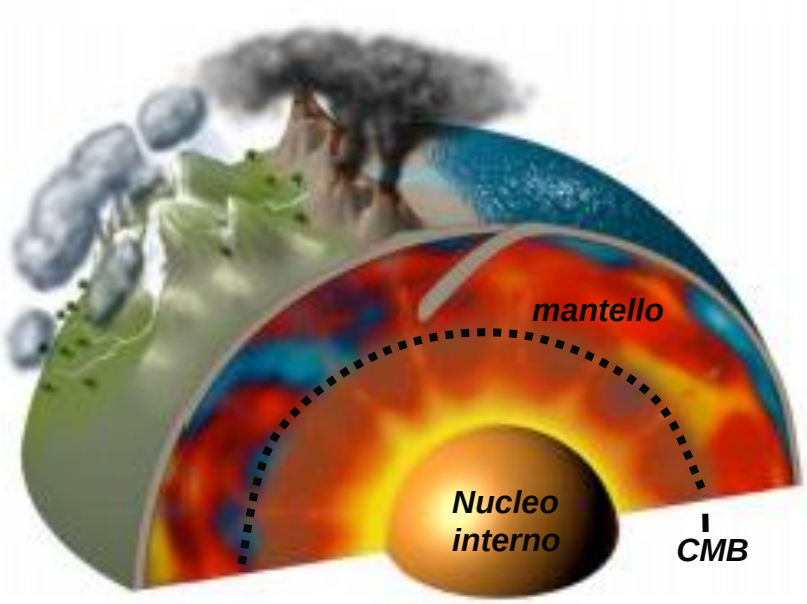
Dipartimento
di Scienze della Terra

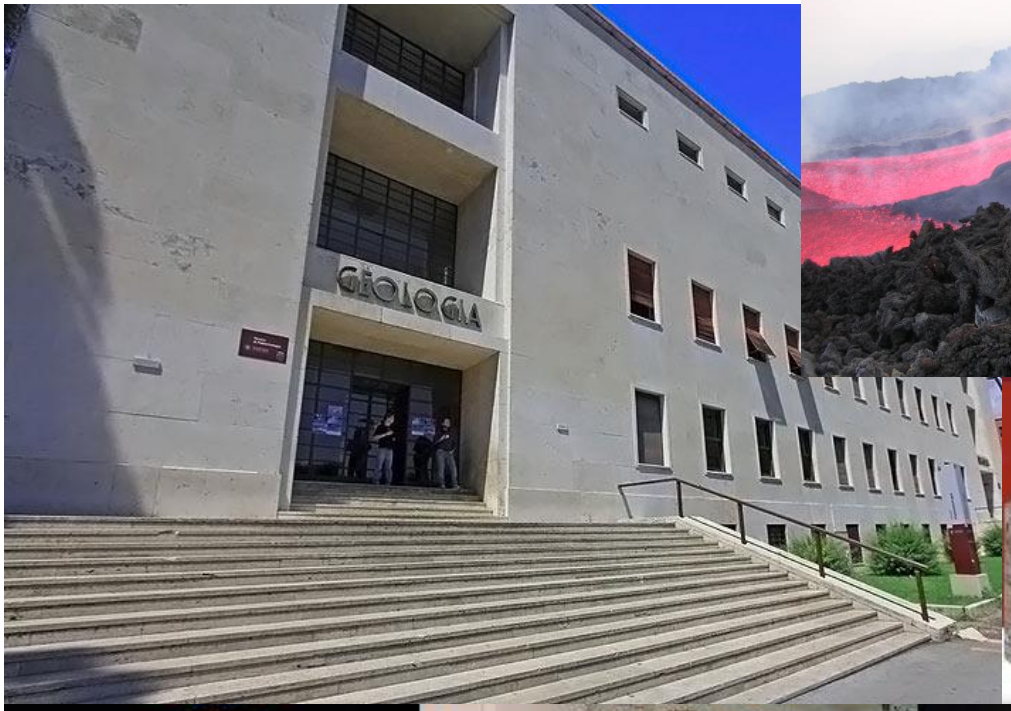
Sapienza
Università di Roma

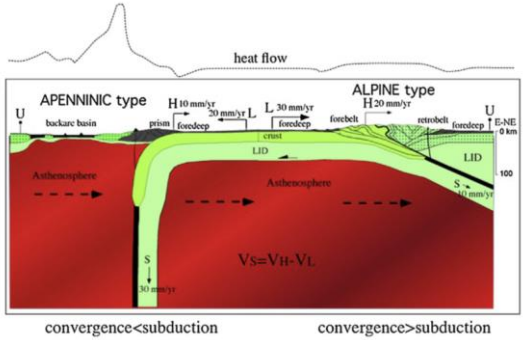
Viaggio al centro della Terra…oltre il visibile

Vincenzo Stagno
-Petrologia Sperimentale



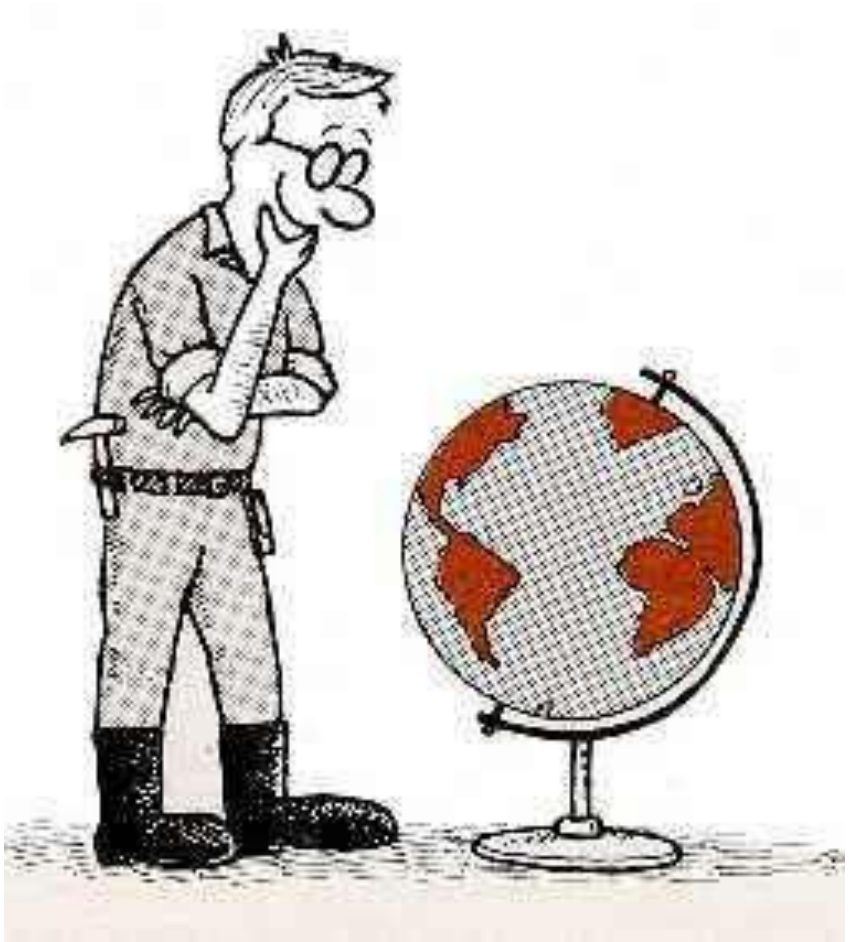
Dipartimento di Scienze della Terra



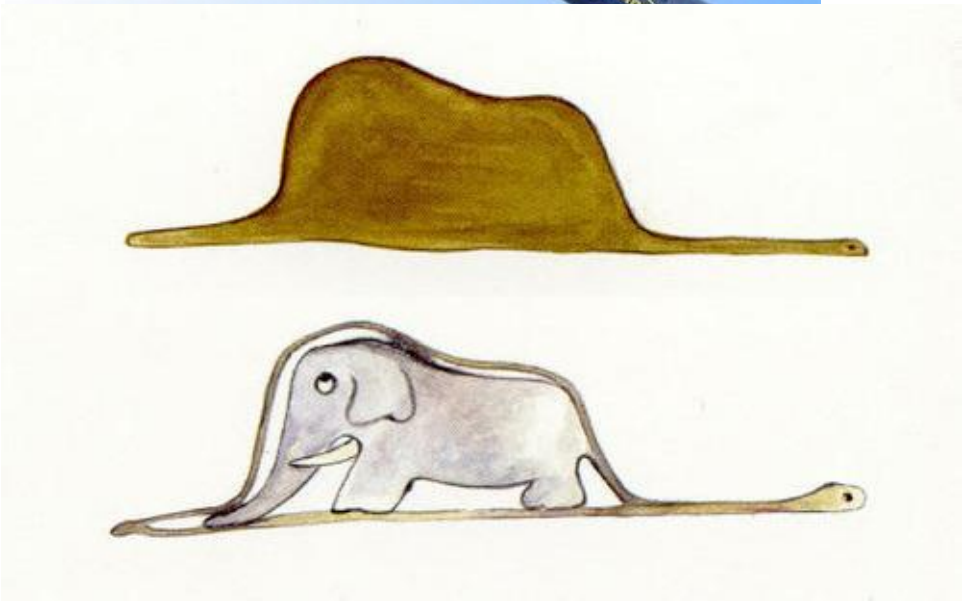


Il mestiere del geologo

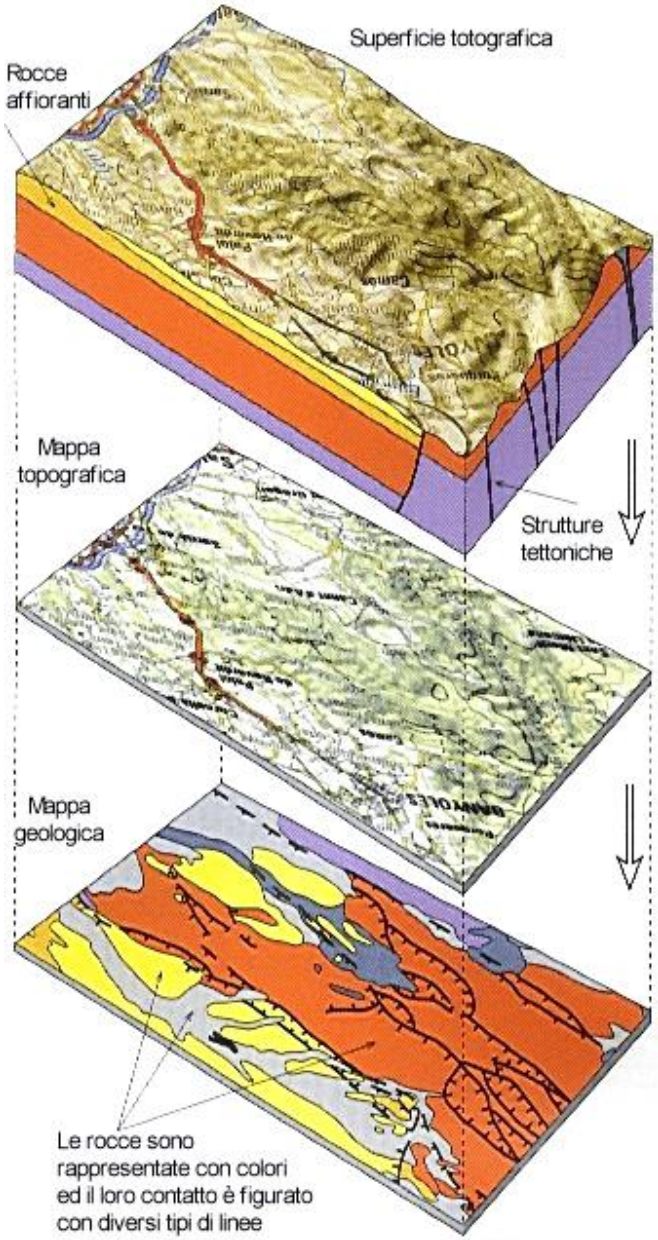
Osservare, riconoscere, descrivere e classificare le rocce che costituiscono il nostro Pianeta.

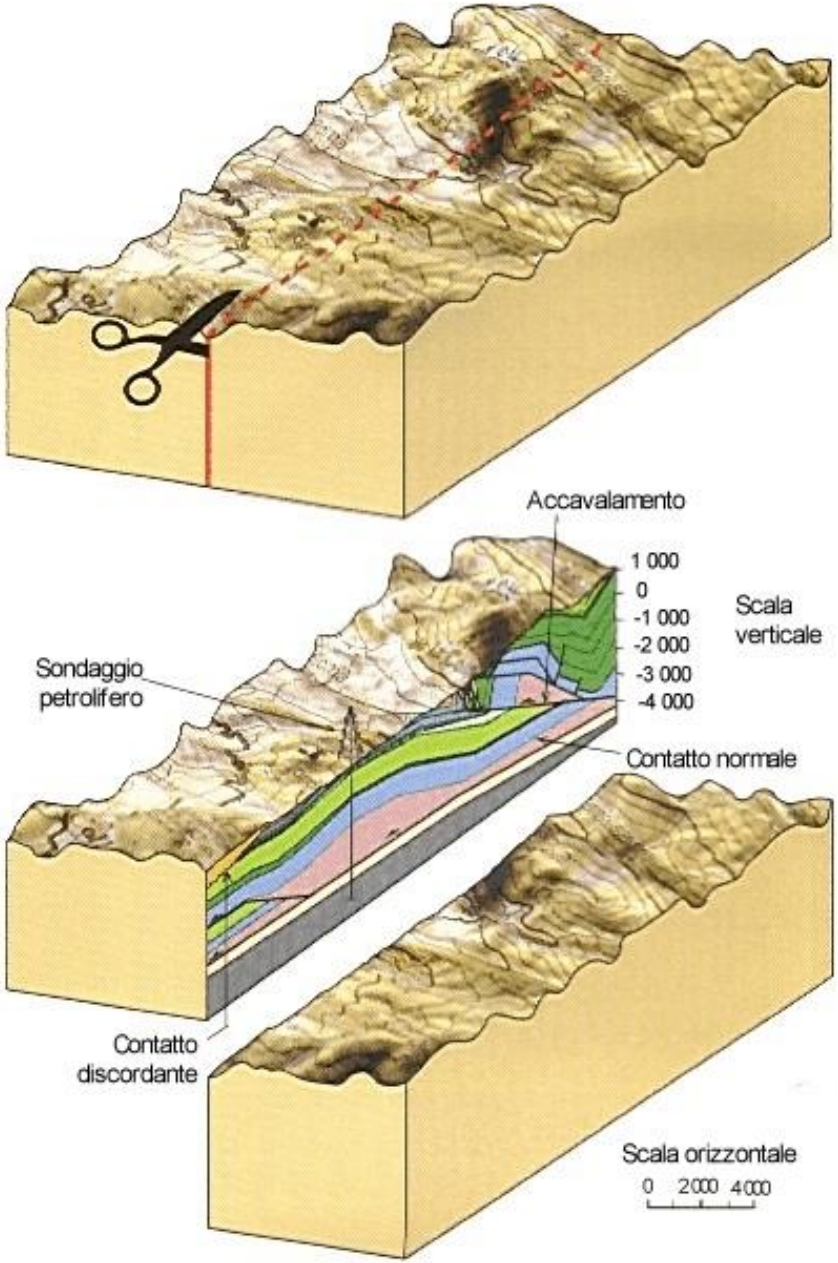


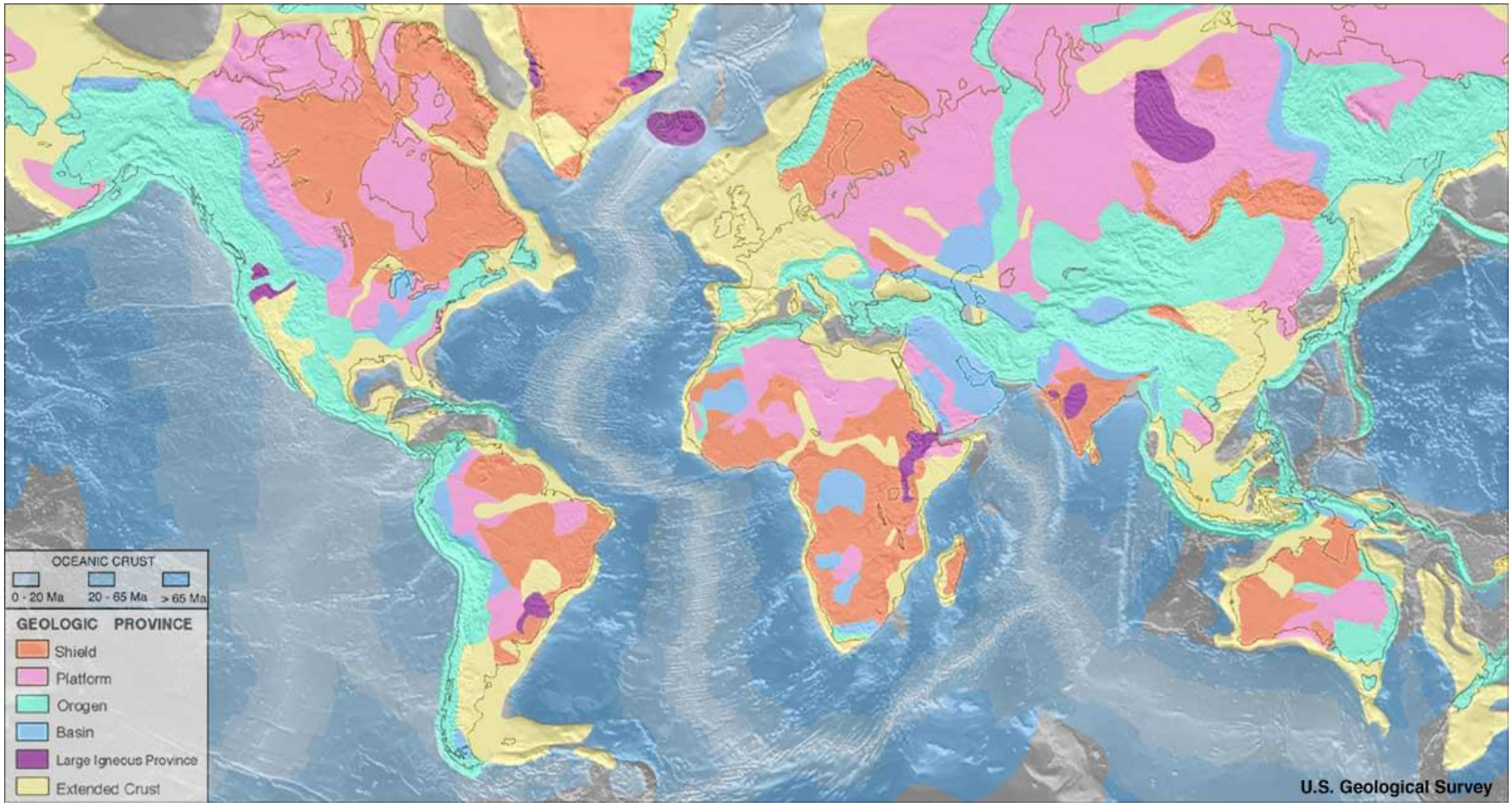
Gli strumenti del geologo



Vedere oltre il visibile

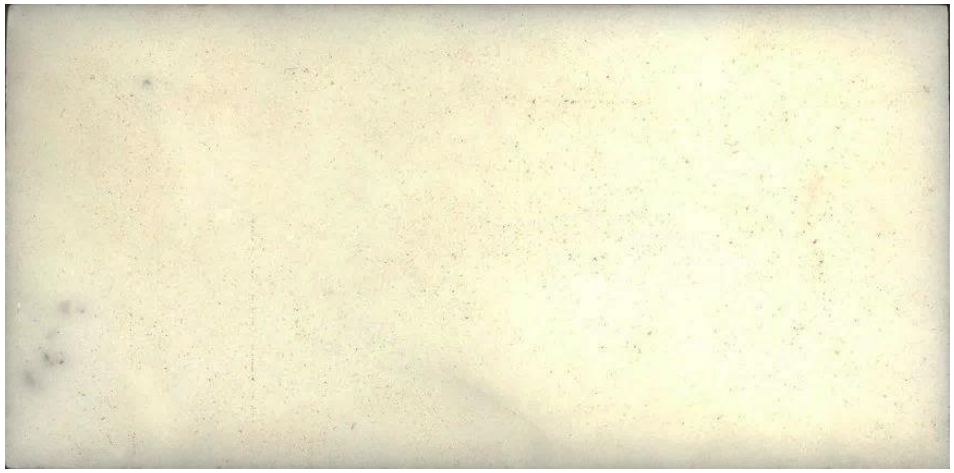




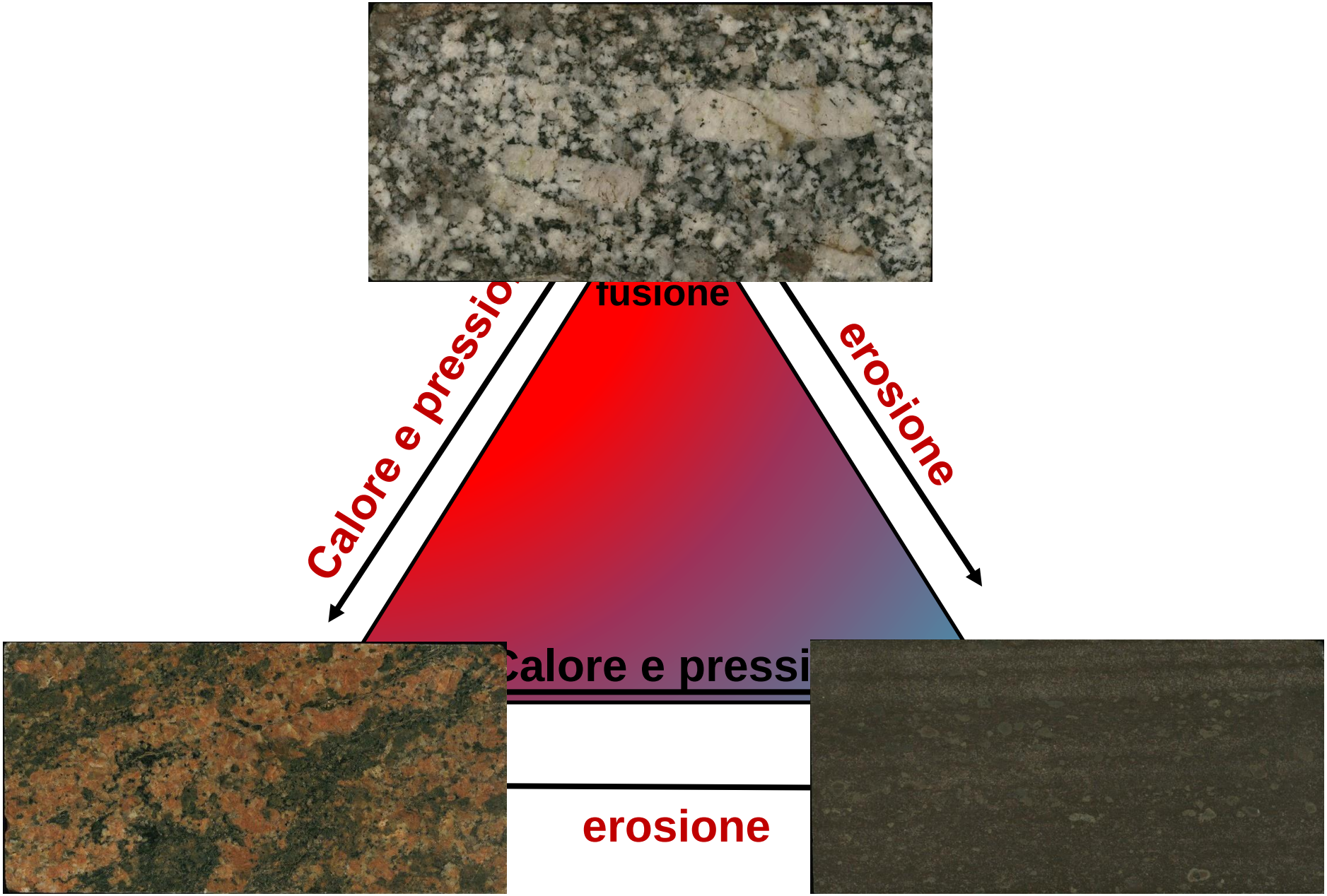

OCEANIC CRUST
0 - 20 Ma
20 - 65 Ma
> 65 Ma
GEOLOGIC PROVINCE
Shield
Platform
Orogen
Basin
Large Ignecus Province
Extended Crust
U.S. Geological Survey

IGNEE

METAMORFICHE

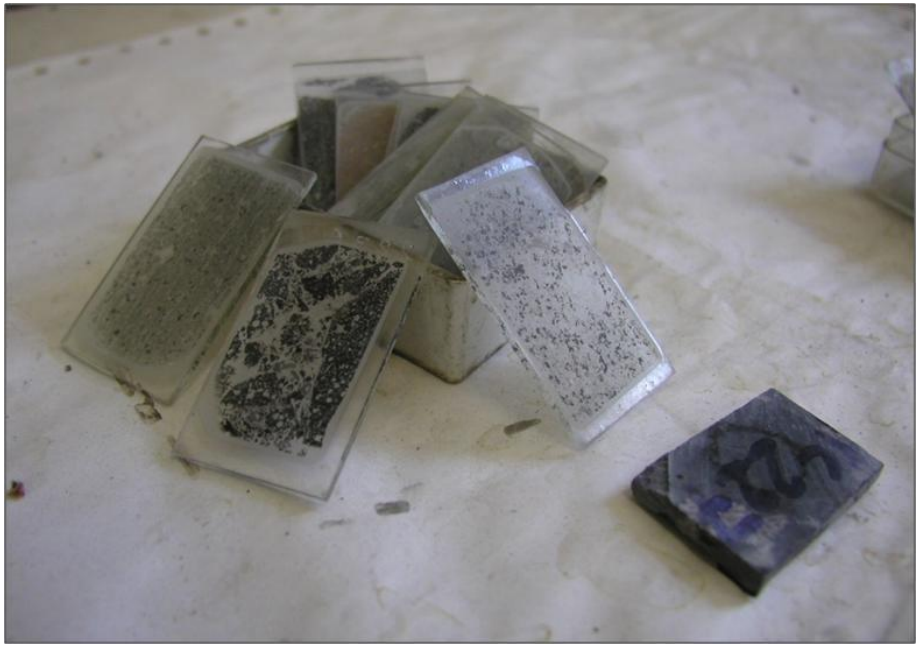


SEDIMENTARIE

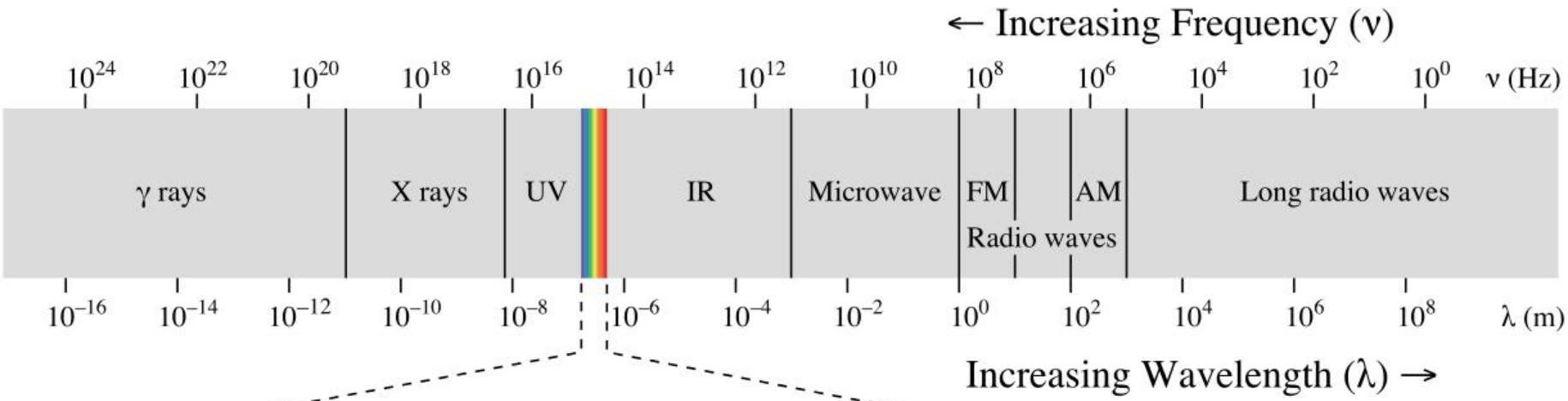

fusione
Calore e pressio
erosione
Calore e pressi
erosione

Rocce = Geomateriali

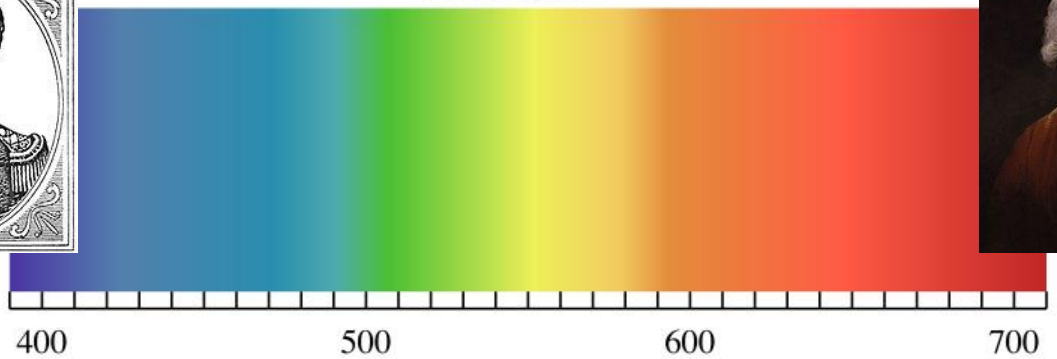
Il microscopio ottico a luce polarizzata

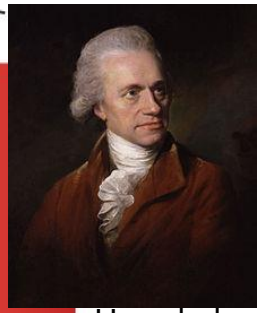


La luce: porzione dello spettro elettromagnetico nel range del visibile



Ritter



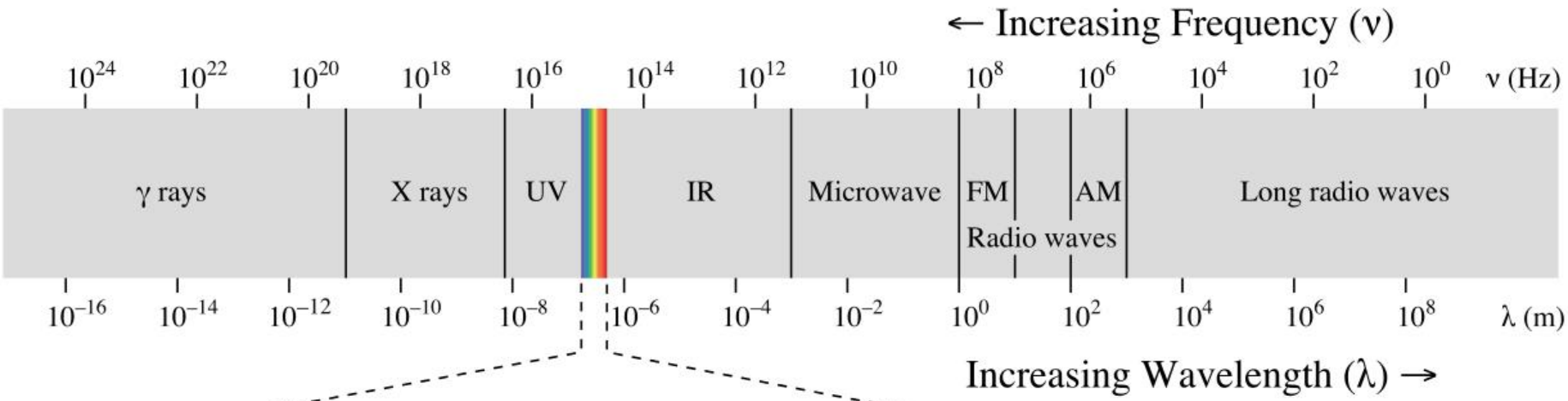


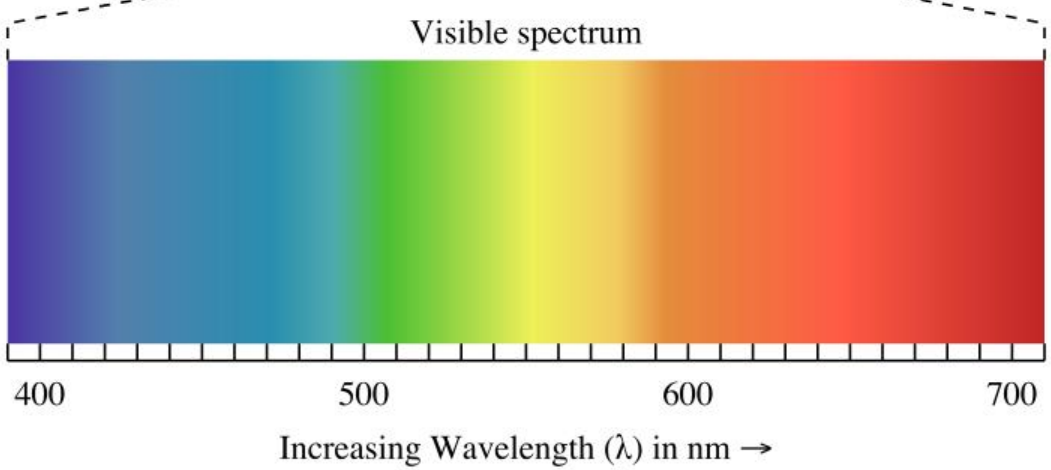
Herschel

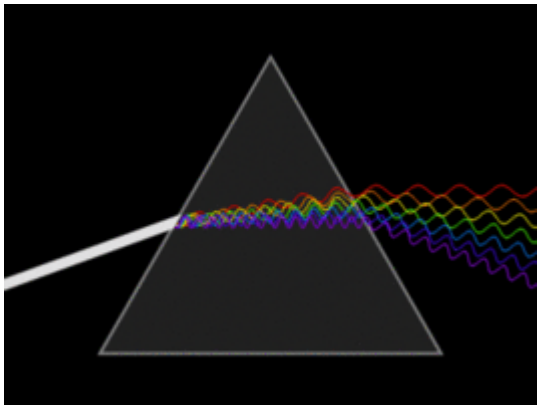
$c = \lambda \nu$

3×10^{8} m/s

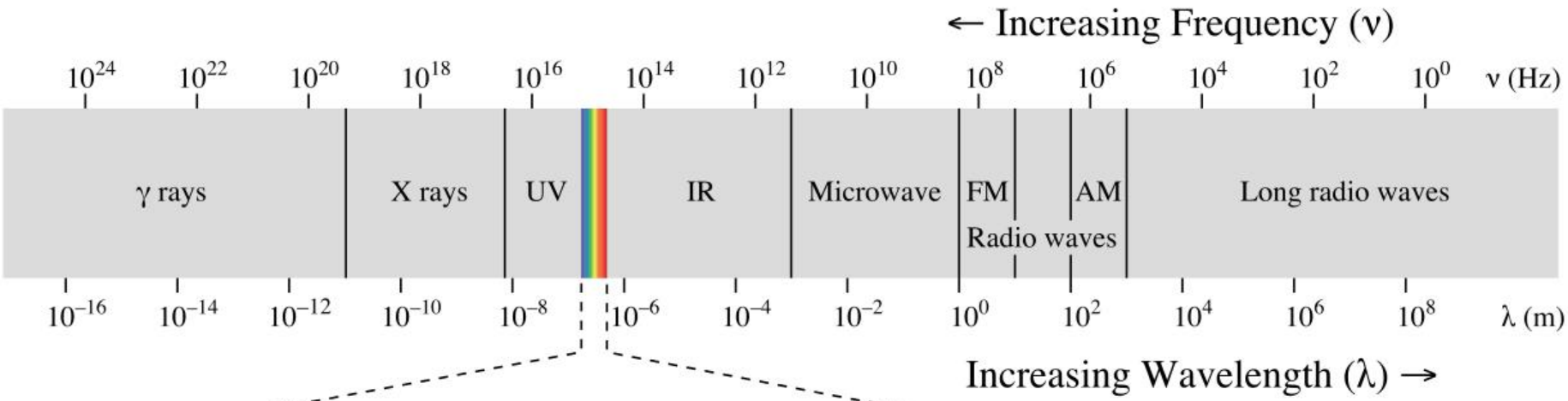
La luce: porzione dello spettro elettromagnetico nel range del visibile

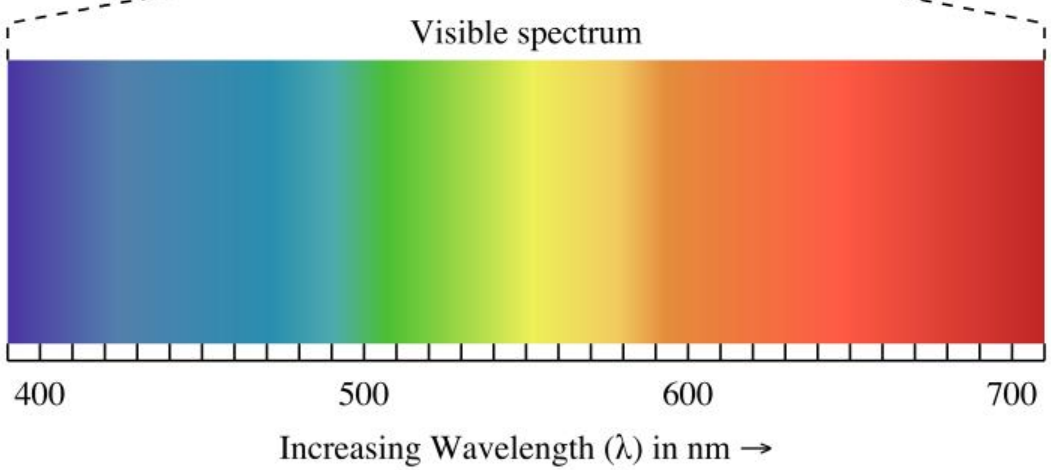


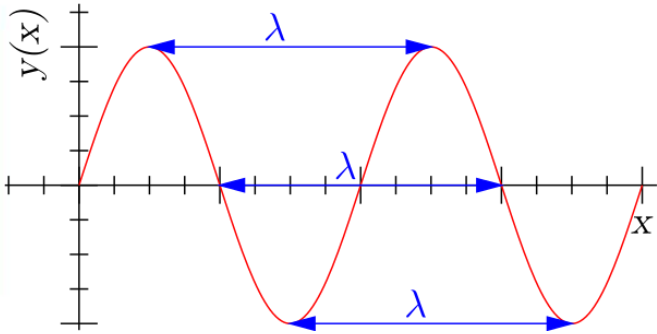




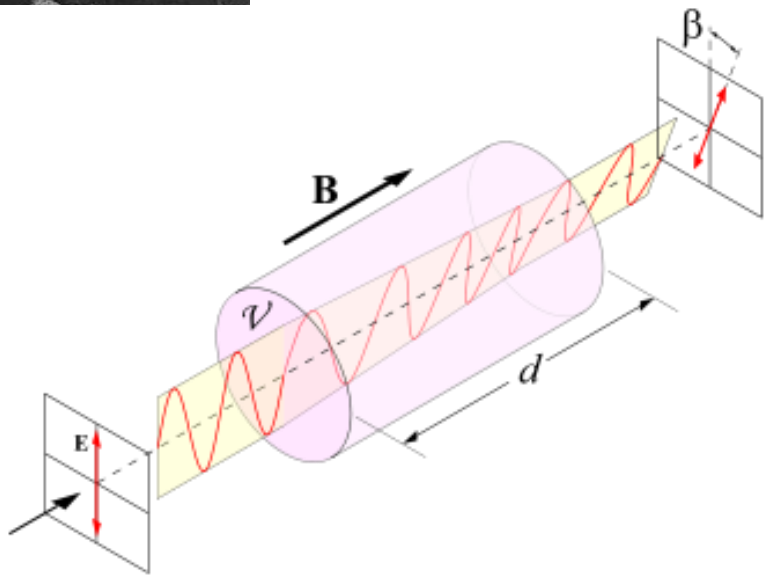
La luce come funzione d'onda

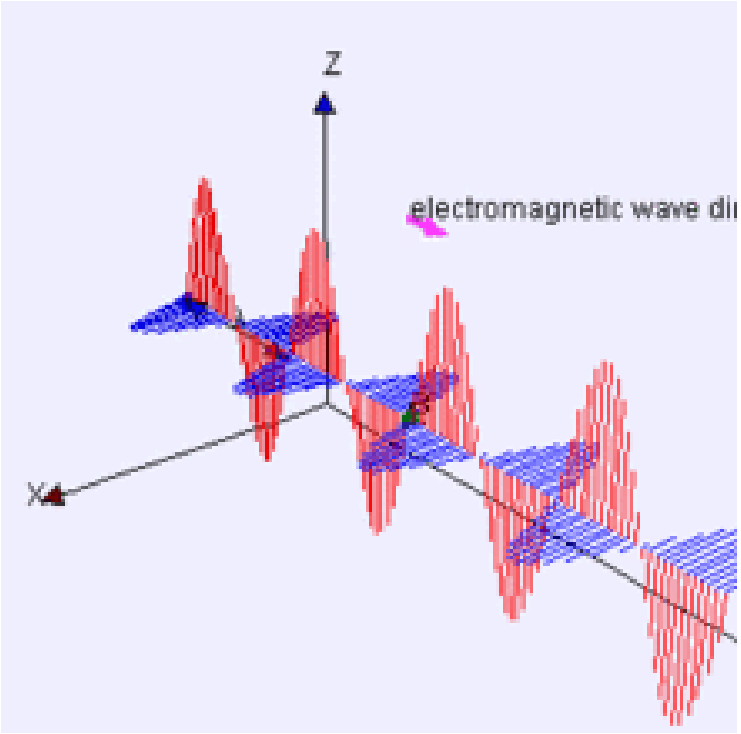






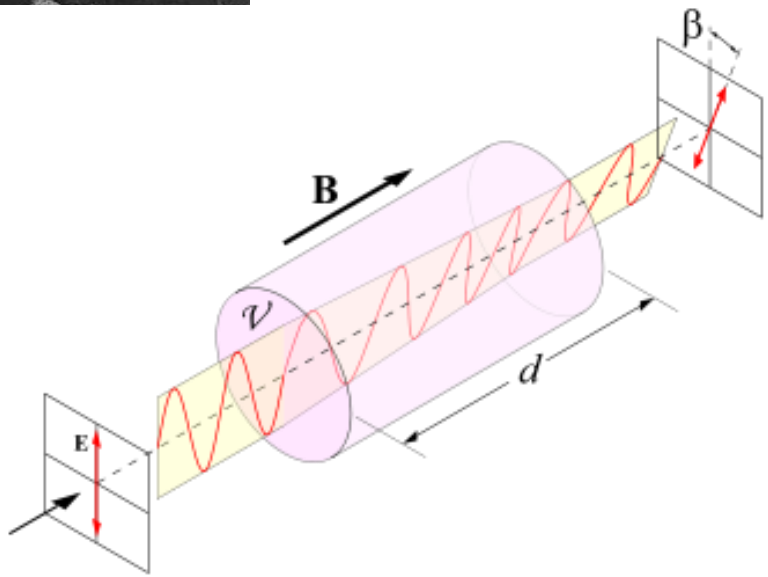
La luce e l’effetto eletromagnetico (Faraday, 1845)

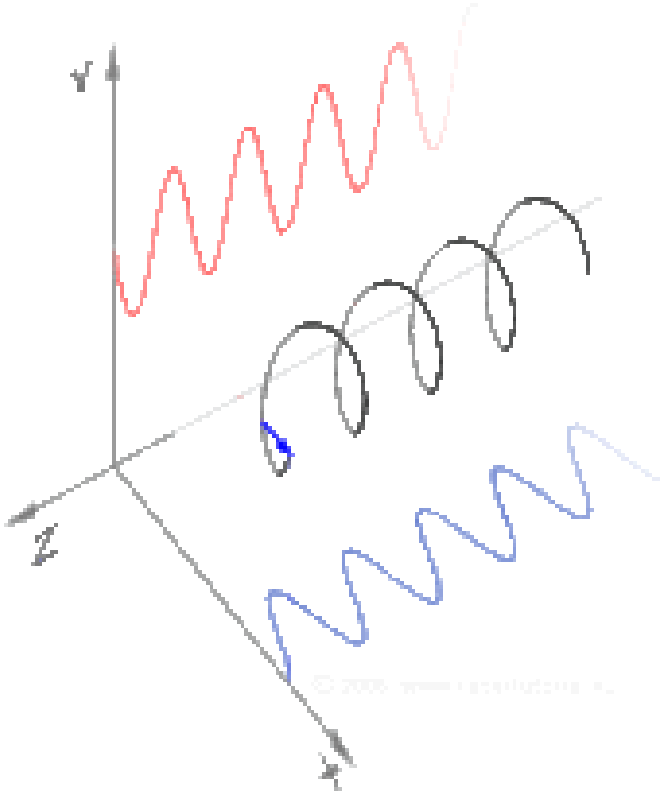




https://www.youtube.com/watch?v=UFEVvsbvlkA

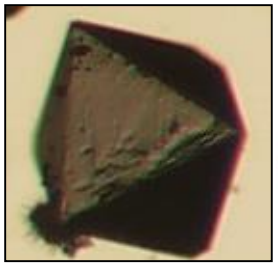
La luce e l'effetto eletromagnetico (Faraday, 1845)

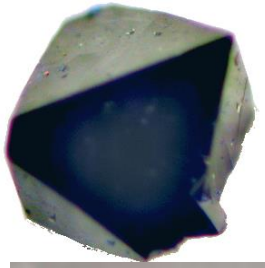




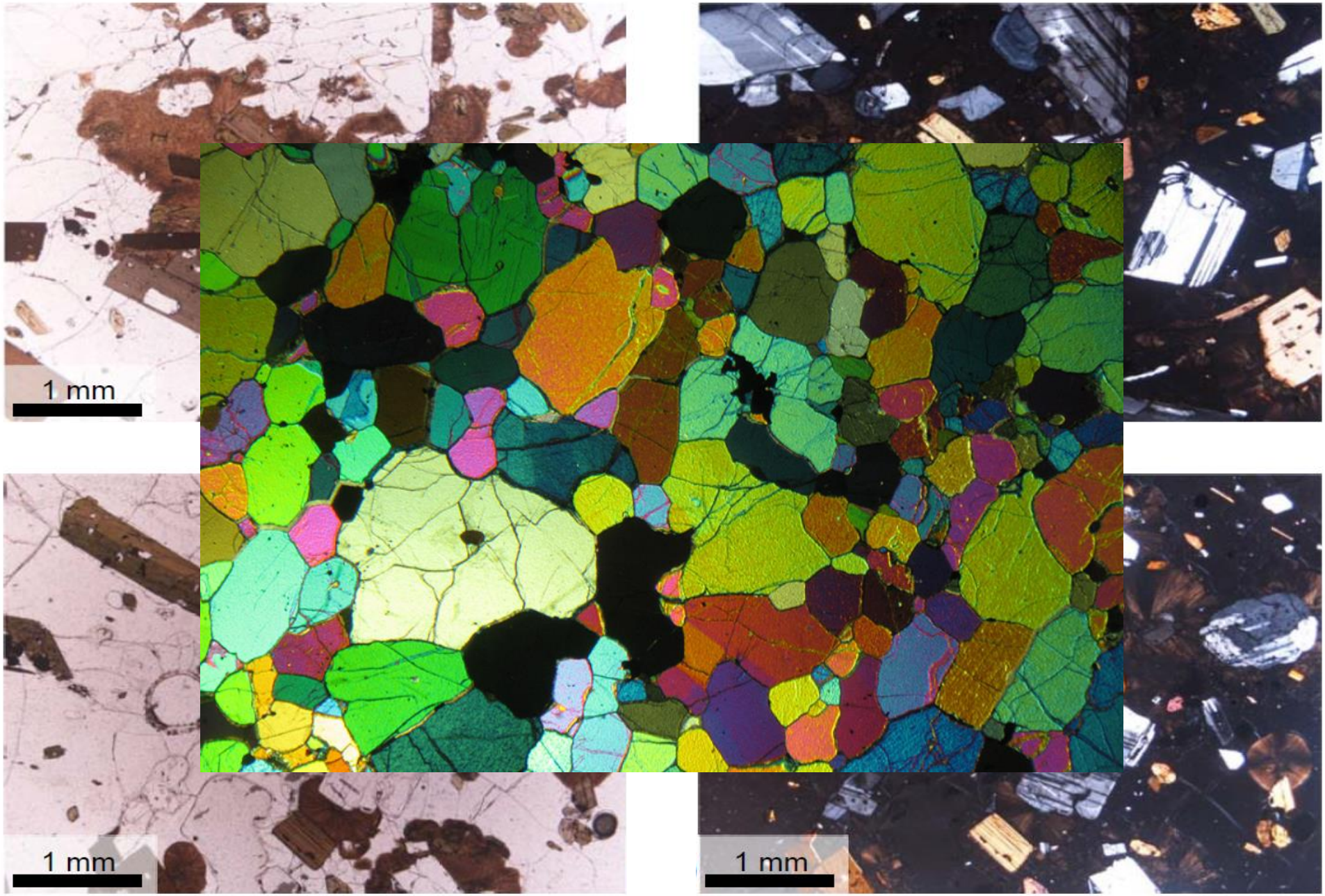
https://www.youtube.com/watch?v=UFEVvsbvlkA

quarzo

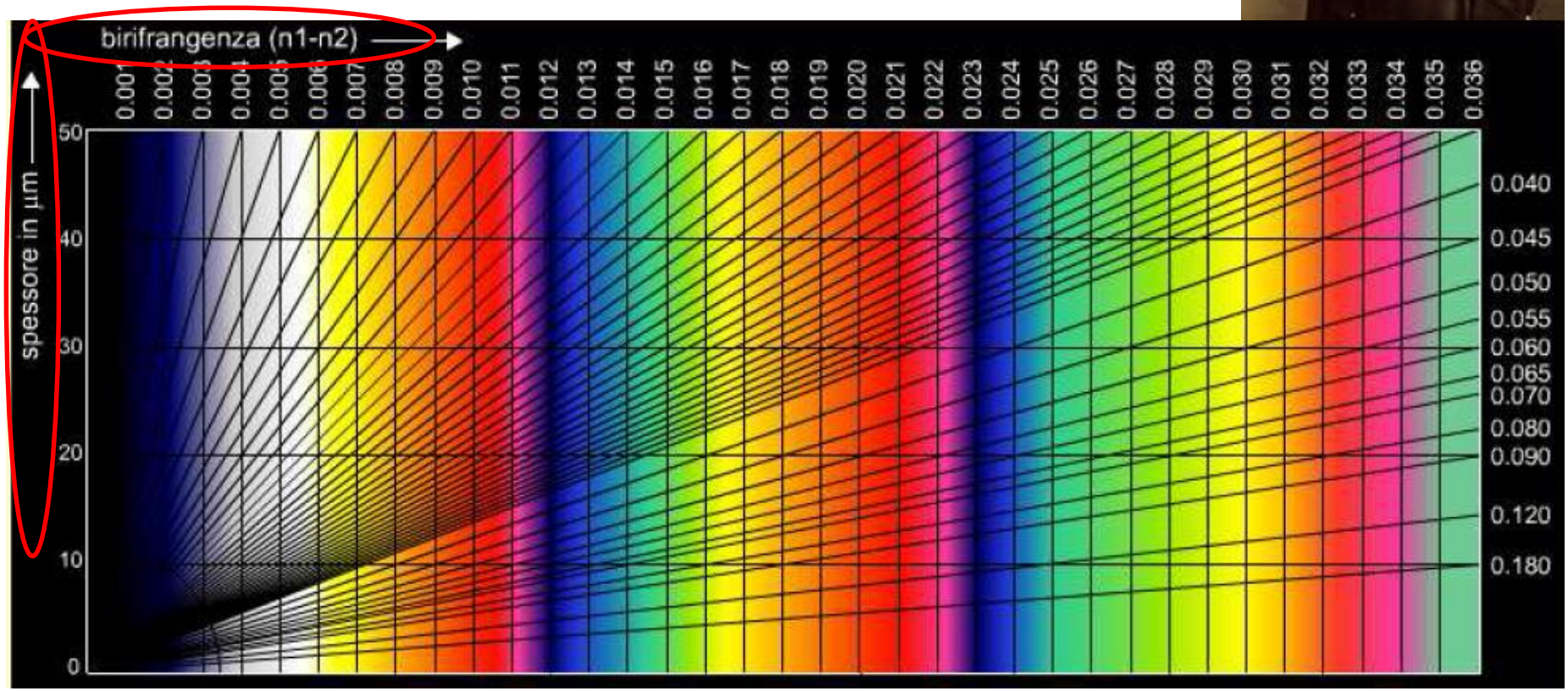




spinello


1 mm
1 mm
1 mm

(August) Michel Levy table

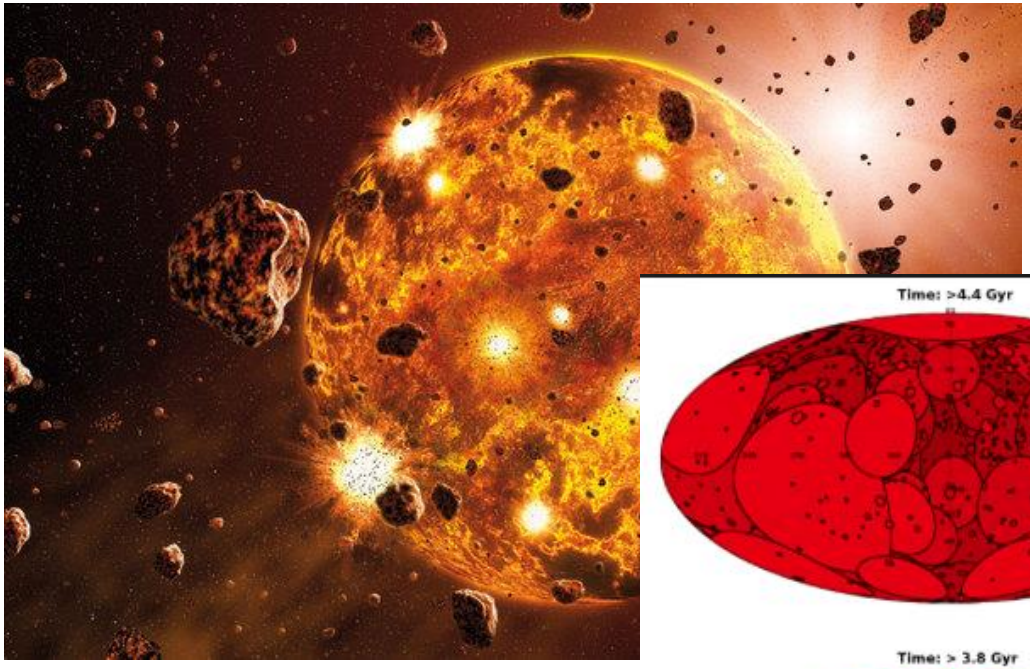


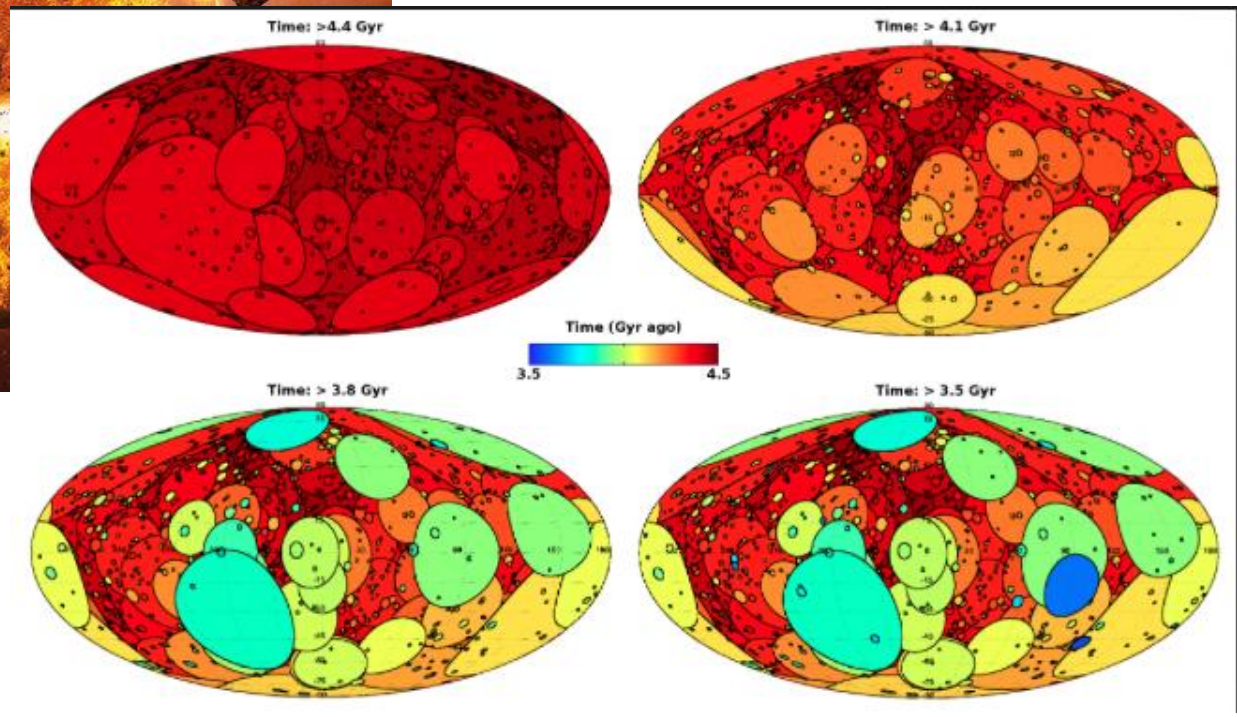
Vedere oltre il visibile

Curiosita'…alla base della scienza

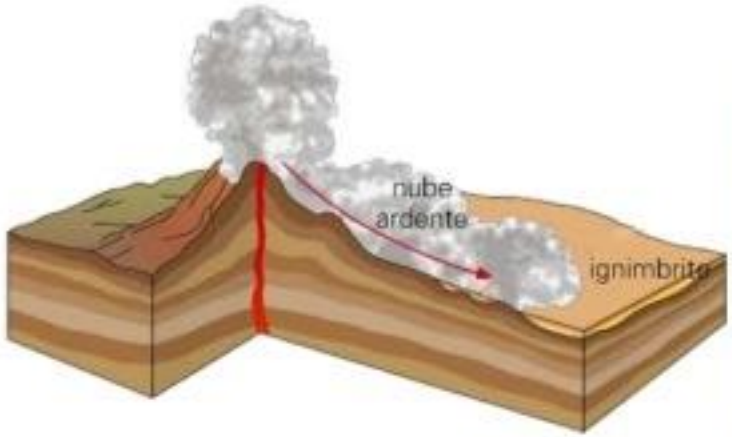
Vedere oltre il visibile

La Terra come doveva essere circa 4 Miliardi di anni fa.

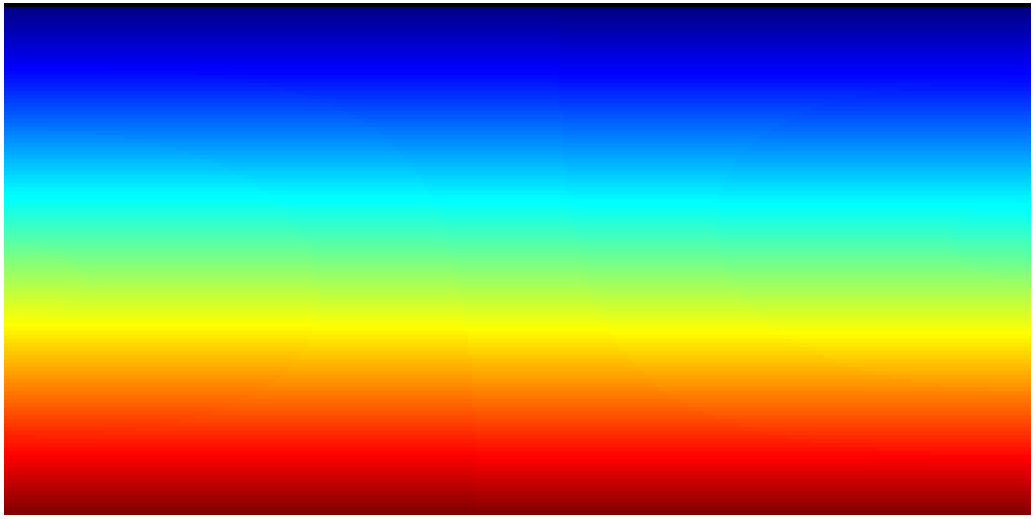




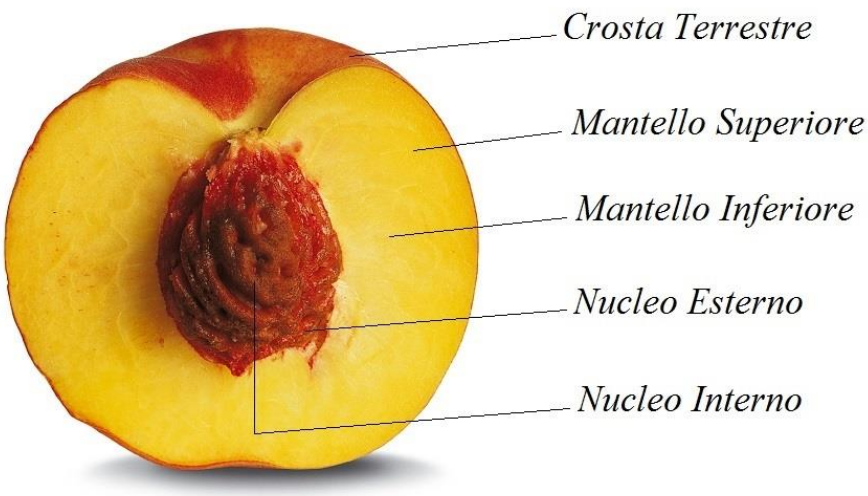
Vedere oltre il visibile…

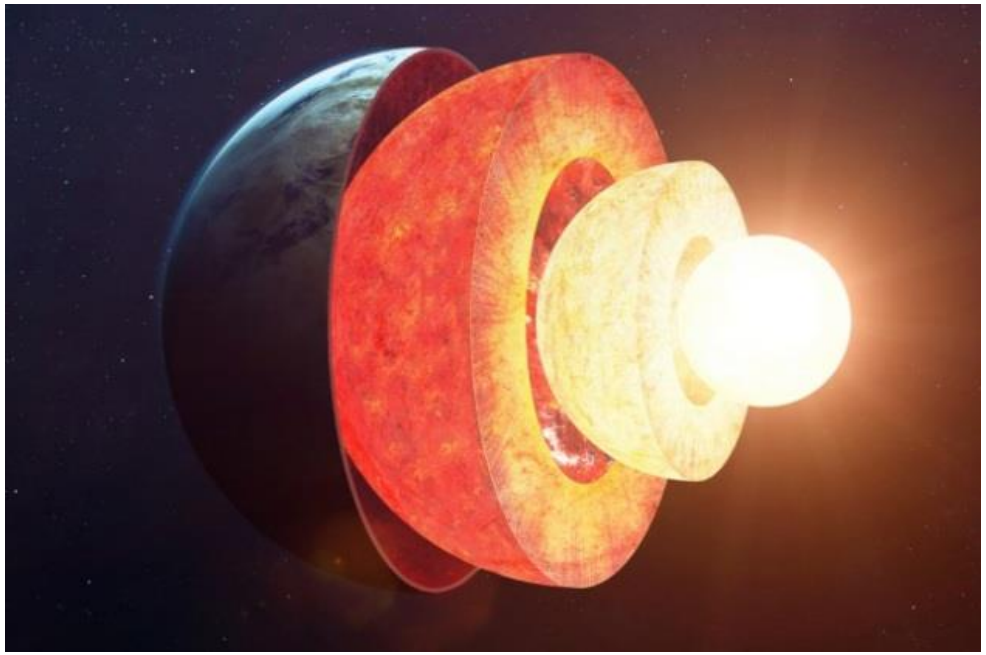


Vedere oltre il visibile…



Vedere oltre il visibile…

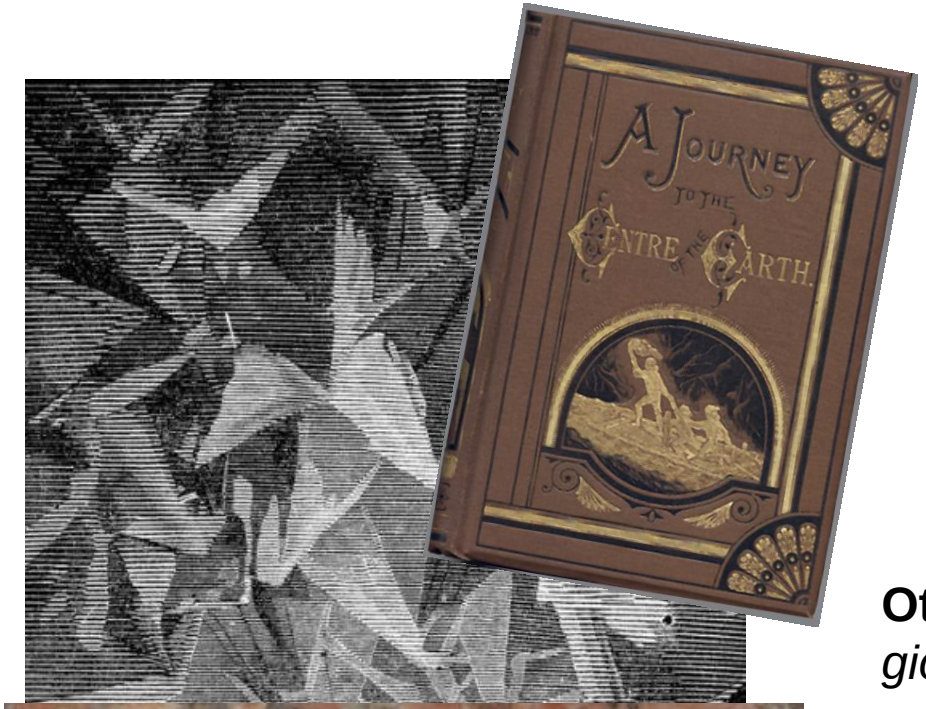


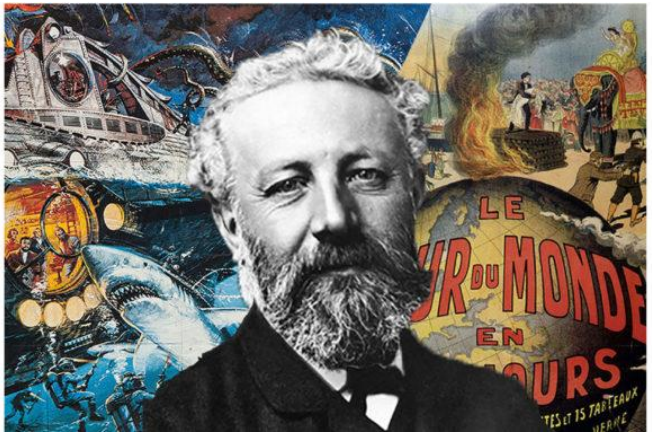


Per comprendere il nostro pianeta e prevedere catastrofi

Mappa di pericolosità sismica del territorio nazionale
LEGENDA
Pericolosità BASSA
Pericolosità MEDIA
Pericolosità ELEVATA
Pericolosità ALTA
Brindisi
Mar Ionio
100
Corriere della Sera

Viaggio al centro della Terra….(J. Verne, 1864)

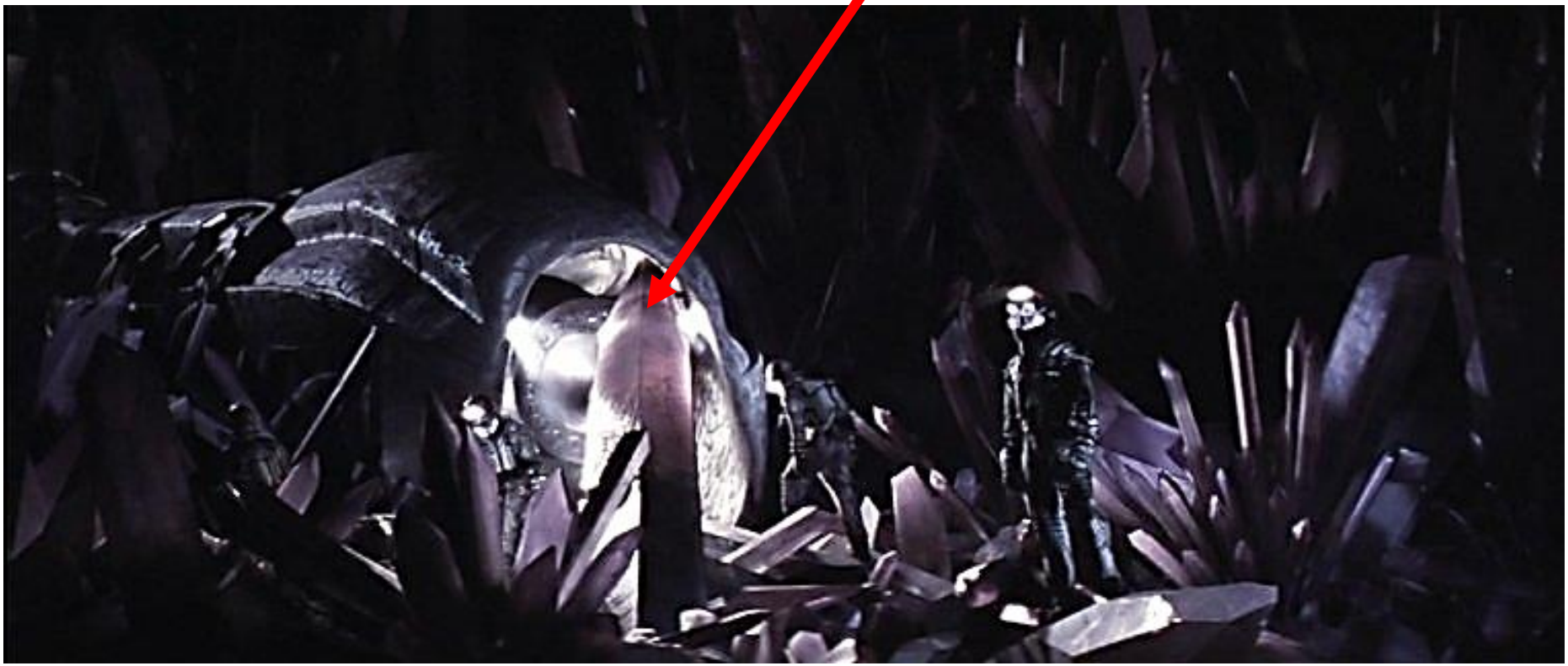




Otto von Lidenbrock: *"Verso le sei, questo gioco di luci si affievolì in modo notevole, fino ad avere quasi del tutto termine; le pareti presero un colore cristallizzato ma cupo; la mica si unì più intimamente al feldspato e al quarzo per creare la roccia intesa in senso classico, la pietra più dura di tutte, quella che sostiene, senza venire schiacciata, i quattro strati del terreno della Terra. Eravamo chiusi in un'immensa prigione di granito."*

Viaggio al centro della Terra….(The Core movie, 2003)

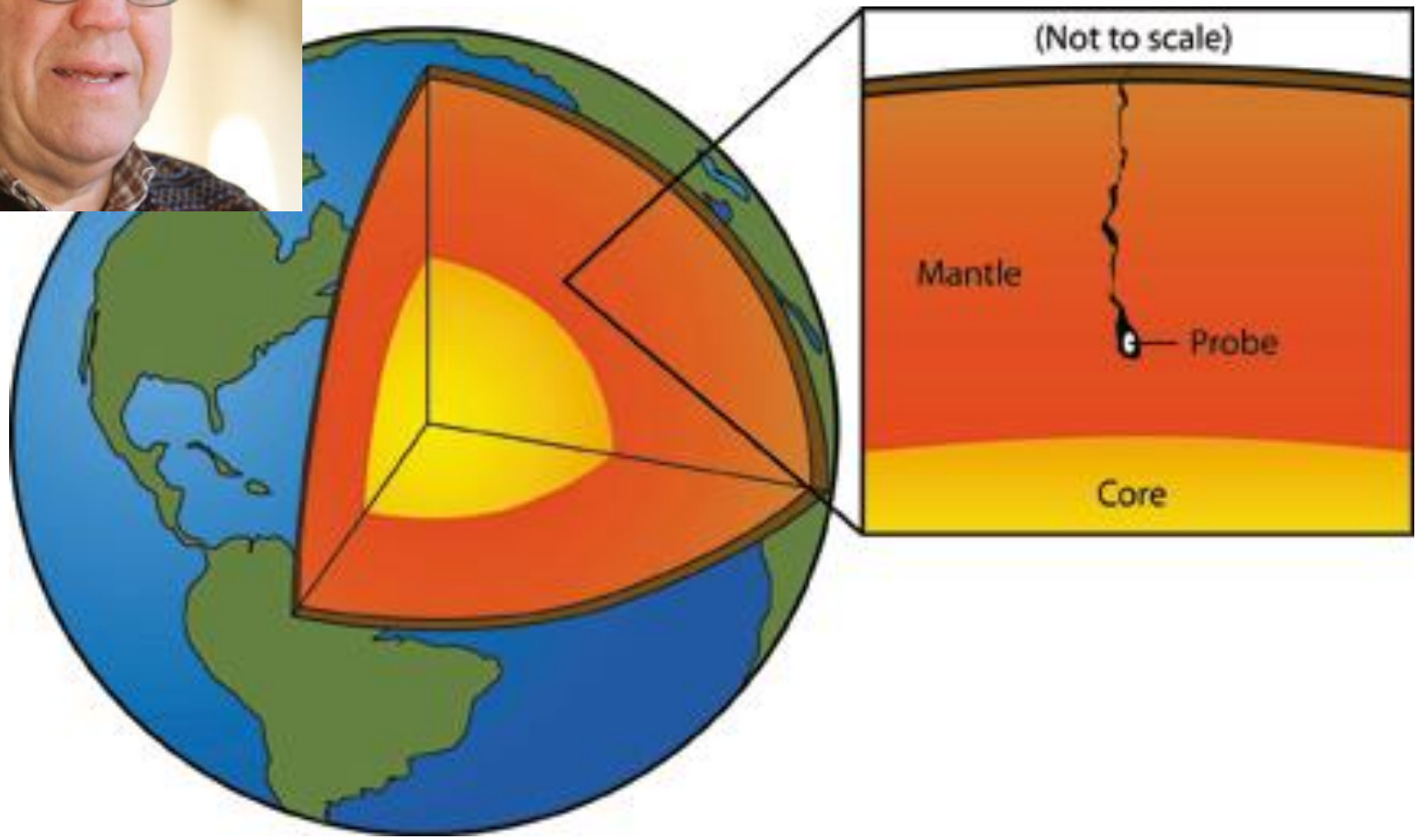
Quarzo ametista e vuoti nel mantello profondo??!



Mission to Earth's core — a modest proposal

Not science fiction, but a technically feasible plan to probe our planet's inner workings.

Dave Stevenson (2003)

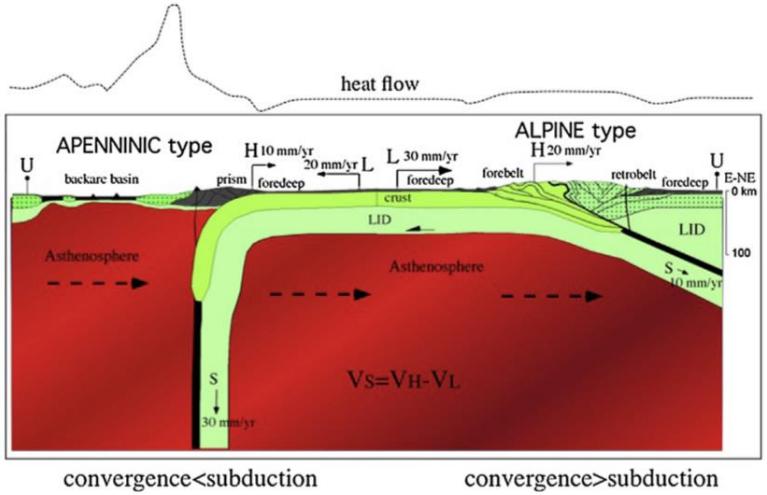


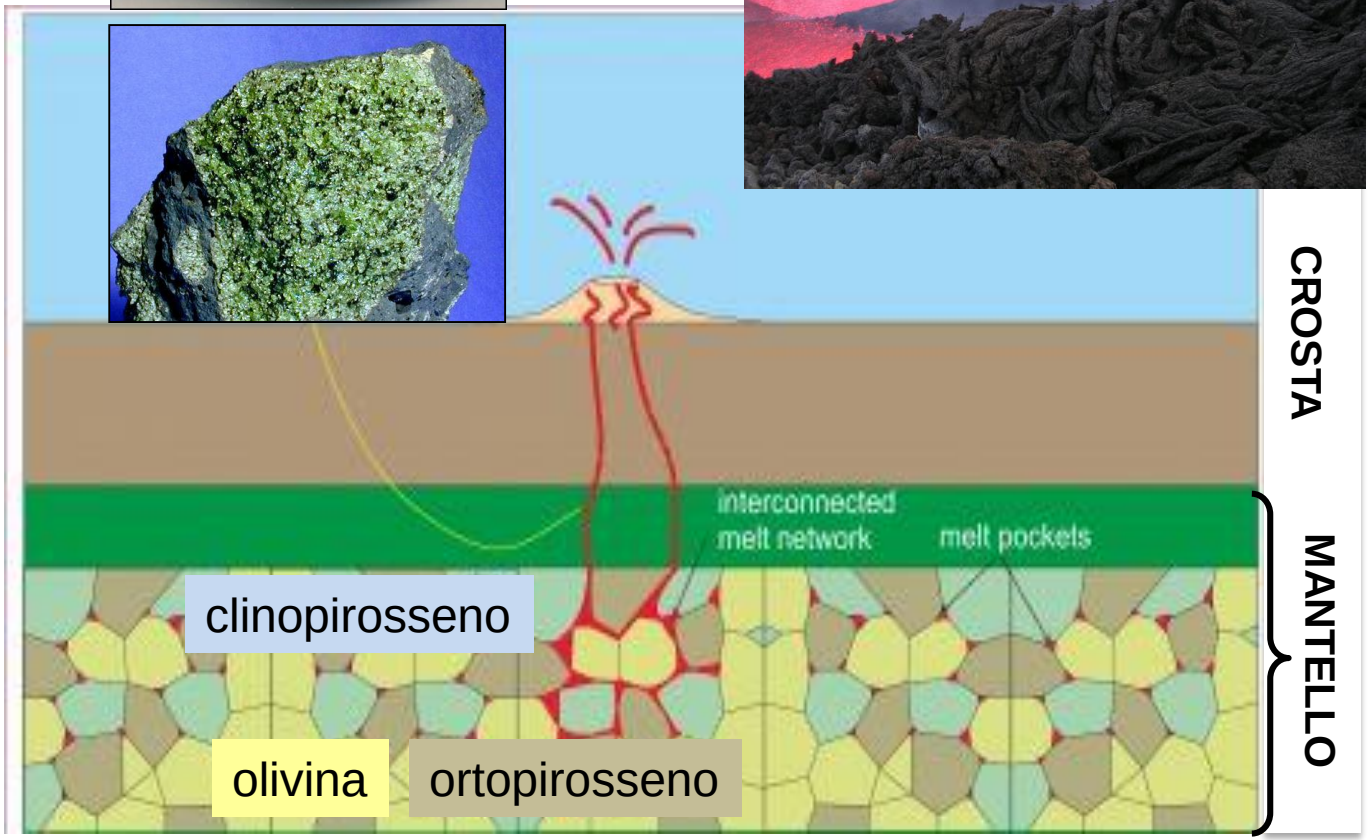
- Composizione della proto-Terra

- Terremoti

Ipocentro ~678 km (!)

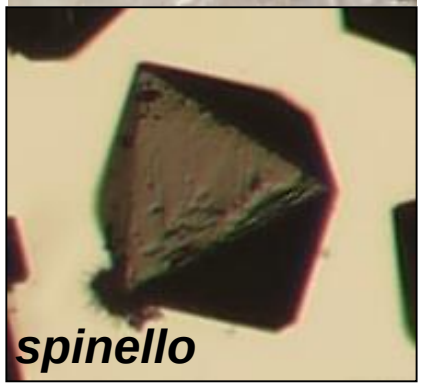
Chichi-jima (Tokyo)



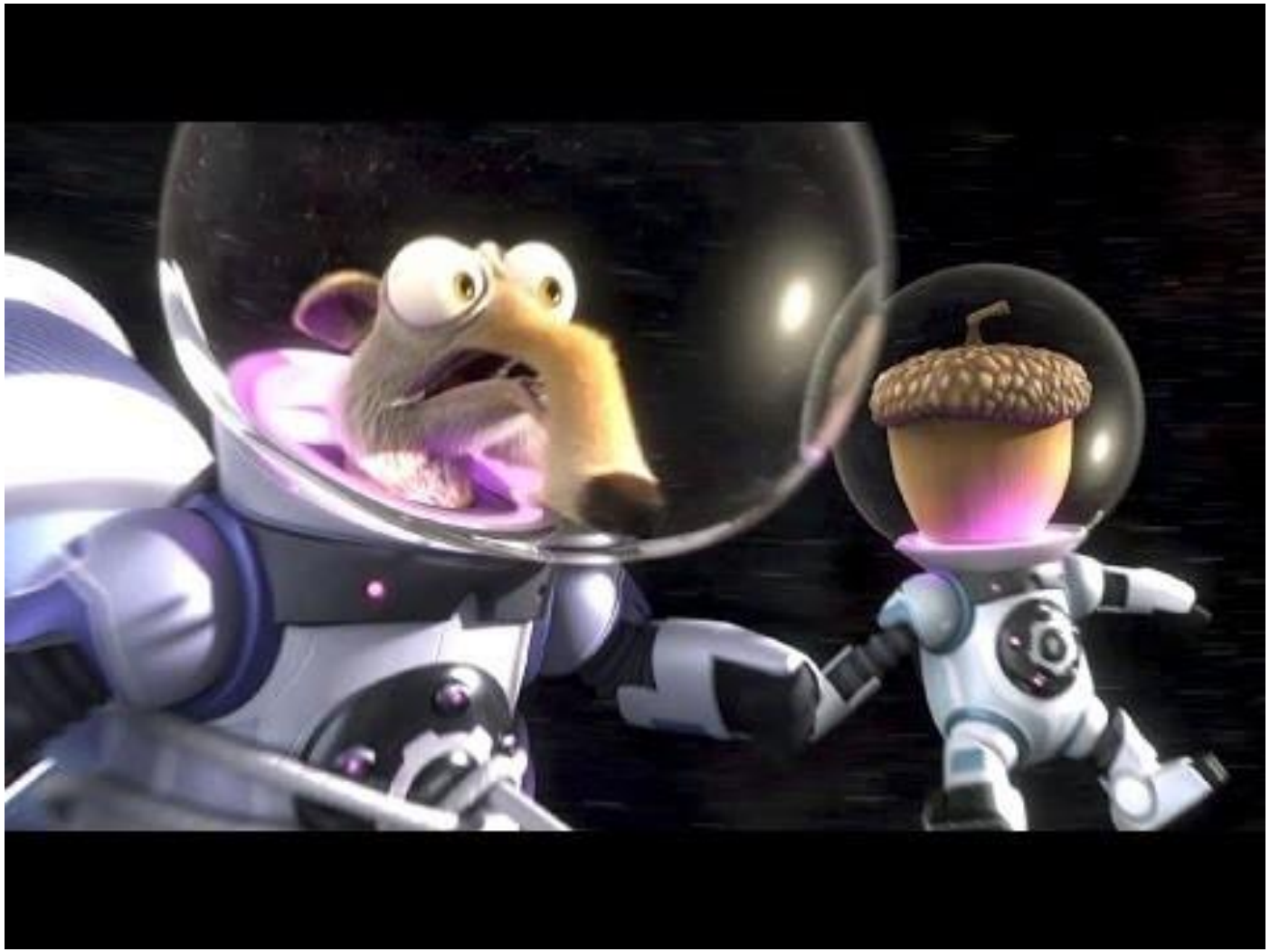

interconnected
melt network
melt pockets
clinopirosseno
olivina
ortopirosseno
CROSTA
MANTELLO

olivina

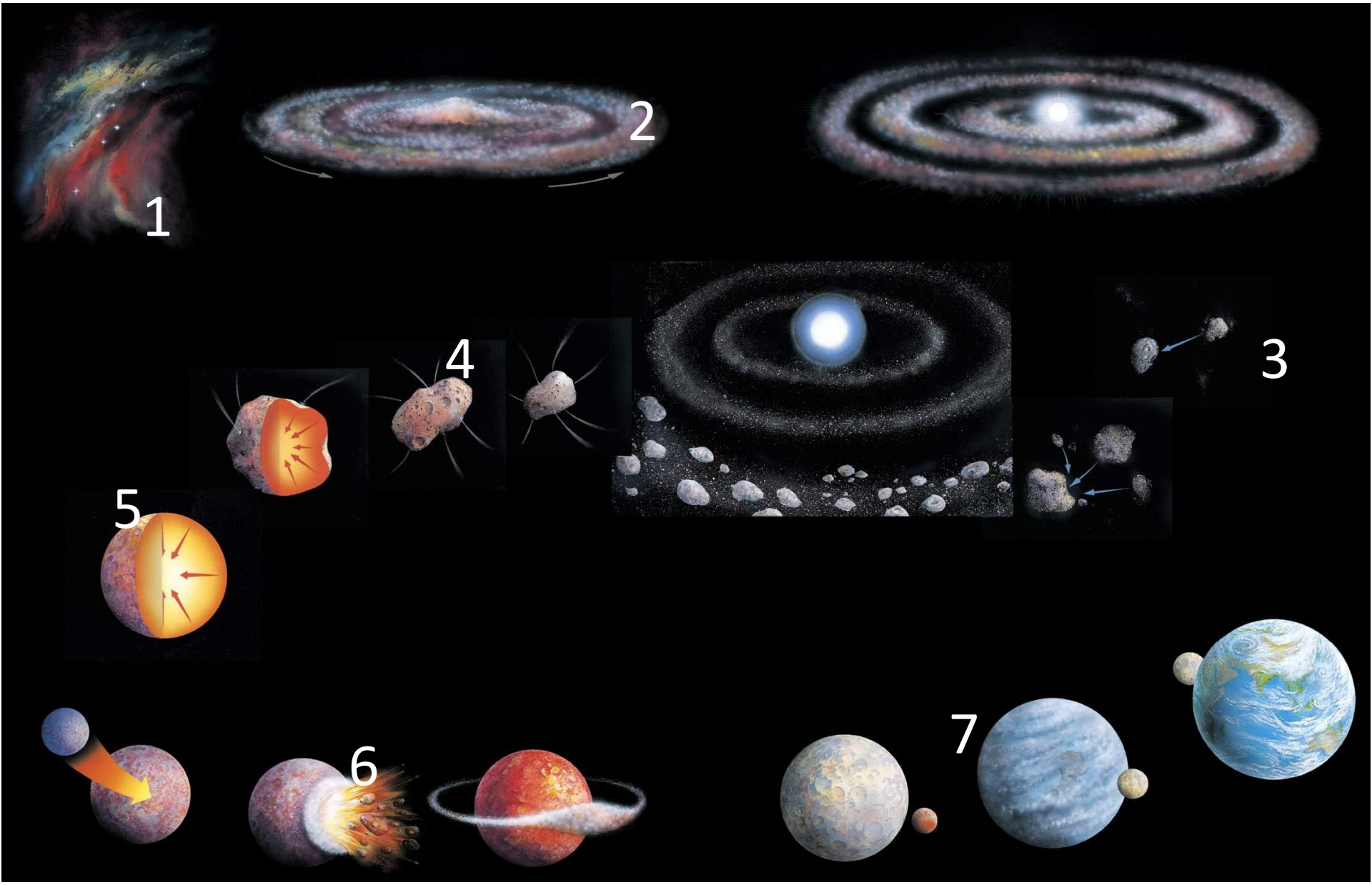
granato


spinello

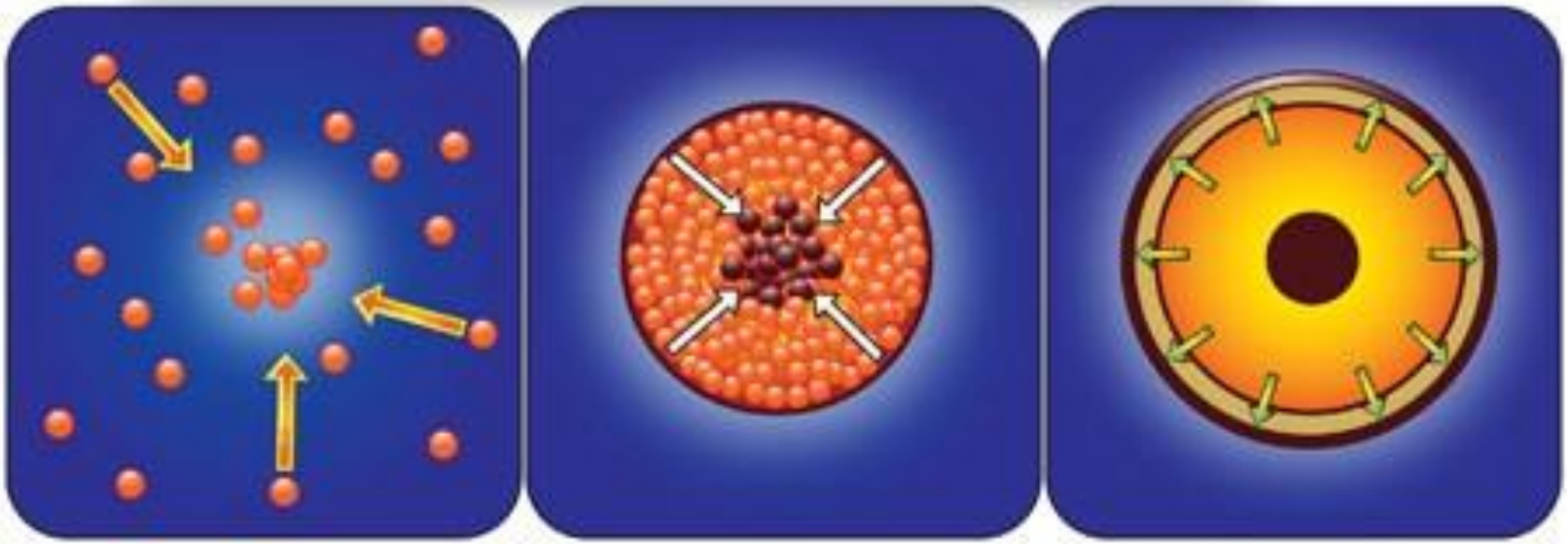
Come si e’ formata la Terra



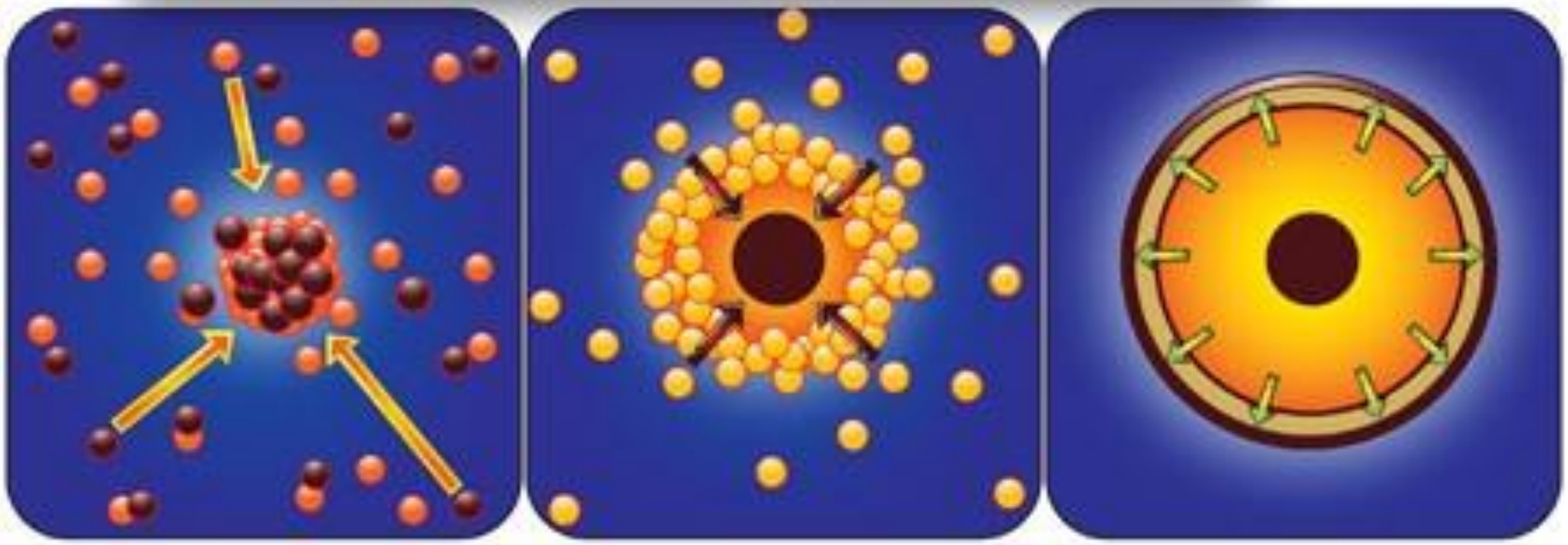
Come si e' formata la Terra



Homogenous accretion



Heterogeneous accretion



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Chondrites

- Carbonaceous
  - CI
  - CM
  - CO
  - CV
  - CK
  - CR
  - CH
  - CB
- Ordinary
  - H
  - L
  - LL
- Ungrouped
- Kakangari
- Rumuruti
- Enstatite
  - EL
  - EH

Metachondrites

- CV
- CR
- En
- H

Achondrites

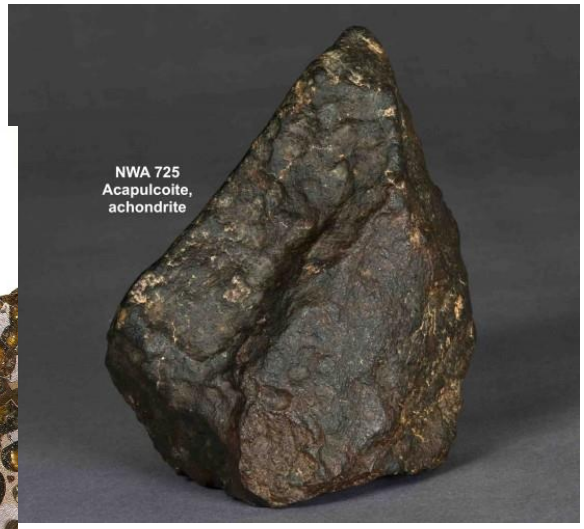
- Primitive
  - Acapulcoites
  - Winonaites
  - Lodranites
  - Brachinites
  - Ungrouped
- Enstatite
- Aubrites
- Angrites
- HED
  - Eucrites
  - Diogenites
  - Howardites
  - Dunite
- Ureilites
- Lunar Meteorites
  - Breccias
  - Basalts
  - Gabbros
- Martian Meteorites
  - Shegottites
  - Nakhlites
  - Chassigny

Stony-Iron Meteorites

- Pallasites
- Mesosiderites

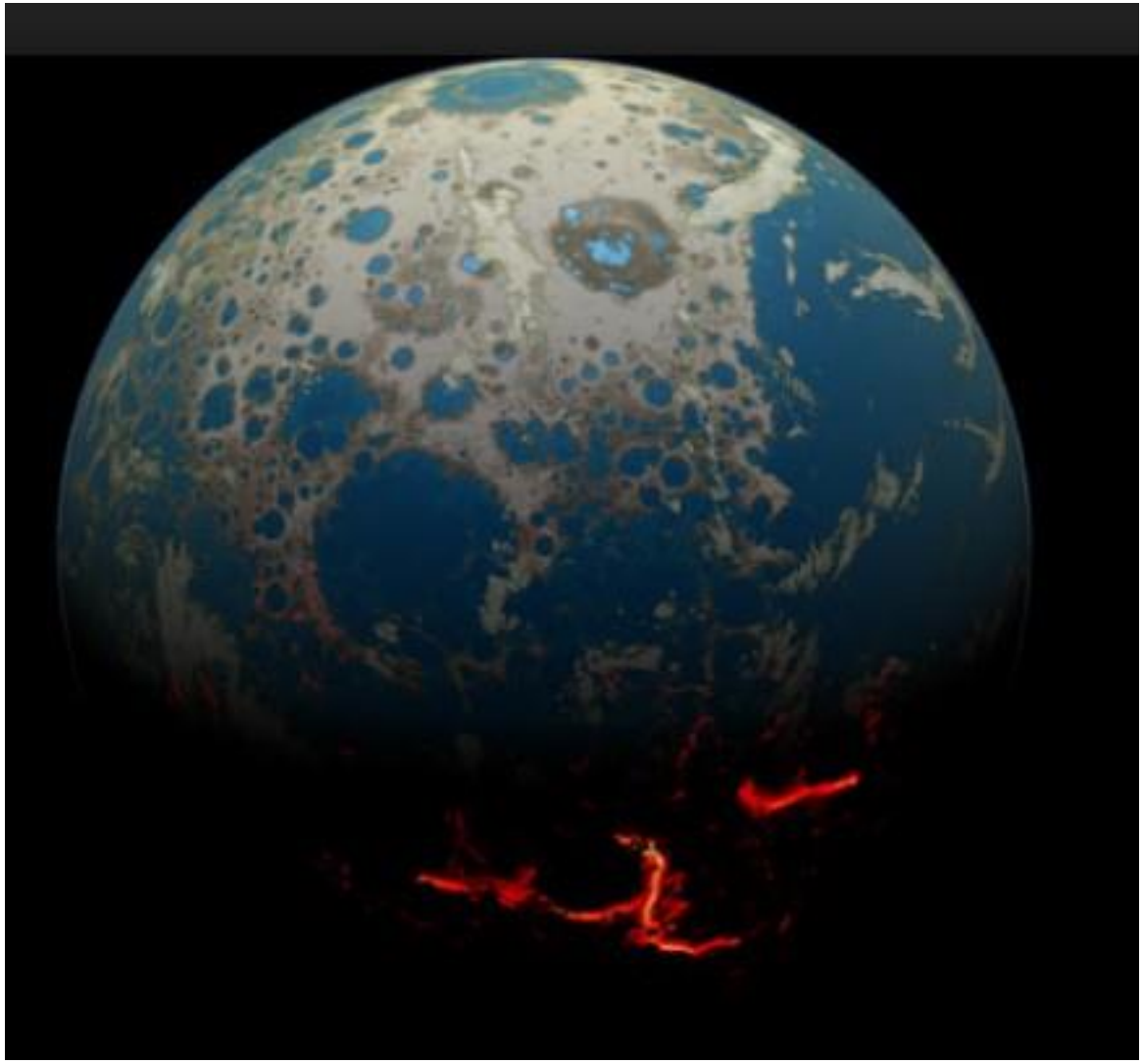
Ivuna, CI Carbonaceous Chondrite

© Natural History Museum, London.
(Image courtesy of the Natural History Museum, London.)

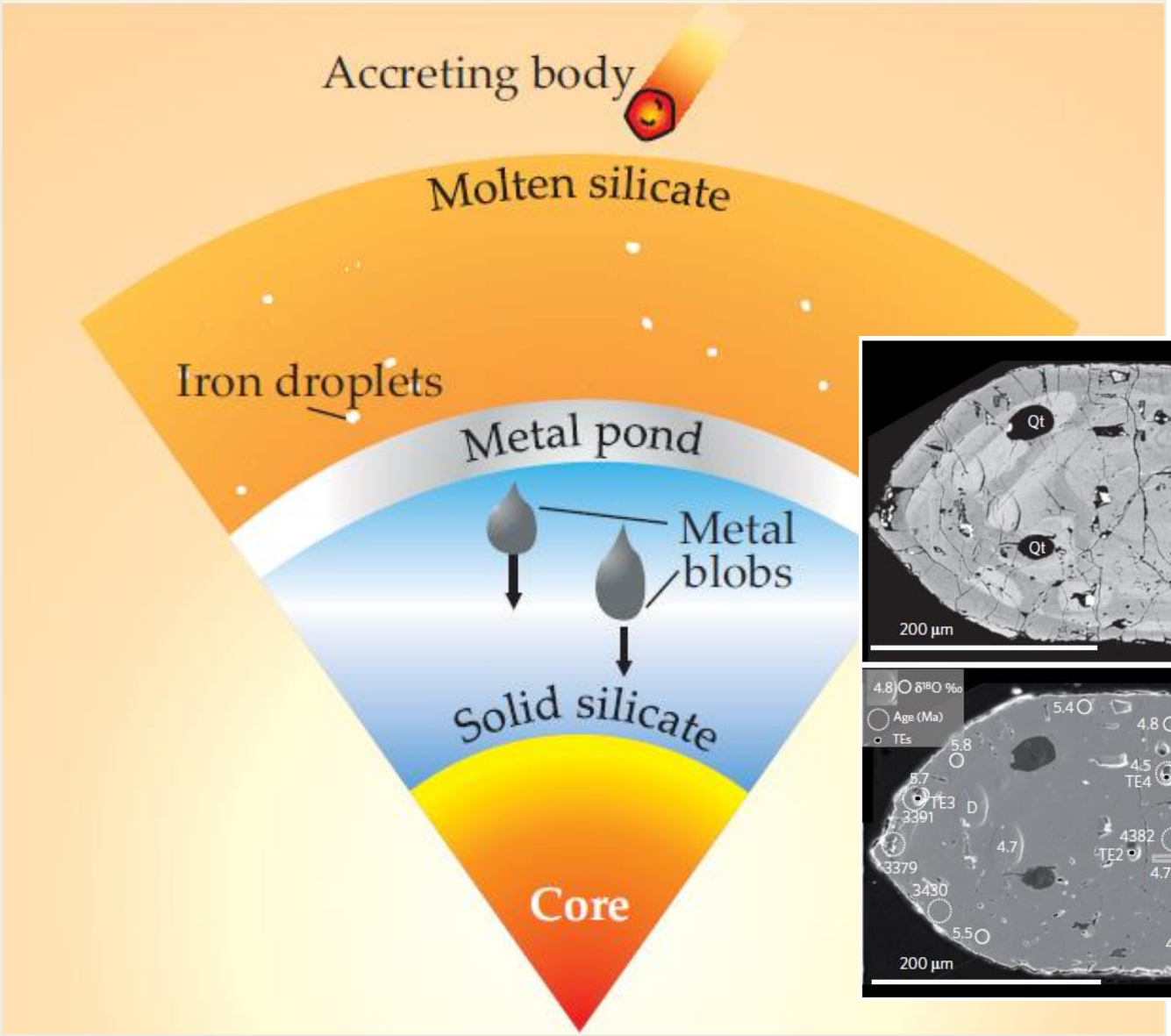


Brenham Pallasite. Photograph by Geoffrey Notkin © Aerolite Meteorites; Monnig Meteorite Gallery.

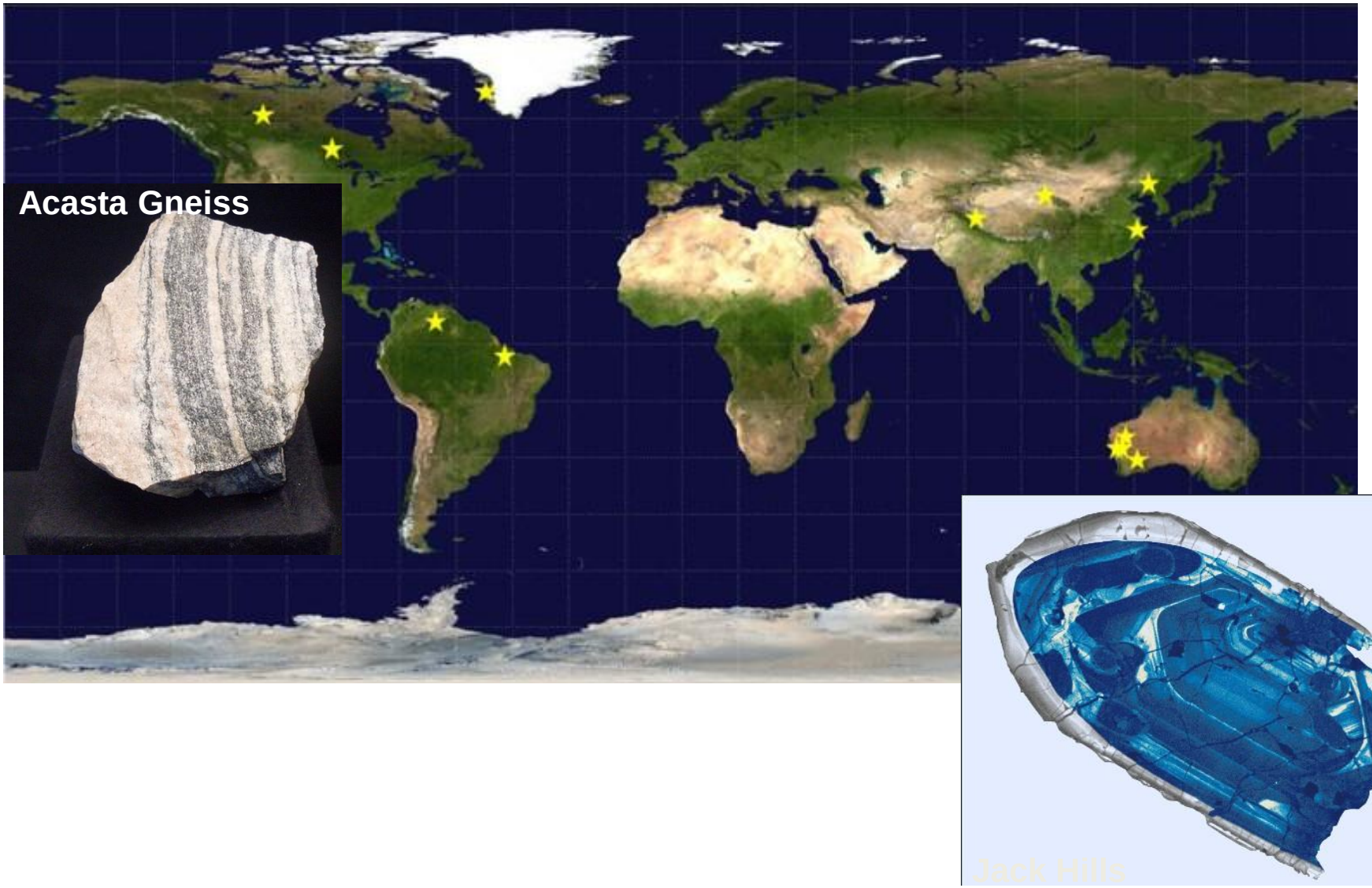
Un oceano di magma



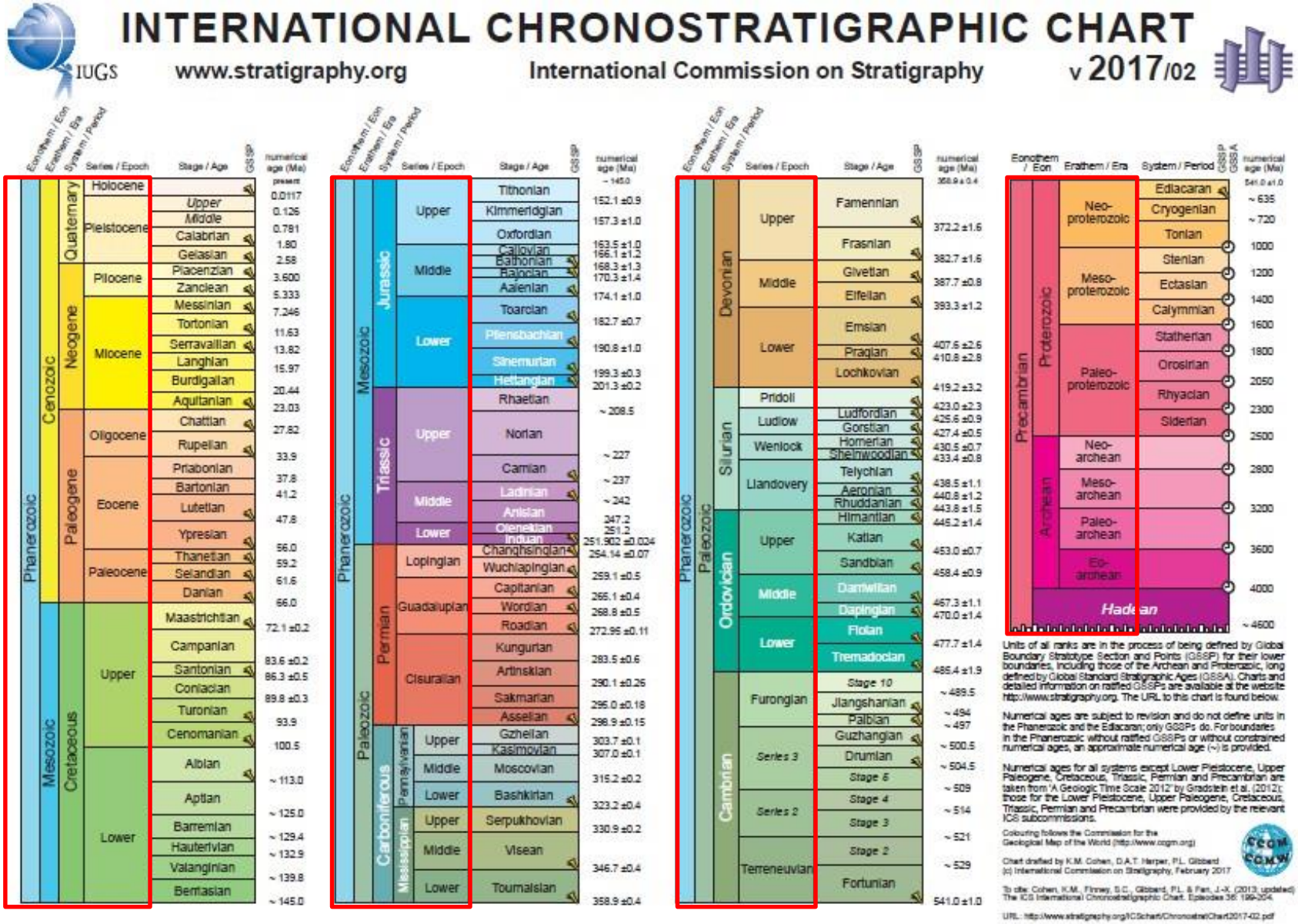
A magma ocean



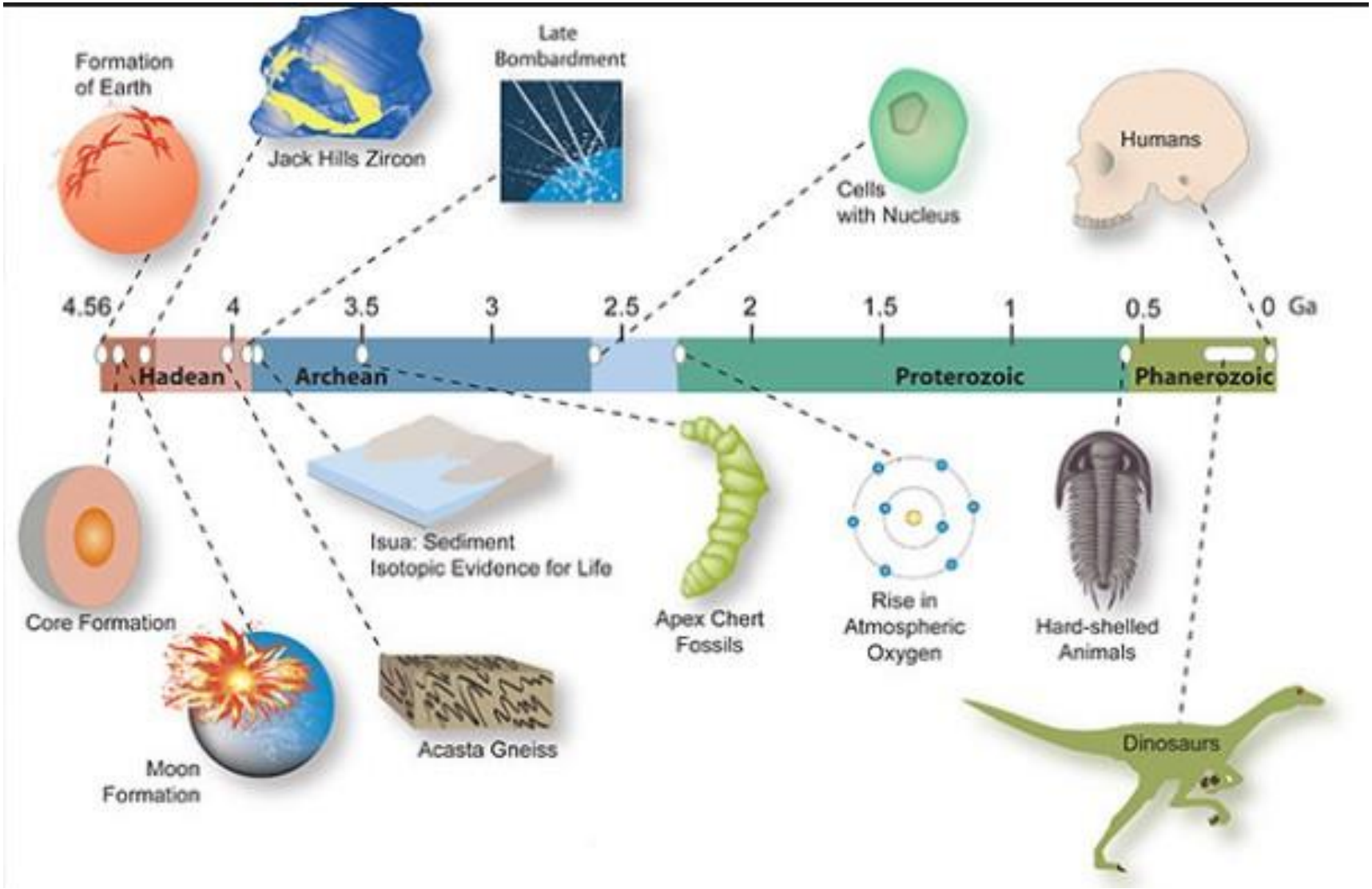
Eta’ della Terra



La Terra nel corso delle ere geologiche



La Terra nel corso delle ere geologiche



Ice Age 4, Scrat Continental Crack

Ice Age 4, Scrat Continental Crack

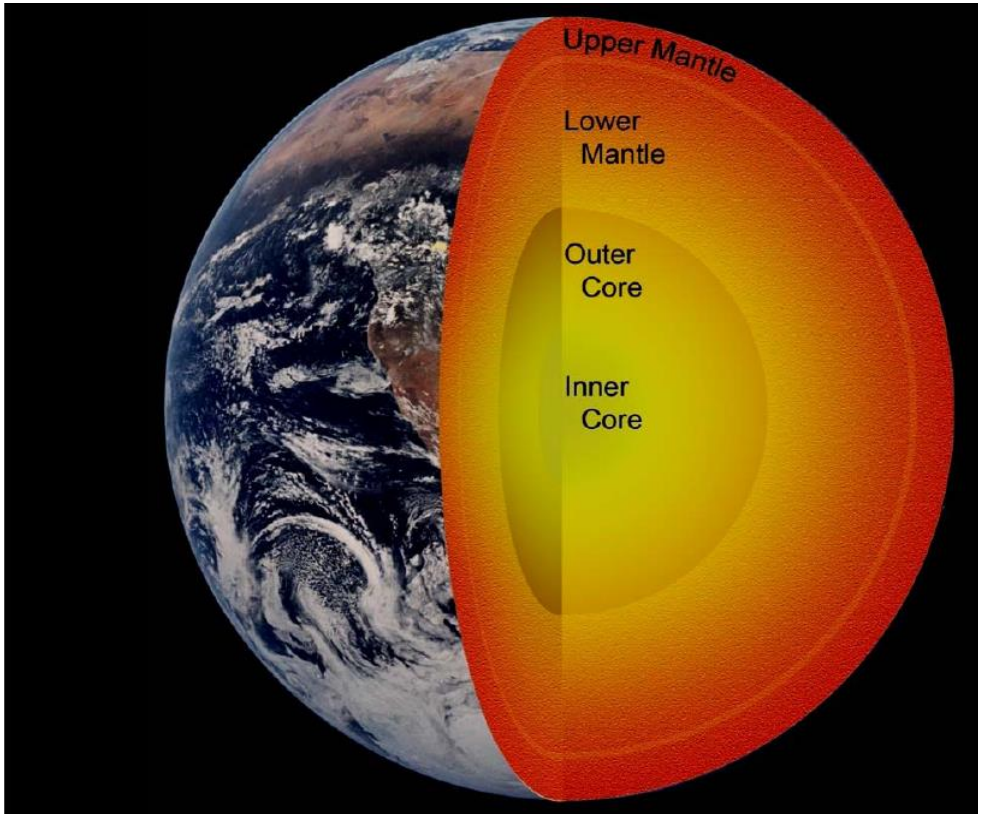
Thermal gradient

3 °C/100m = 30 °C/km

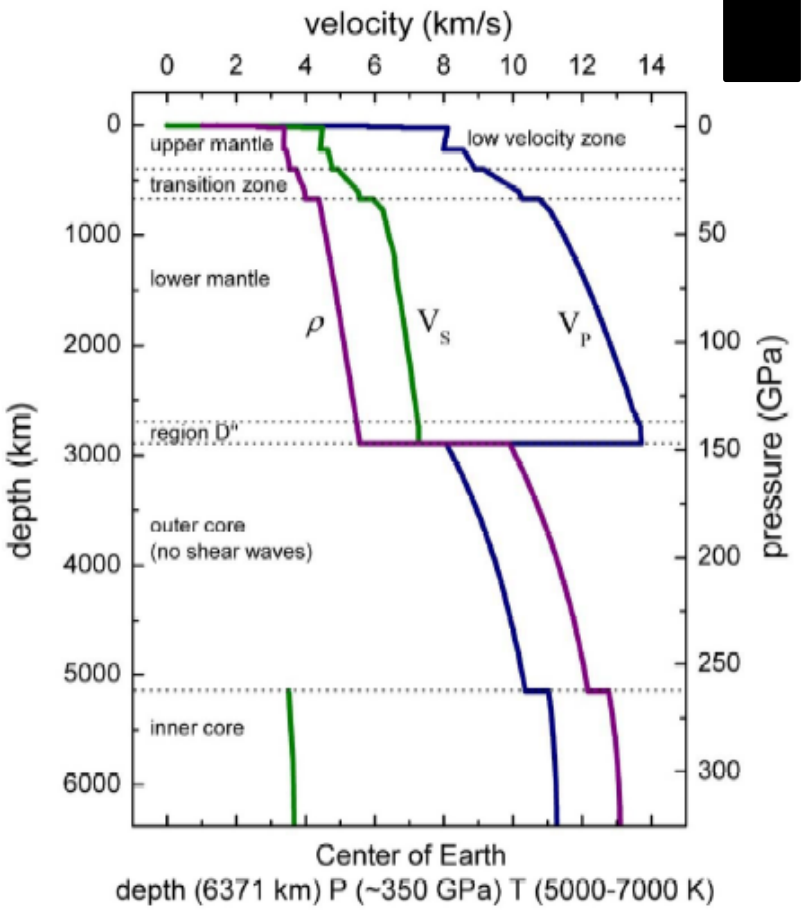
Inner core
Radius of 1200 km
T = 5400 °C

How well do we know the planet were we live on?

Earth



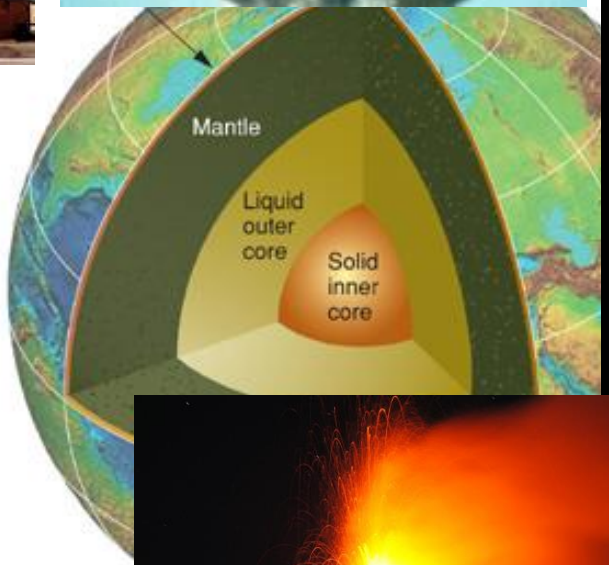
modello PREM



Dziewonski and Anderson 1981

Kola borehole (12.226 km)

(200 – >600 km)

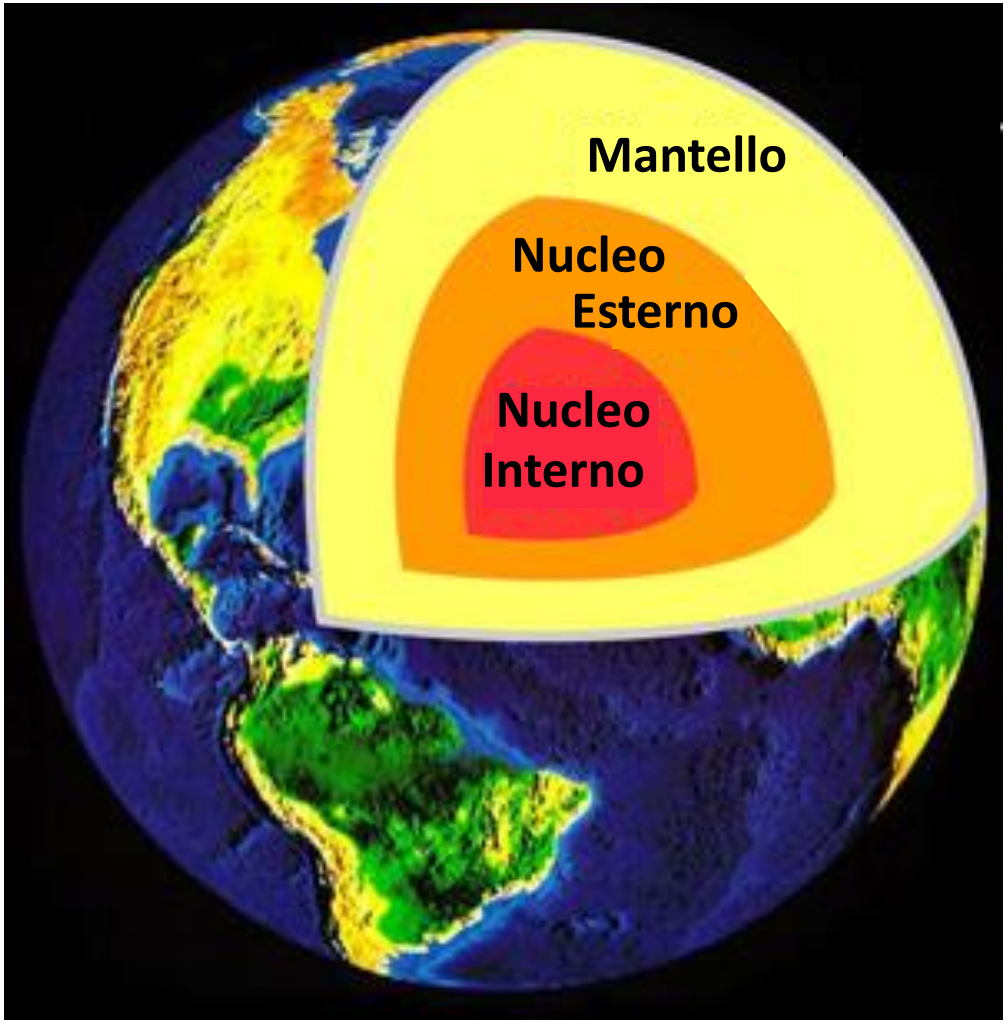


oliths (8 – 200 km)

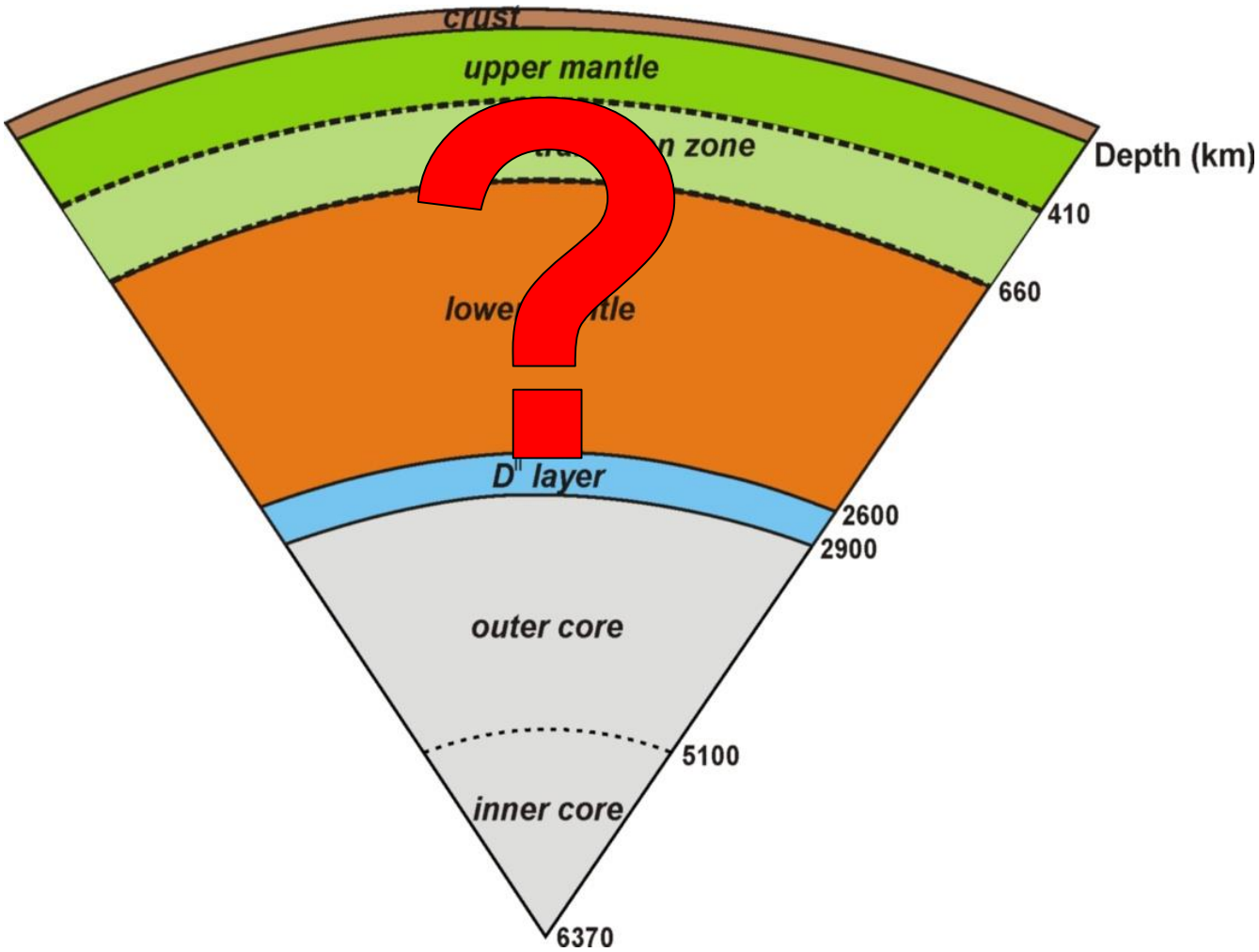
Chayvo field, Russia (12.376 km)

Etna, Italy (8-15 km)

Interno della Terra



Composizione mineralogica del mantello profondo ~2900 km



Petrologia sperimentale

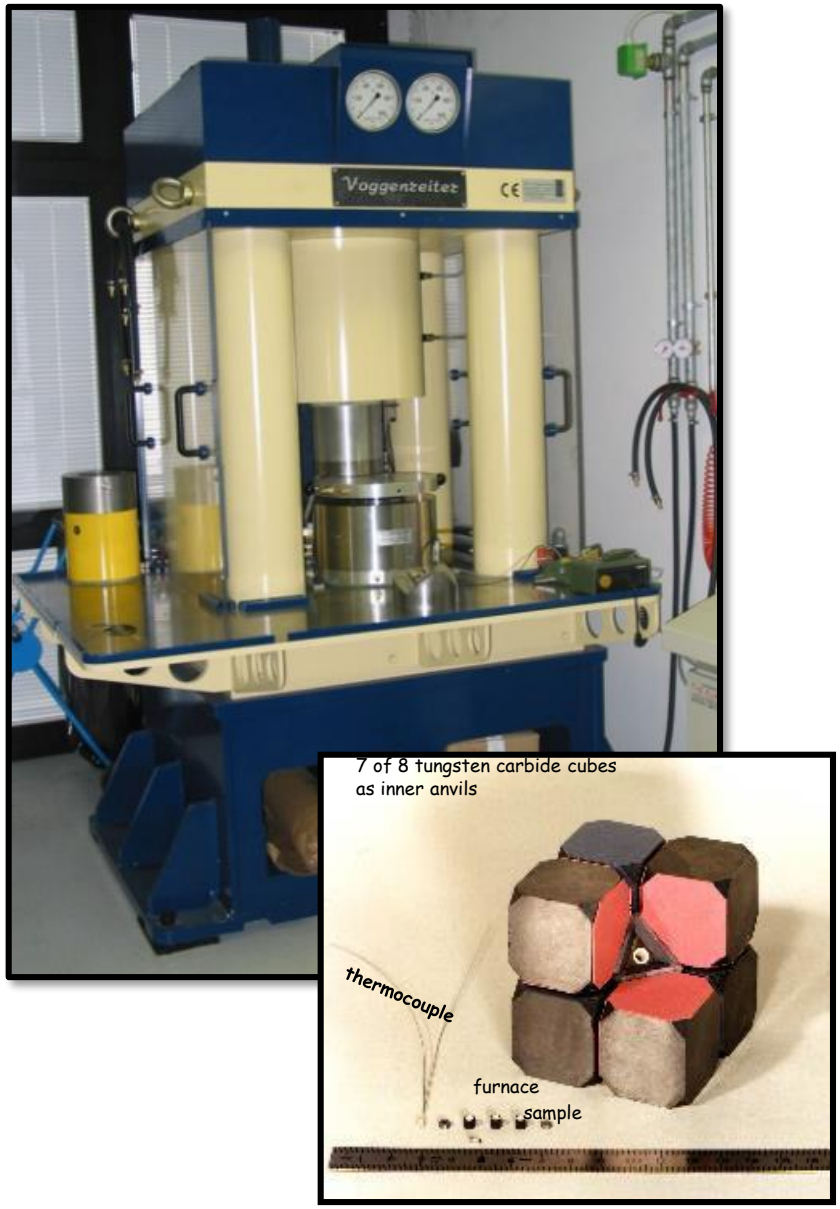
Riprodurre in laboratorio le condizioni di

- ***pressione***
- ***temperatura***
- ***composizione chimica***

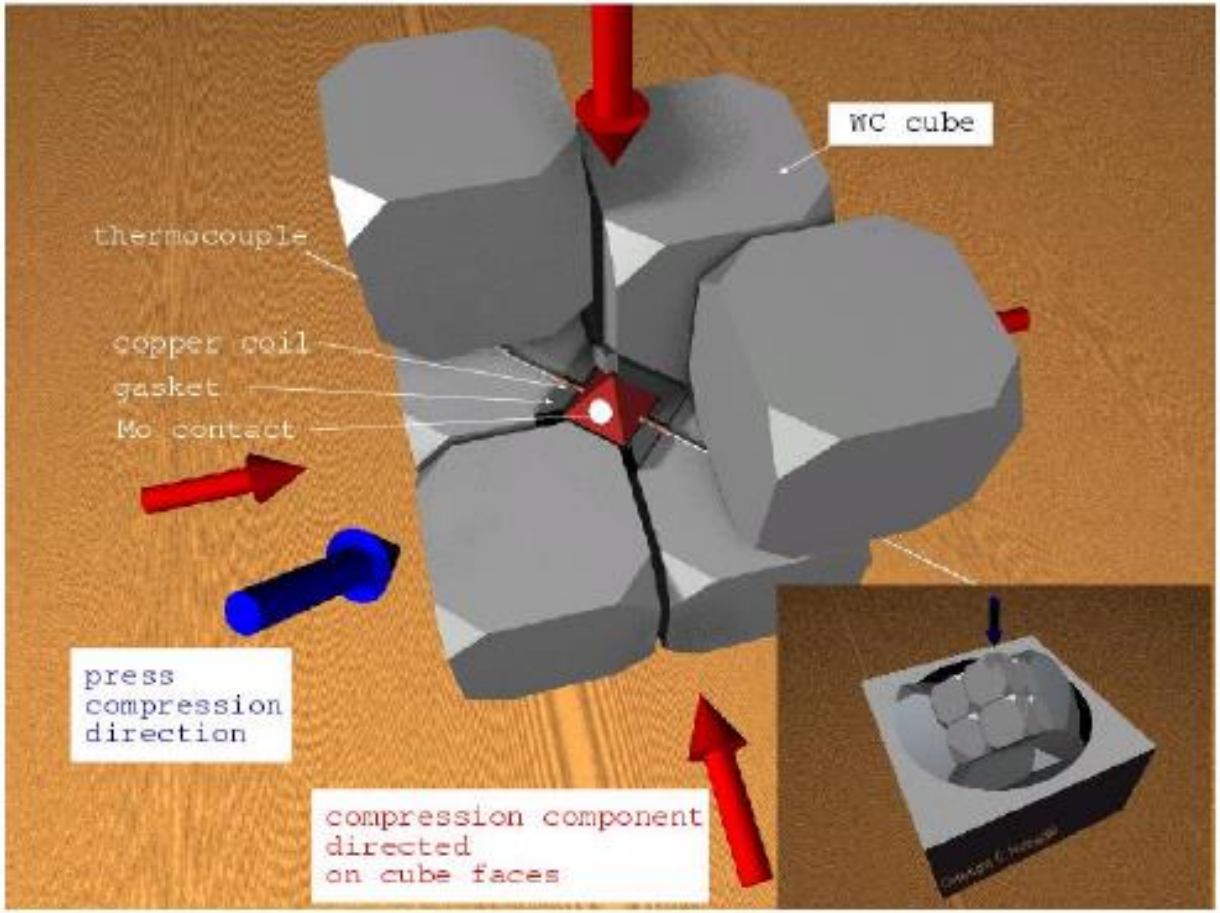
dell' interno della Terra per conoscerne la composizione mineralogica

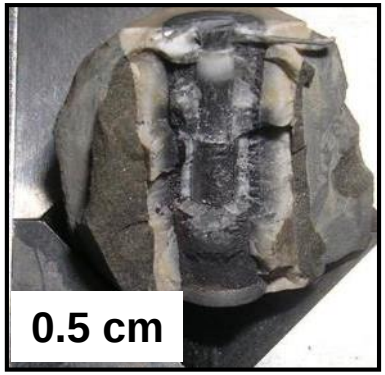
Pistone-cilindro

Pressa idraulica ad incudine multipla

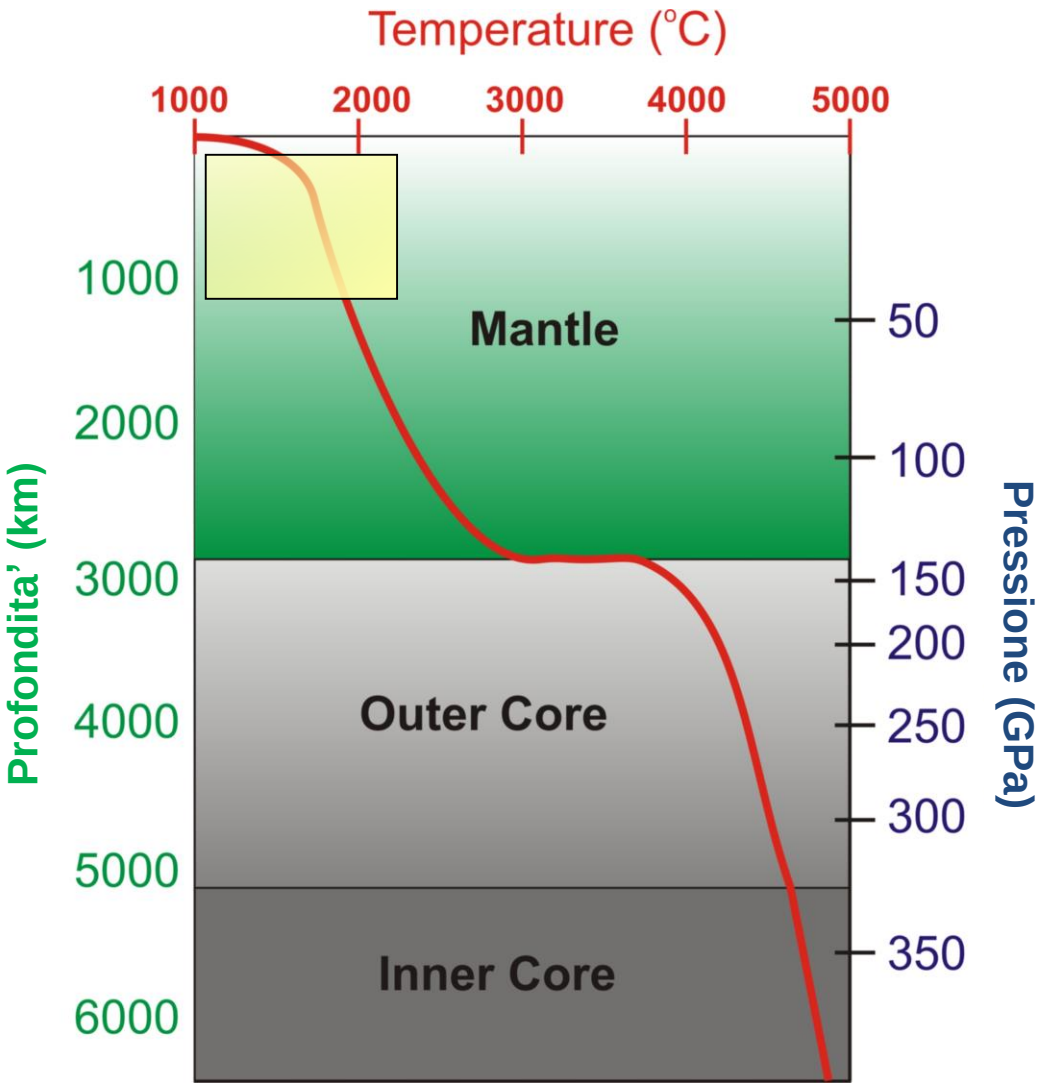


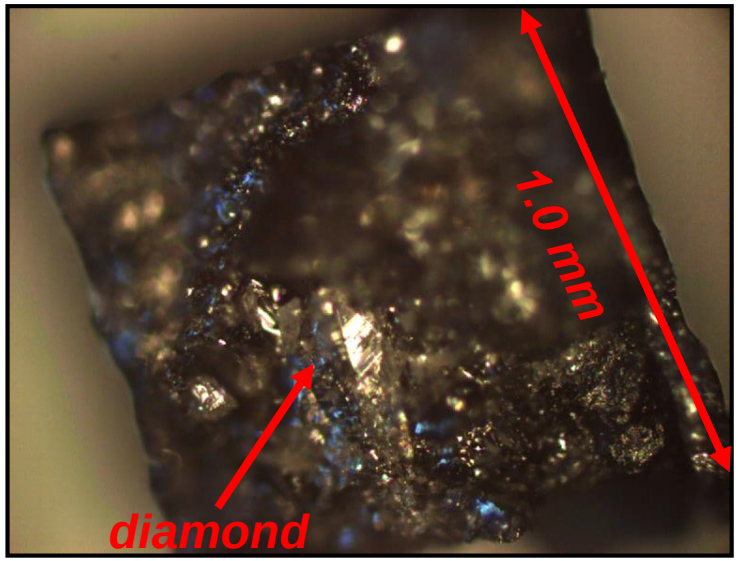
Pressione = Forza/Superficie

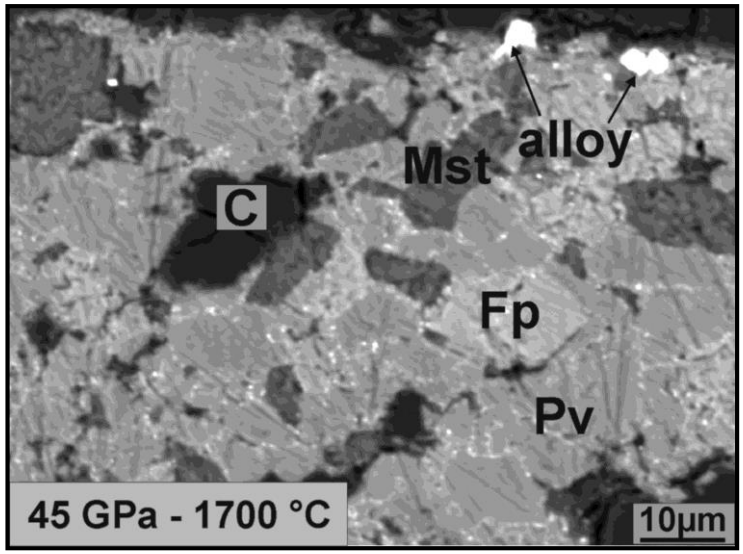




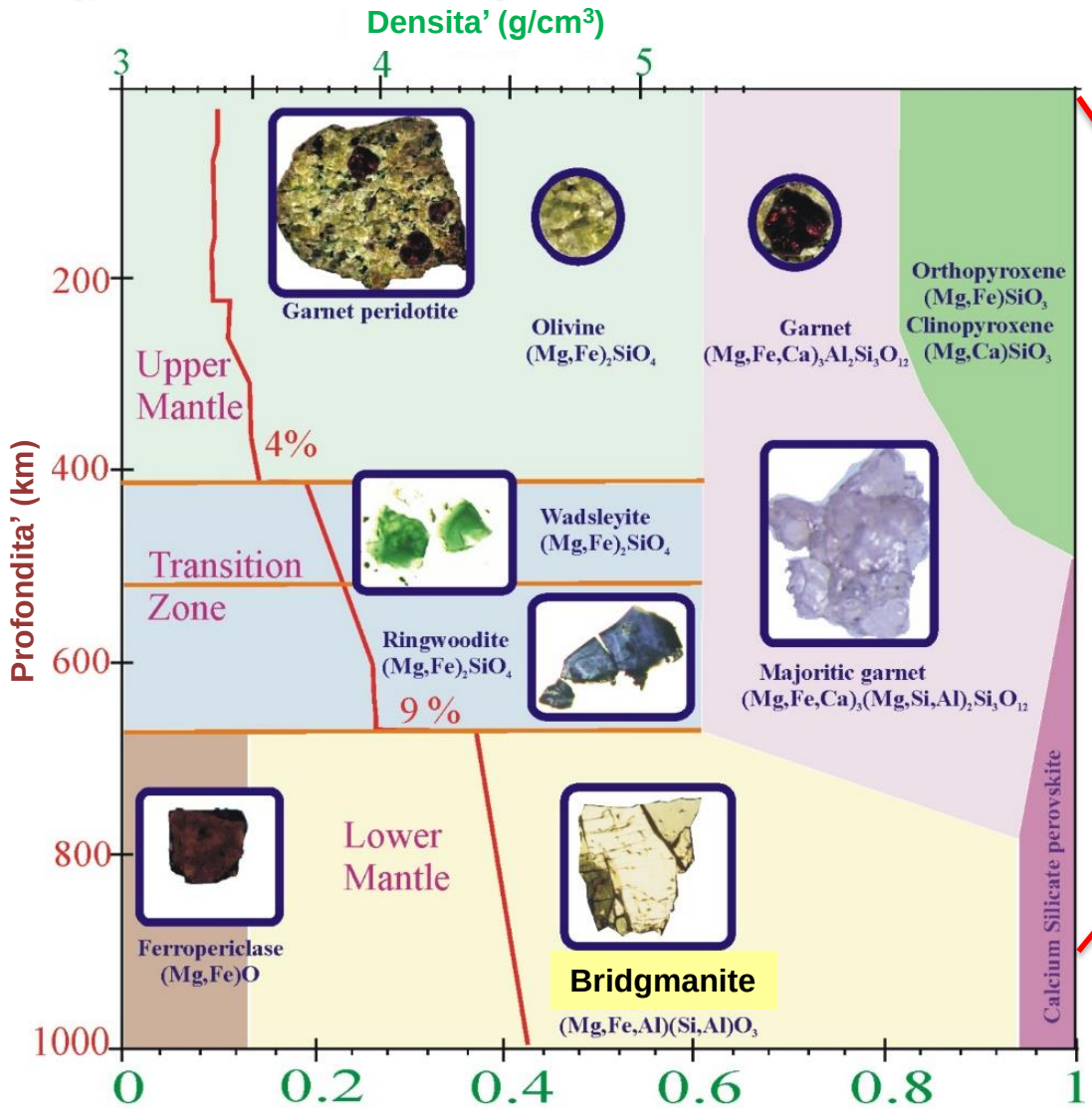
Dal laboratorio al mantello terrestre

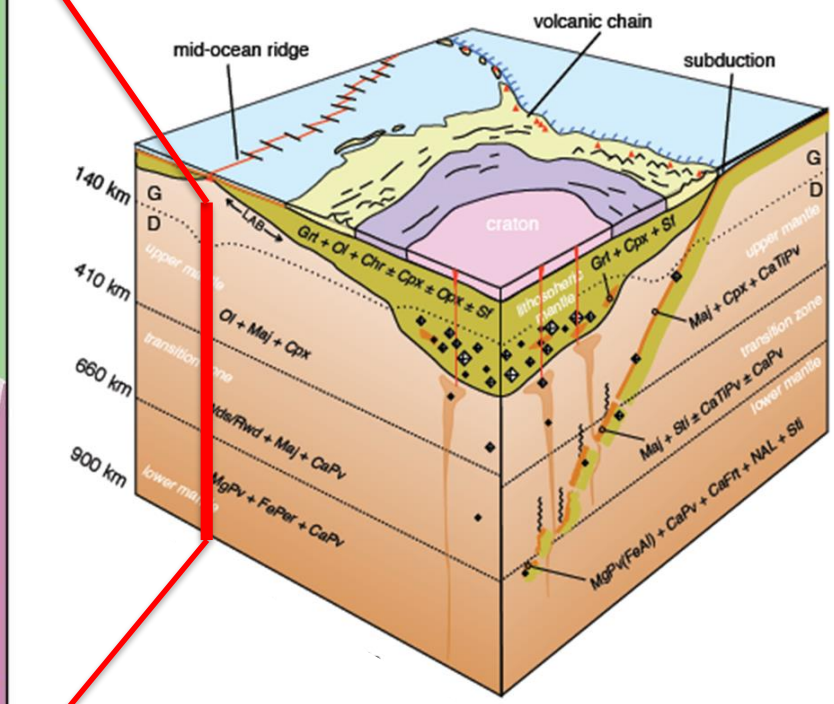






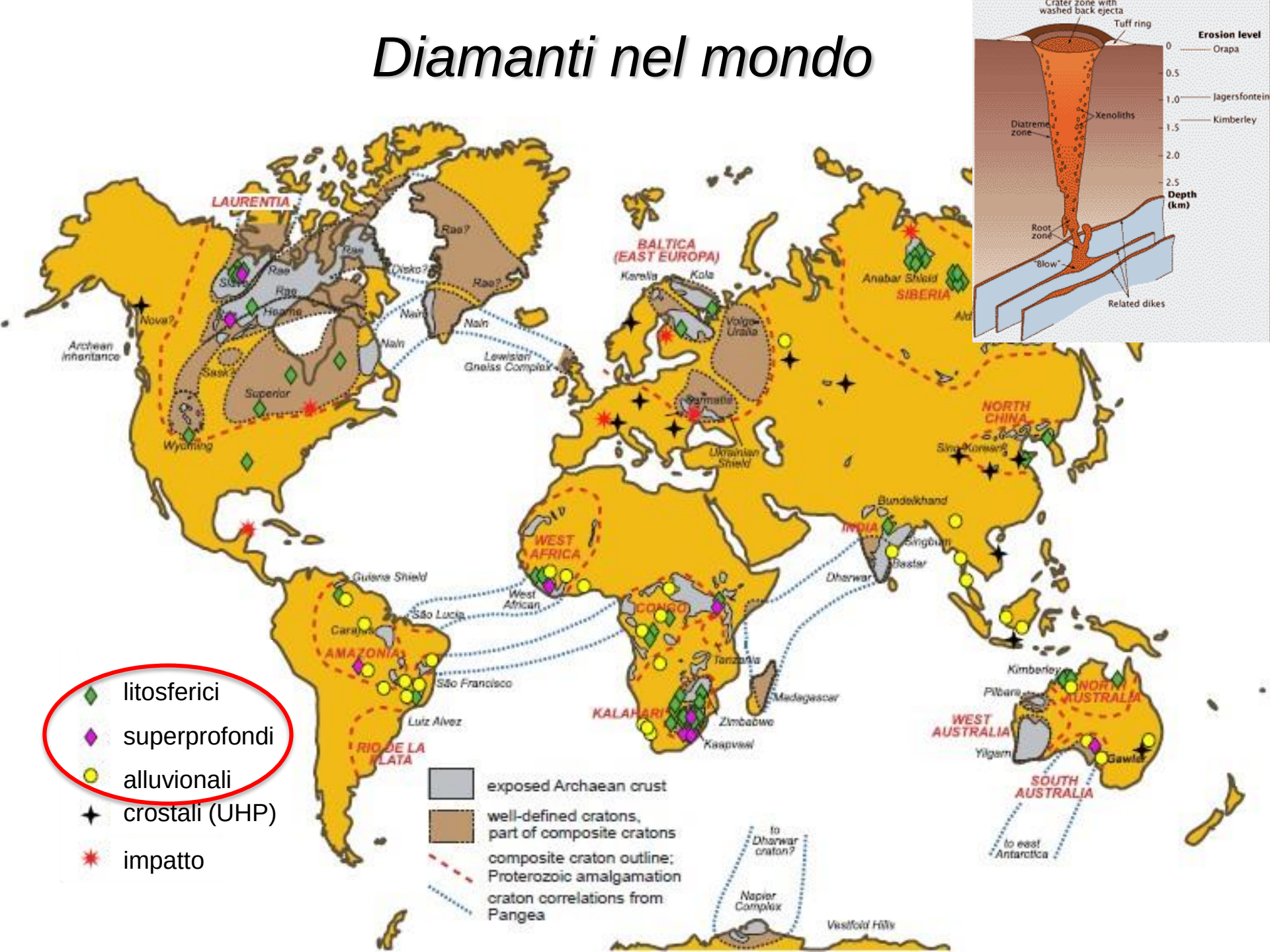
Composizione mineralogica: mantello terrestre (peridotitico)



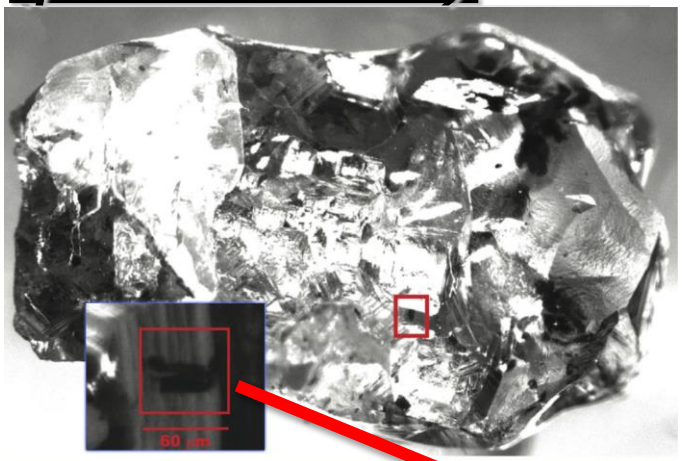


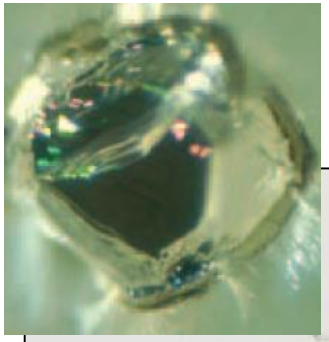
Frost, 2008- Elements, modified

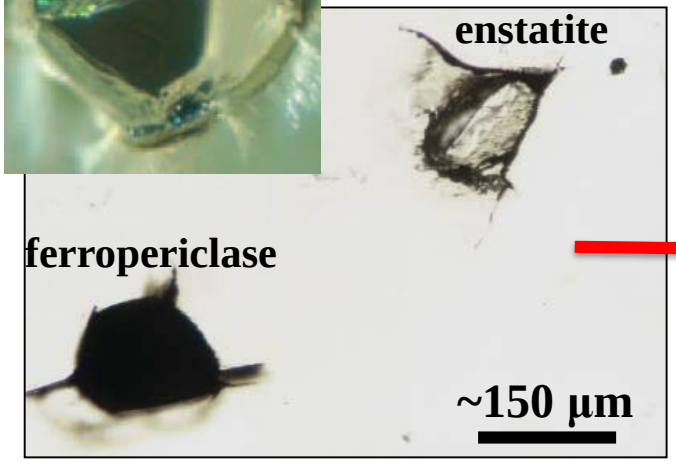
Diamanti nel mondo



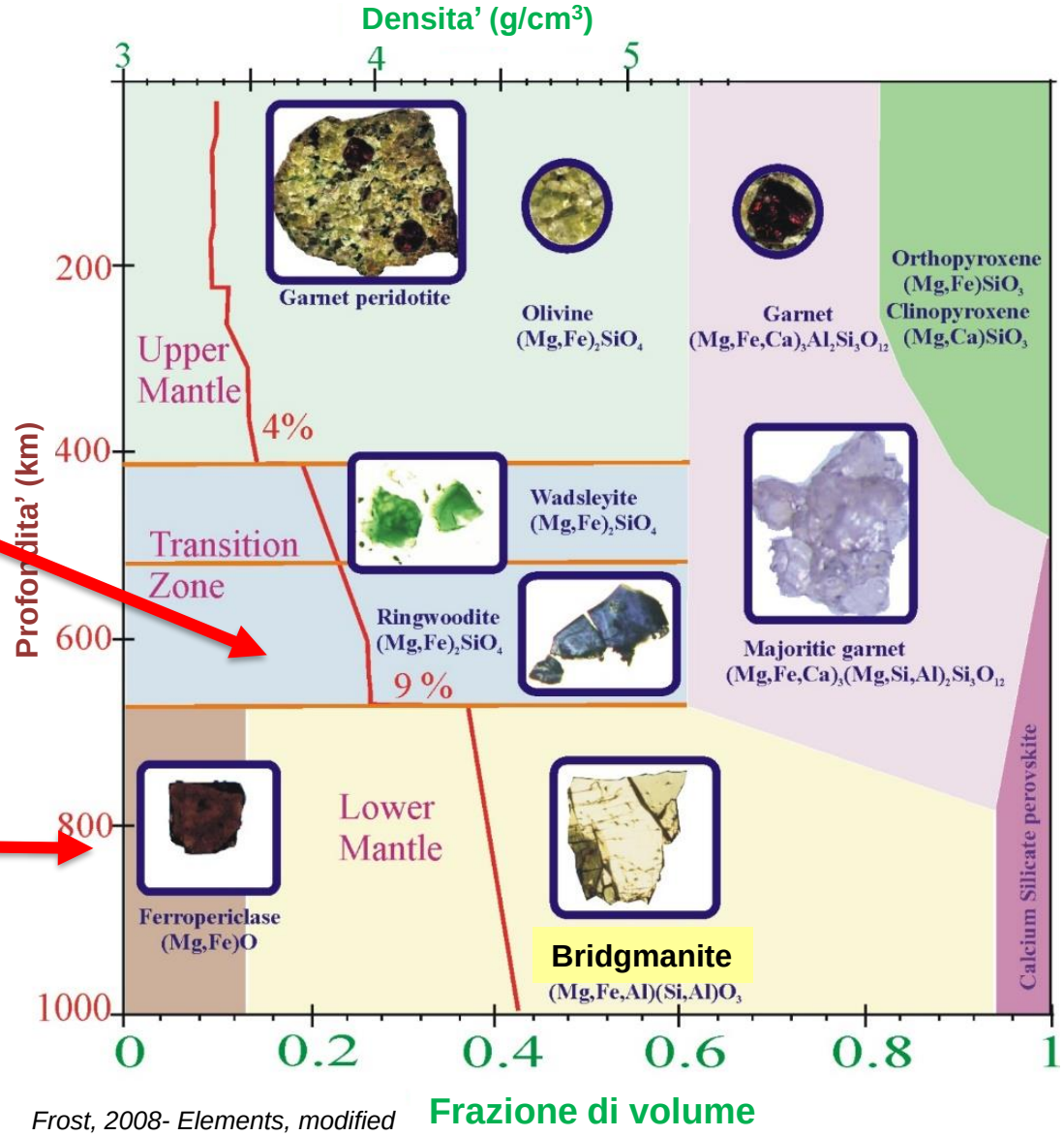
Composizione mineralogica: mantello terrestre (peridotitico)





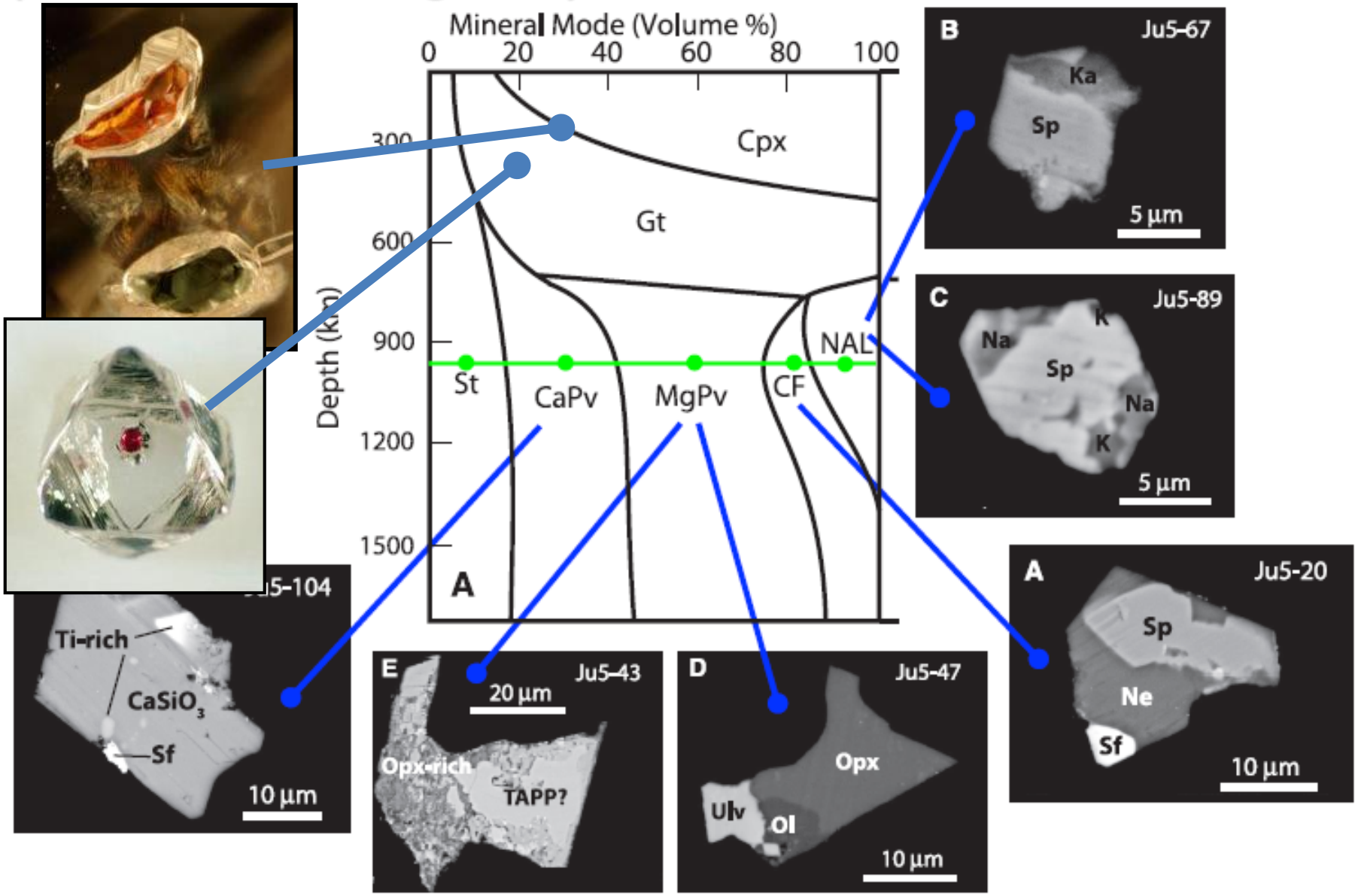


Inclusioni in diamante (deposito alluvionale Sao Luiz, Brasile)

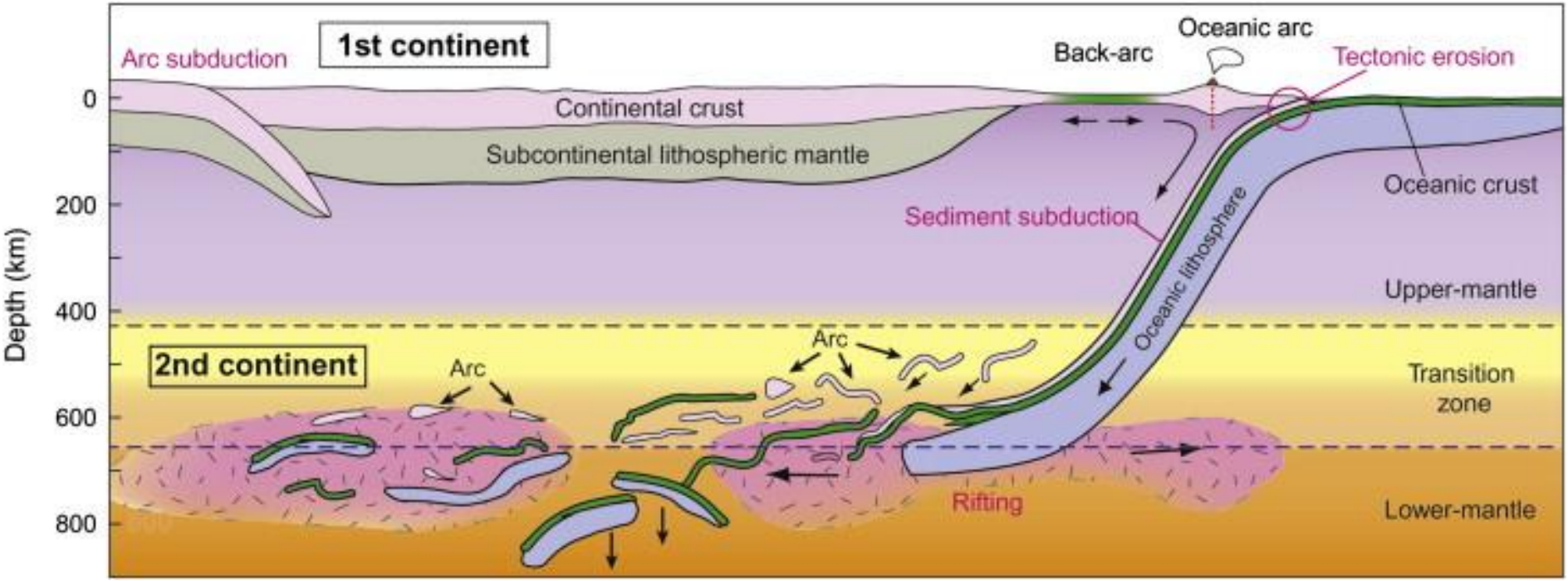


Frost, 2008- Elements, modified

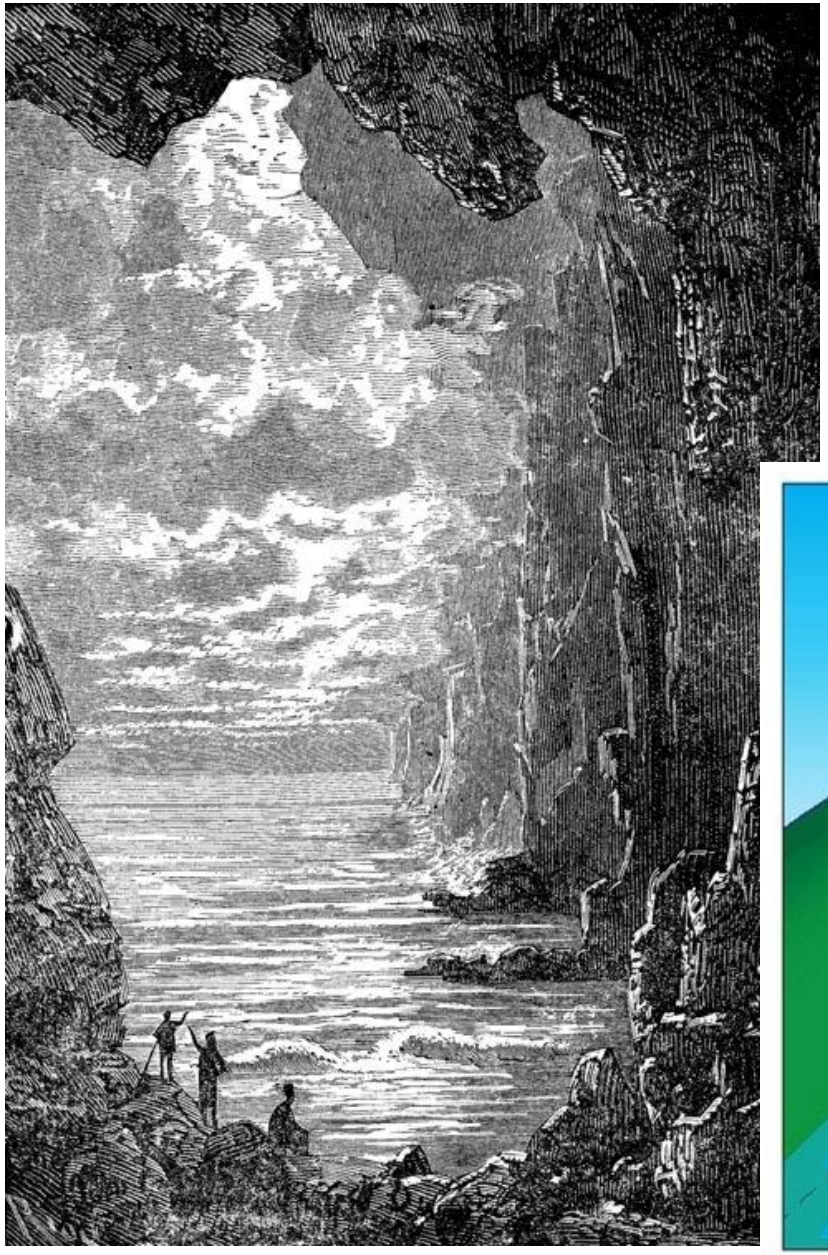
Composizione mineralogica: mantello terrestre (basaltico-eclogitico)

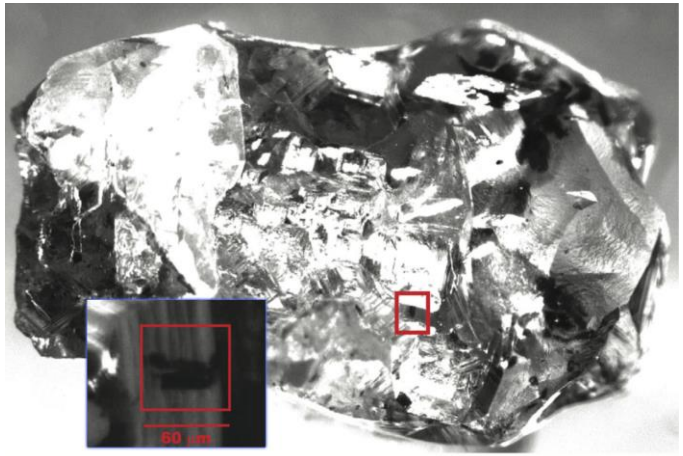


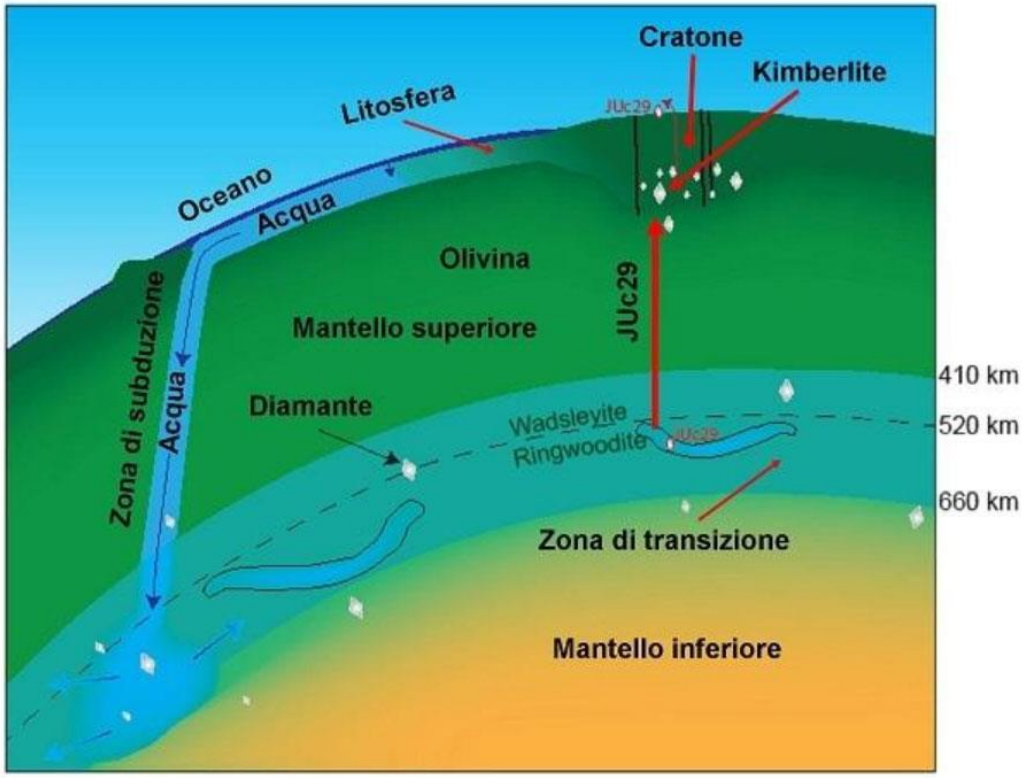
Verne e…il secondo continente profondo



Kawai et al. 2013 – Geoscience Frontiers



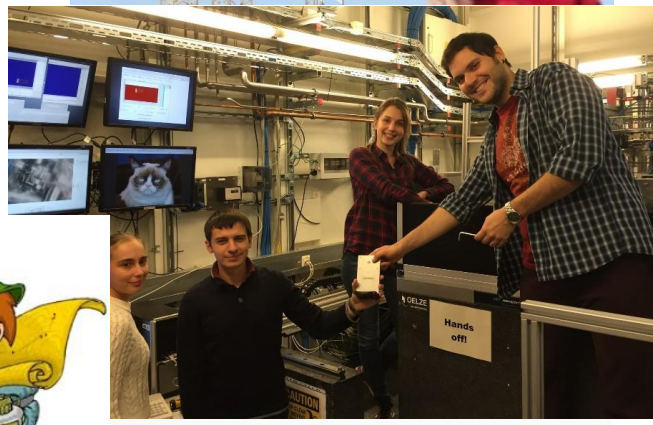

60 µm


Cratone
Kimberlite
Litosfera
JUc29
Oceano
Acqua
Olivina
Mantello superiore
JUc29
Zona di subduzione
Acqua
Diamante
Wadsleyite
Ringwoodite
JUc29
410 km
520 km
660 km
Zona di transizione
Mantello inferiore

Ringwoodite contenente acqua!!!

Evidenza della presenza di acqua nel mantello terrestre (ma non lo aveva detto anche Jules Verne???)

Possibili sbocchi professionali



Come vi vedete voi tra 10 anni??!