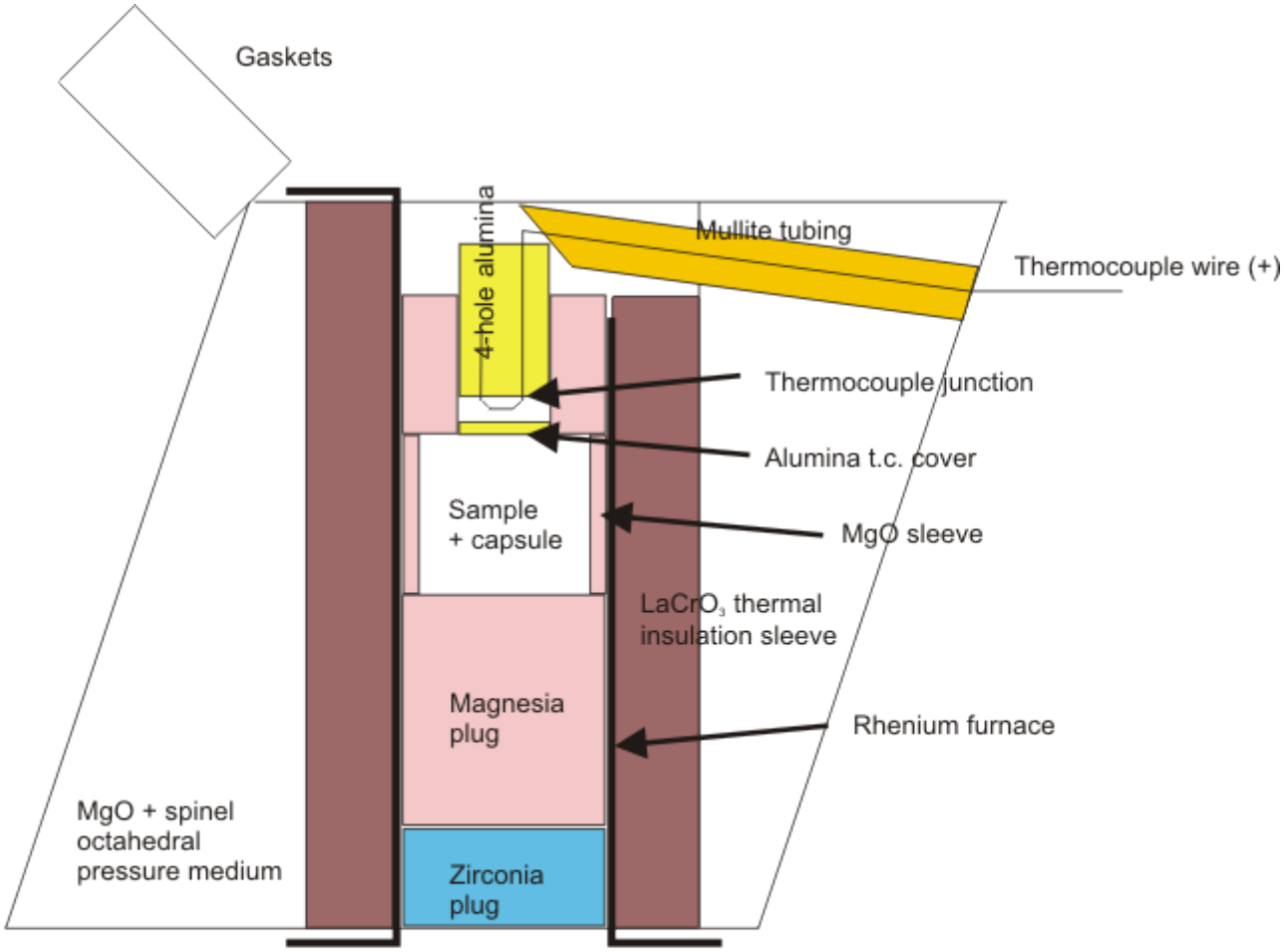
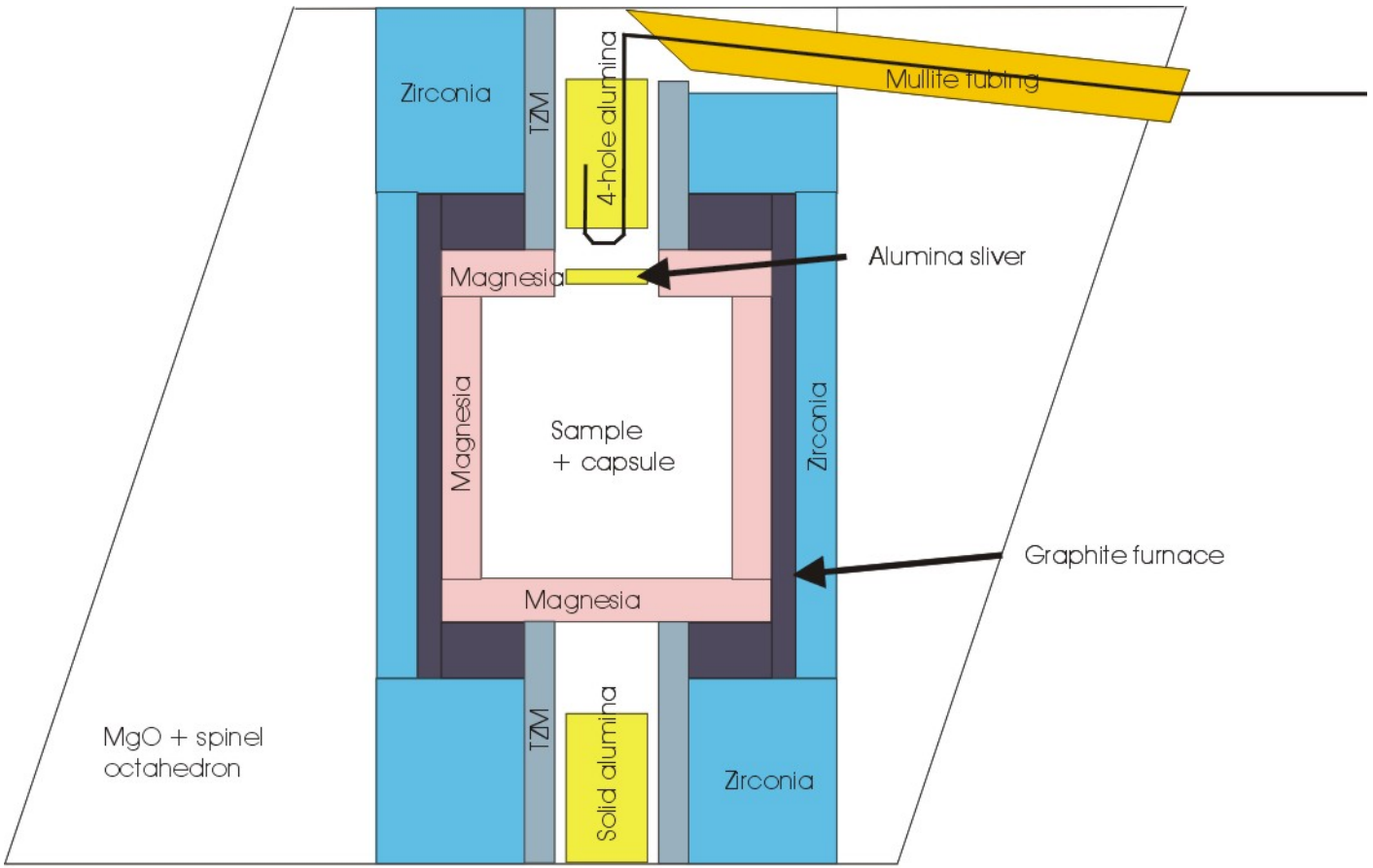


# Purpose

- We needed to calibrate multi-anvil cells for the COMPRES cell project
- (pictures of the cells to follow)
- But the cells are VERY absorbing, and we didn’t want to alter them.




# Example: COMPRES 10/5 assembly




14/8 "G2" assembly

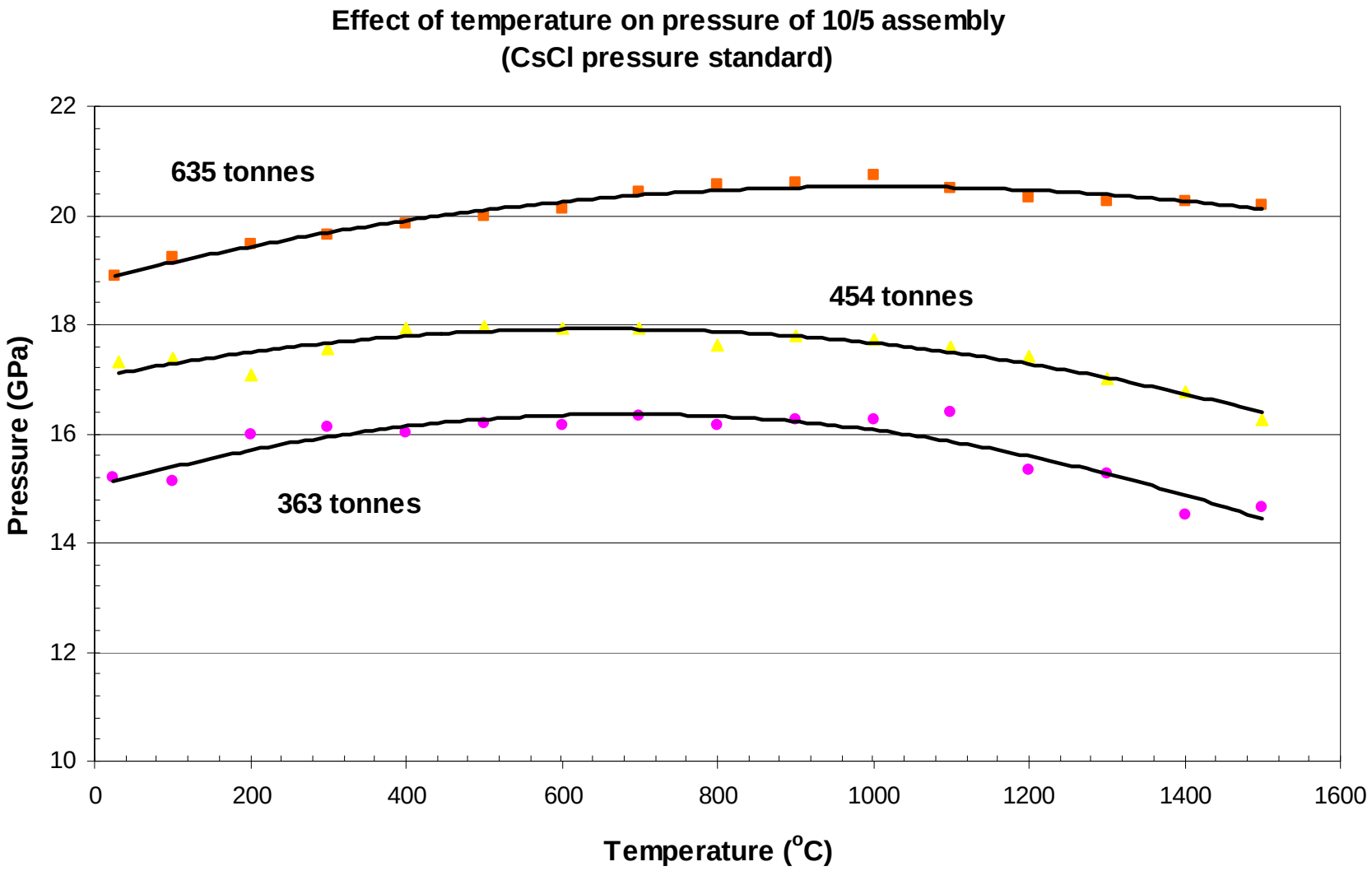
Example: COMPRES 14/8 box heater assembly

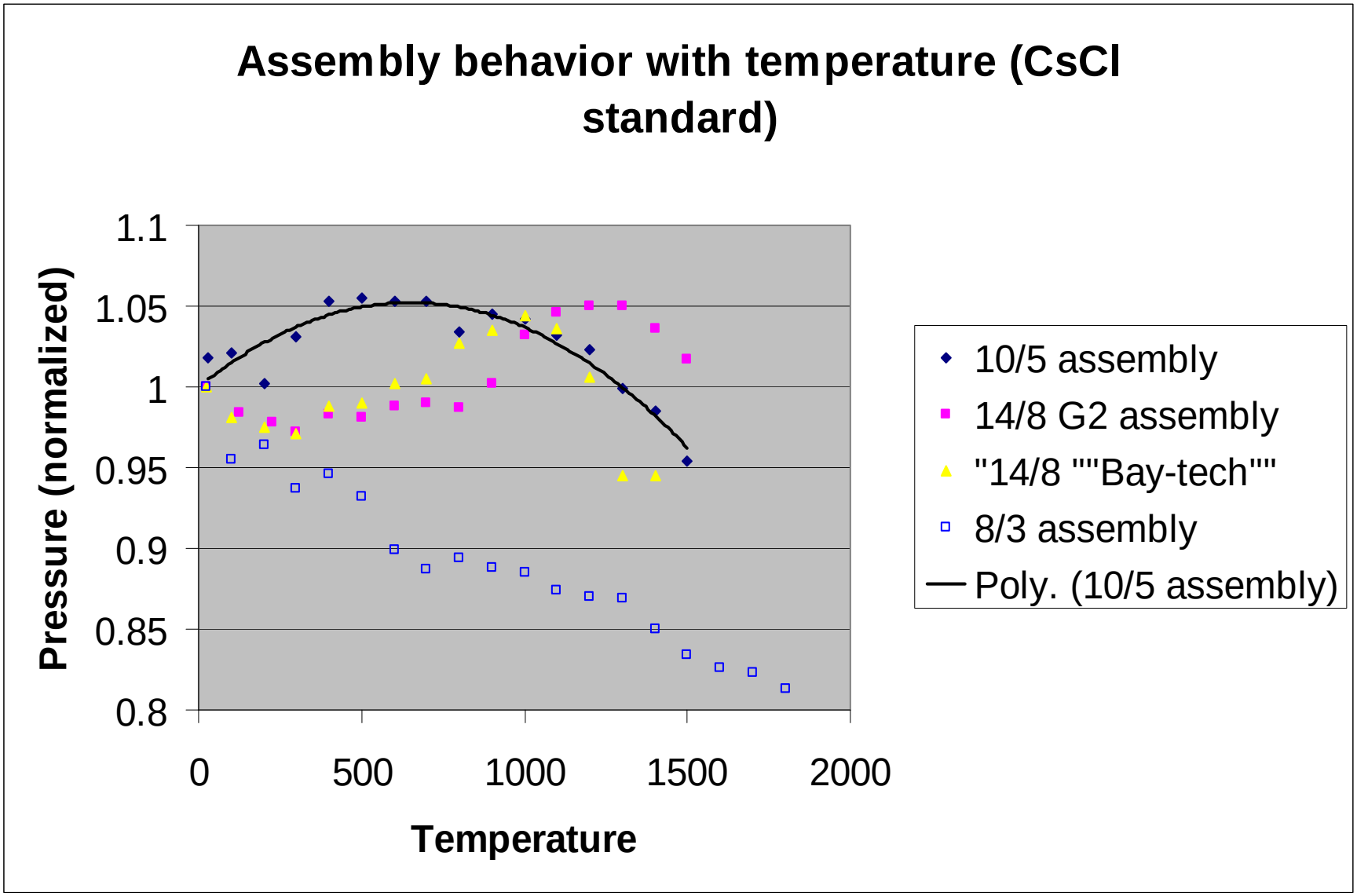
# Pressure standard

- We tried MgO and W, but soon settled on CsCl, and used the Decker (1971) equation of state for CsCl.

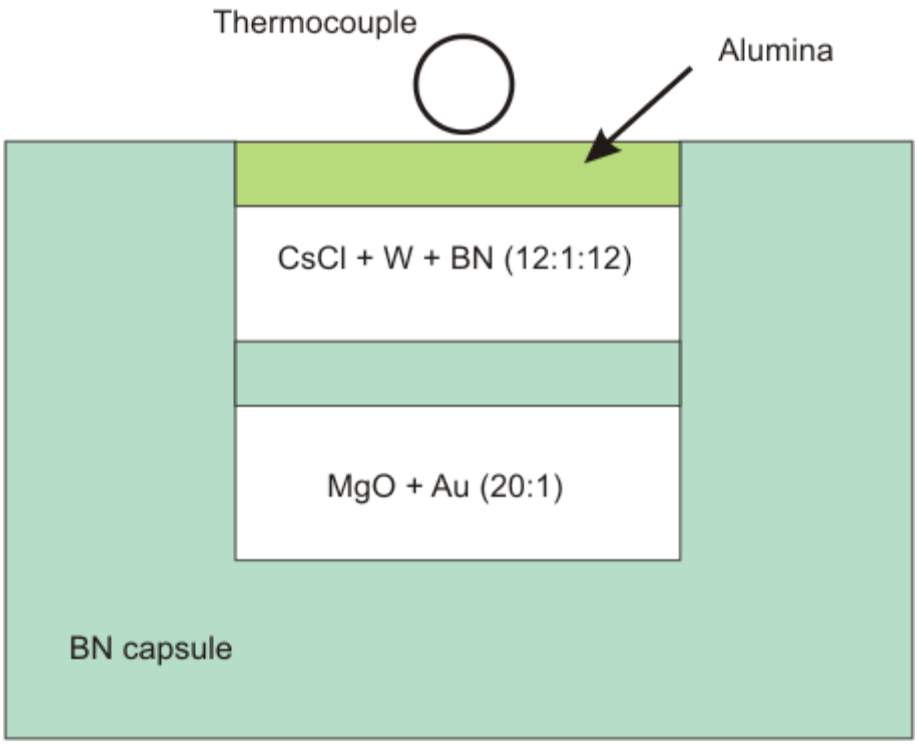
# Advantages of CsCl

- Good scatterer.
- Simple cubic symmetry, so no extinctions.
- Highly compressible ($K_0 = 16$).
- High melting point compared to NaCl.
- No phase transitions at high pressure.

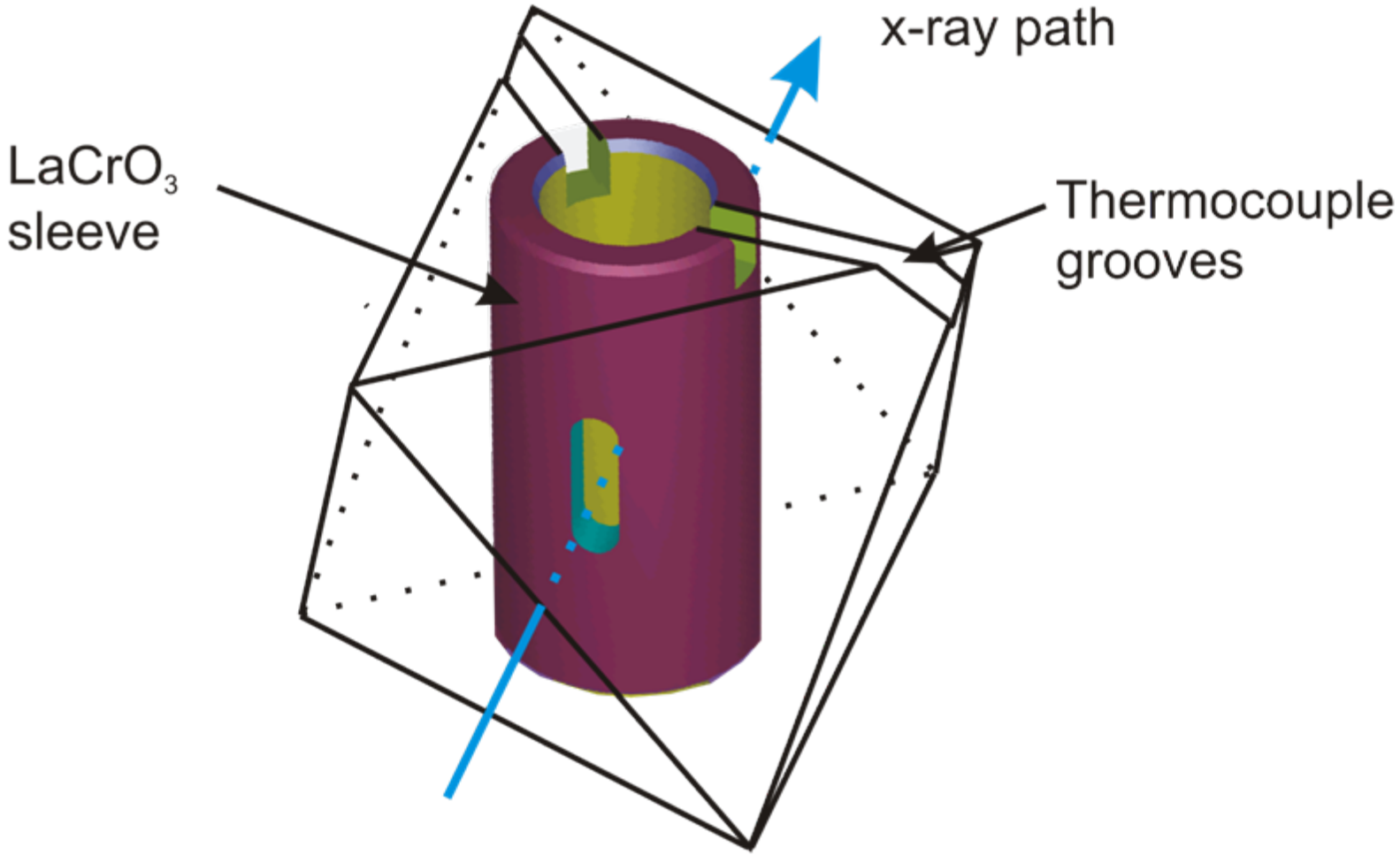

Effect of temperature on pressure of 10/5 assembly
(CsCl pressure standard)
635 tonnes
454 tonnes
363 tonnes
Pressure (GPa)
Temperature (°C)
22
20
18
16
14
12
10
0
200
400
600
800
1000
1200
1400
1600


Assembly behavior with temperature (CsCl standard)
Pressure (normalized)
1.1
1.05
1
0.95
0.9
0.85
0.8
0
500
1000
1500
2000
Temperature
10/5 assembly
14/8 G2 assembly
"14/8 ""Bay-tech""
8/3 assembly
Poly. (10/5 assembly)

- Summary – CsCl is very useful for precise calibrations in many situations.
- However, how does Decker EOS for CsCl compare to better-known standards?
- The next part of this study is a comparison of CsCl to MgO, Au, and W.

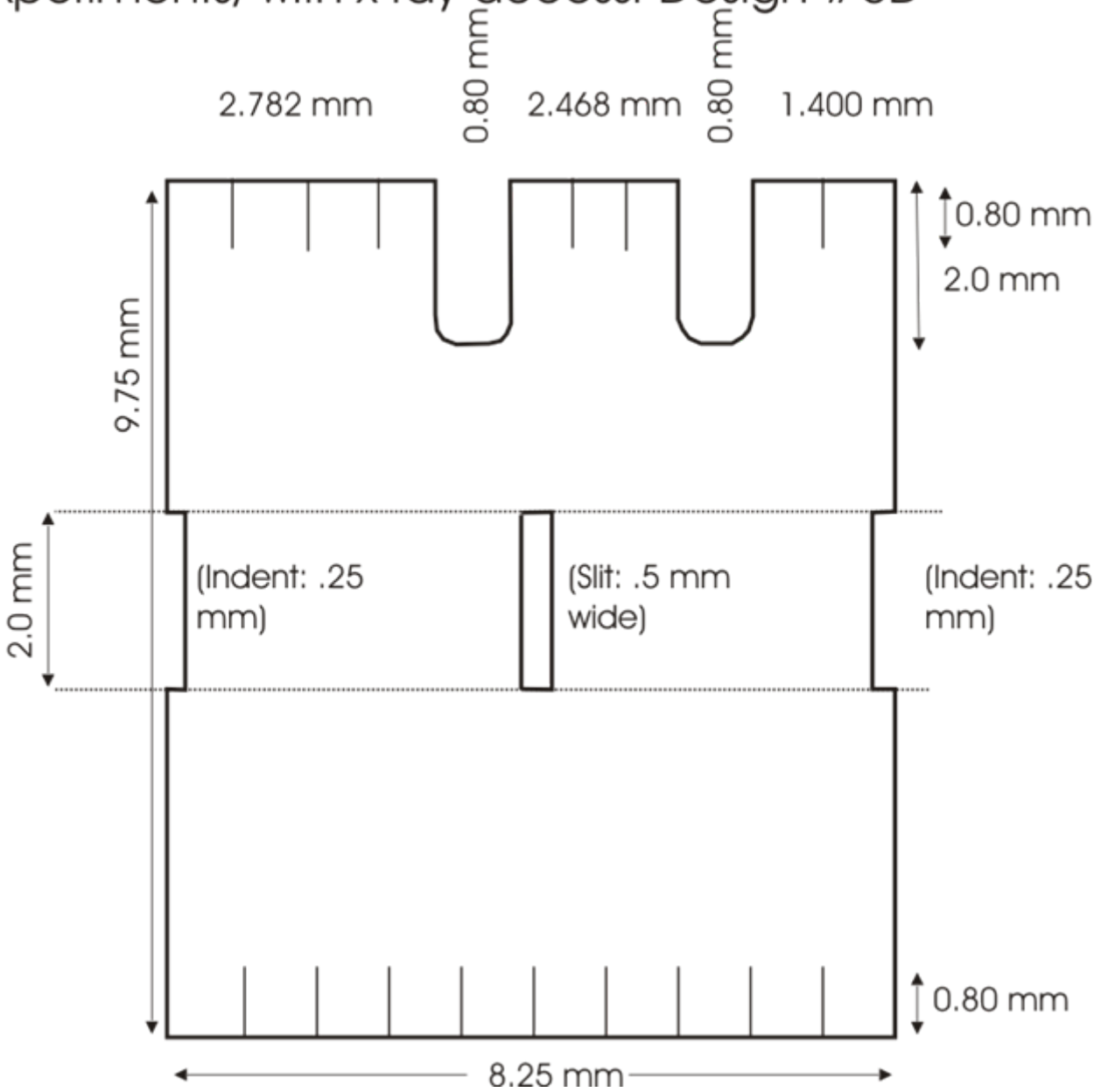


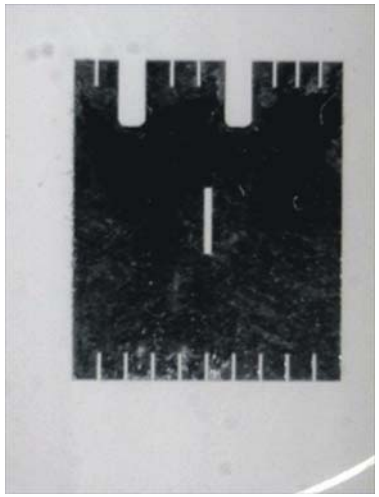

(Sample arrangement for equation of state comparison)

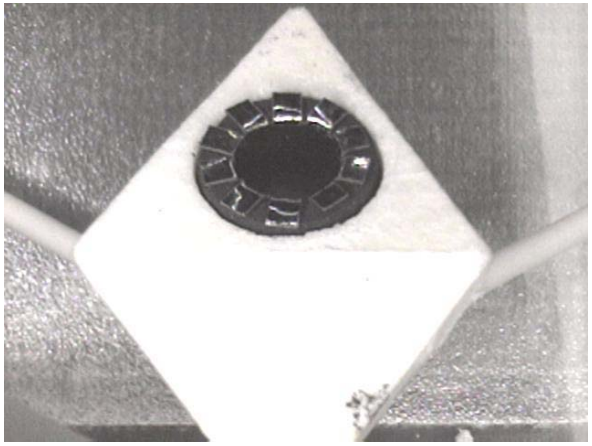



**Octahedral multi-anvil cell with x-ray access.**

# Miniature rhenium furnaces for high-pressure experiments, with x-ray access. Design #6D



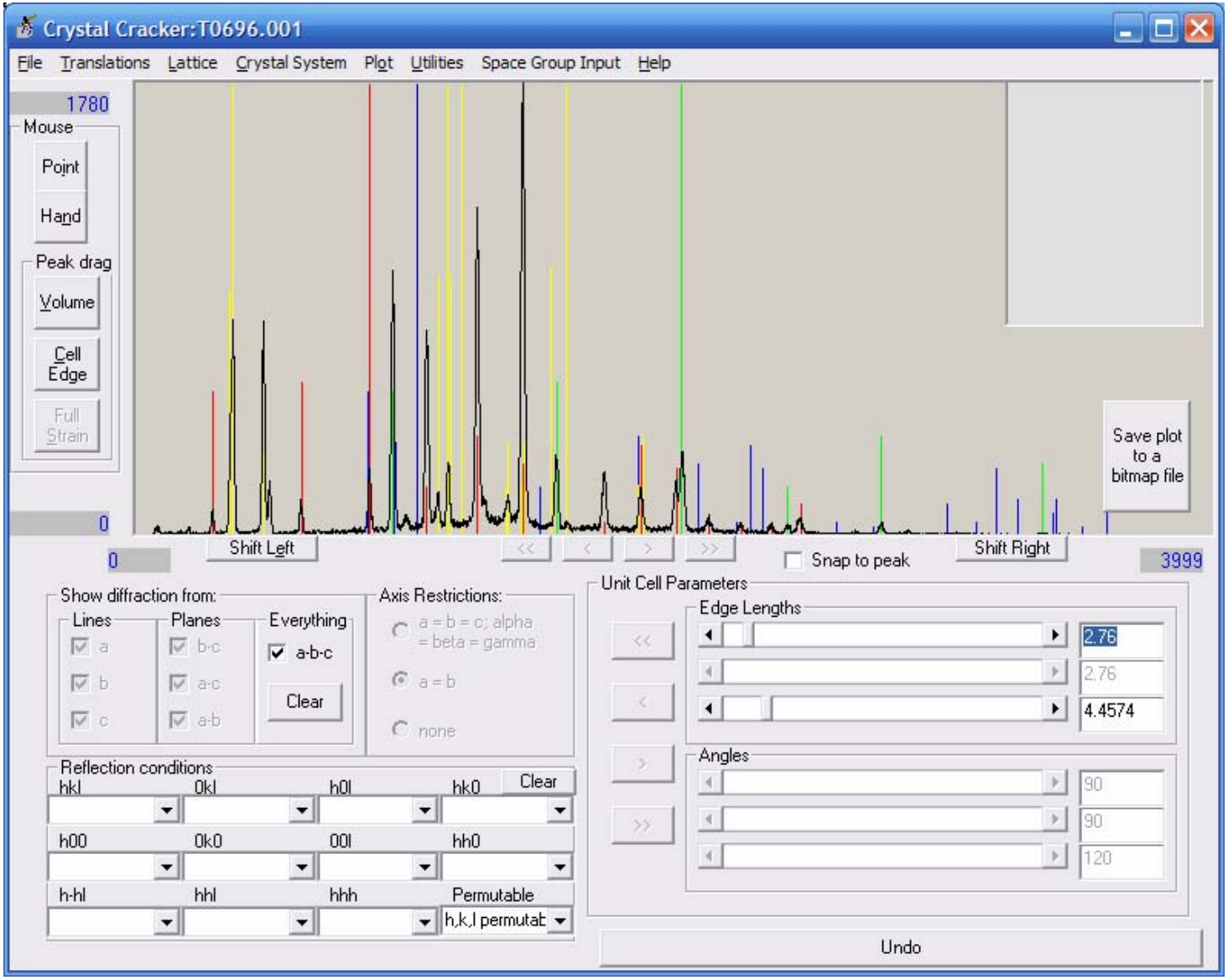




# *In-situ* assemblies

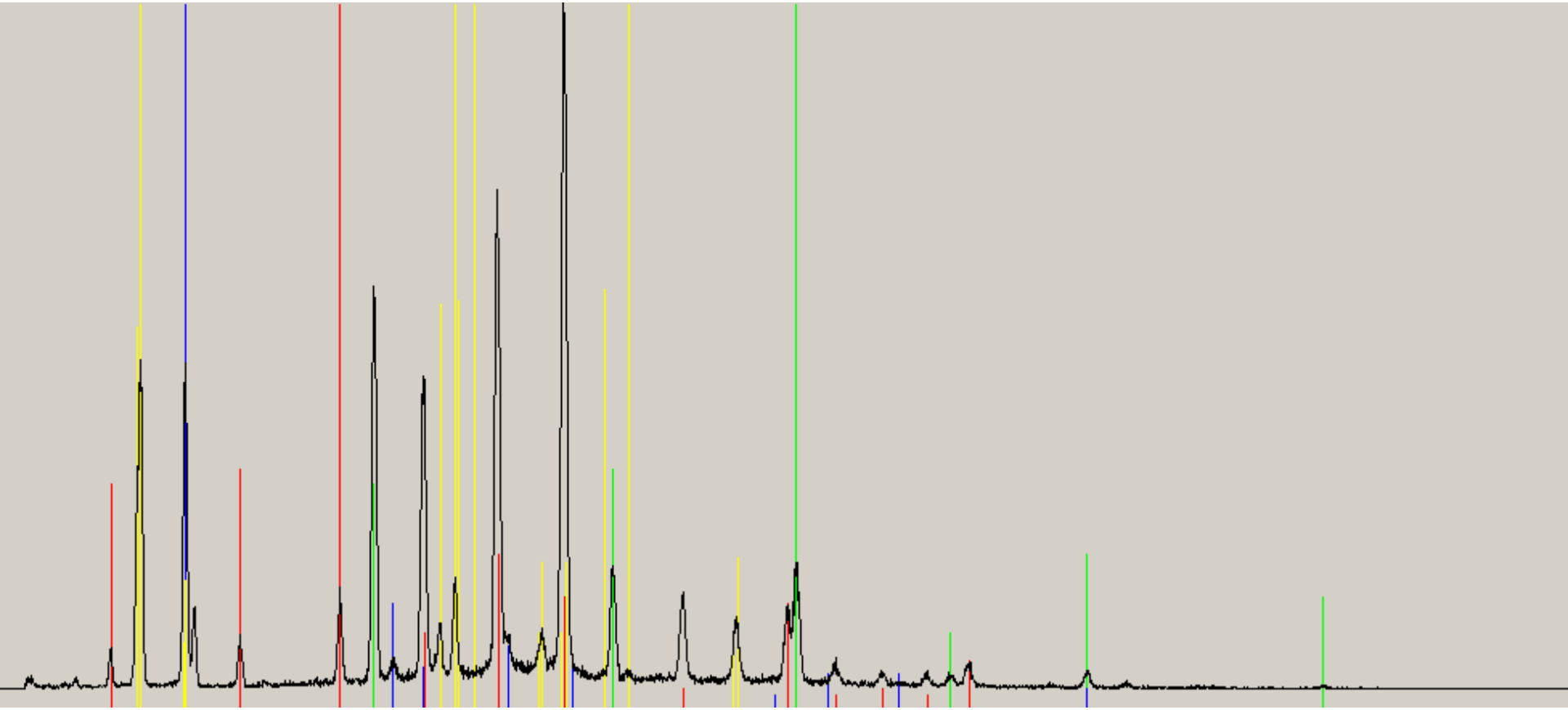
- Forsterite ($Mg_2SiO_4$) sleeve replacing zirconia – below 14 GPa.
- $LaCrO_3$ and Re with windows – from 14 GPa to 22 GPa, up to 2000 degrees C.

# Technique of analysis




Analysis was by homewritten program “Crystal Cracker.”

# CsCl + W



Red: CsCl

Green: W

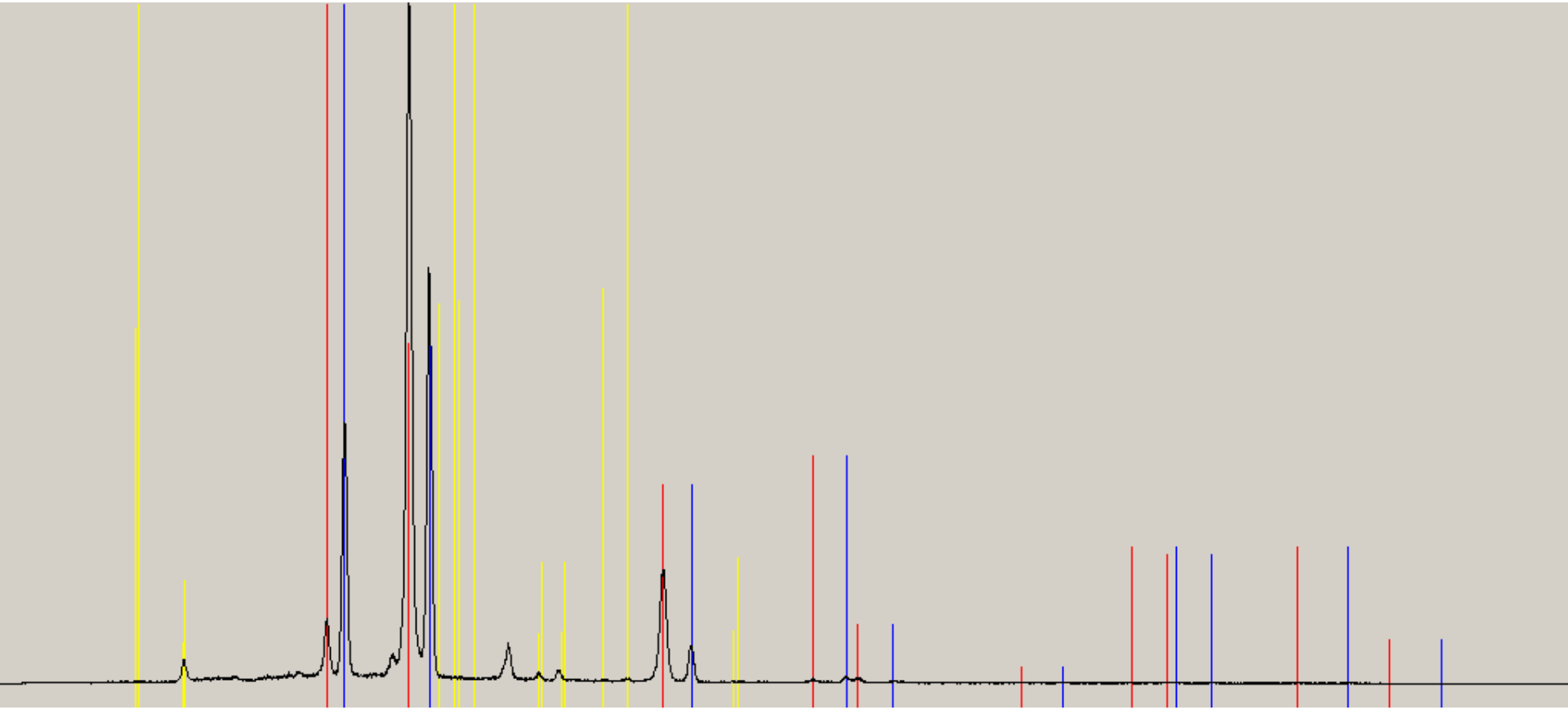
Blue: BN

Yellow: Fluorescence

The program can move the lines with P and T (fluorescences do not move).

The pattern can be automatically fitted and P calculated from the equation of state of any standard.

# MgO + Au

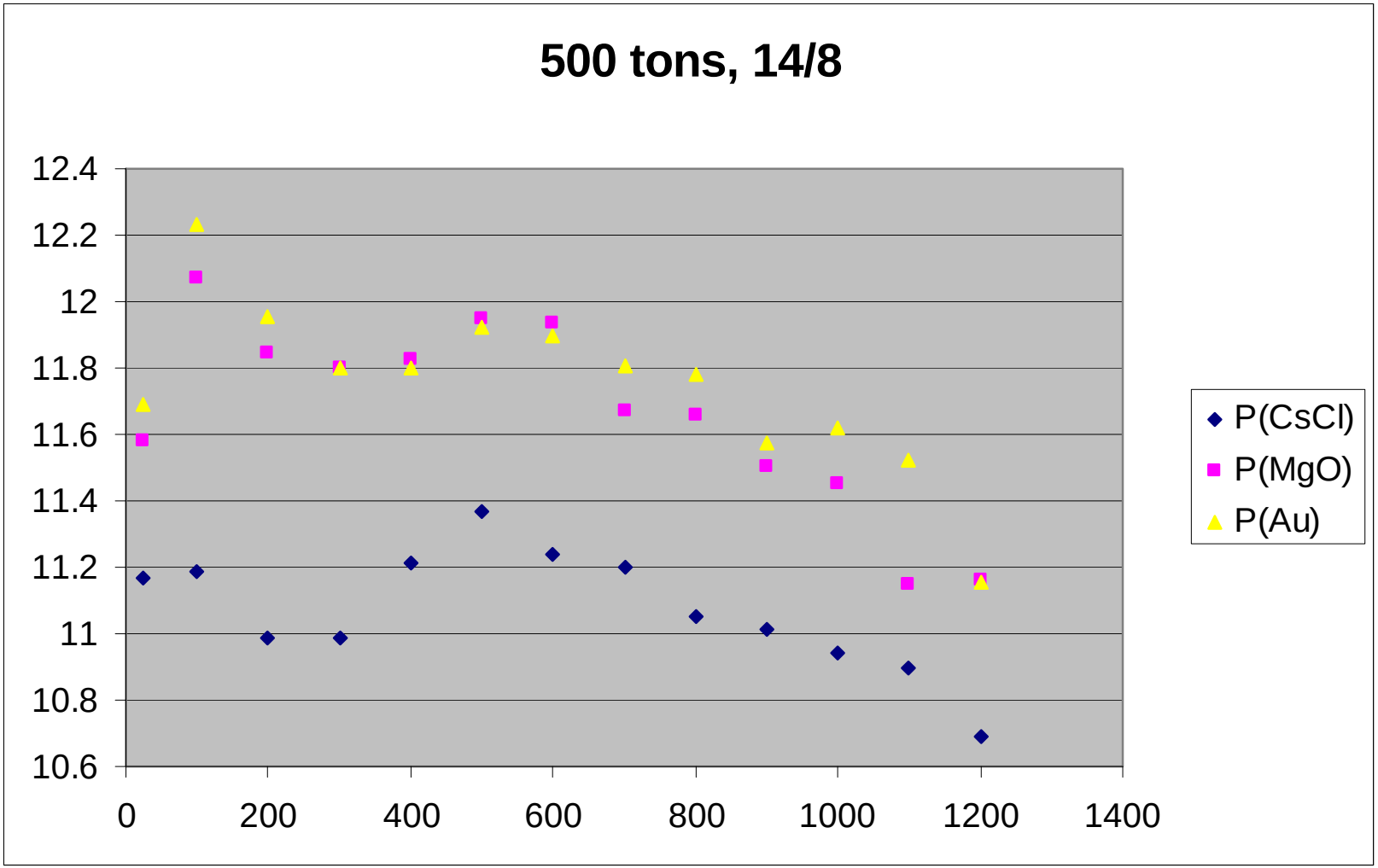


Red: MgO

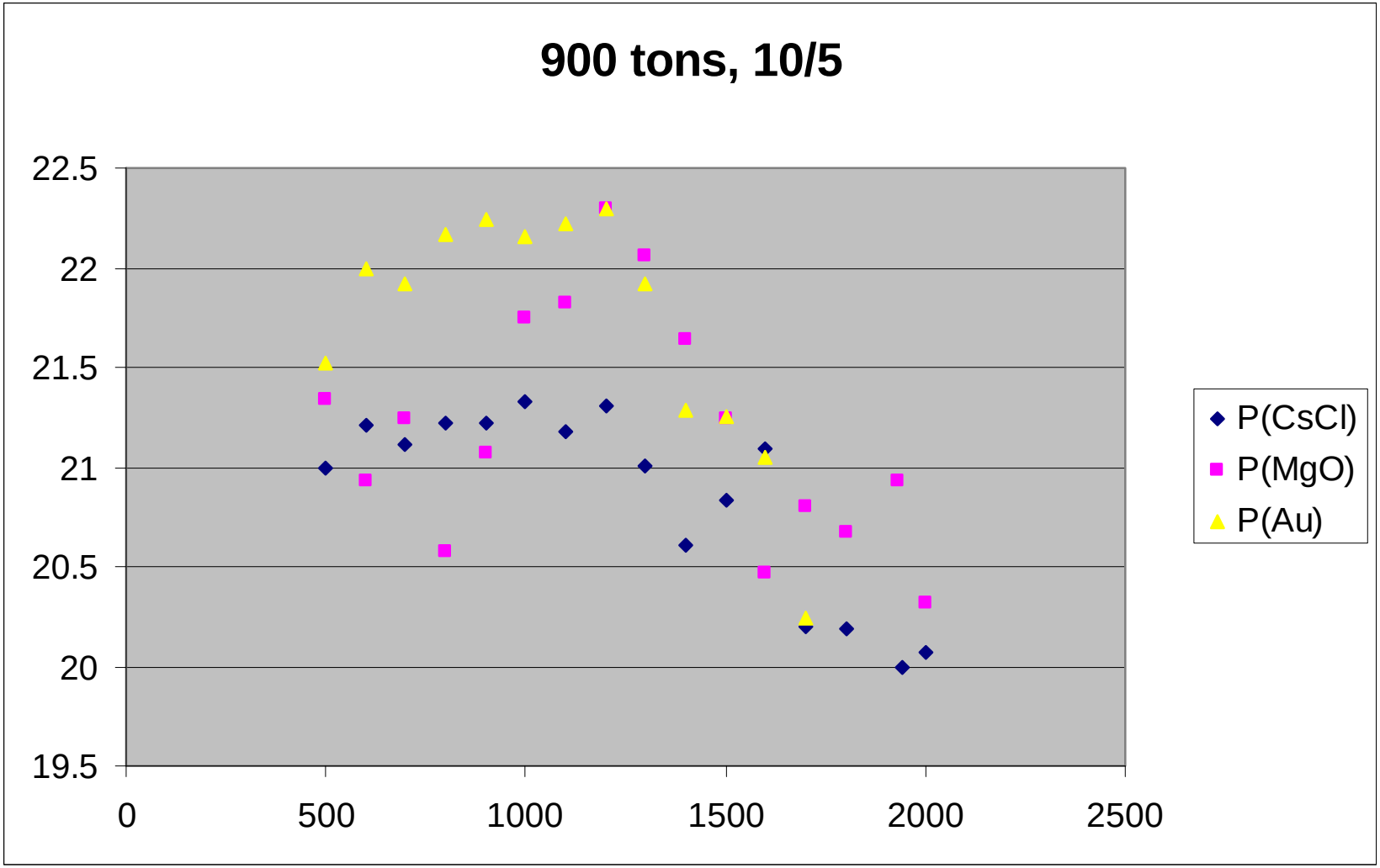
Blue: Au

Yellow: Fluorescence

# Results – comparison of CsCl to MgO and Au.



# Results – comparison of CsCl to MgO and Au (cont.)



# Summary

- CsCl is a good, sensitive pressure standard for high-resolution pressure measurements.
- The old Decker equation for CsCl is systematically lower than new MgO and Au equations of state by 1 GPa at moderate temperatures, ~0.5 GPa at higher temperatures (in the 10 – 20 GPa range).