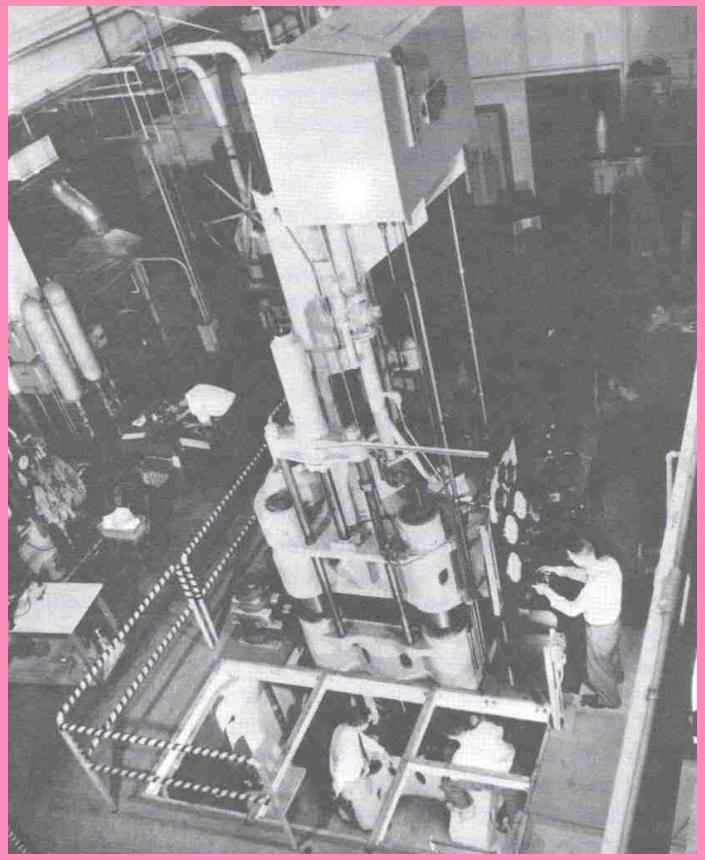
THE DIAMOND MAKERS



Robert M. Hazen—Carnegie Institution

Scientific American—Bright Horizons 17

July 6, 2013—At Sea!!!

ALLUVIAL MINING IN BRAZIL, 19th Century

THE EUREKA!

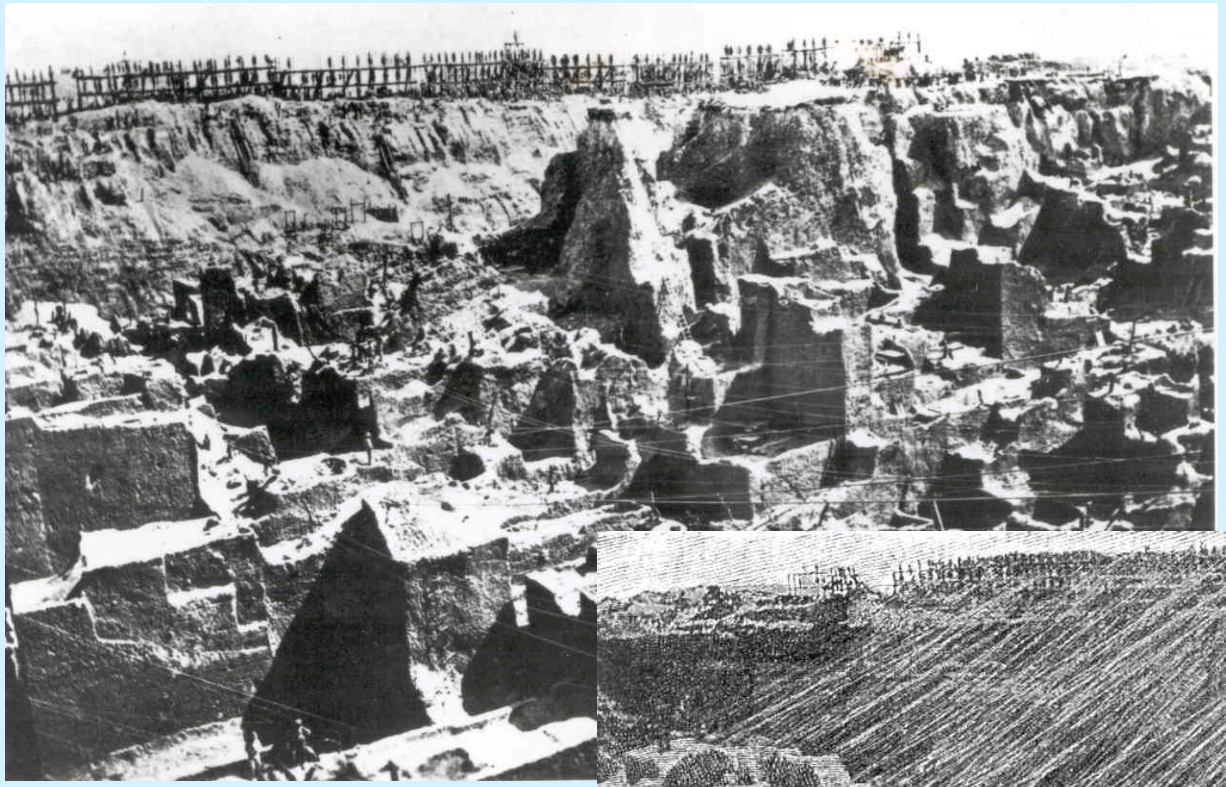
Erasmus Jacobs, c.1907

Discovered 1866-67
10.73 carats

THE DIAMOND RUSH

KIMBERLITE

THE KIMBERLEY PIPE



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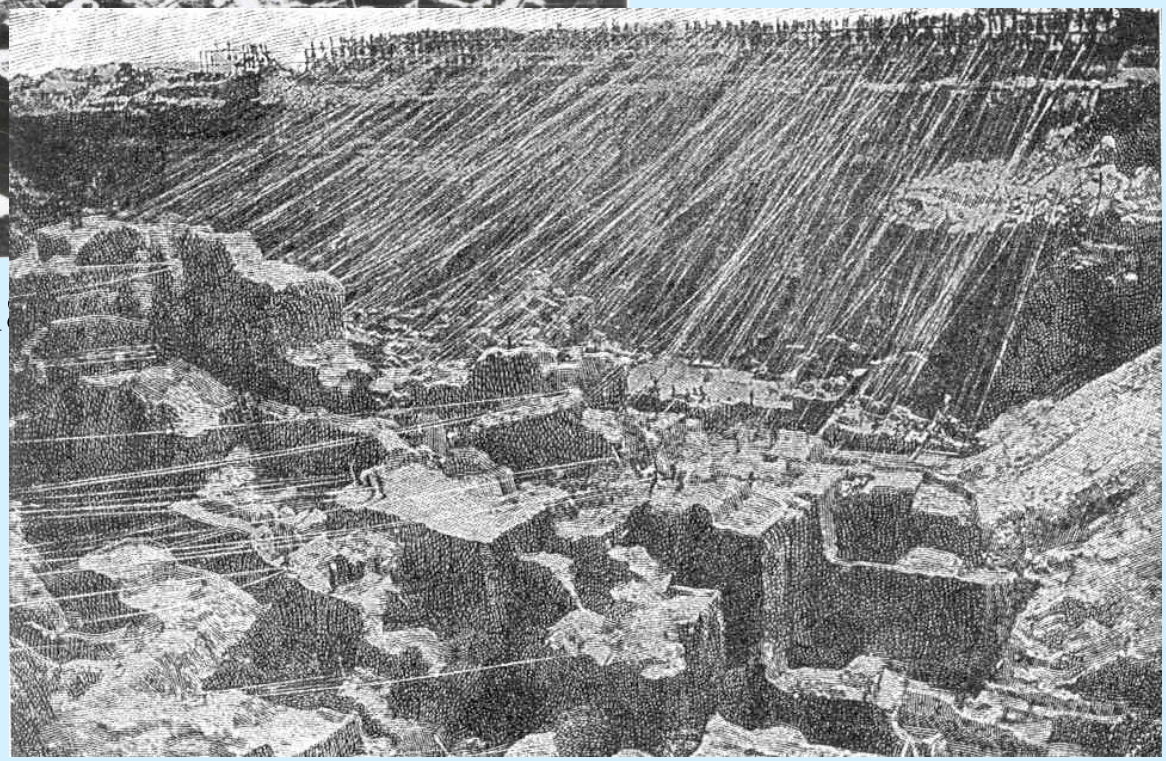


1874

THE CULLINAN
3,106 carats

Thomas Cullinan, William McHardy & Fred Wells

THE CROWN JEWELS

Cullinan I & II

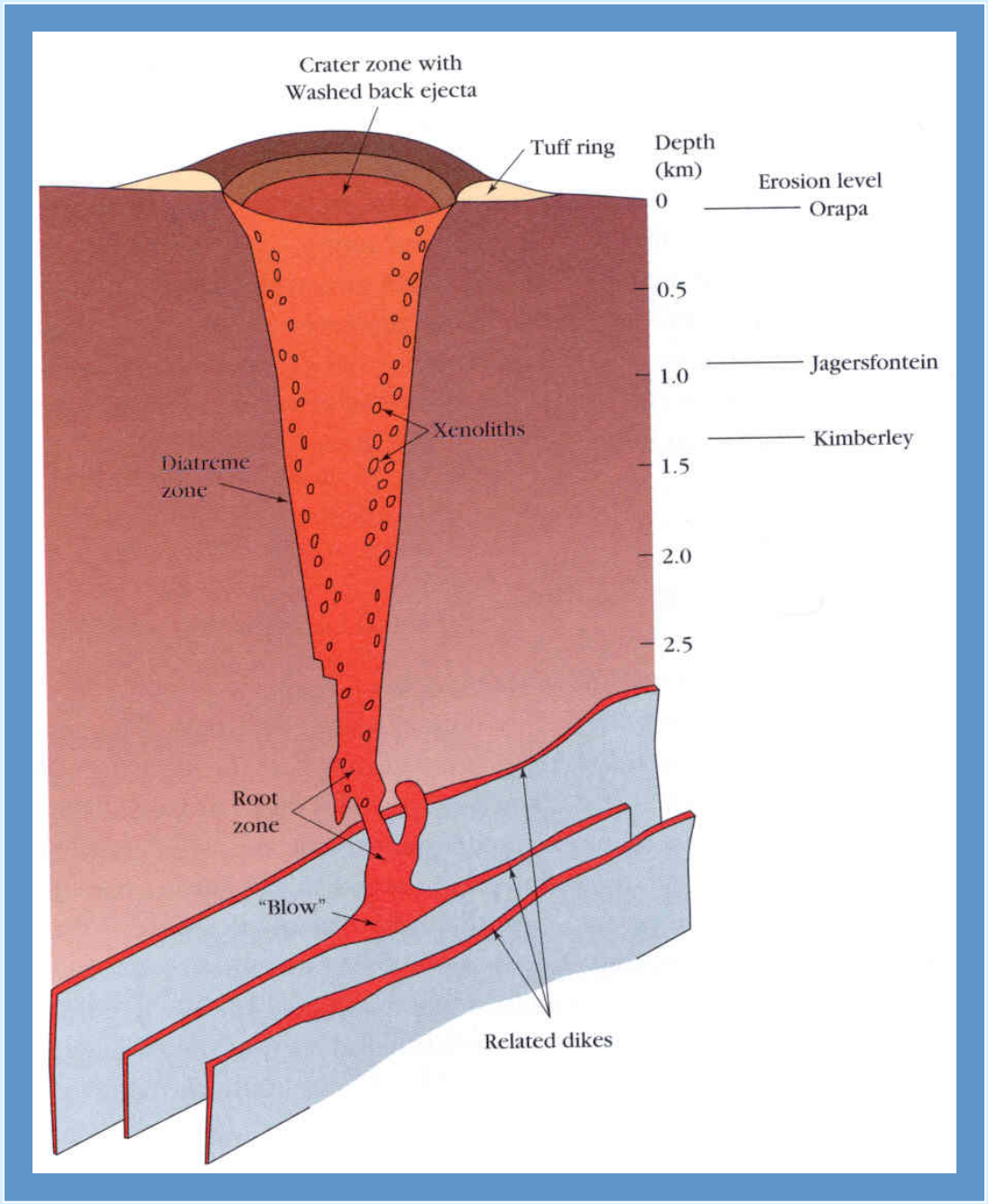
CLUE #1: Geologic Setting

Kimberley Pipe

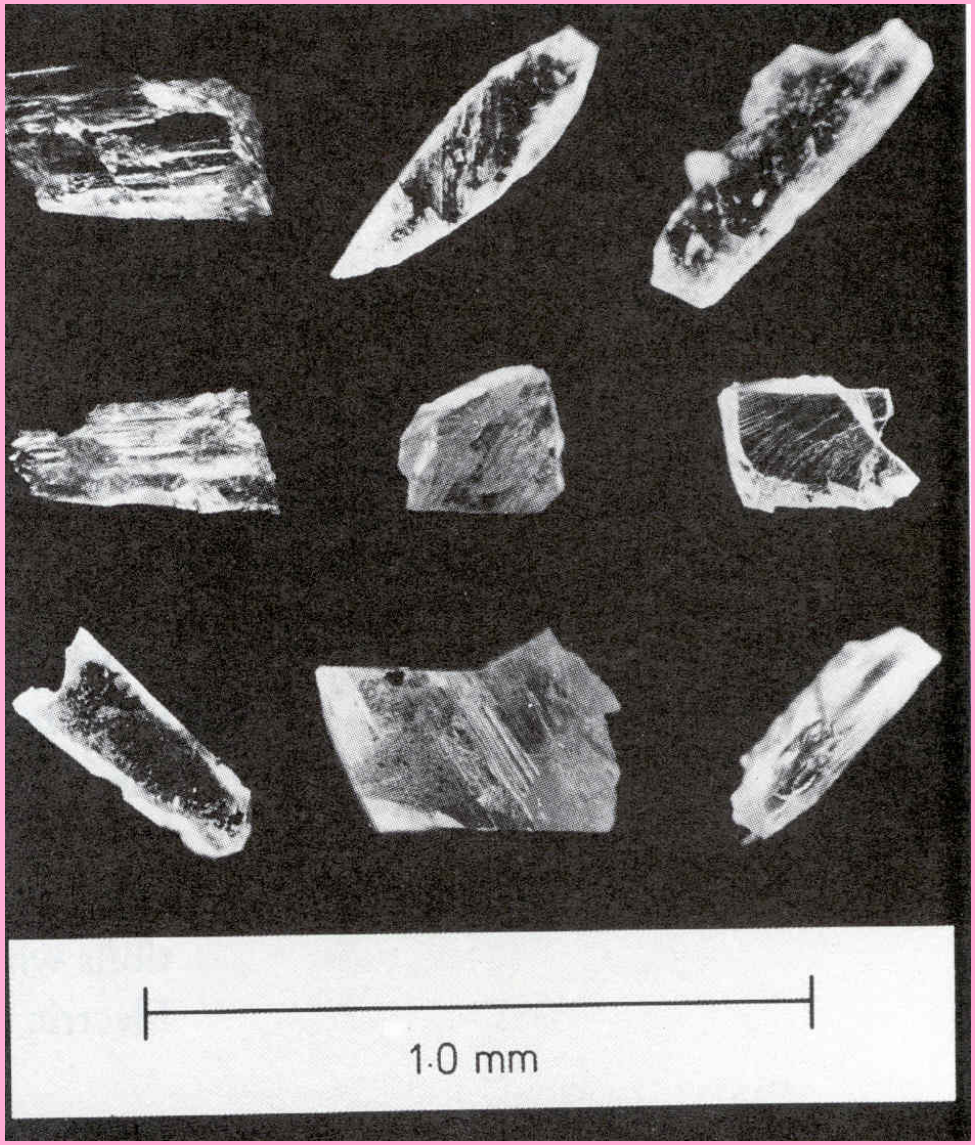
Internationalnaya Pipe

Diamonds are mined from kimberlite pipes.

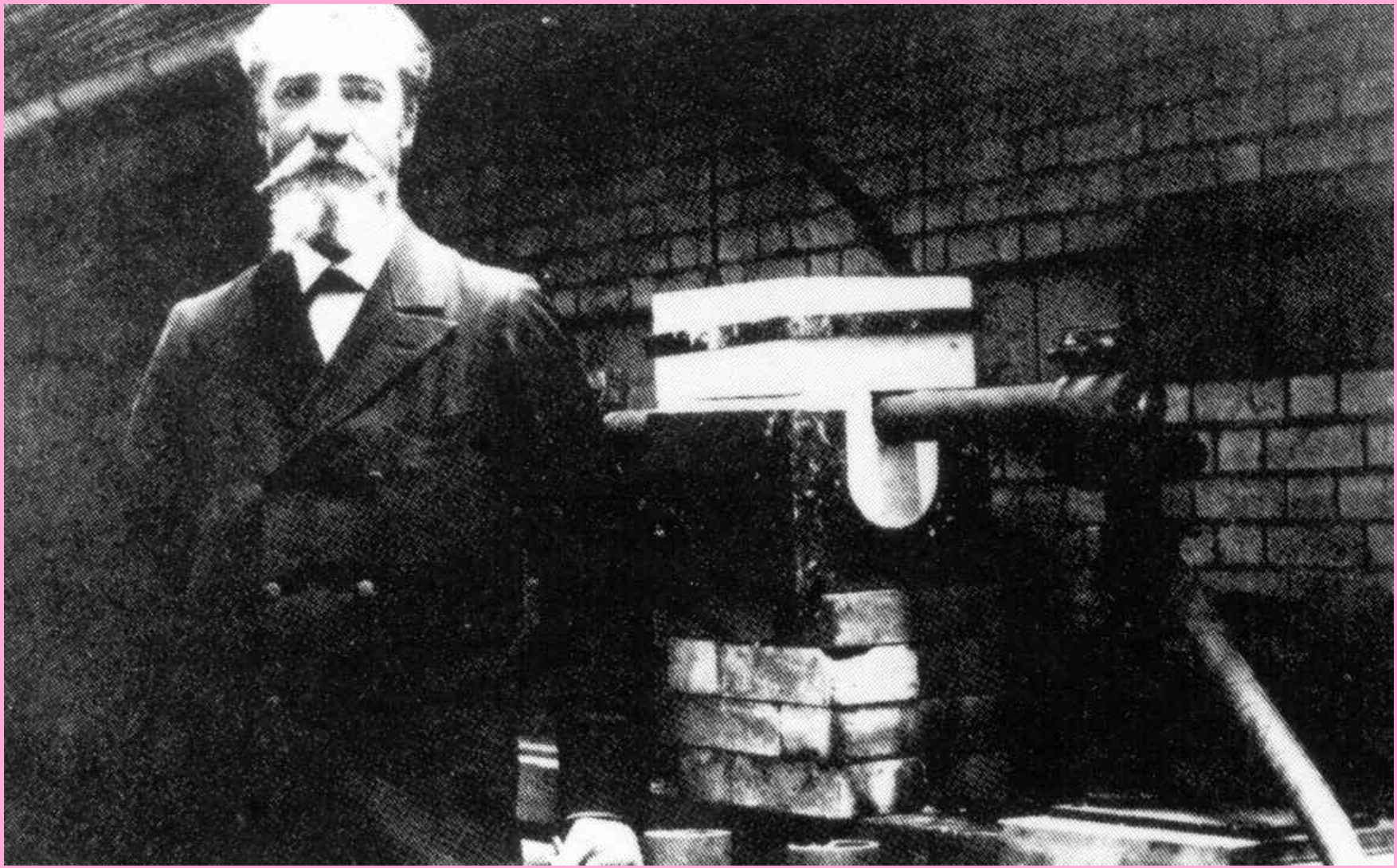
THE ARGYLE MINE


Crater zone with
Washed back ejecta
Tuff ring
Depth
(km)
Erosion level
0
Orapa
0.5
1.0
Jagersfontein
Xenoliths
Kimberley
Diatreme
zone
1.5
2.0
2.5
Root
zone
"Blow"
Related dikes

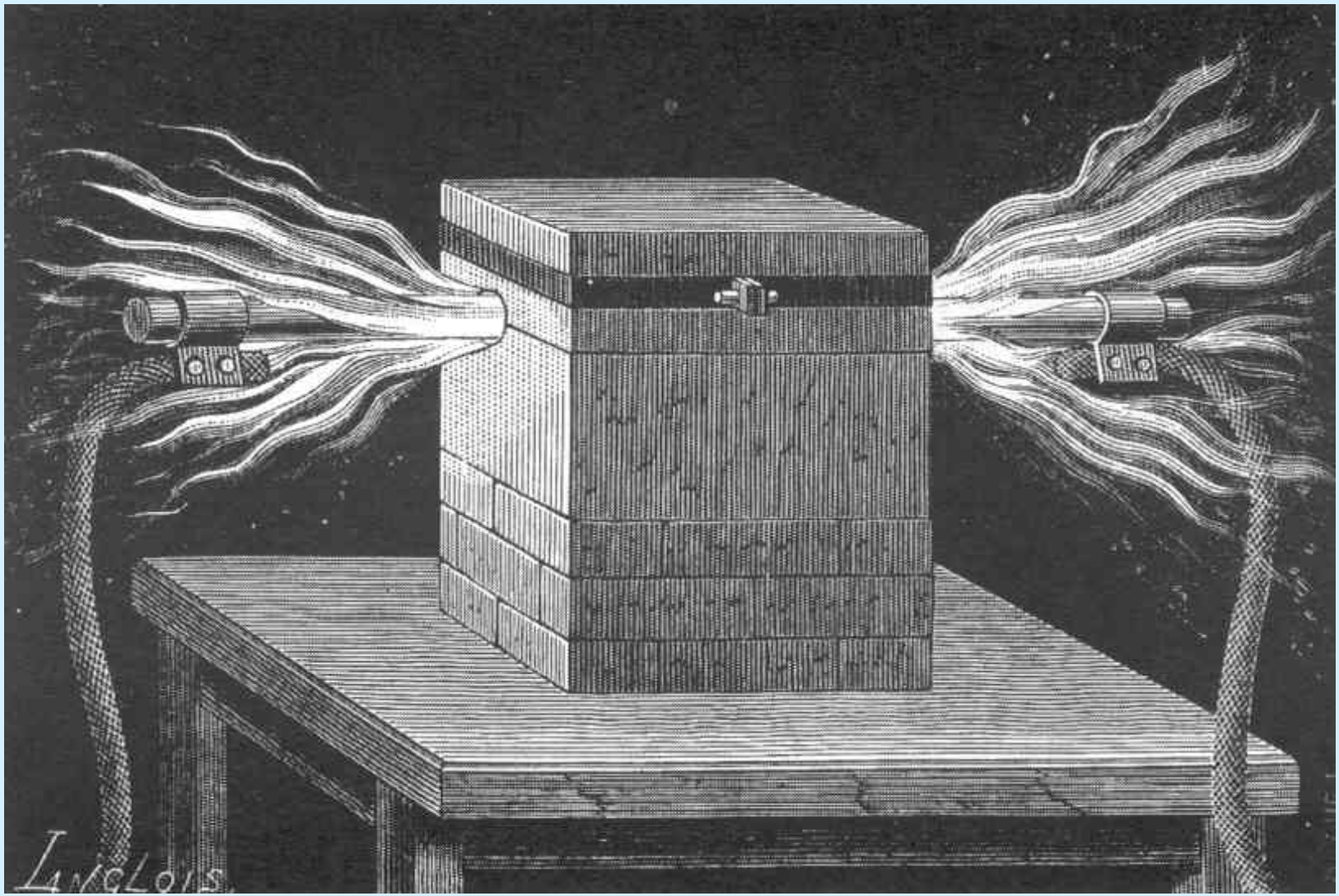
JAMES BALLANTYNE HANNAY



FREDERIC-HENRI MOISSAN



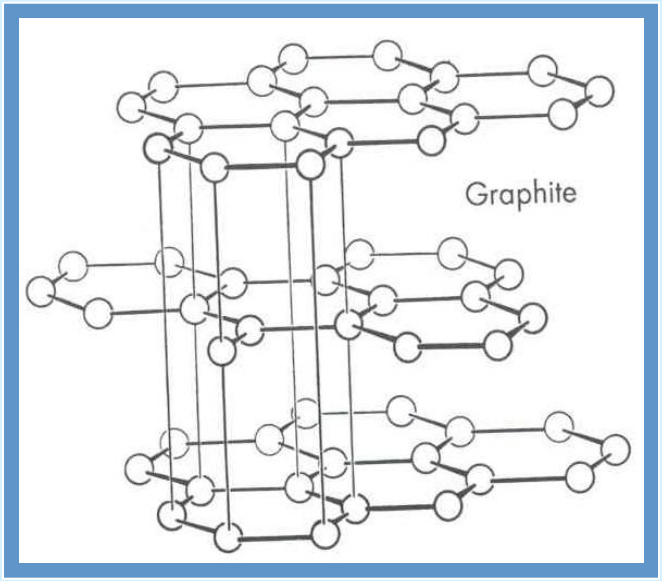
CARBON-ARC FURNACE

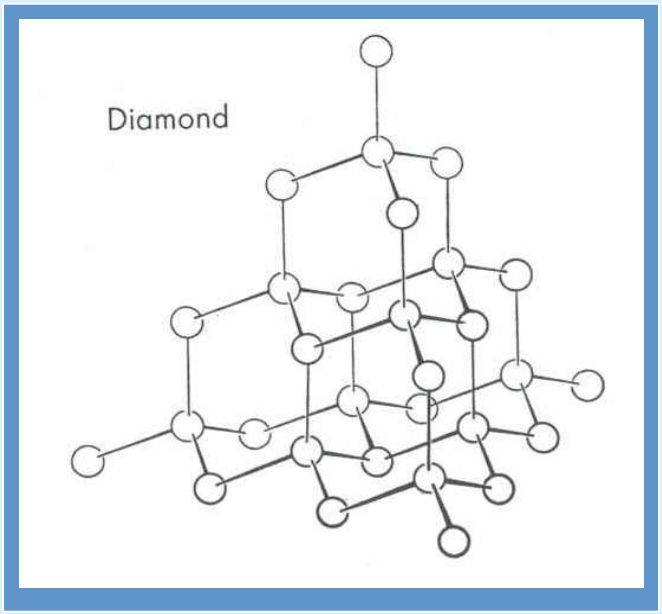


Charles Wagner, McPherson College
c. 1940

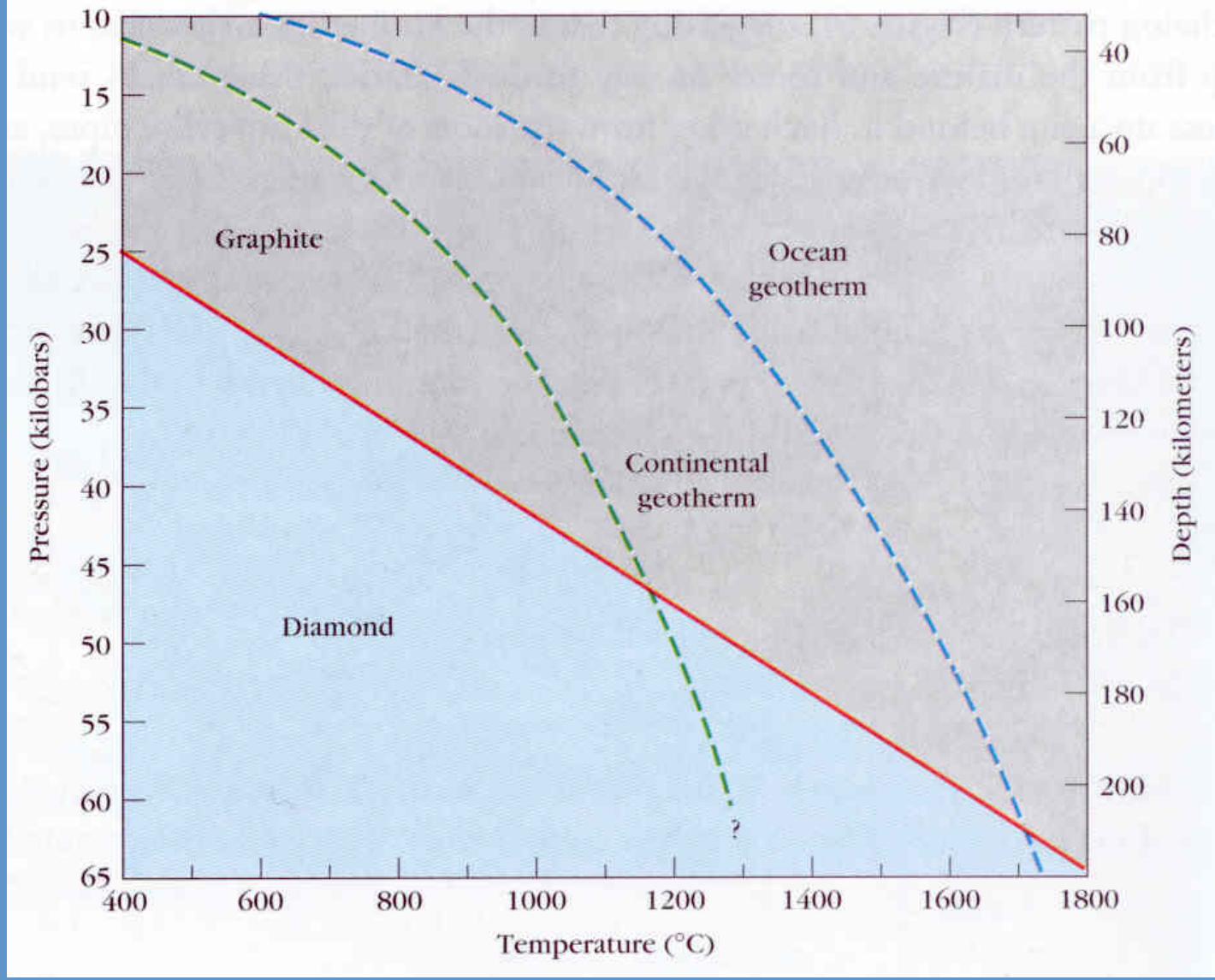
MOISSANITE
SiC

CLUE #2: Atomic Structure

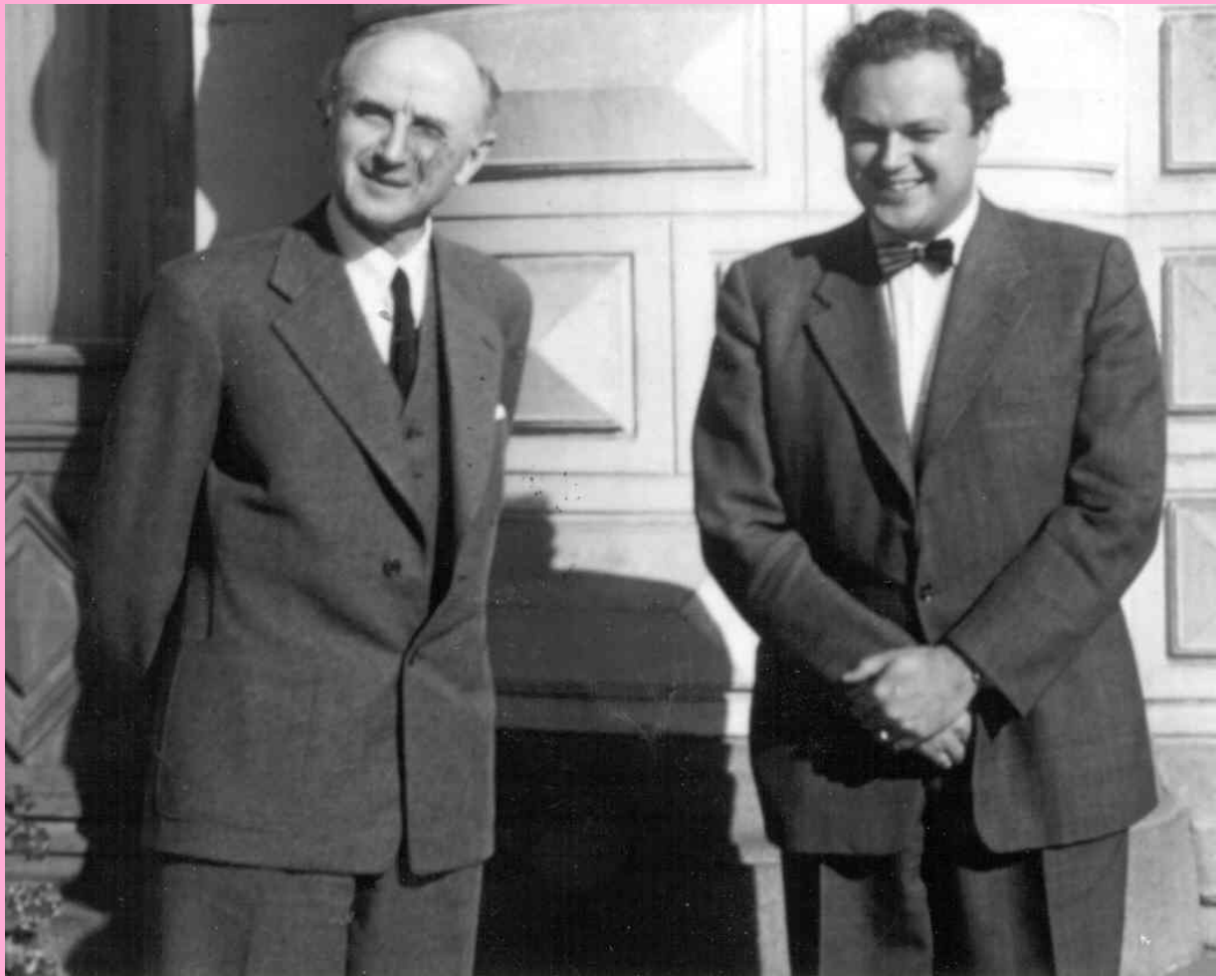




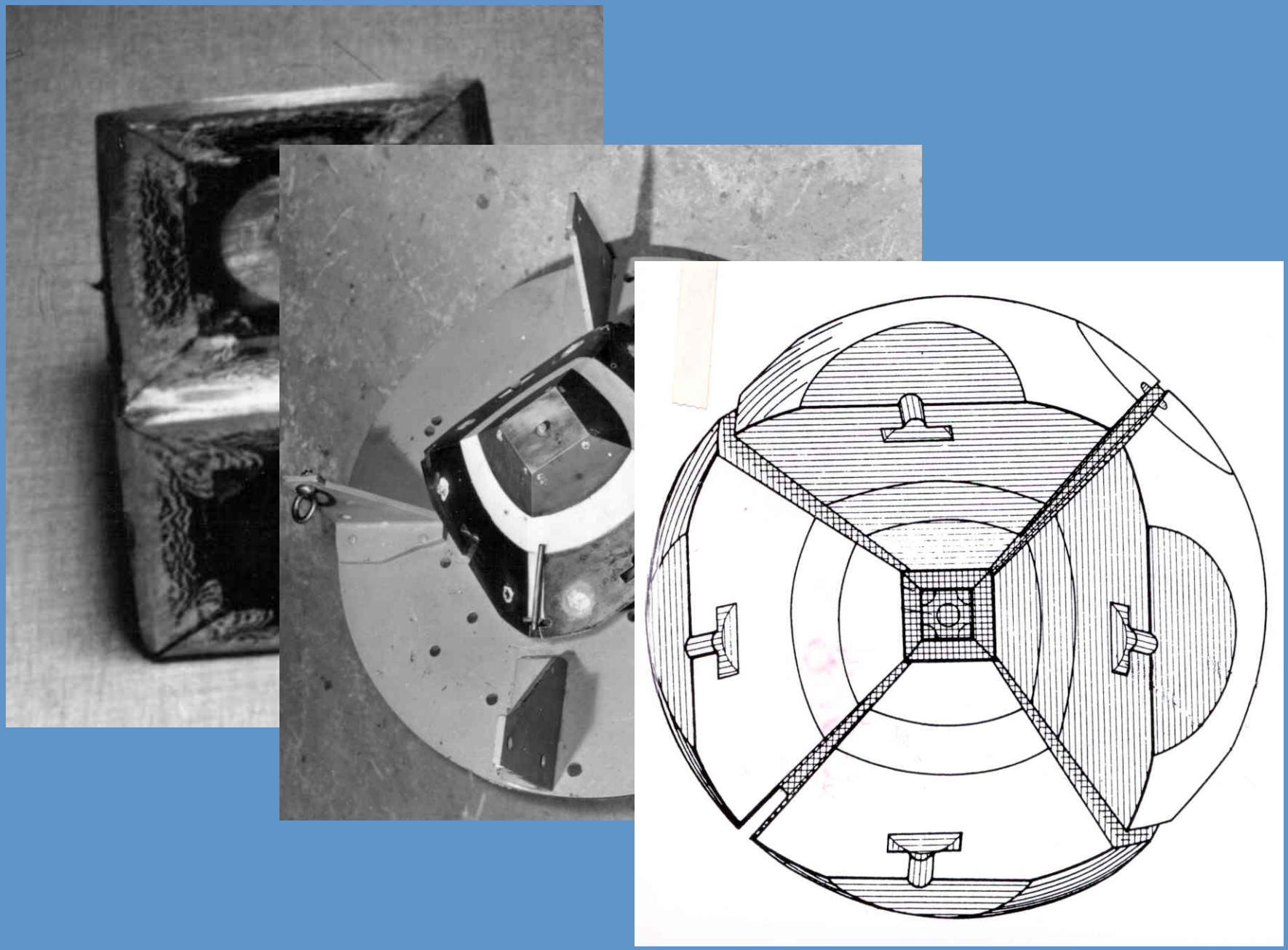
CLUE #3: Phase Diagram

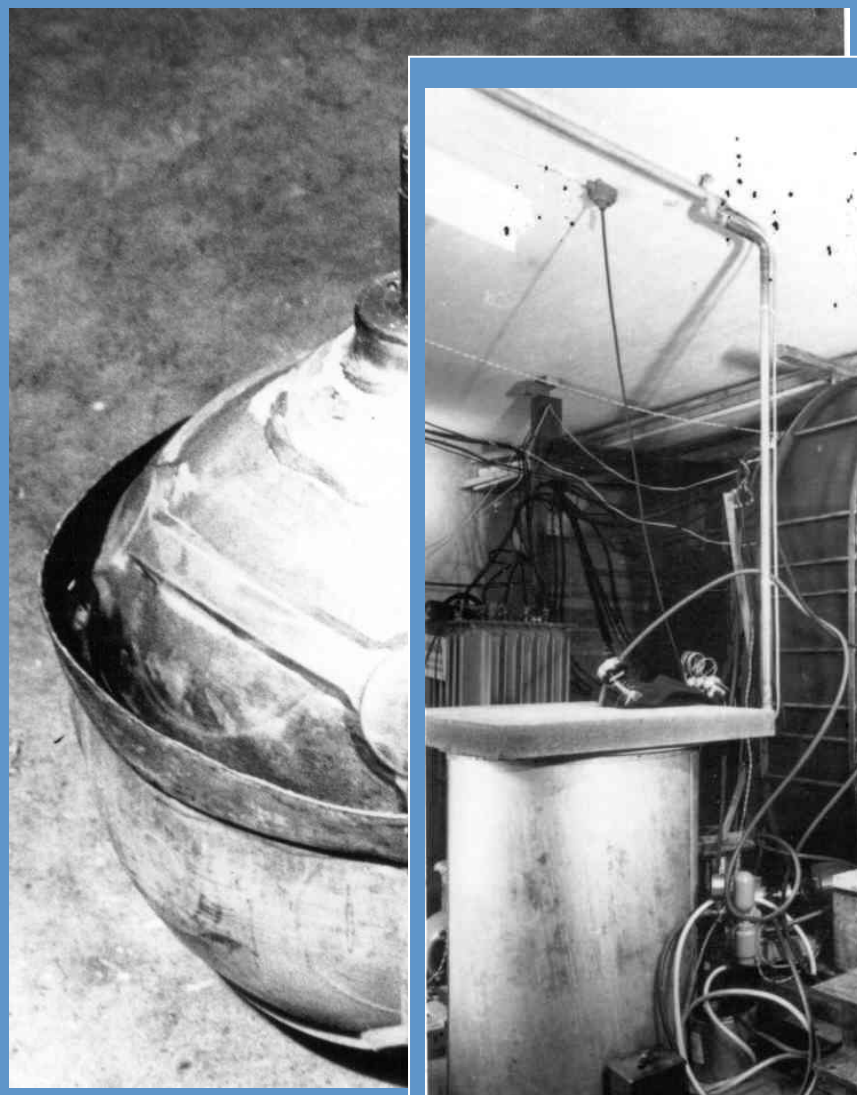


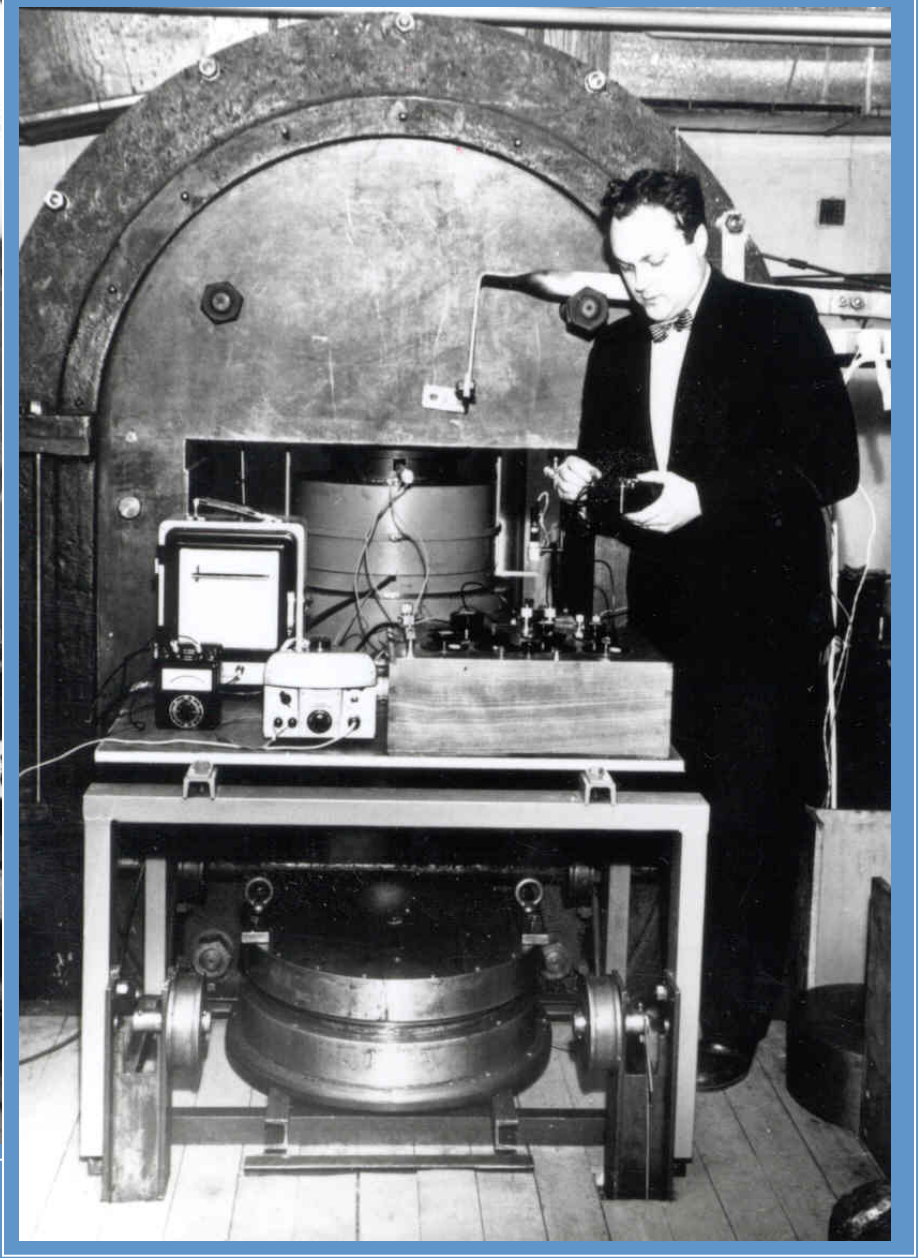
BALTZAR VON PLATEN & ASEA



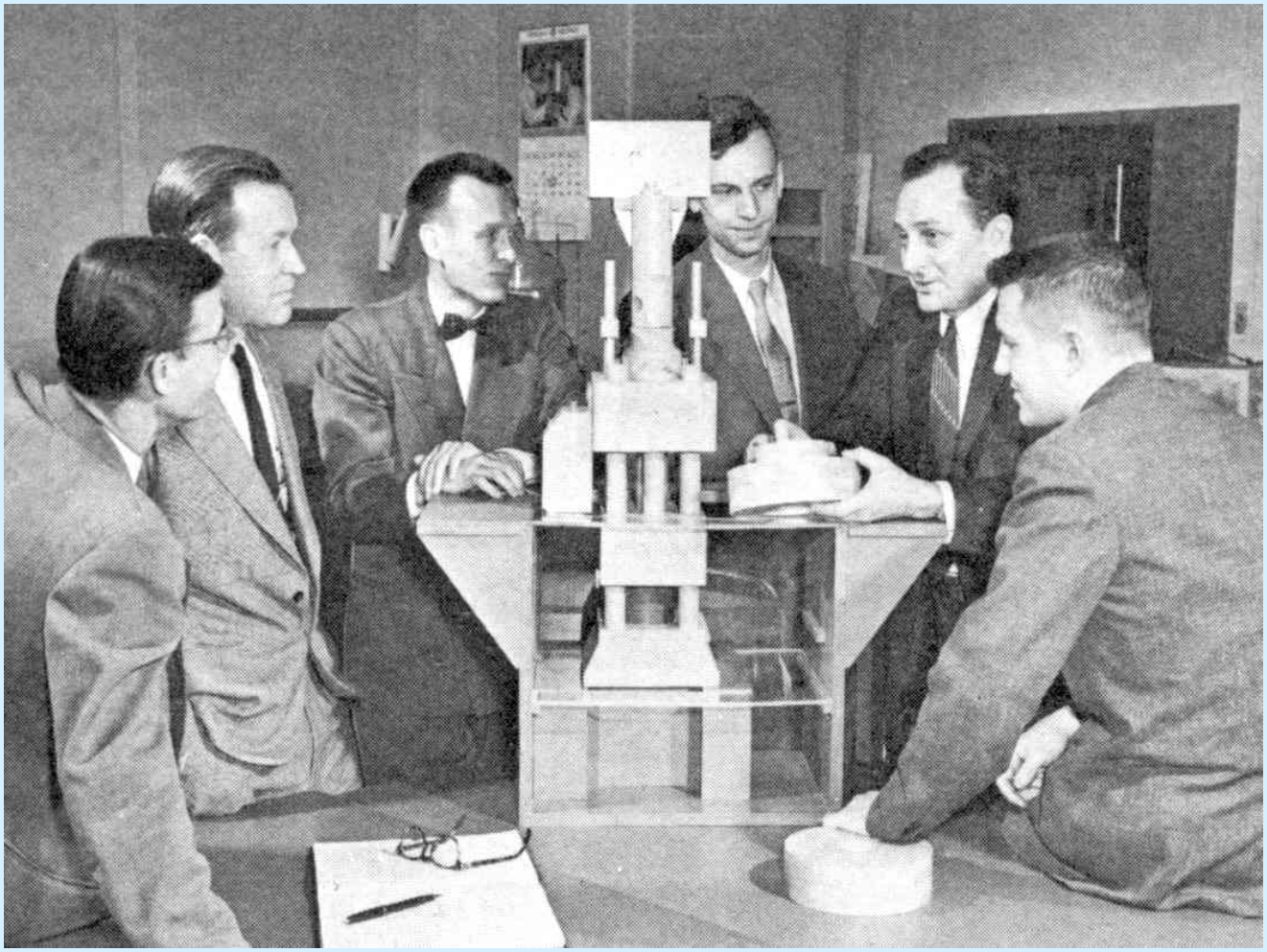
Von Platen & Erik Lundblad





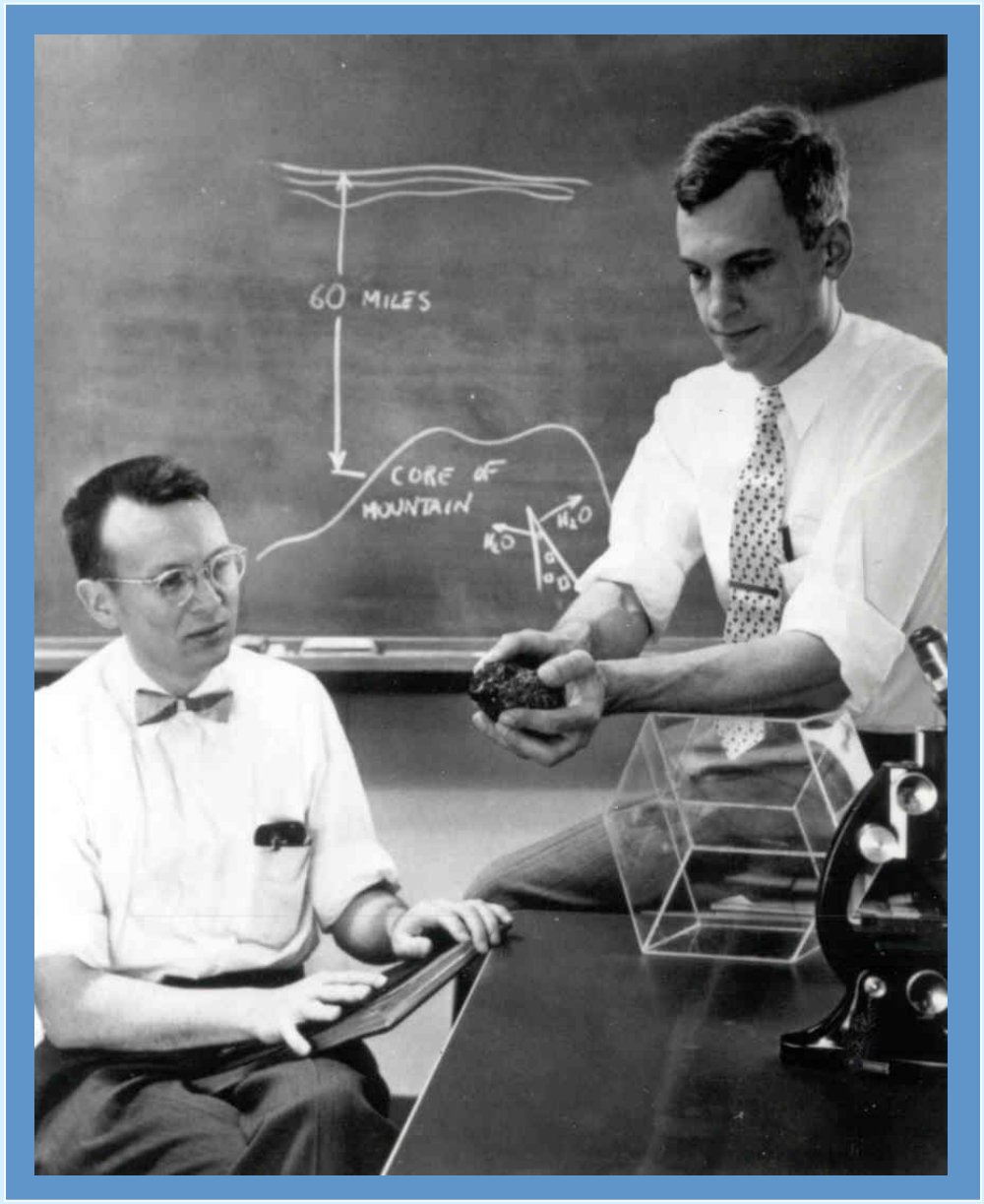


GENERAL ELECTRIC:
Project Superpressure



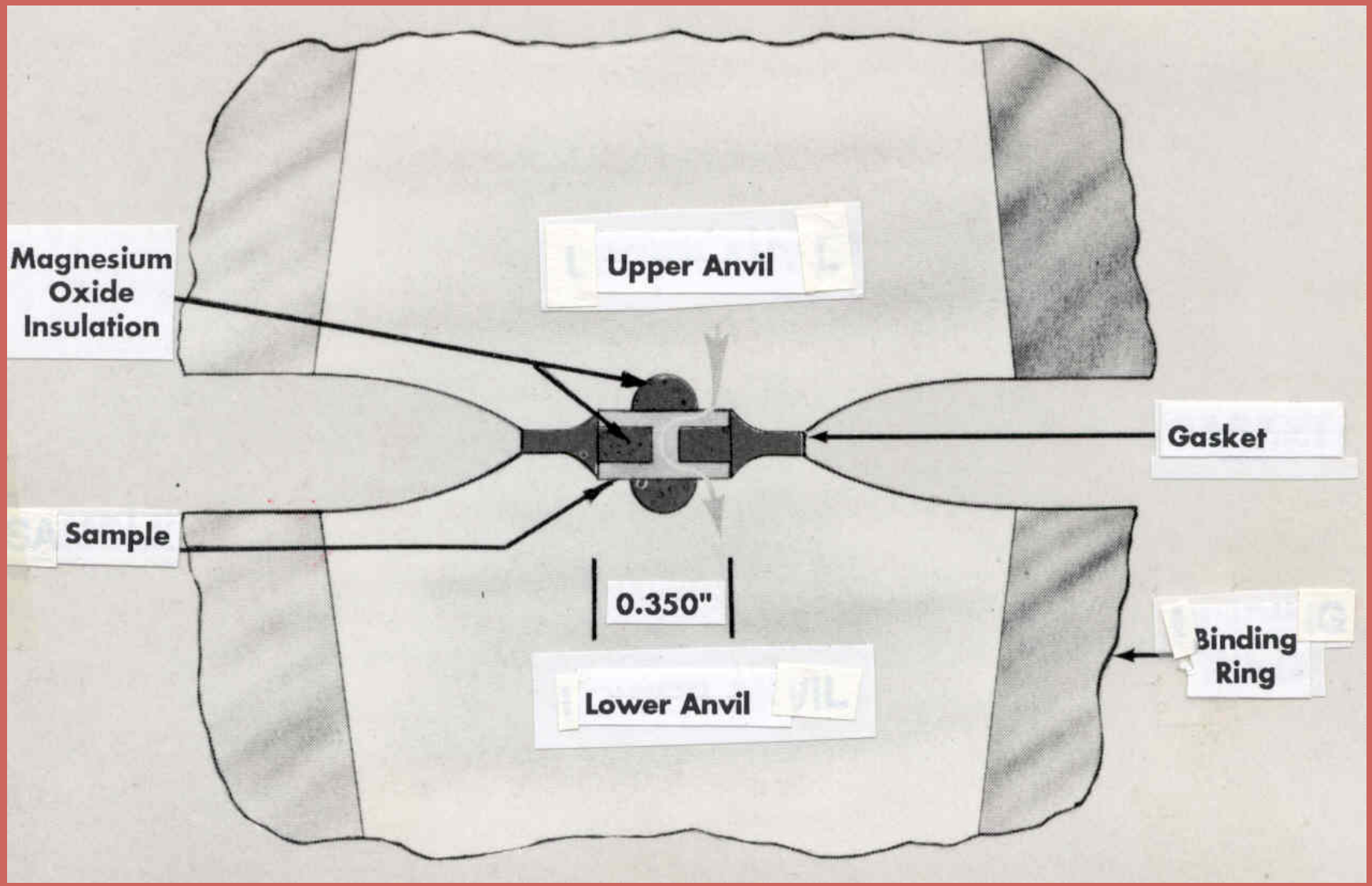
Bundy, Strong, Hall, Wentorf, Nerad & Cheney

Herbert Strong & Francis Bundy

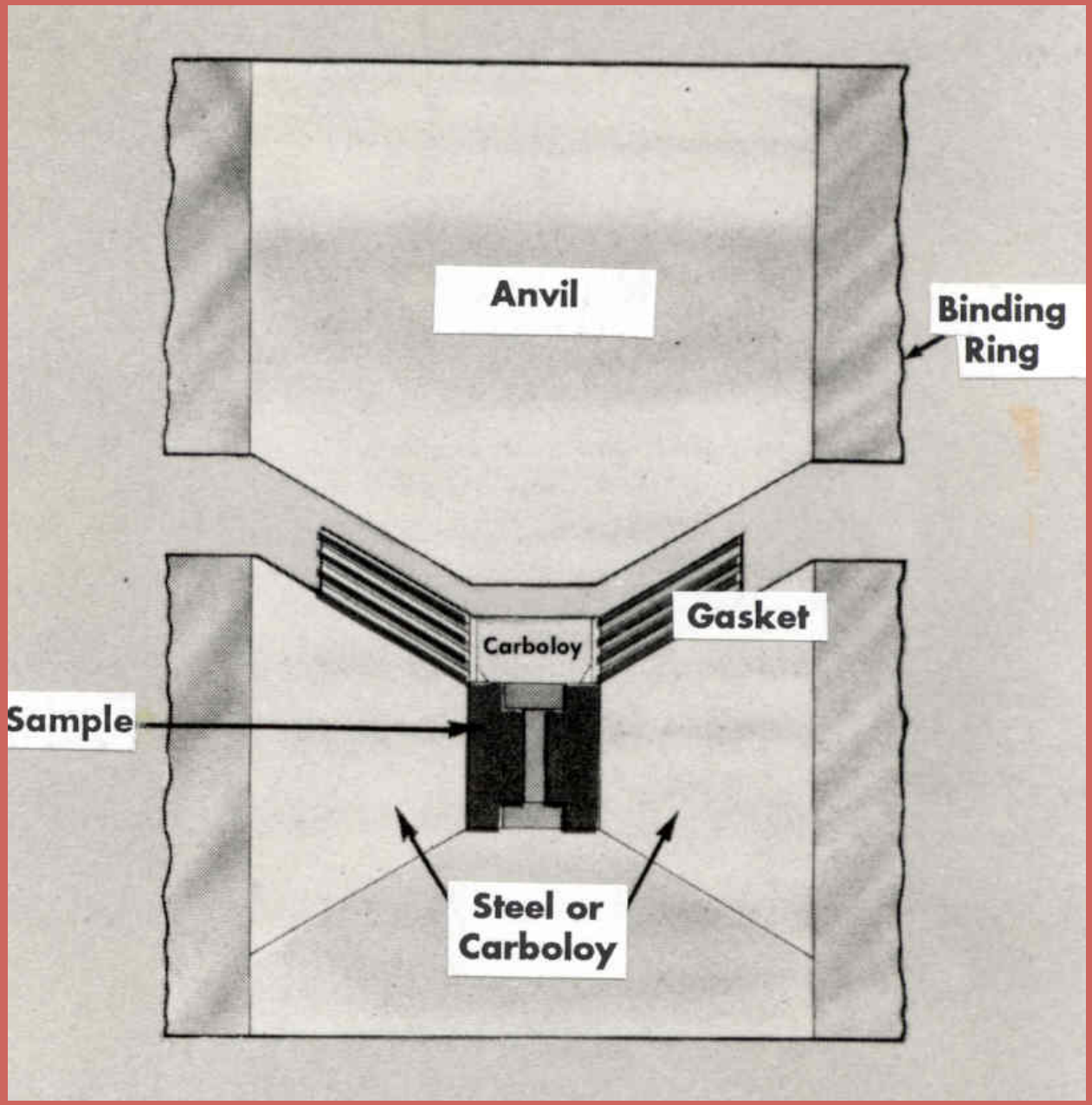


Tracy Hall & Robert Wentorf, Jr.

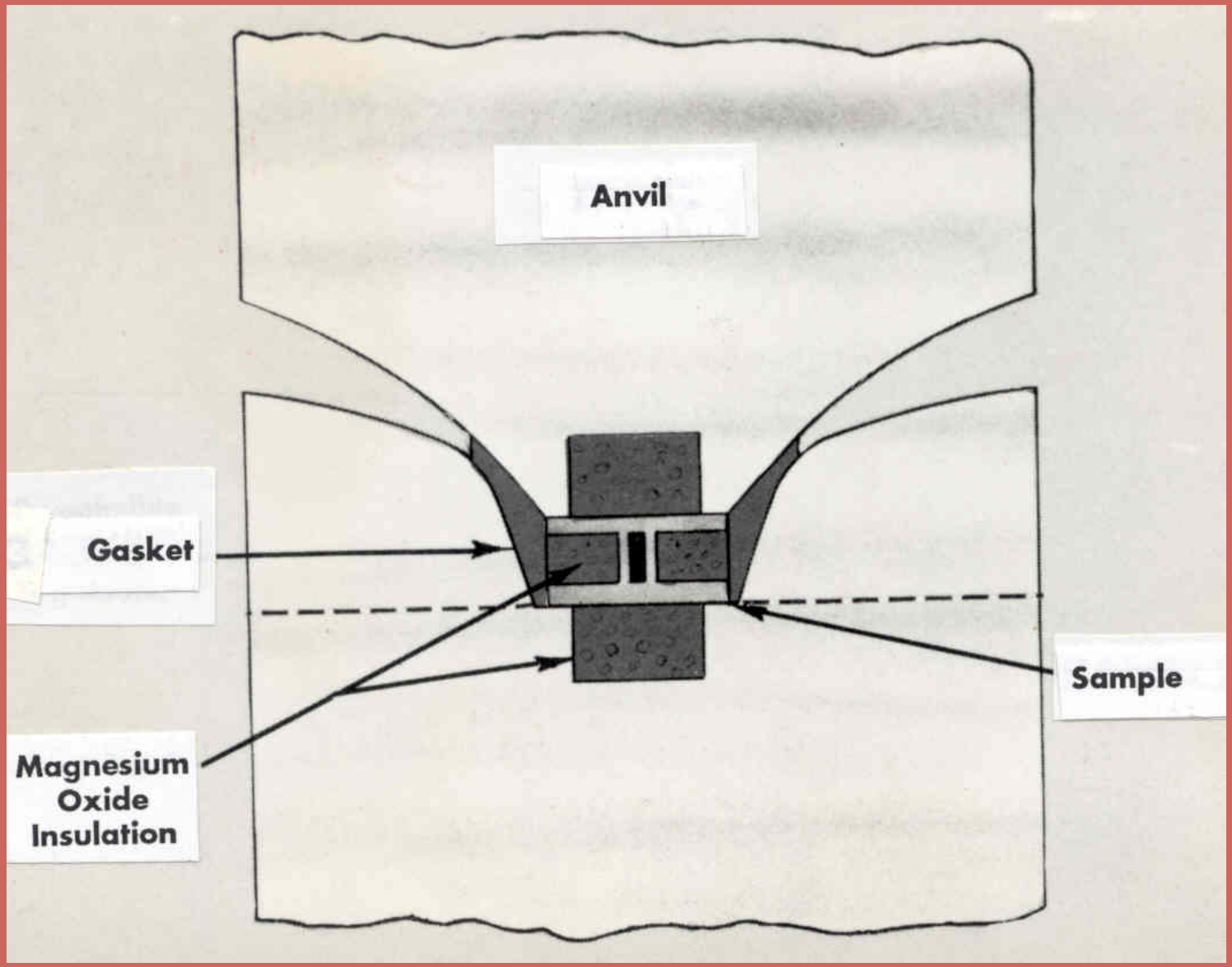
The Flying Saucer



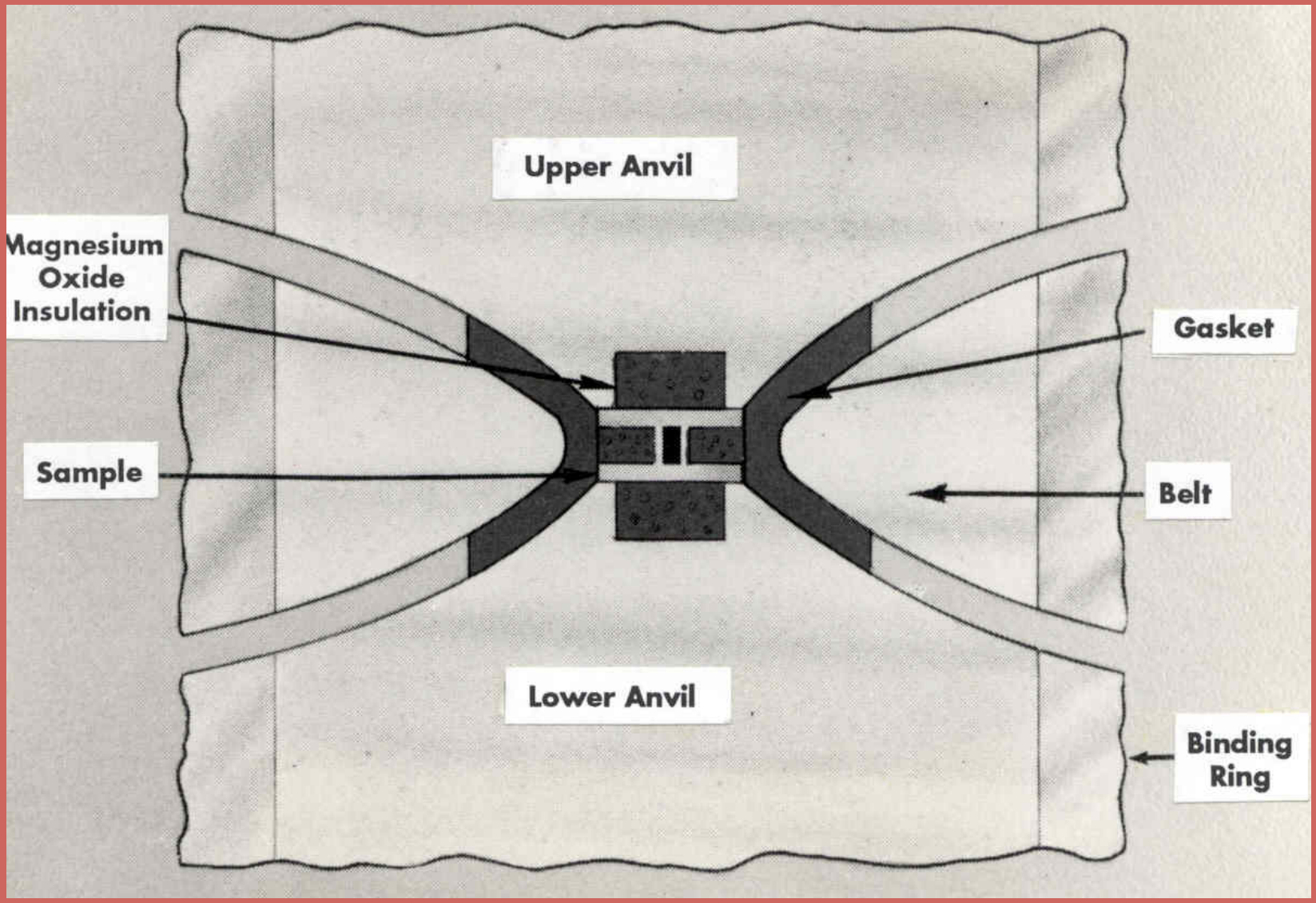
The Cone Apparatus



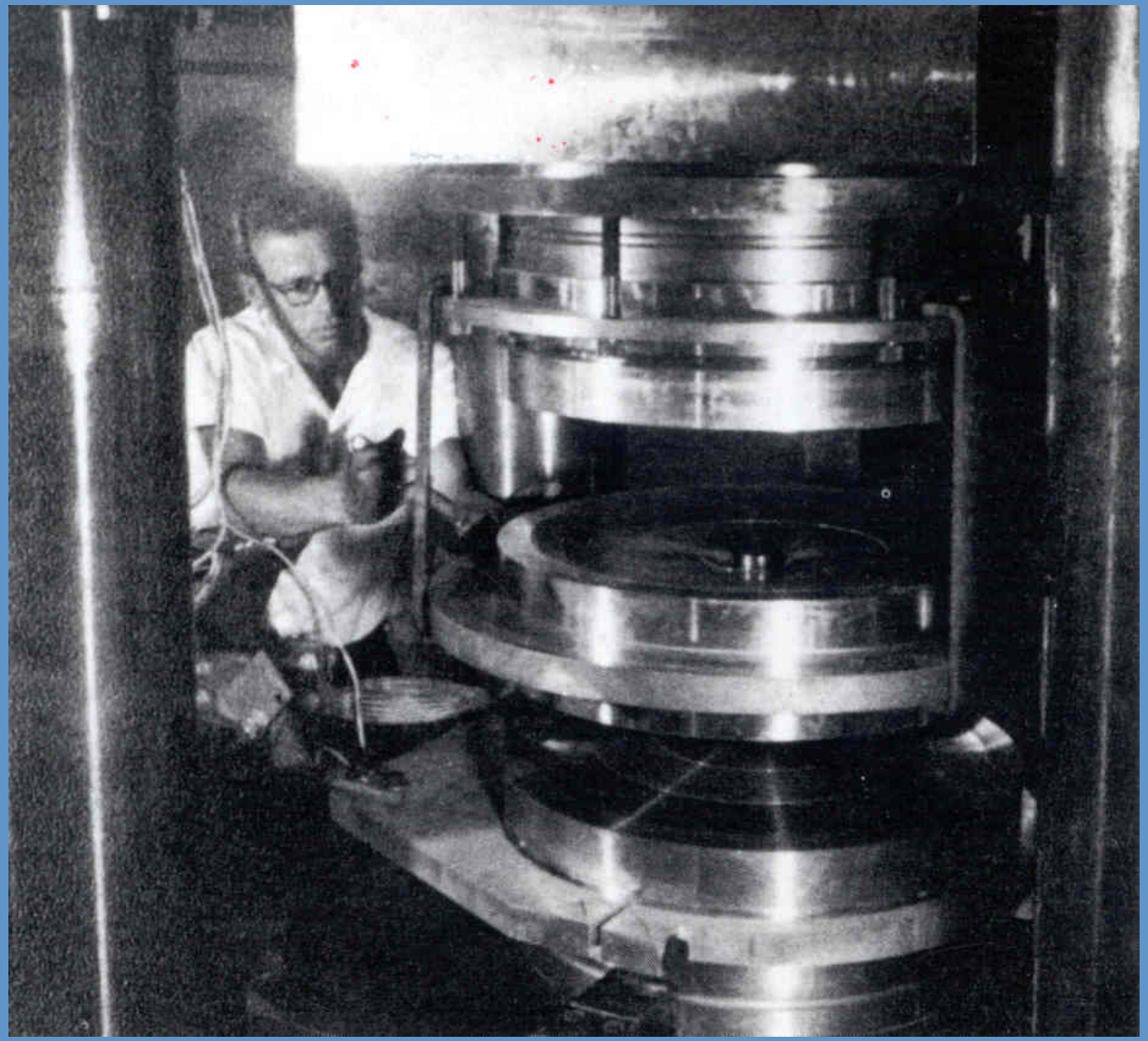
The Half-Belt Apparatus

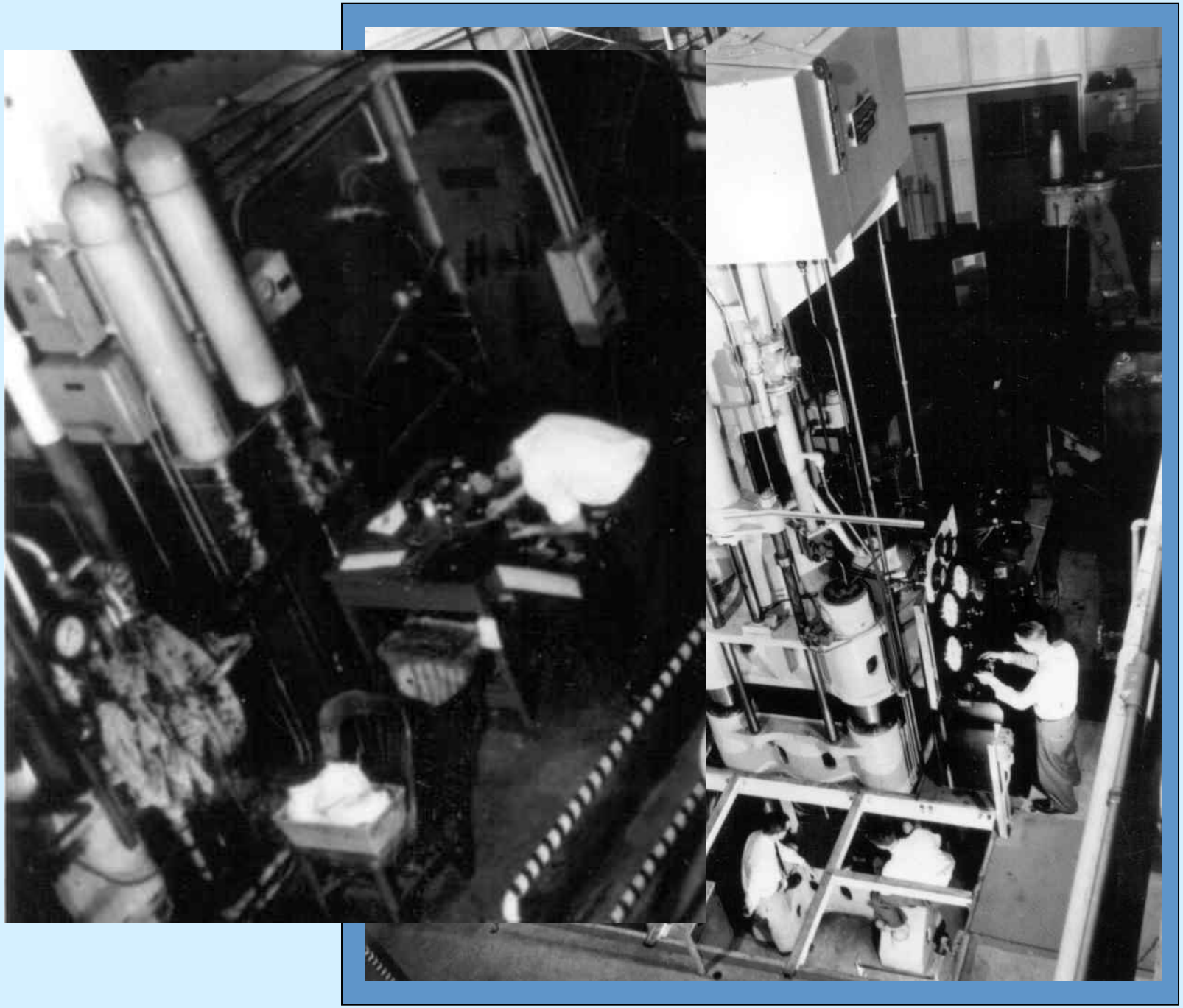


The Belt Apparatus



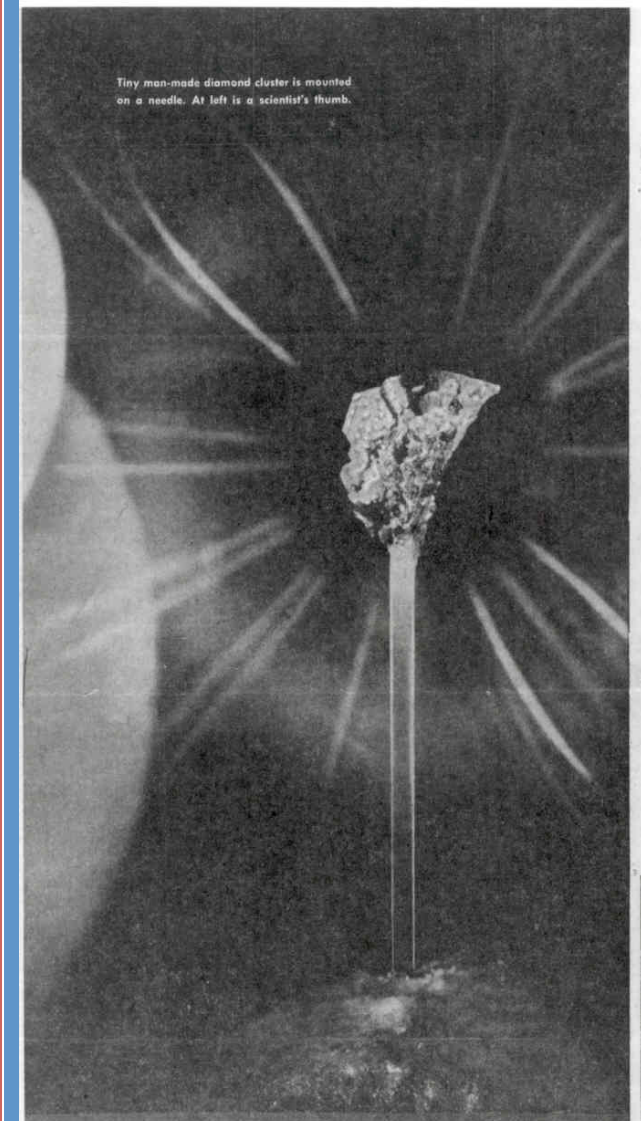
Hal Bovenkerk and the belt apparatus





Herb Strong's "Man-Made" Diamond
15 December 1954

Percy Bridgman & Irving Langmuir (seated) with Wentorf, Strong & Bundy



Tiny man-made diamond cluster is mounted on a needle. At left is a scientist's thumb.

Here's how General Electric developed man-made diamonds

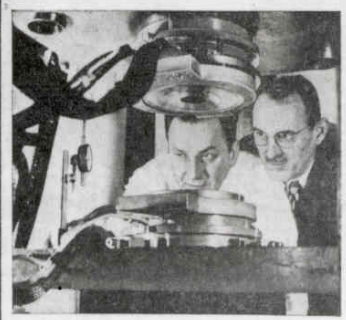
It took seven scientists four years and thousands of tries to produce small stones identical with those of nature

Early this year, General Electric displayed diamonds made in our Research Laboratory. They are tiny stones—the biggest only 1/16th of an inch long. But they are real diamonds, exactly like stones dug from the earth.

This discovery of General Electric research is the kind of basic knowledge that creates new products and new jobs.

Seven scientists and their technical assistants worked for four years in the promising new field of combined high-temperature, high-pressure research. A unique pressure chamber for a giant 1000-ton press was built, where pressures of 1,500,000 pounds per square inch and temperatures of 5,000 degrees Fahrenheit could be achieved simultaneously—duplicating the "squeeze" 240 miles inside the earth. Thousands of experiments were made.

More work and expense will be necessary to bring down the cost of General Electric diamonds before they are practical for industrial use. But learning how to make real diamonds is a landmark in our 76-year-long search for ways to make new and better products for everyone. As we see it, it is a good example of progress in the American way.



At the G-E "diamond mine," a 1000-ton press, are Dr. A. L. Marshall, manager of Chemistry Research, and A. J. Nerad, who supervised the project. Write for the story of the development, "Man-Made Diamonds," General Electric Company, Dept. J2-117, Schenectady, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

GENERAL ELECTRIC

Dear Sir

My name is Chucky Singer.
I am eight years old and I am in
the third grade. I am sending
you a piece of coal I found for
you to make into a diamond
in your machine. Please send
it back to me.

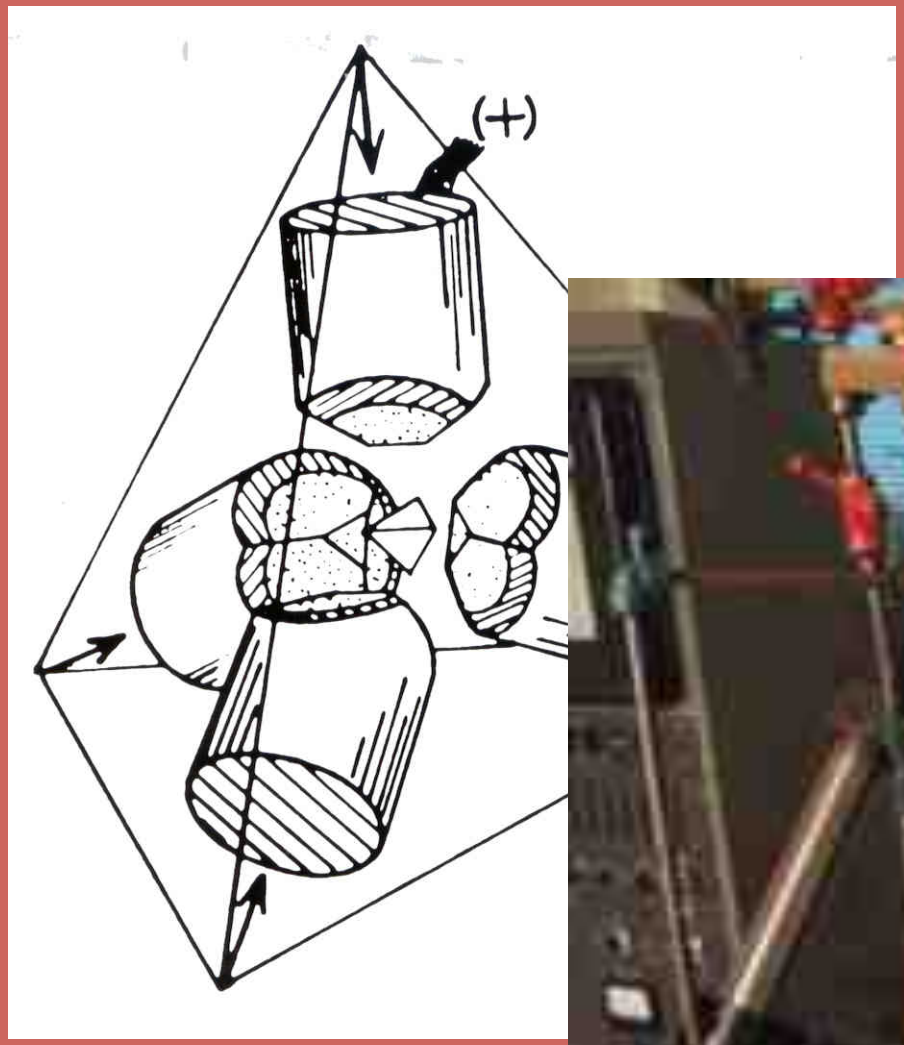
Thank you

Chucky Singer

1 LEONARD ROAD.

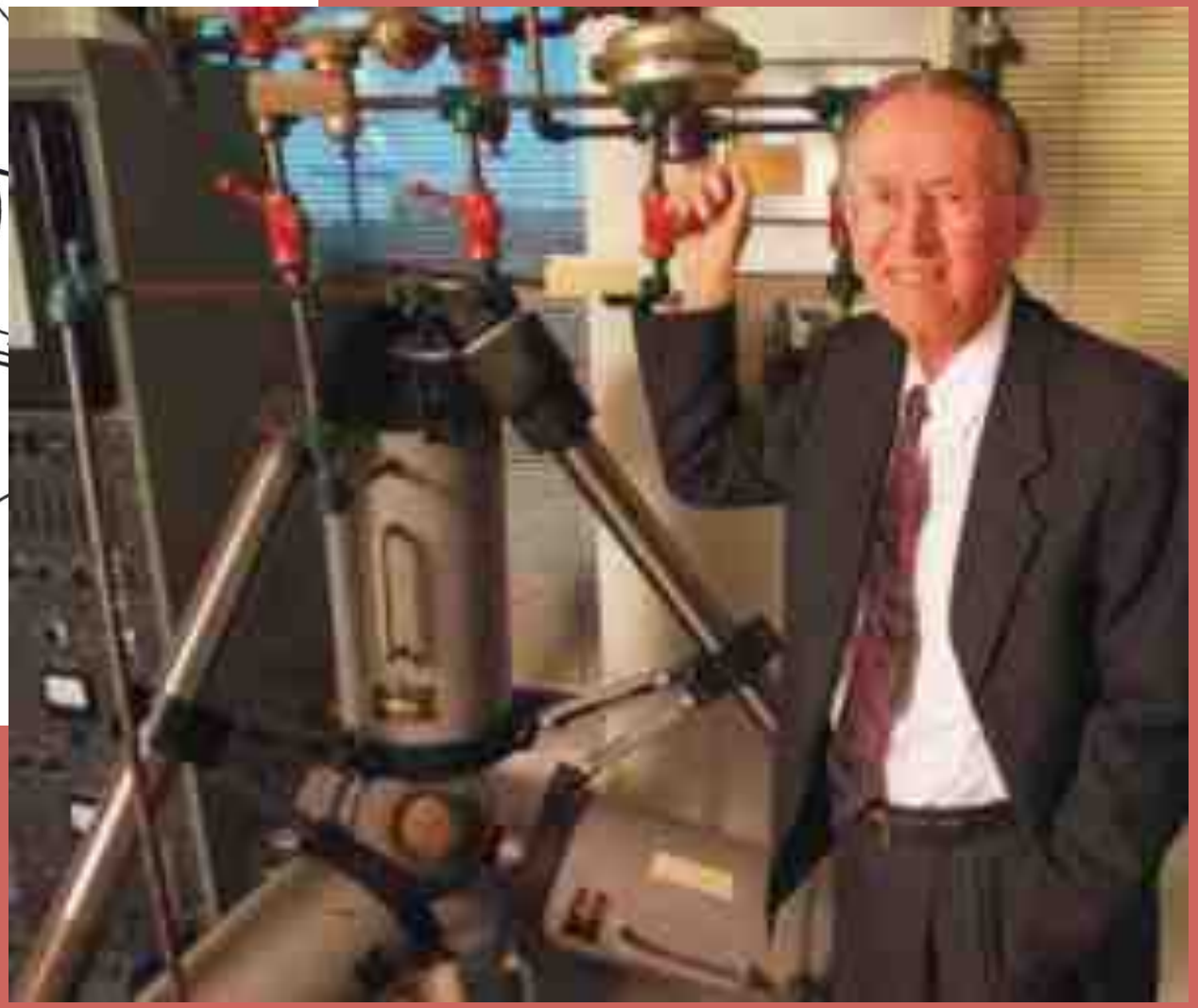
PEABODY MASS.

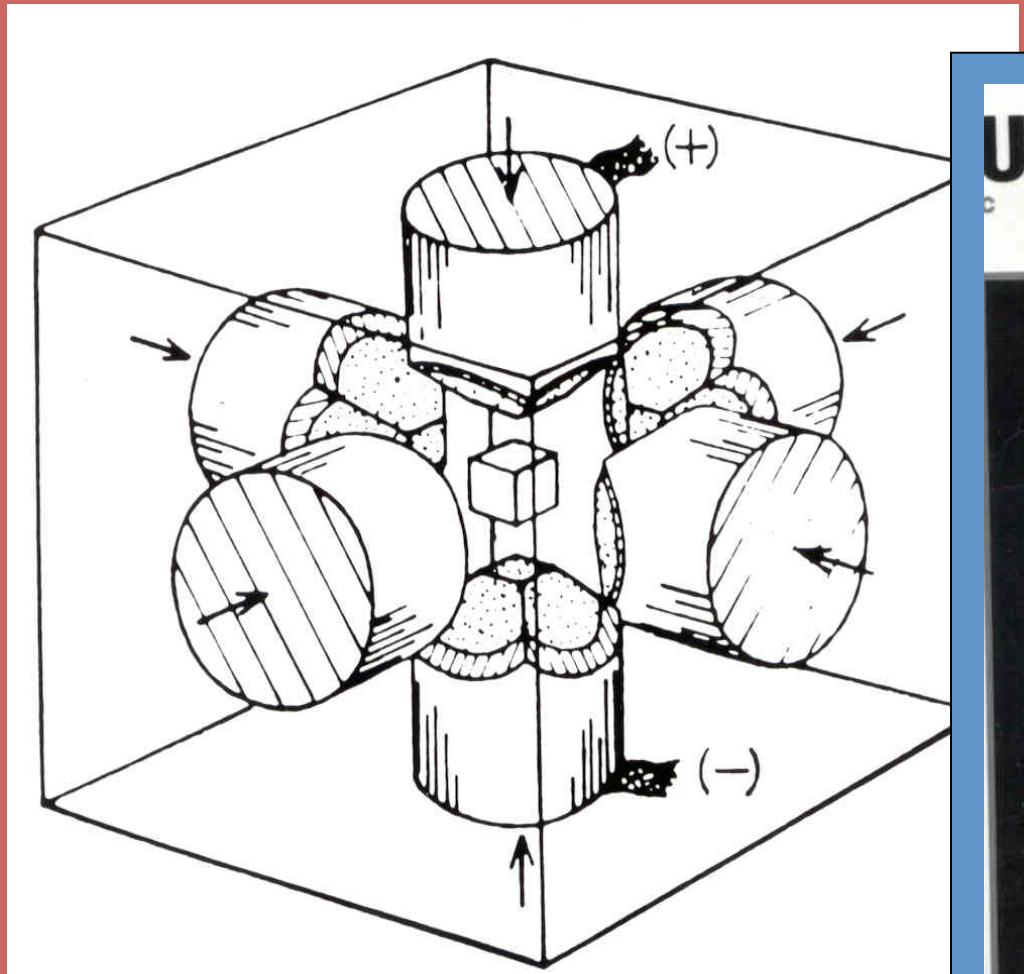
Strong (left) and Wentorf (right)
with Arthur M. Bueche



TRACY HALL

Tetrahedral Anvil Press





The Cubic Anvil Press

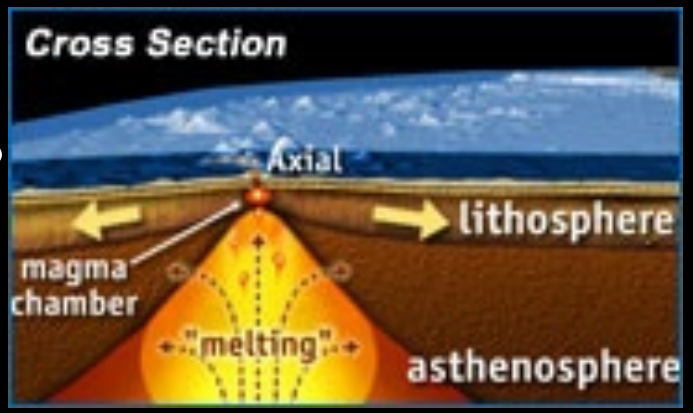
- **Begun in 2009 with support from the Sloan Foundation.**
- **Now into the 4th year of a 10-year program.**
- **Network of ~1000 collaborators in >40 countries.**
- **On the order of $100 million in new funding.**

DCO website: **http://deepcarbon.net**

DEEP CARBON OBSERVATORY

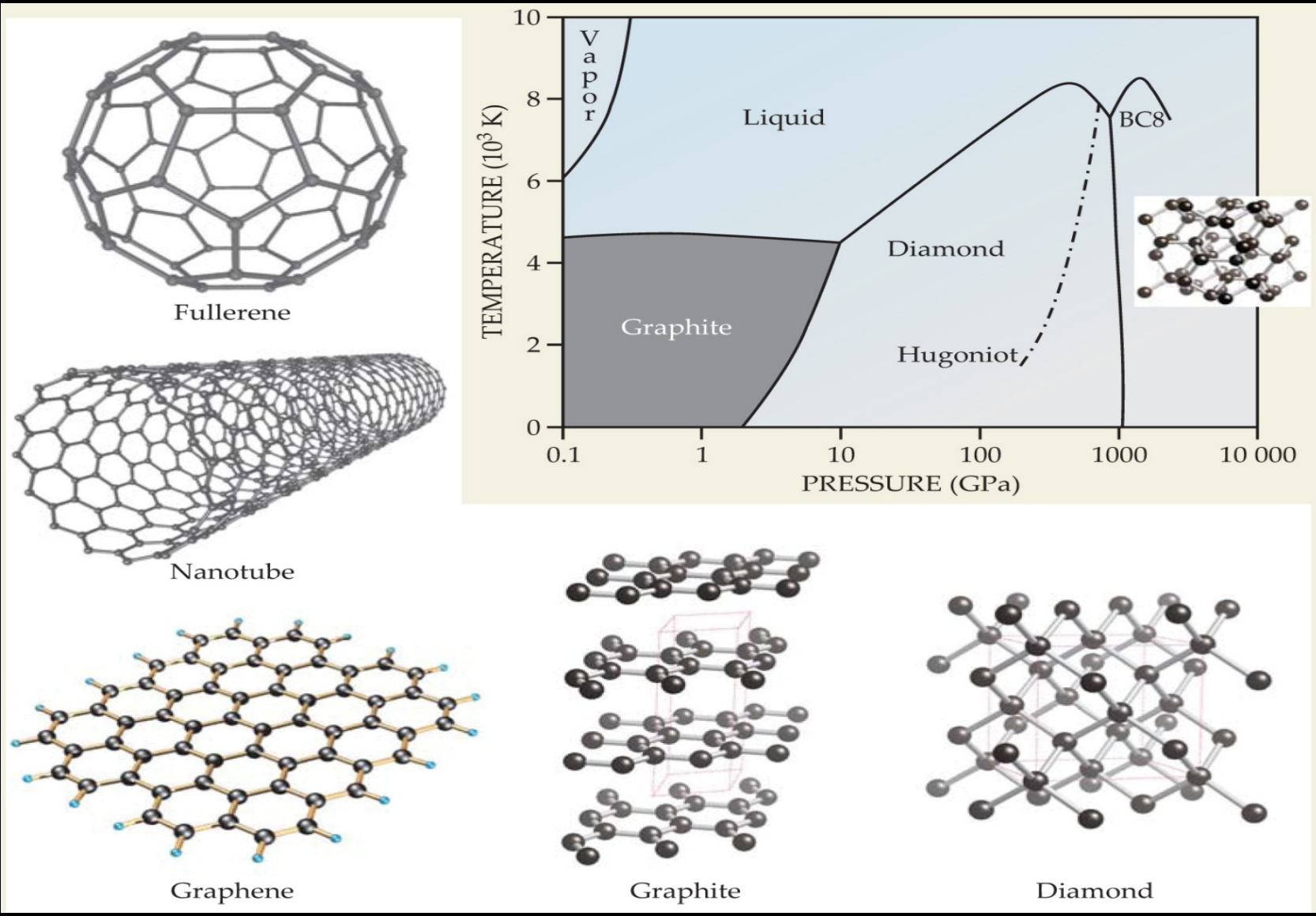
Questions about Carbon in Earth

- What are properties of carbon at extreme pressure and temperature?
- Where is the carbon and how does it move among deep reservoirs and the surface?
- Is there a deep source of organics?
- What is the nature and extent of deep microbial life?



We need fundamental advances to understand Earth's deep carbon.

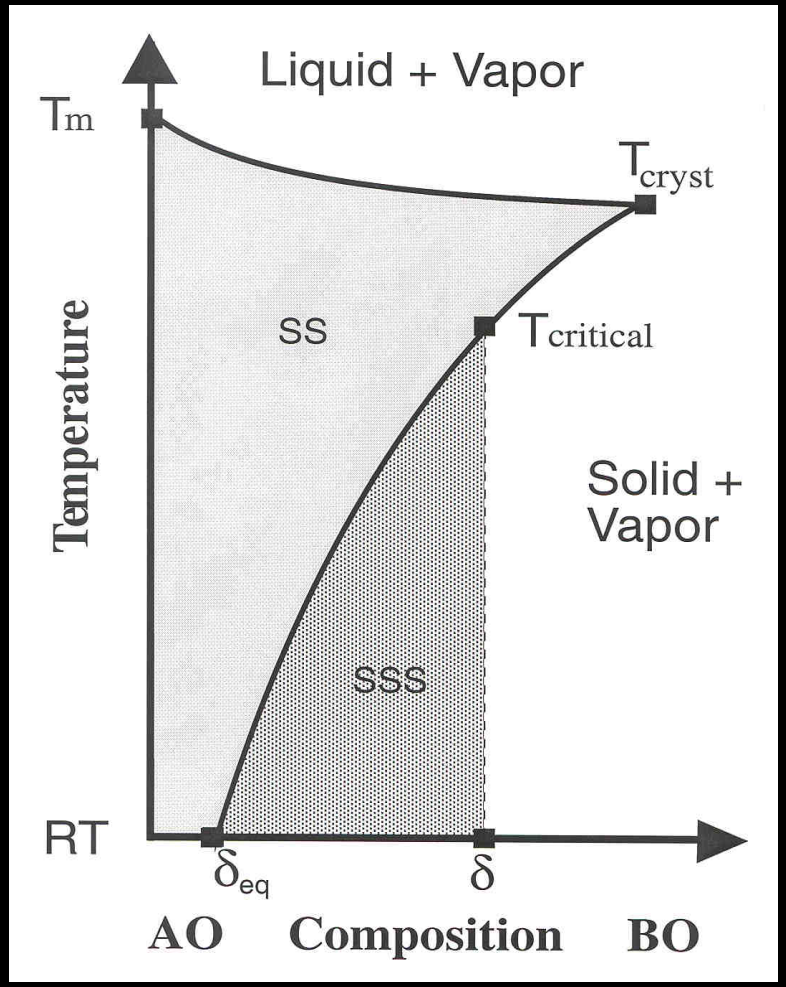
Carbon exhibits rich polymorphism, regimes of stability and metastability, and dimensionality.

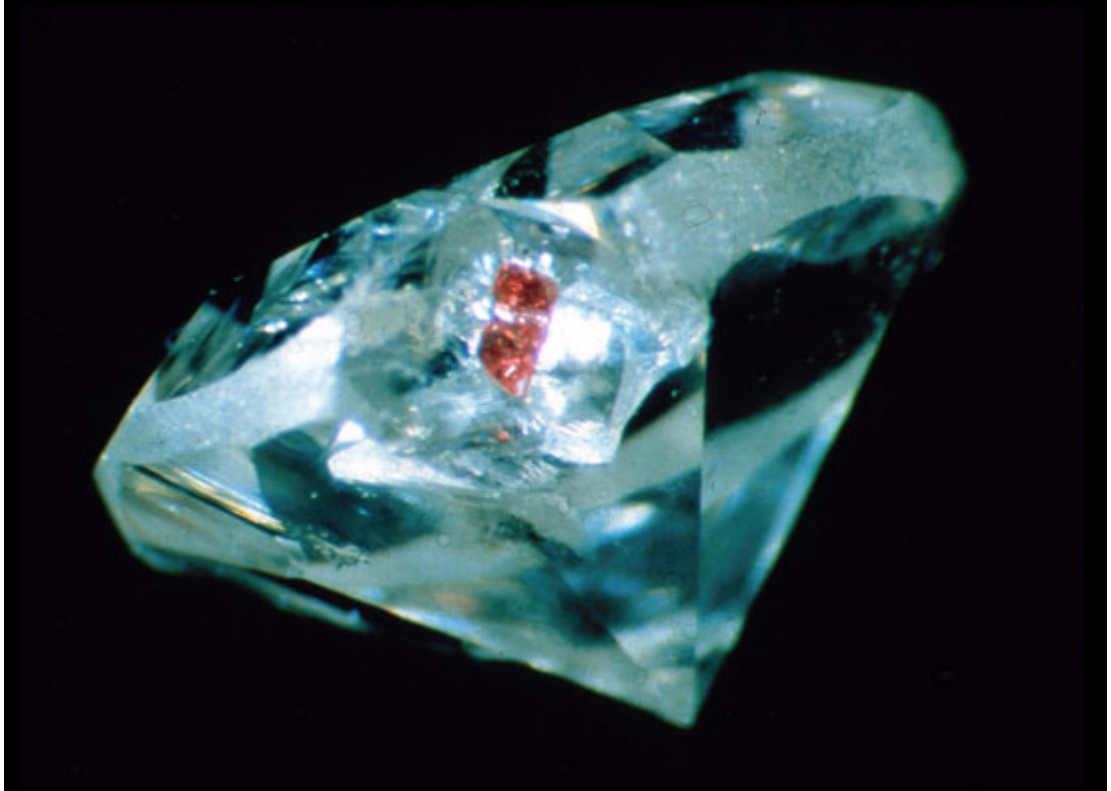


[Hemley, Crabtree & Buchanan, *Physics Today* (2009)]

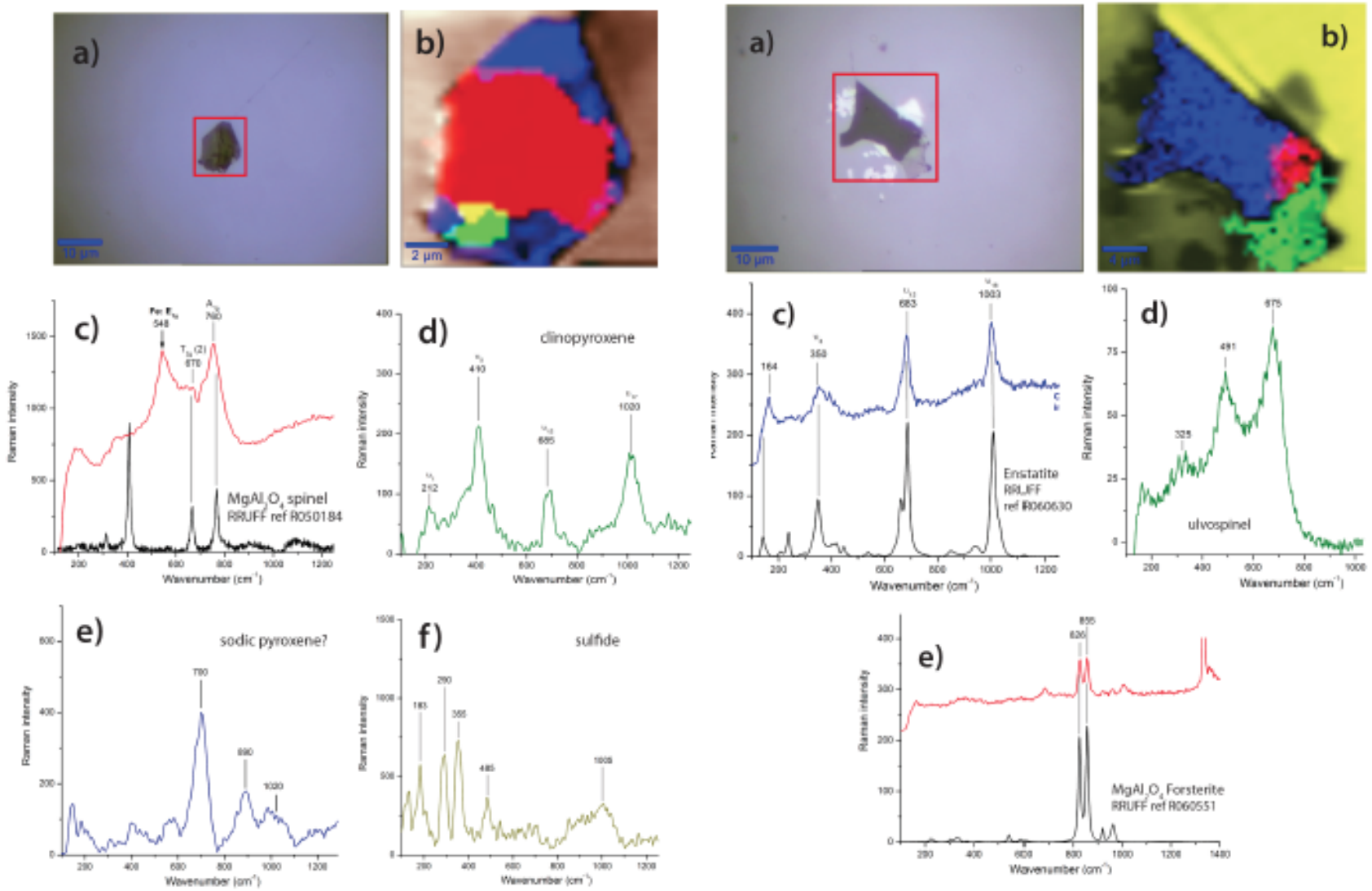
Inclusions in Diamond

How much carbon can be incorporated into mantle oxides and silicates?

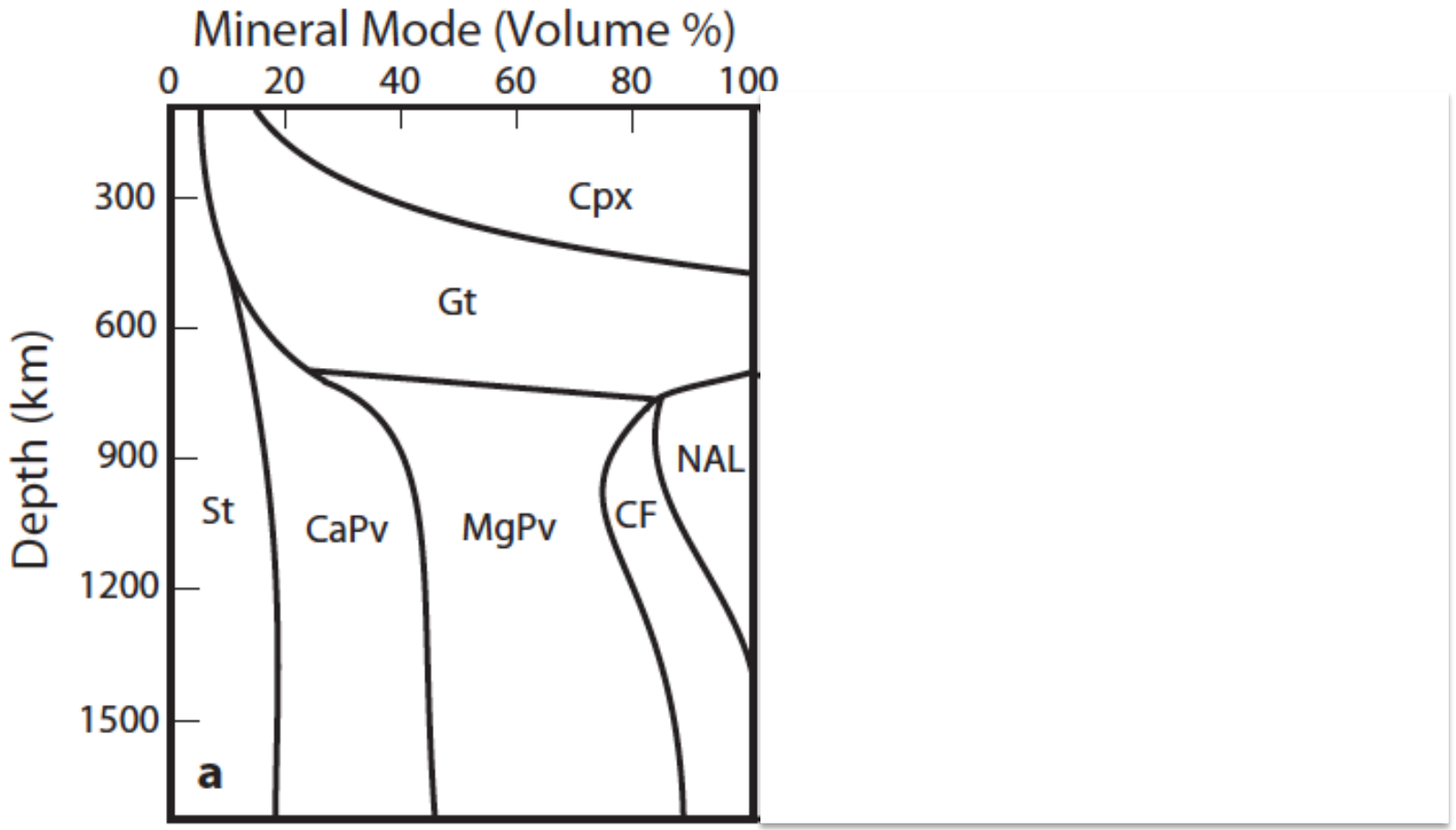




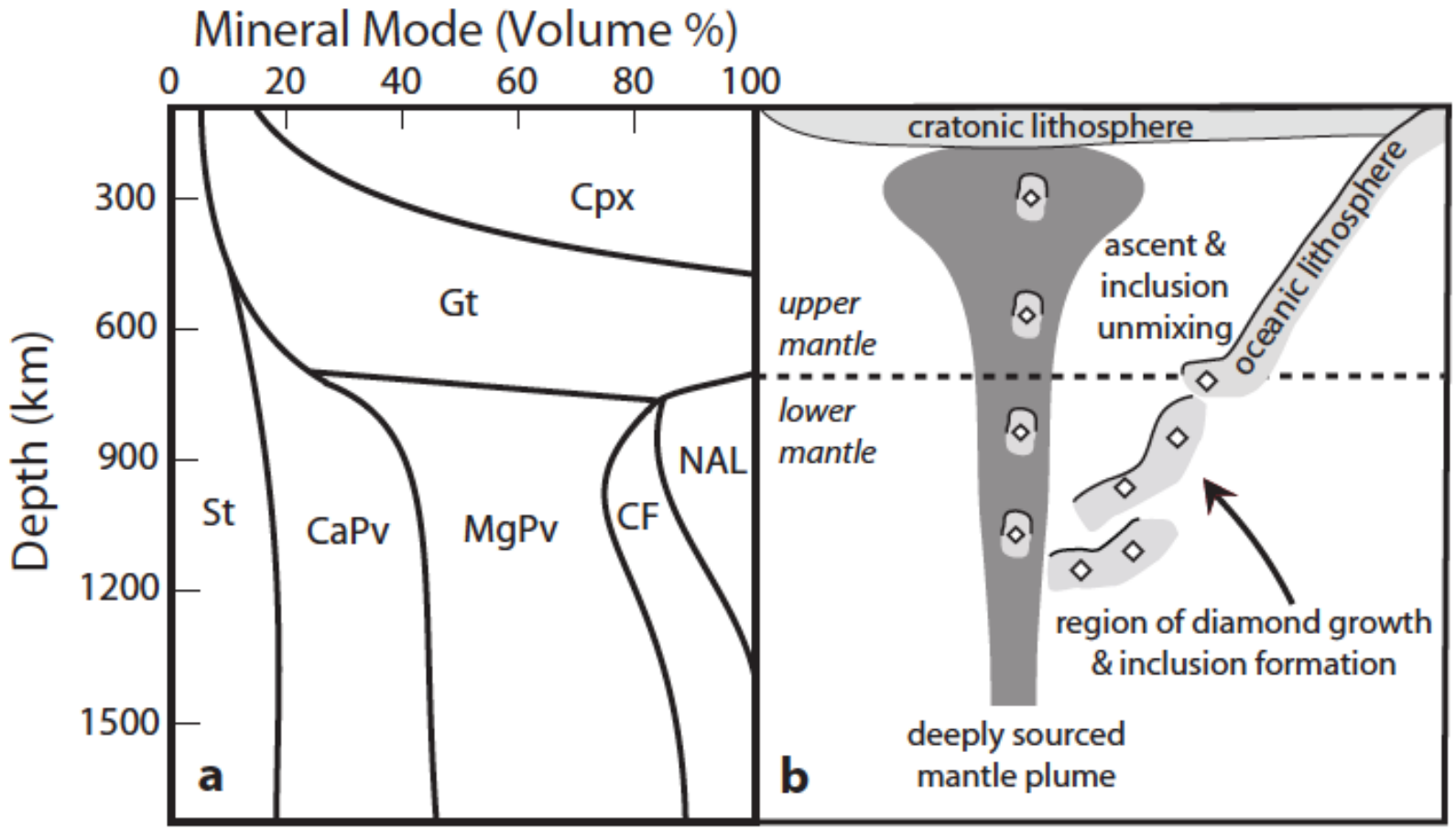
Diamond inclusions reveal subduction history.



Walter, Kohn, Araujo, Bulanova, Smith, Gaillou, Wang, Steele, Shirey
(2011) Science **333**, in press.

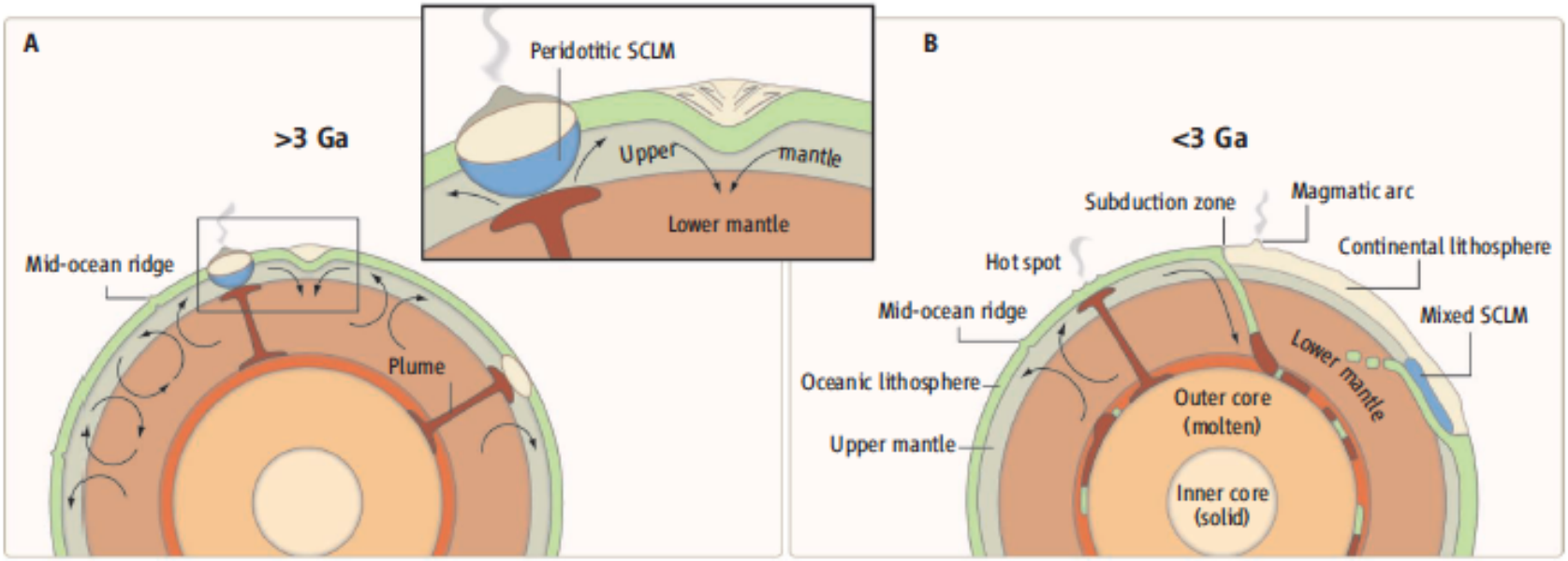


Walter, Kohn, Araujo, Bulanova, Smith, Gaillou, Wang, Steele, Shirey
(2011) Science **333**, in press.

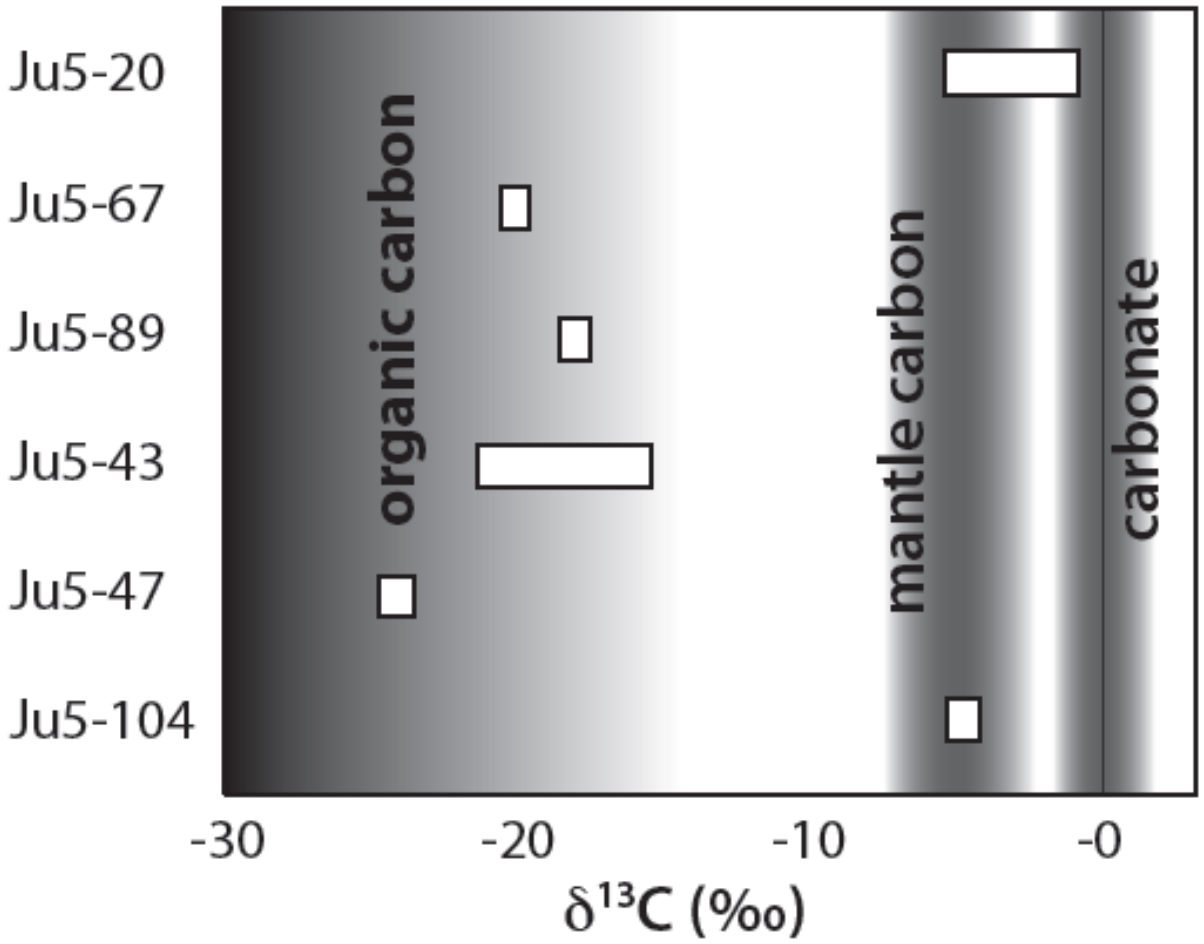


Walter, Kohn, Araujo, Bulanova, Smith, Gaillou, Wang, Steele, Shirey
(2011) *Science* **333**, in press.

A major change in Earth's mantle geodynamics around 3 Ga is required to explain both non-subduction crustal tectonics and the absence eclogite in the record

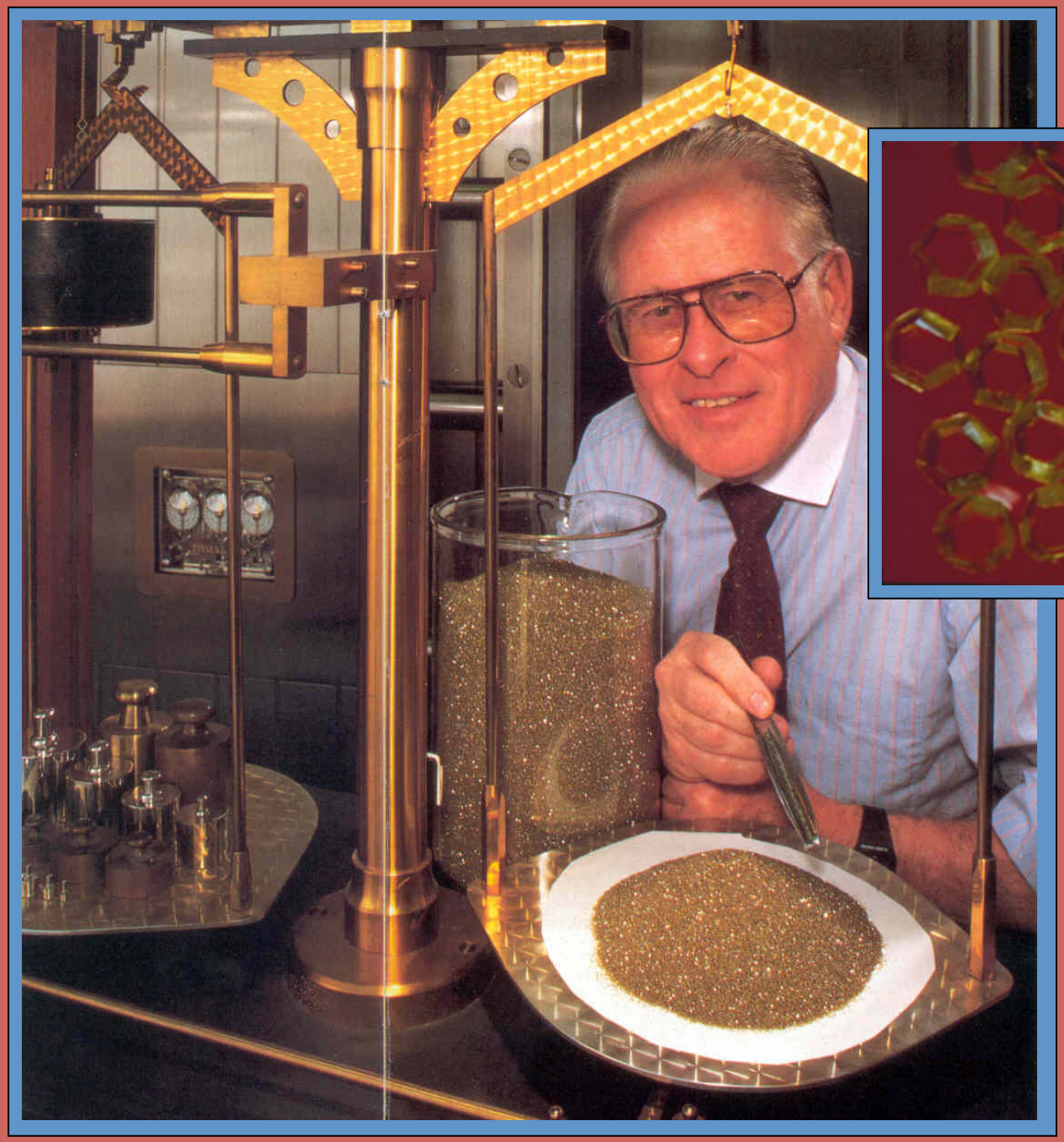


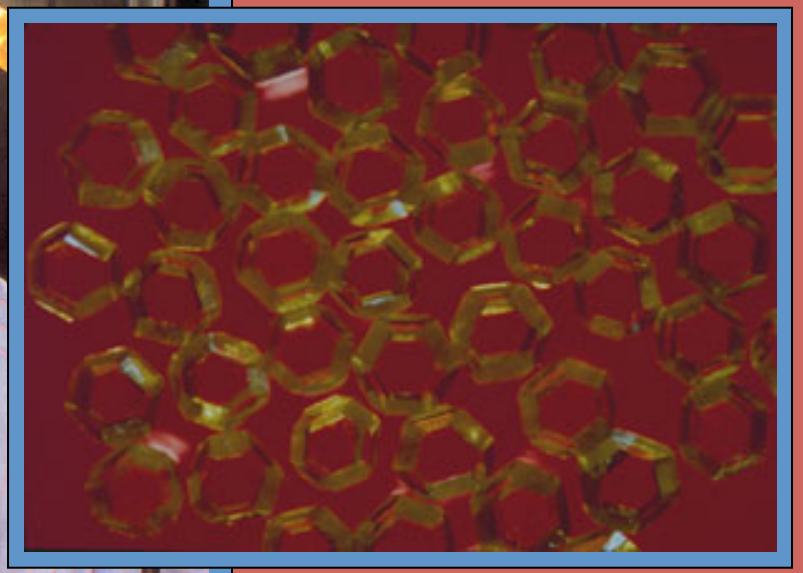
van Kranendonk (2011) Science **333**, 413-414.



"Because the diamond hosts have carbon isotope signatures consistent with surface-derived carbon, we conclude that the deep carbon cycle extends into the lower mantle."

DCO website: **http://deepcarbon.net**





Thank You!