Spatial resolution of reactants and products
Maps! (2D or tomography)

X-ray absorption contrast imaging
to watch chemistry occur

Scale limits to high pressure experiments

ERL Imaging of DAC reactions?
Marcy Anorthosite
Keene Valley, NY
East Dover, Vermont
Alpine Ultramafic in Moretown schist
Amphibolite grade metamorphism

Serpentinization of Olivine and Opx (Zonal)

Hoffman & Walker (GSA Bull., 1978)
On a laboratory spatial scale: for 60 kilobar (multi-anvil) superconductor synthesis

\[
\text{Sr}_2\text{CuO}_3 + \delta^{3/2}\text{O}_2
= \text{Sr}_2\text{CuO}_{3+\delta}
\]

\[
\text{KClO}_3 = \text{KCl} + ^{3/2}\text{O}_2
\]
From Scott, Kirtley, Walker et al. (Nature, 1997)

High Meissner Fraction

Quenchable

Optical scale

EMP/SSM scale

DAC scale?

DAC transparency
What if you wanted to measure Oxygen solubility in molten Fe at a megabar? [core issue]

[I am doing this with Mike Walter, Simon Clark, Martin Kunz, and the COMPRES-supported ALS 12.2.2 team]
Single *in situ* property ($I_{\text{trans}}$) needed to characterize chemistry along a binary join.

Absorption ($\mu$) &/or emission
Peritectic possible to recognize when reactants are spatially resolved.
Does this work?

FeS

50 kilobars

Station 12.2.2  ALS

Melting shows erosion
50 kilobars

Melting shows erosion

Topography convolved with chemistry - and - resolution for ‘big’ beams is limited by the phosphor sharpness a real advance!

Fe-FeS after first melting at ~50 kbar

Expected liquid

Usselman, 1975

Fe-FeS

First Liquid

6 KV X-ray counts

Position (Pixels = ~1.5 microns)

100 µm

Fe

FeS
Spatial resolution at sub-micron scale
-- needed to look at micron-scale DAC rxns --
will need ERL-like resolution

Challenges: - achieve ERL prospectus
- master the raster strategy
- master optimal sample fabrication strategy
- choose problems wisely