Signals from beneeth

Questions to nuclear physics which comes from inside of Earth

CREDO meeting

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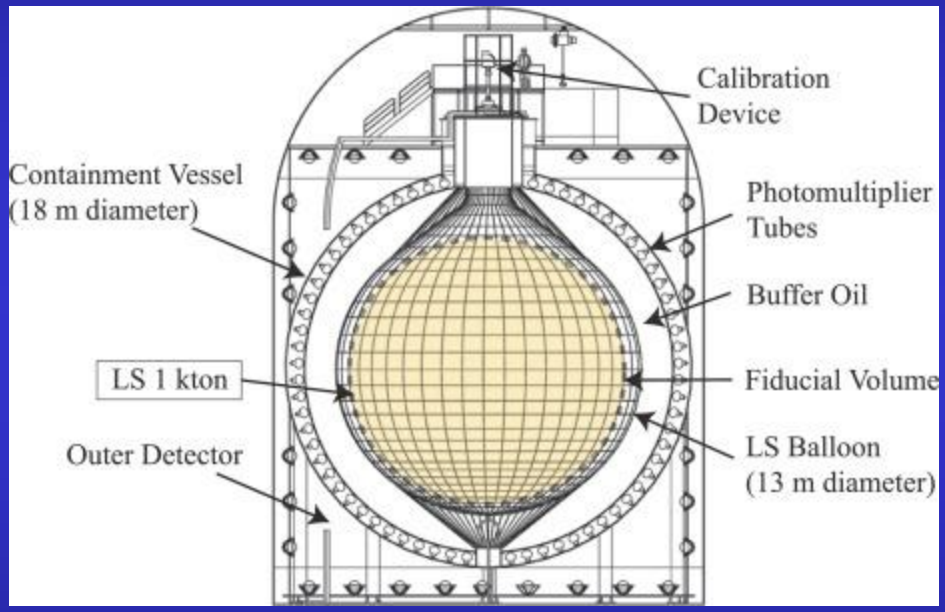
KAMLAND eperiment



Kamland experiment result

- Measurement of flux of geo-antineutrinos
- Less than half of expected registered
- Heat production by U and Th series is 20.0+0.5 TW plus ^{40}K next 4 TW instead of expected 44 TW

{*Nature Geoscience* **volume4**, pages647–651 (2011)|}

- What then produces half of heat inside globe? (chemical? nuclear?)

Some puzzling things in geology

(my choice)

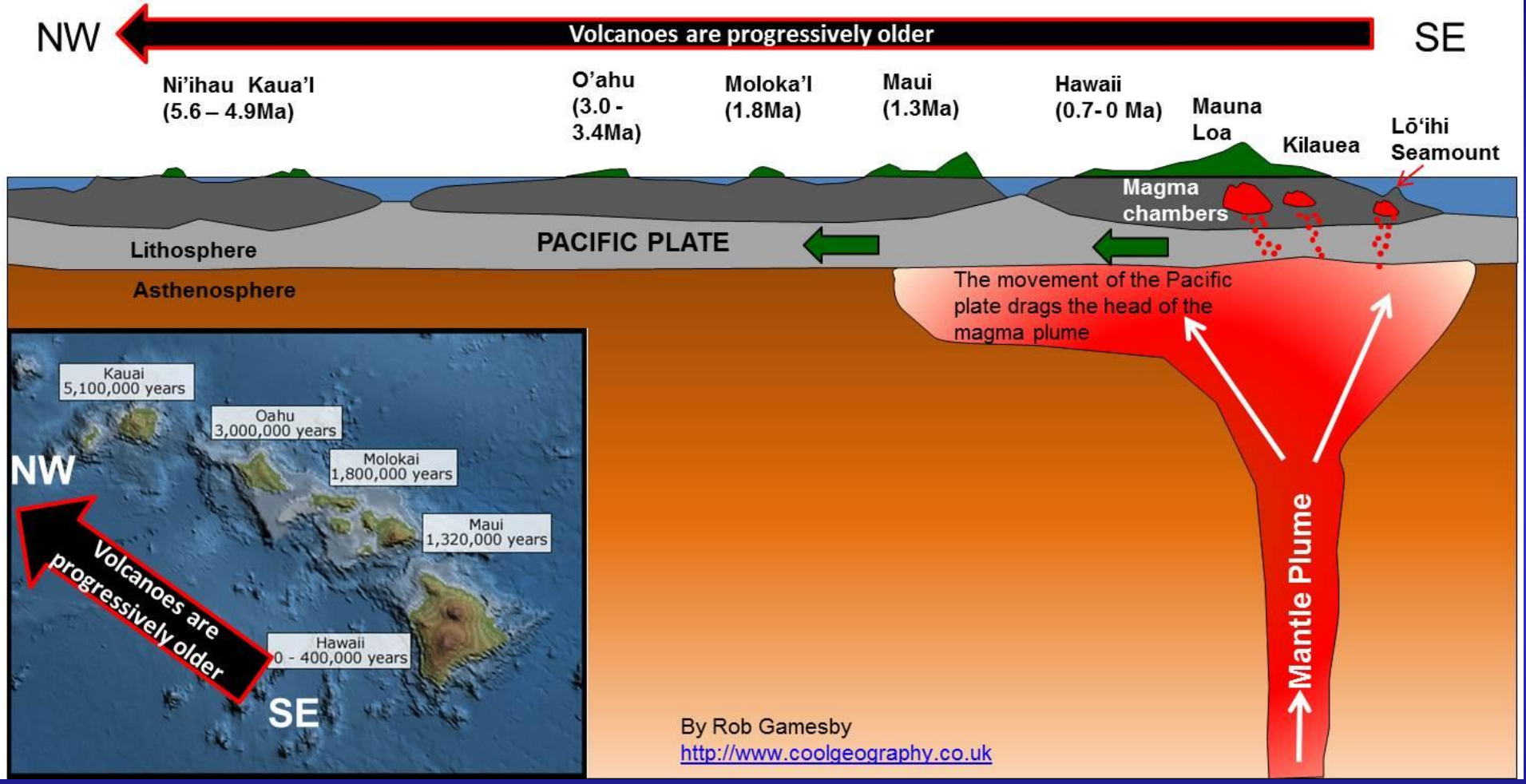
- Hellium–3 presence in deep crust/mantle trapped gas
- Heat source of „geological hot spots”
- Hard to explain nuclear tracks in diamands (radiohalos – separated elements etc.)
- Some larger varations from natural isotopic abundances
- Nature of kimberlite pipes

He-3 in volcanic gas puzzle

- Earth during hot formation was degassed since gas atoms thermal motion speed > Vo (it is still happens to H and He atoms)
- He-4 in rocks comes from alpha decays, but where He-3 could came from?
- $^{6}Li+n \rightarrow {}^{3}H+{}^{4}He$; tritium dacays to He-3
- Do we have enough neutrons?

(alpha,n), fission, natural reactors?

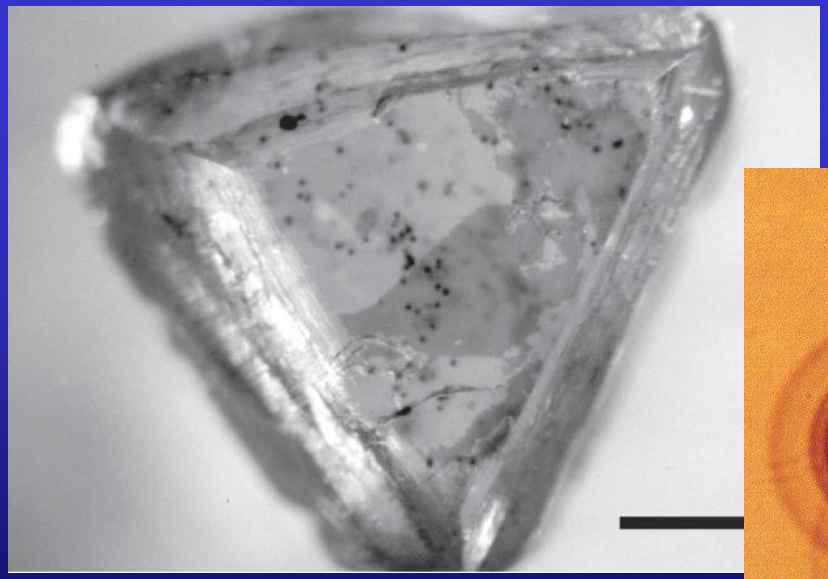
Geologic Hot Spots

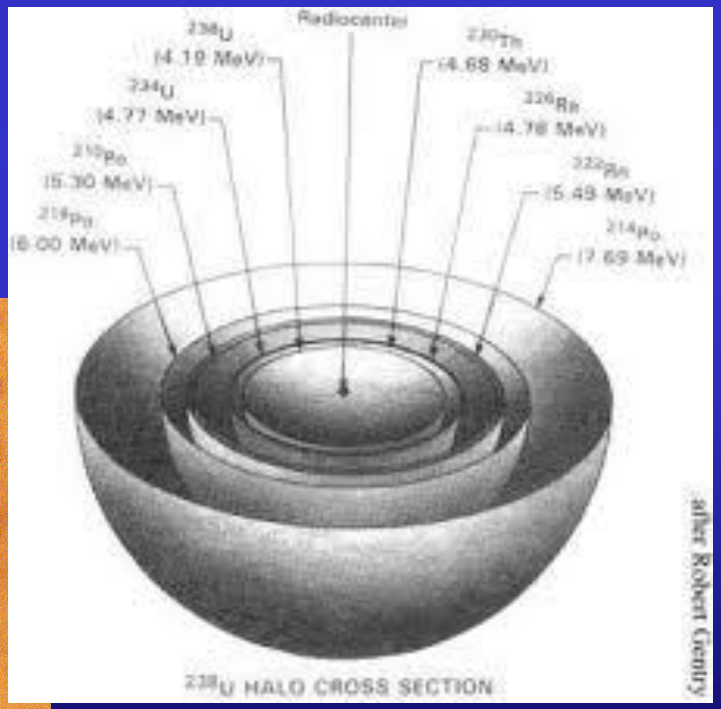


- Why during ~5 Ma the heat source did not dissapeared ?

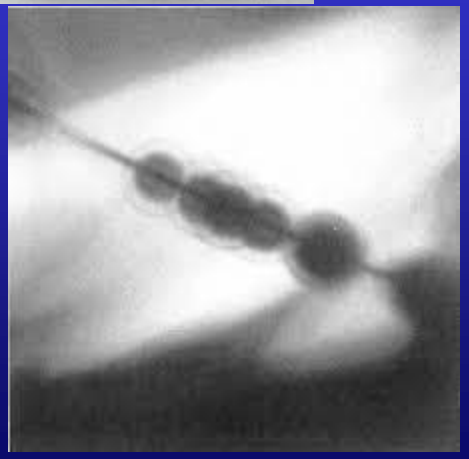
Diamonds as track detectors
Radiohaloes

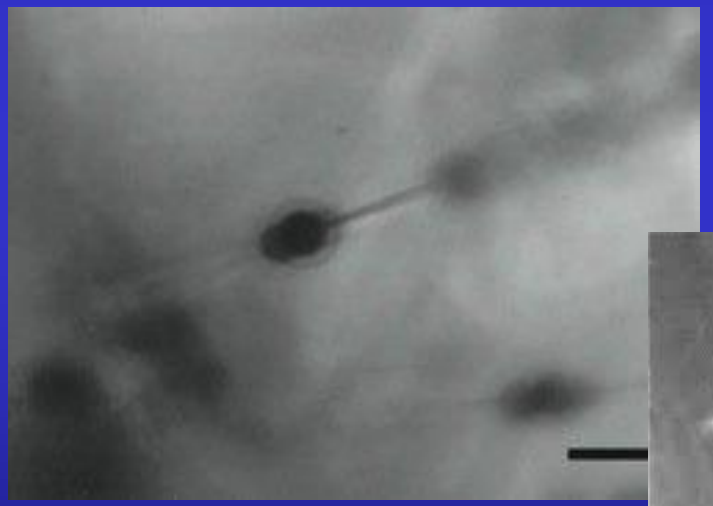
- 29 microns range of 8.8 MeV alphas





Radiohaloes and nuclear tracks in diiamond difficult to explain





What kind of nuclear process can/could happend inside globe?

- Natural nuclear reactor? – excluded due to production of neutrinos
- Cold fussion?
- **Excess fission and alphas (no U,Th)?**
- **Dark matter decay ?**
- **Seldom high energy deep globe impacts/penetrations?**

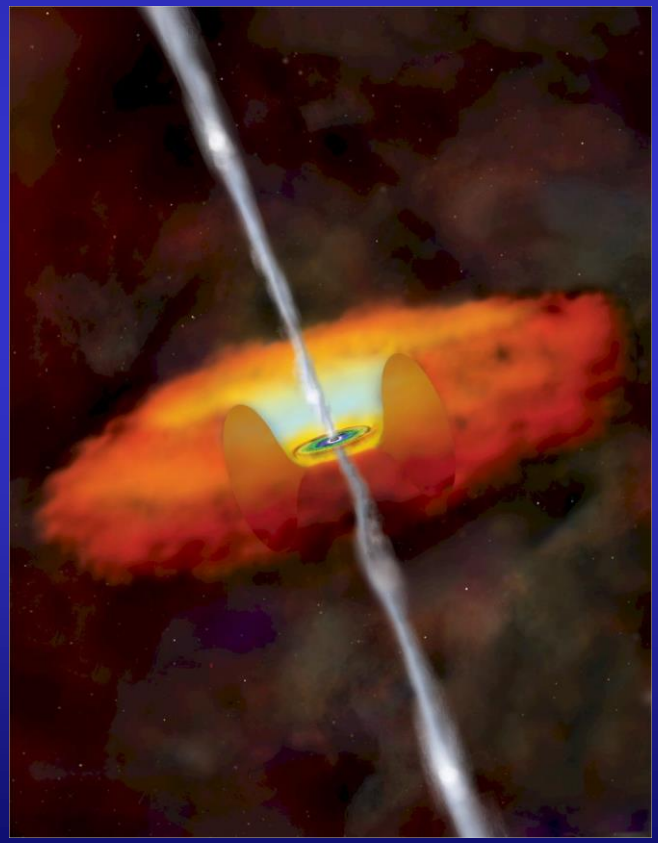
Is there baryonic dark matter?

- E.Witten proposed existance of an early universe pieces, which does not underwent inflation and contains s-quark as dense baryonic matter

[Witten, Edward. (1984). Cosmic separation of phases, Phys. Rev. D 30, 272-285]

How dense barionic dark matter can be produced instead?

- A neutron star merge with black hole
- Some ultradense mater escapes in jets
- Decays to normal matter



How stable is this ex-neutron star matter?

A common (?) oppinion is that it is not stable but in fact we do not know

Main featue: density > 10^{14} g/cm^3,

(1 mm^3 has mass > 10^{11}g (or 10^5 t)

Witten proposed that such objects can exists as not expanded parts of early universe if contains s quarks.

What if sea quark s exchange with constituent quark d inside neutron star?

Can such matter be present in Solar System?

- **Puzzling cross of Earth with production of seismic wave (Teplitz at al., 2005, Anderson et al.m 2002)**
- **Roberto Battiston and Cristiano Fidani Particle Detection Using Moon Seismology – go down to 1 kg range of mass (Benerdt, 2006), (Herrin 2006)**
- **Jan Rafelski et al.., Acta Phys. Pol. Vol. 43 (2012) CUDO (Cosmic UltraDense Object), - Tunguska meteorite?**
- **Vela Incident ?**

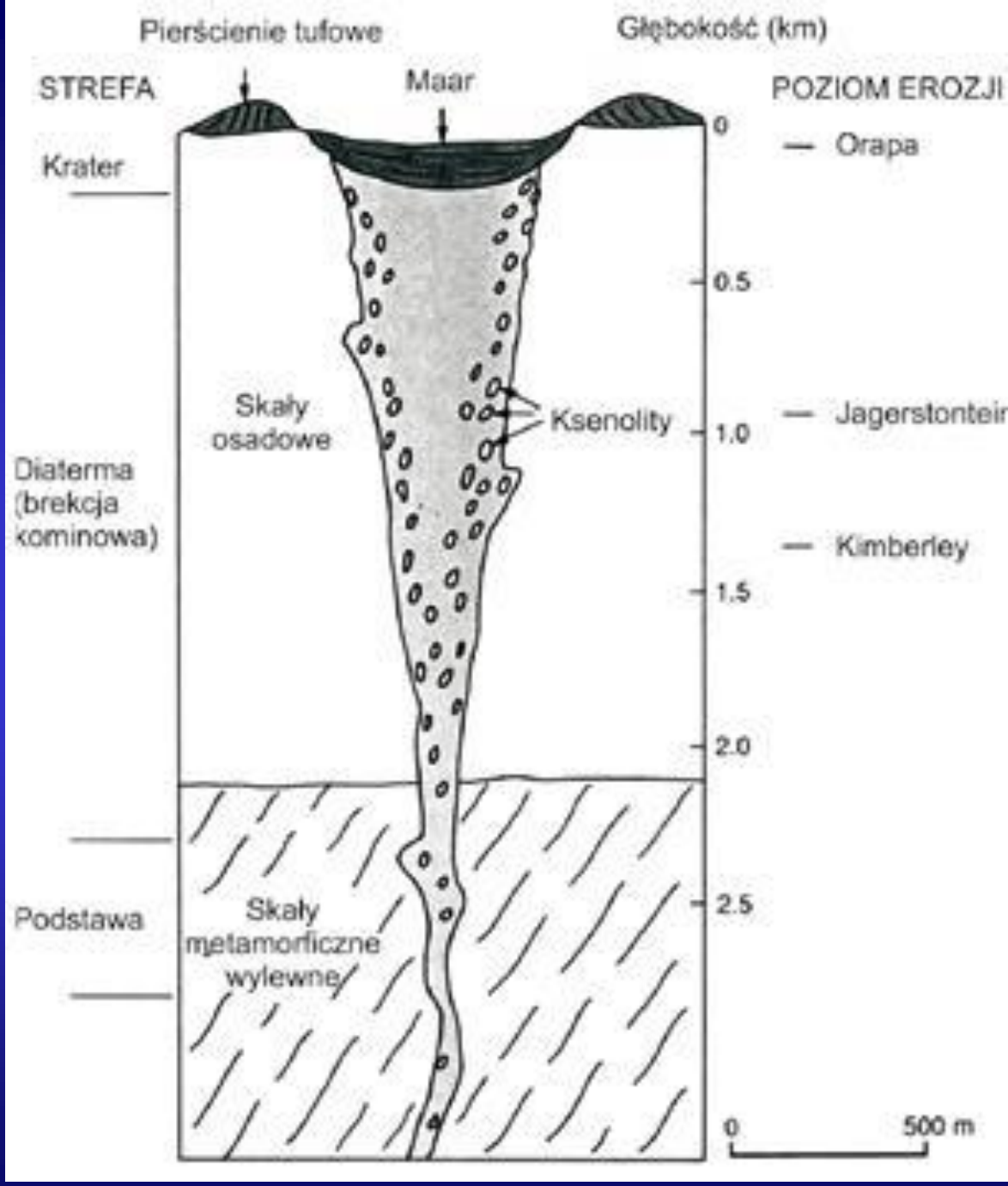
Kimberlite pipes as traces of massive CUDO passage through Earth

Paszkowski M., MIETELSKI J.W (2013) Are kimberlite pipes a kind of macroscopic nu clear tracks fordem in collision with CUDO?, Acta Physical Polonica B. vol. 44, 787- 794.

Paszkowski M., MIETELSKI J.W. (2013) Extraterrestrial mechanism of kimberlite emplacement. In Goldschmidt Abstracts 2013, *Mineralogical Magazine*, v. 77, 1933.

What the Kimberlite pipe is?

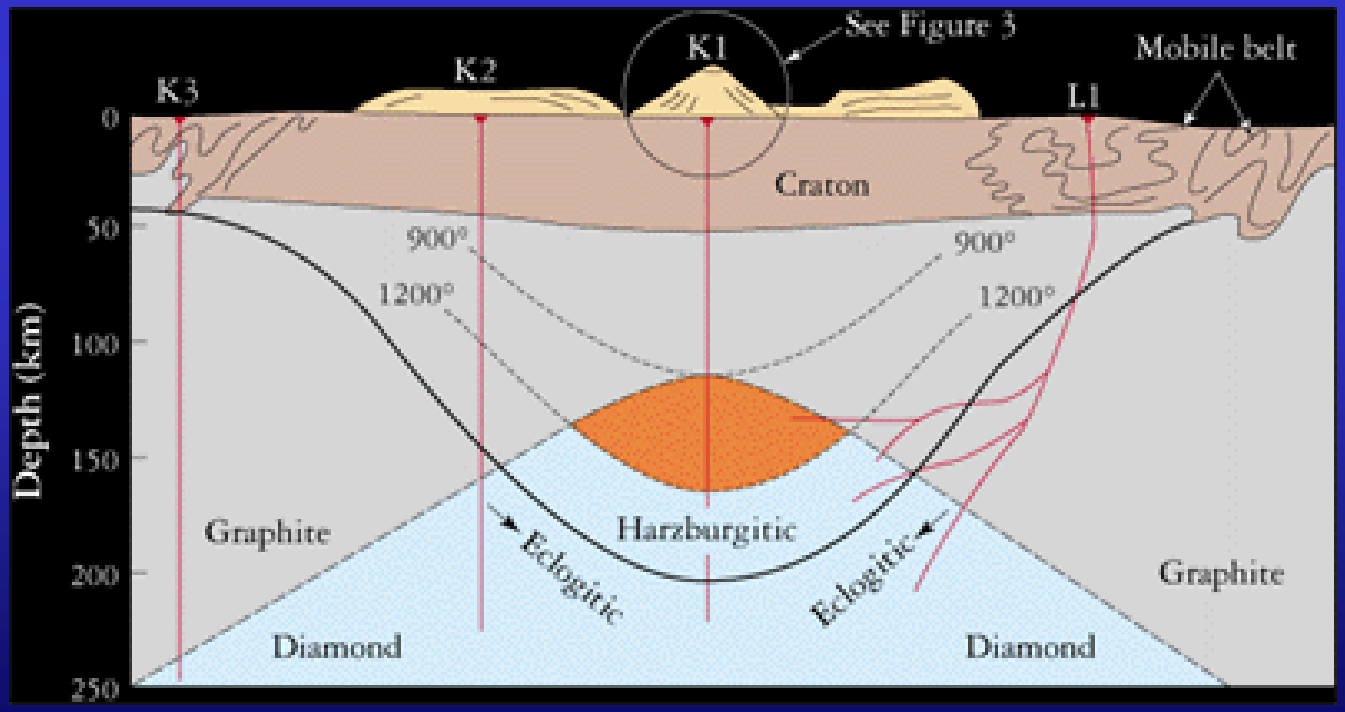
- Depth across whole Earth crust, down to the mantle (some dozens of km)
- Diameter only at range of 1 m (!)
- Filled with mntle material mixed with crust origin xenoliths.



Kimberlite pipes (~5600 found so far)

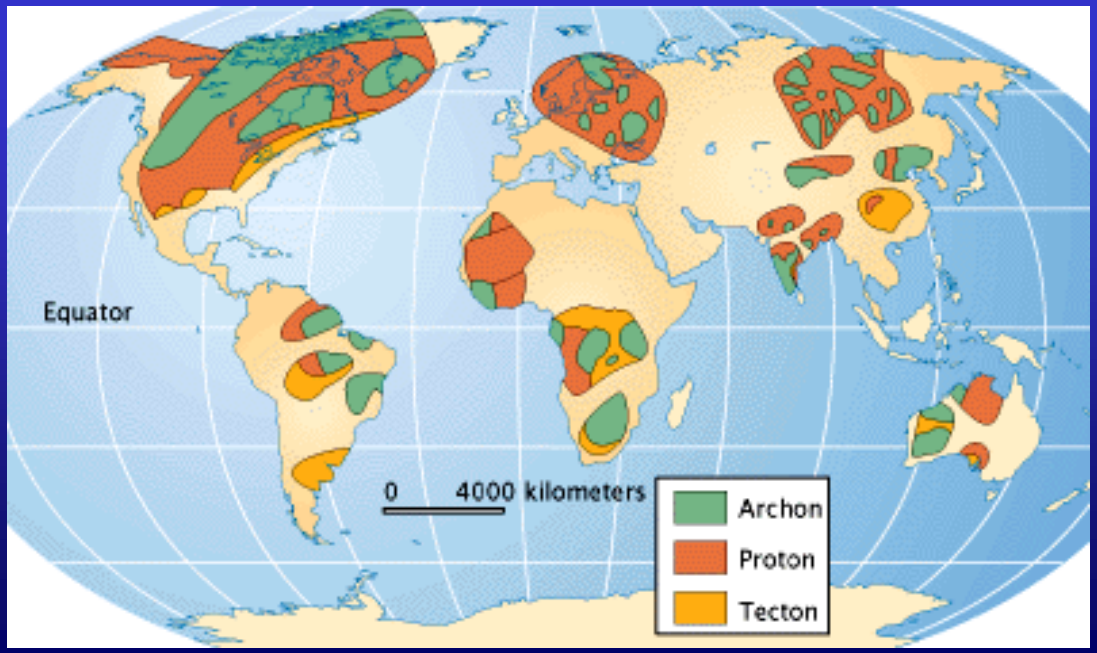
Diamonds makes kimberlite pipes well studies but difficut to study by wider range of scientists

- The ascend in pipe must be fast enough to prevent diamond not trnsferr into graphite



Diamond mines

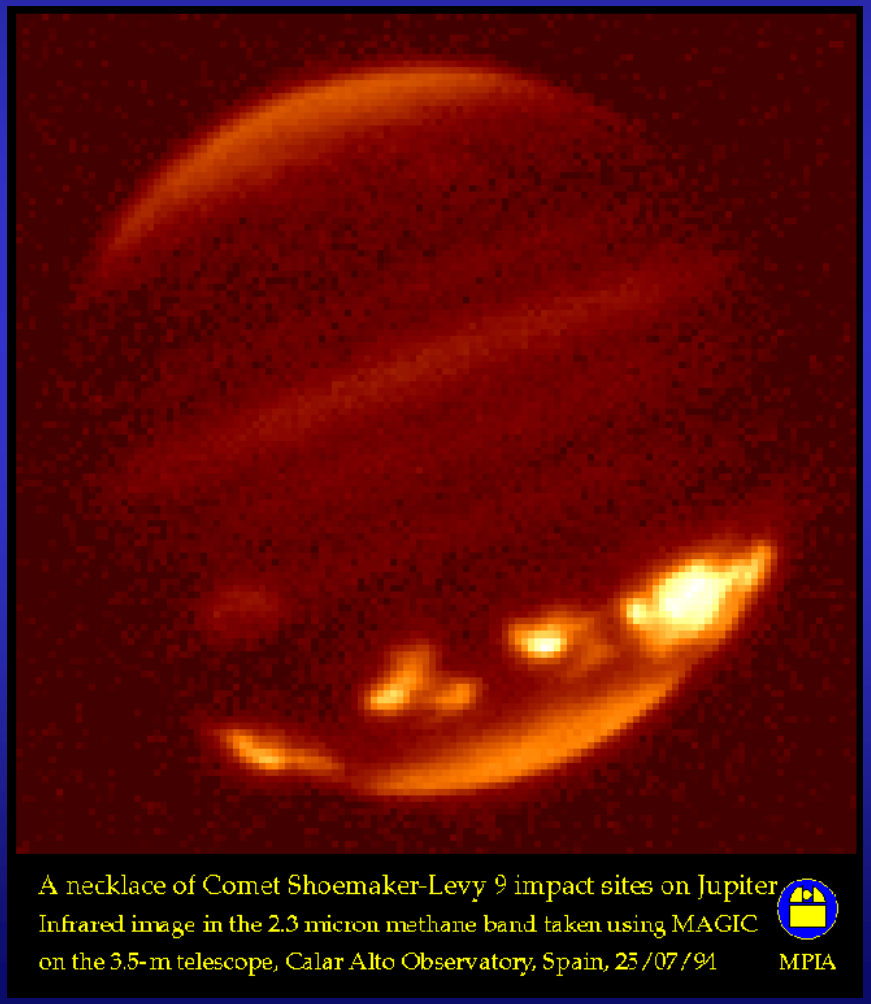
- Old cratons (the most old rocks on Earth)



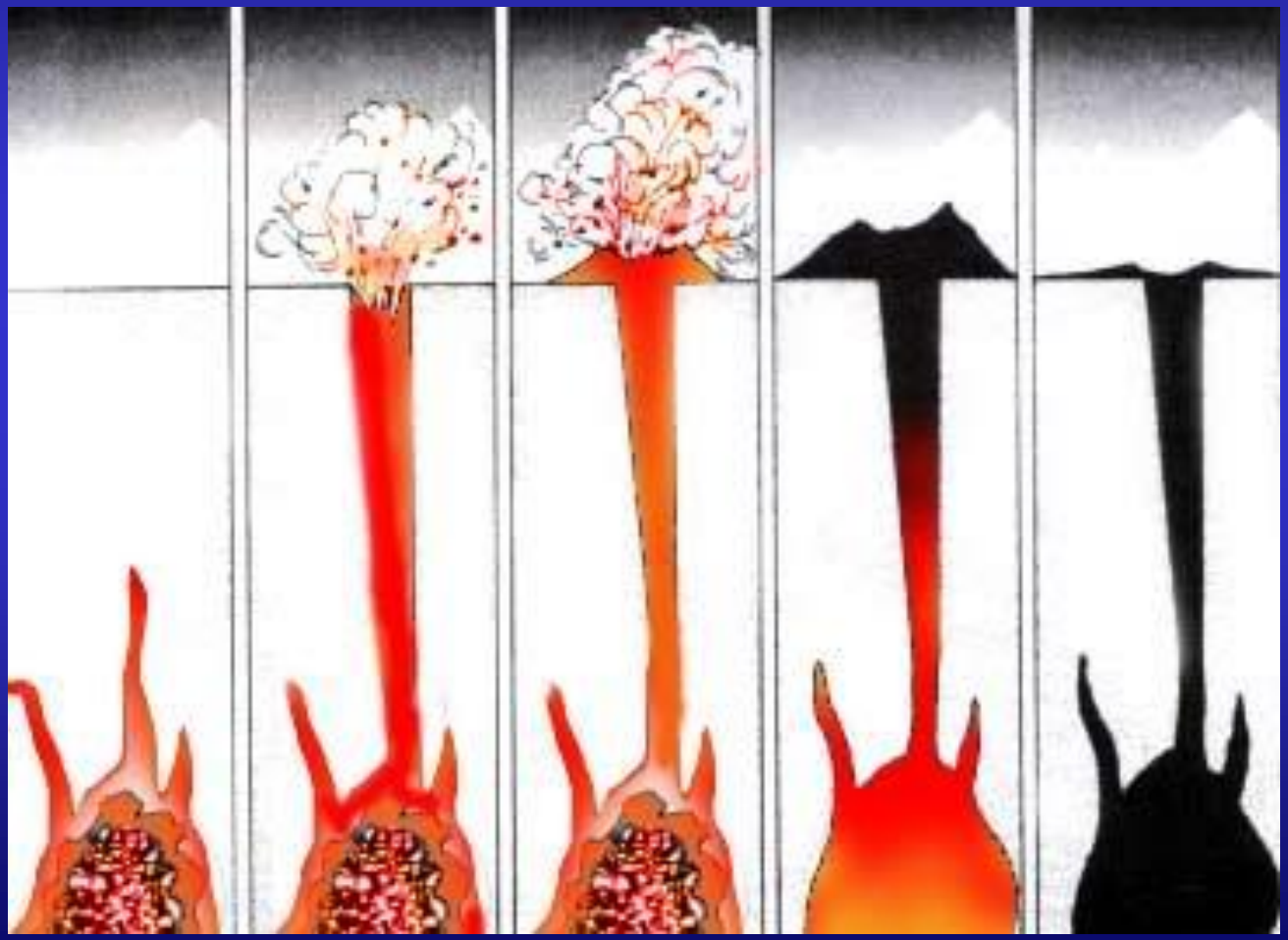
Kimberlit pipes in Africa

Kimberlit pipes in Africa

Trace of Shoemacher-Levy 9 on Jupiter – also along stright line!



How the pipe origin? – current model of magma needle and gas eruption



Problems with magma needle model

1. Why heat did not dissperssed but acted in direction?
2. Wht was the source of energy?
3. Why kimberlite material is not melted, but rather only pressed into pipe
4. Why the xonoliths are sometimes not showing any traces of high temperature?

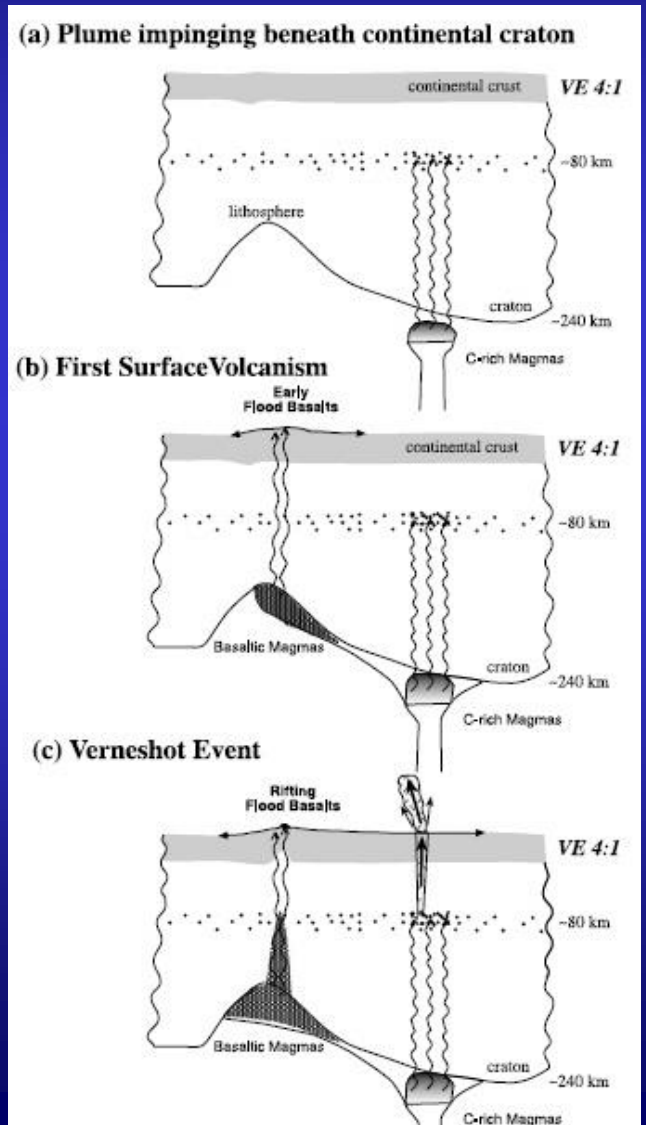
An alternate model: Verneshot ?

Gas explosion

Philips Morgan et al..,

Earth and Planetary Science Letters 217 (2004) 263-284

But why appears a pipe?, not linear break? Why it is directional?



Our model

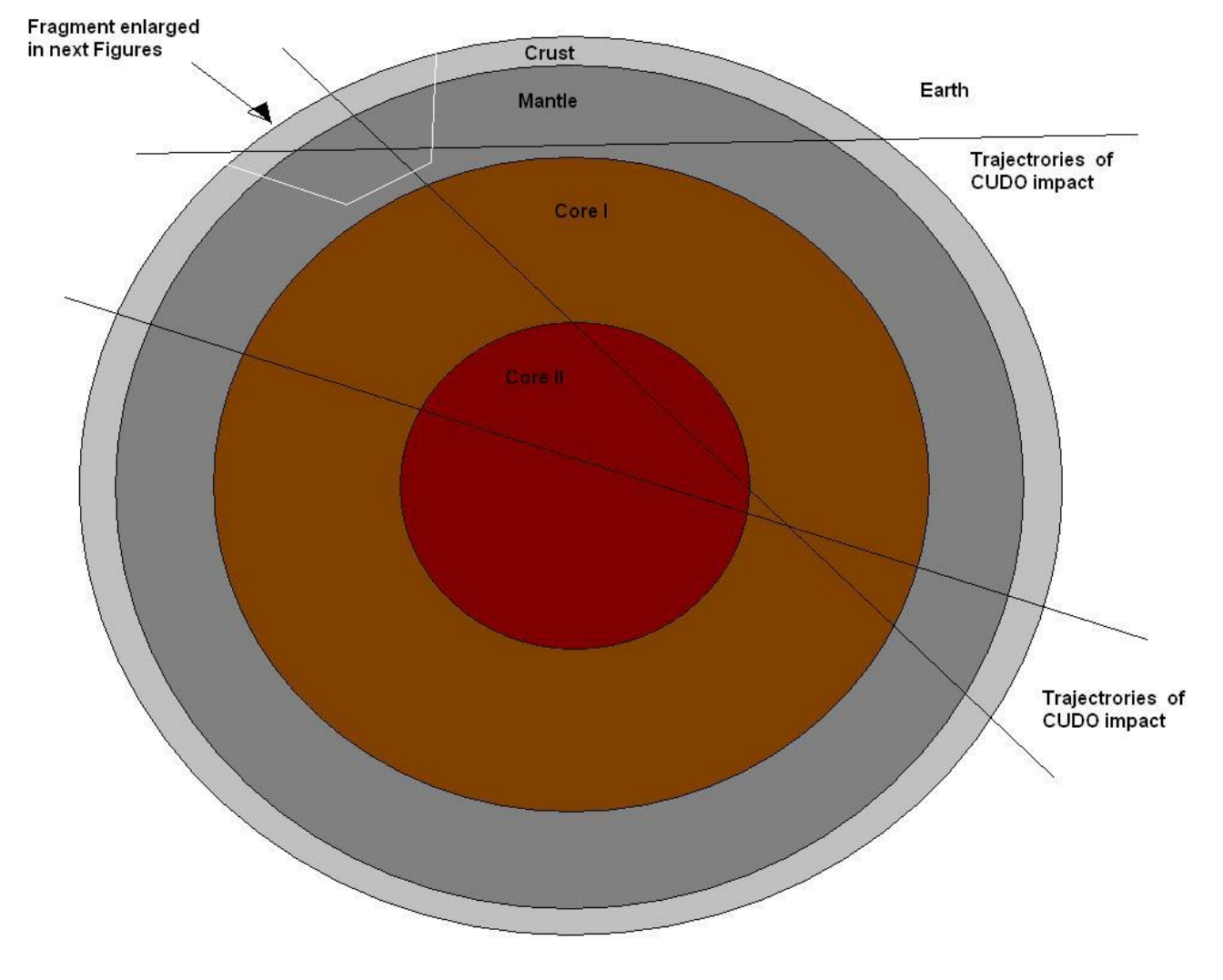
Macroscopic body (in sense of mass >~10^5t) with density of nuclei (few mm diameter) - CUDO

- penetrates across globe
- no impact crater is formed
- matter compressed to plasma on front of CUDO - possible nuclear reactions and generation of secondary particles
- shock wave generated
- Generated heat melts rocks and degasing of them enlarge nuclear track to size of pipe

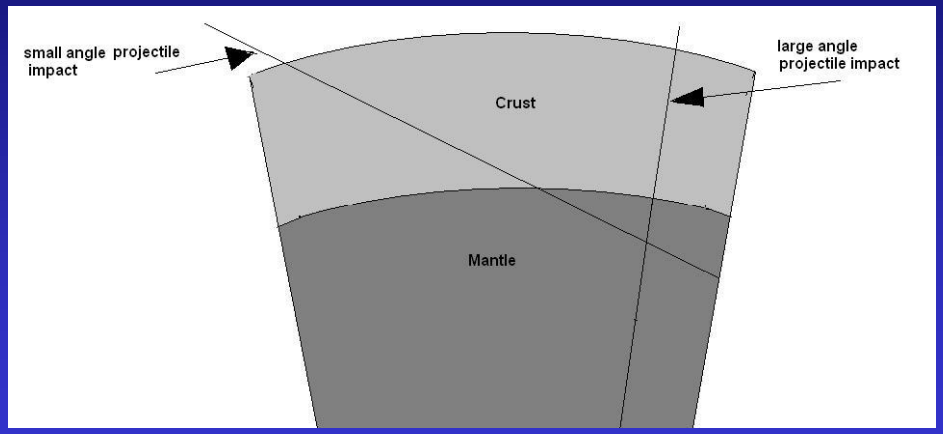
Energetic aspects

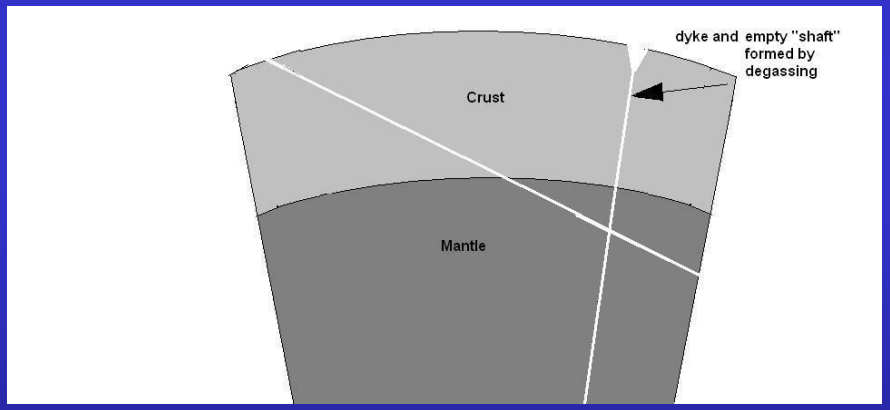
- Thermal energy needed for adiabatic heating up to 1 MK a tunnel with 1 m^2 area across globe is ~10^{20}J (20 Gt TNT) whereas to penetrate only crust it is 10^{15}J (0.5 Mt TNT)
- Kinetic energy of CUDO with mass 10^5t moving only 4.5 km/s is enough to penetrate crust, to heat up to 1 MK and penetrate globe is 1000 km/s
- Additional work can be done by decompression of gasses and therfore lower energy can be needed

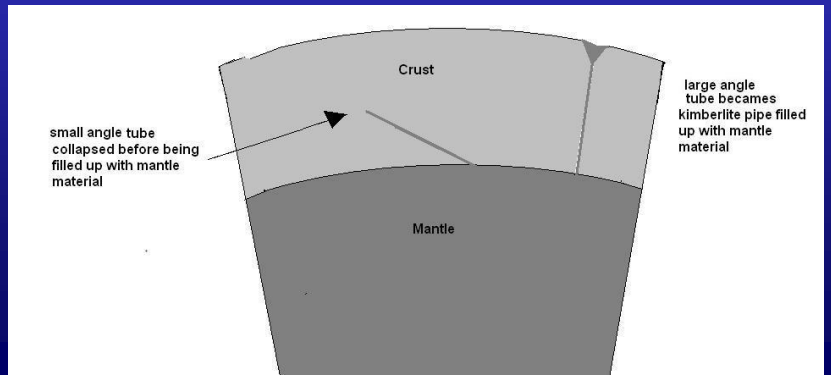
Different passages of CUDO



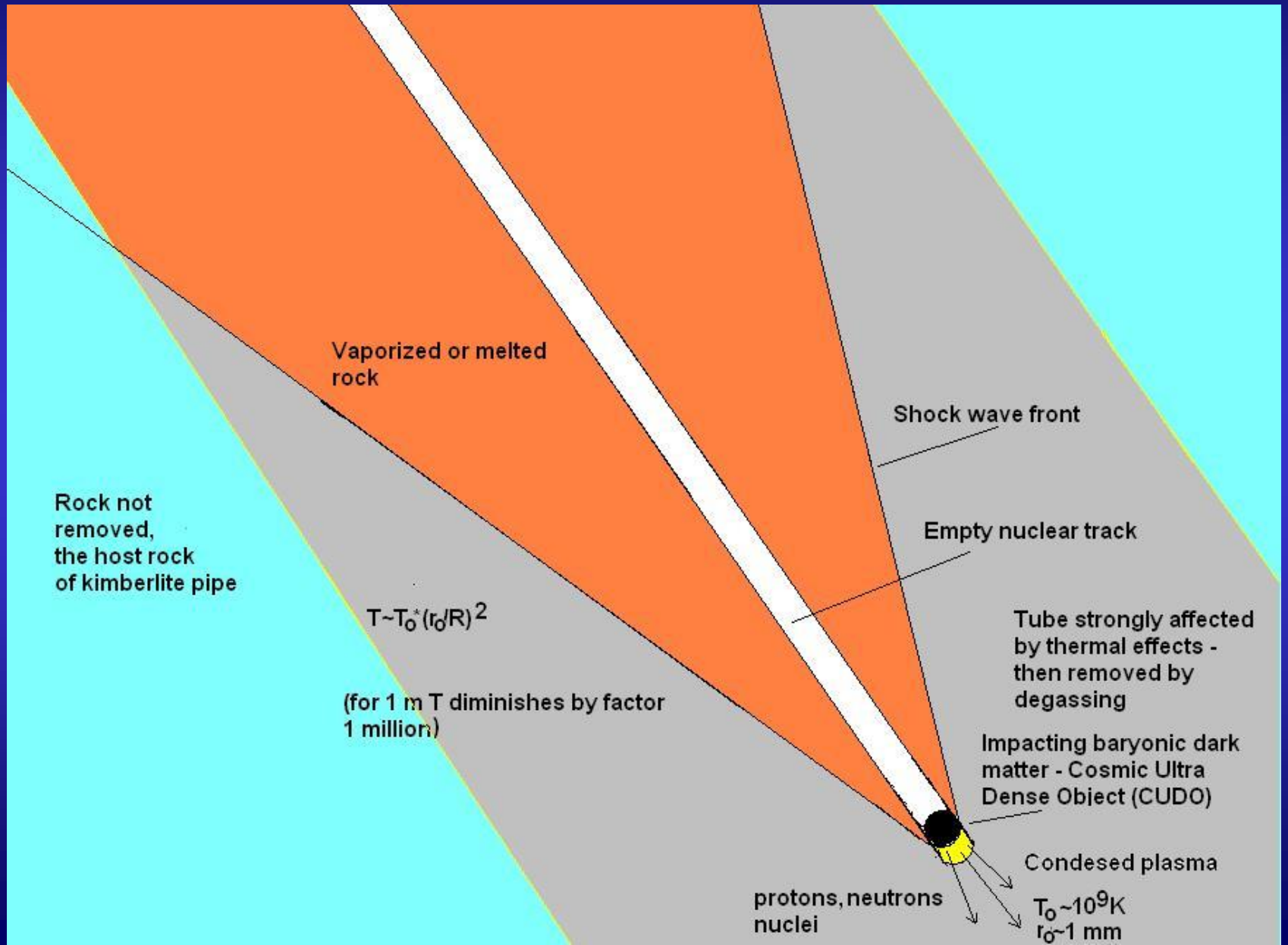
Why pipes are vertical?







The process in microscale



What is explained by us for kimberlite pipe

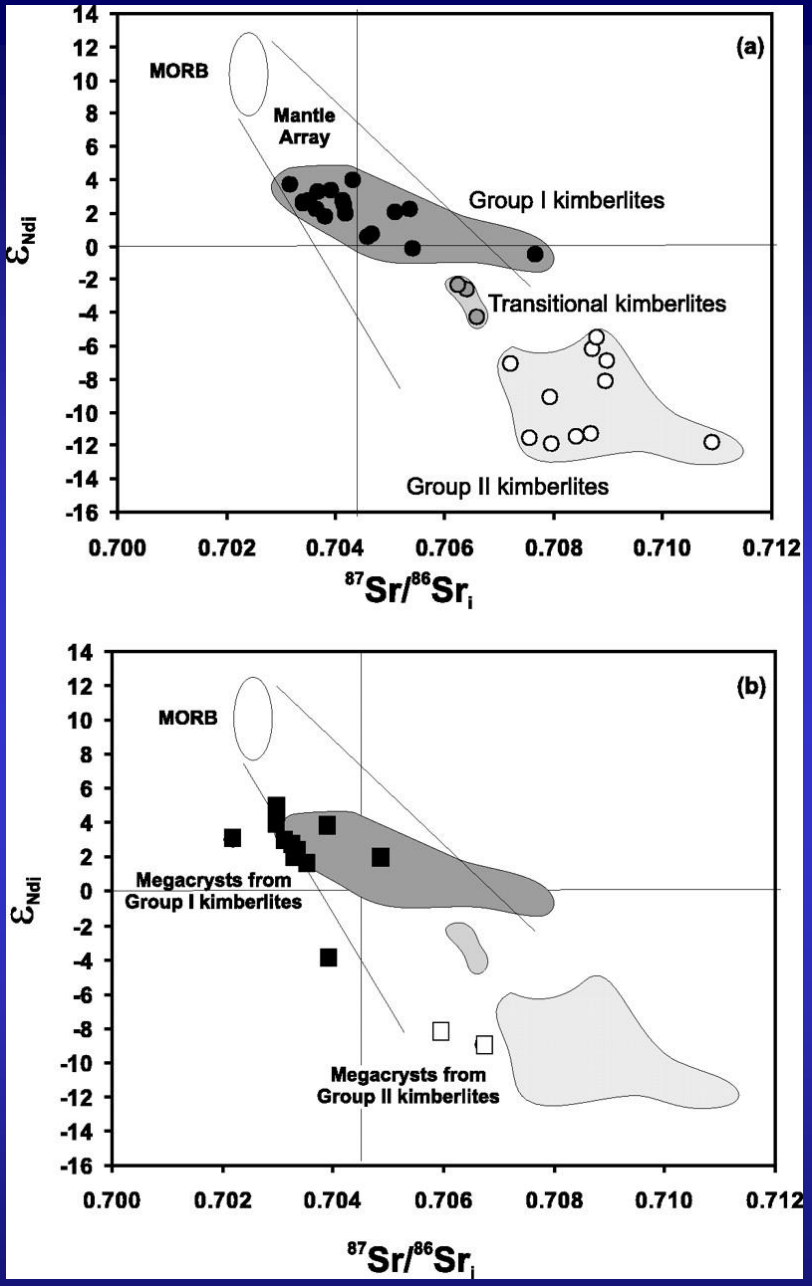
- Geomtric aspects (vertical orientation, small diameter, great depth)
- Nature of rocks which fill the pipe
- Variation of isotopic ratios
- Presents on old cratons

Already some isotopic pecularities of kimberlites are known:

„Their $^{87}Sr/^{86}Sr$ ratios are generally between 0.704 and 0.706 but a value of 0.713 was found in one sample. They show a surprisingly large spread in lead isotope ratios ($^{206}Pb/^{204}Pb$: 17.5-20 $^{208}Pb/^{204}Pb$: 37.3-39.4). The isotopic patterns of the xenolithic material and of the kimberlites and autoliths are considered to provide a strong indication that the upper mantle beneath Southern Africa is isotopically heterogeneous on a regional scale”
Kramers, J. D. Earth and Planetary Science Letters, Volume 34, Issue 3, p. 419-431.

Example of strange isotopic ratios

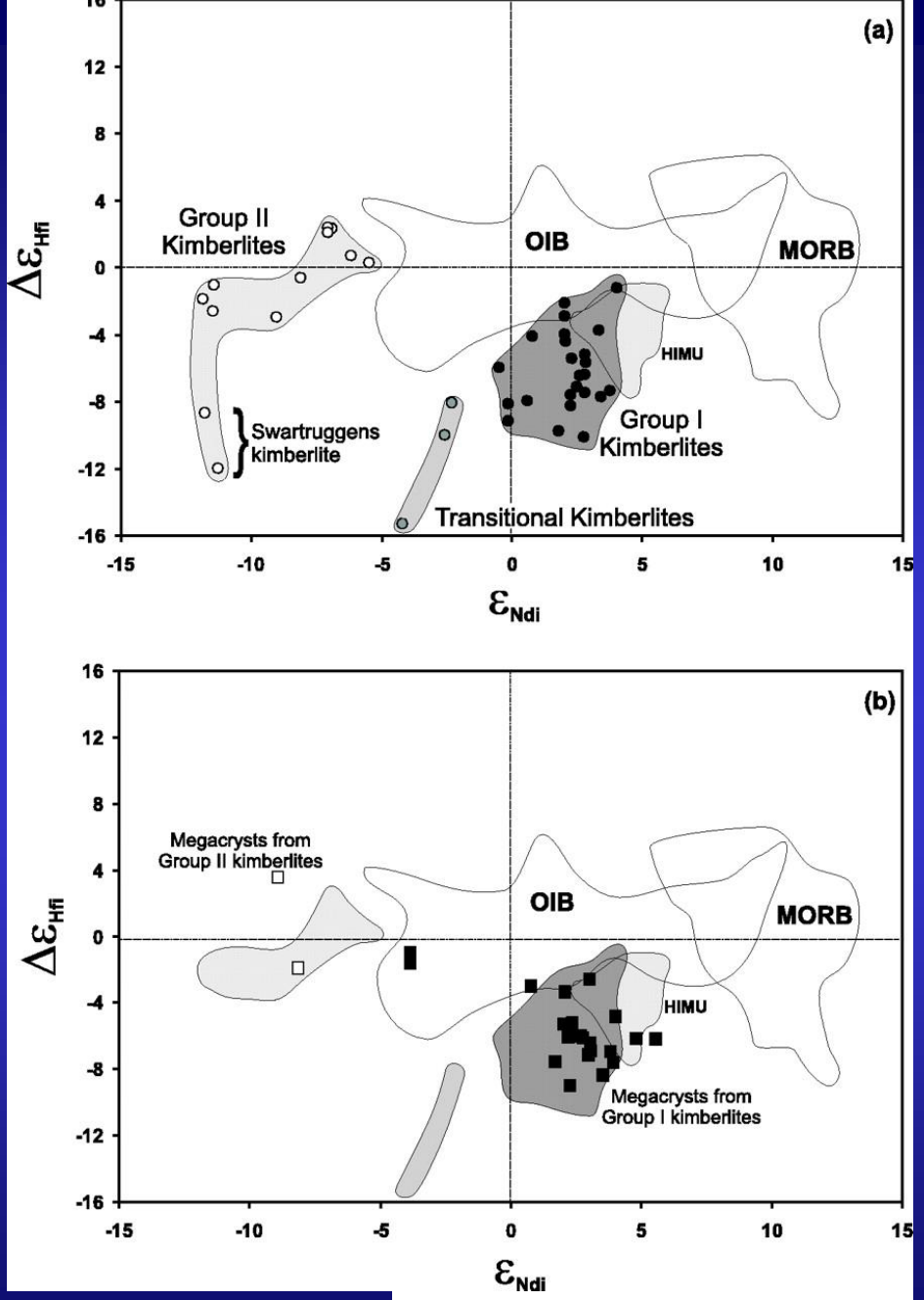
(a) εNd versus 87Sr/86Sri for Group I (black circles), Transitional (grey circles) and Group II kimberlites (open circles),



NOWELL G M et al. J. Petrology 2004;45:1583-1612

JOURNAL OF PETROLOGY

(a) ΔεHfi–εNdi for Group I, Group II and Transitional kimberlites from Southern Africa (symbols as in Fig.



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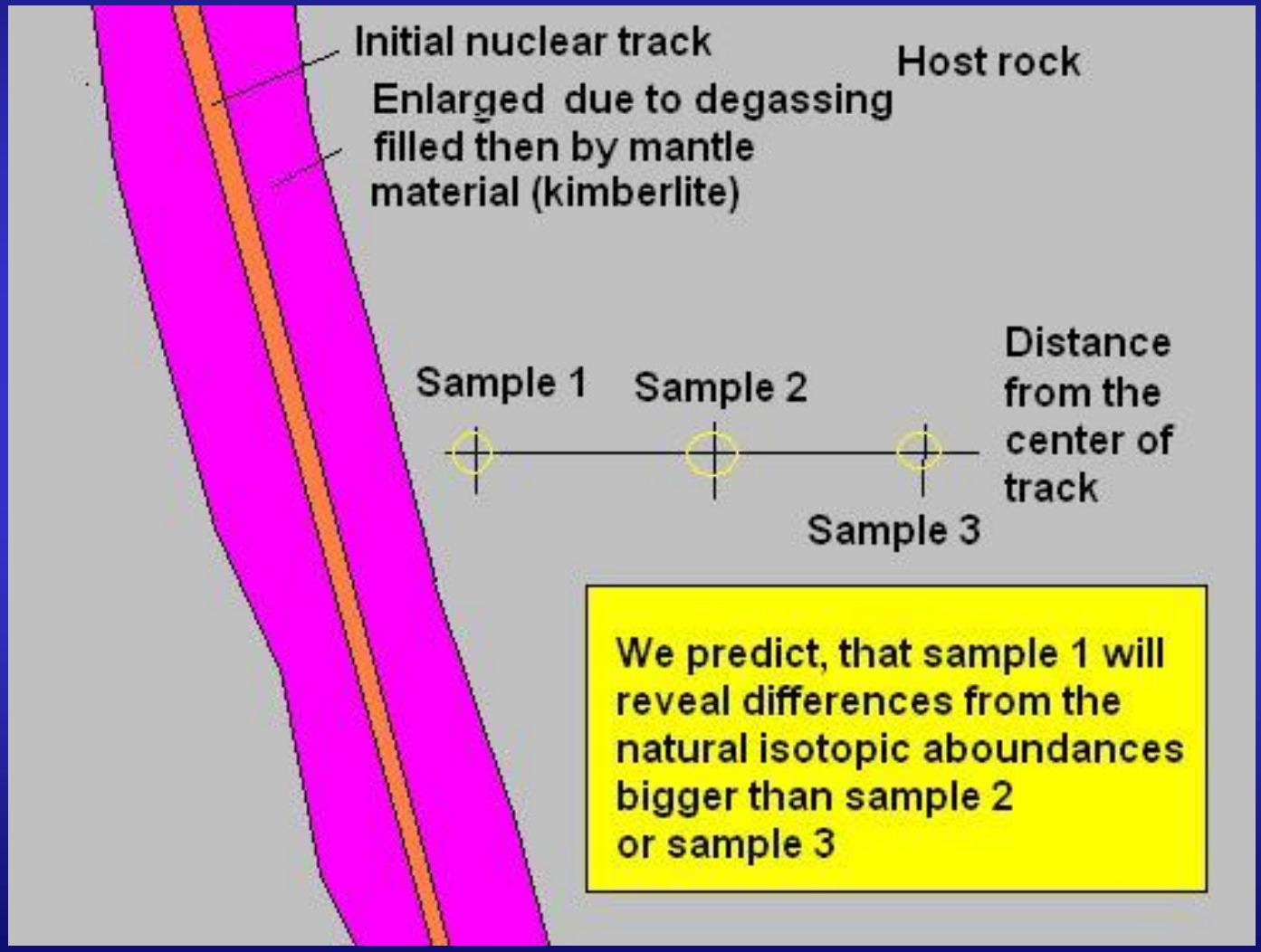
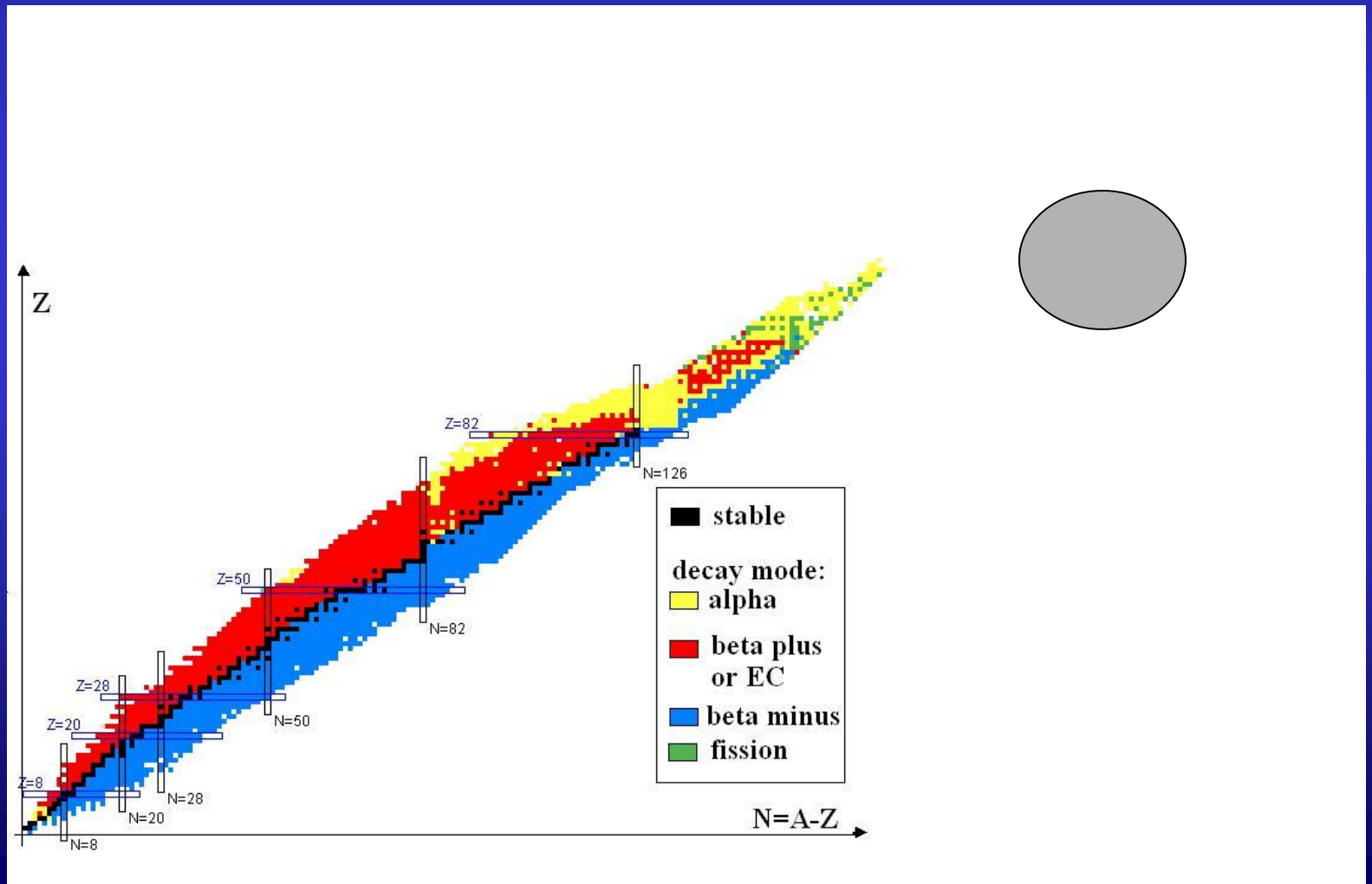
Is it scientific?

- Explains all known features of phenomenon
- No discrepencies with observations
- Predicts some possible to detect fingerprints of the process (activation of isotopes, traces of shock wave – as two the most important)

Proposed sampling



How one can get to island of stability?



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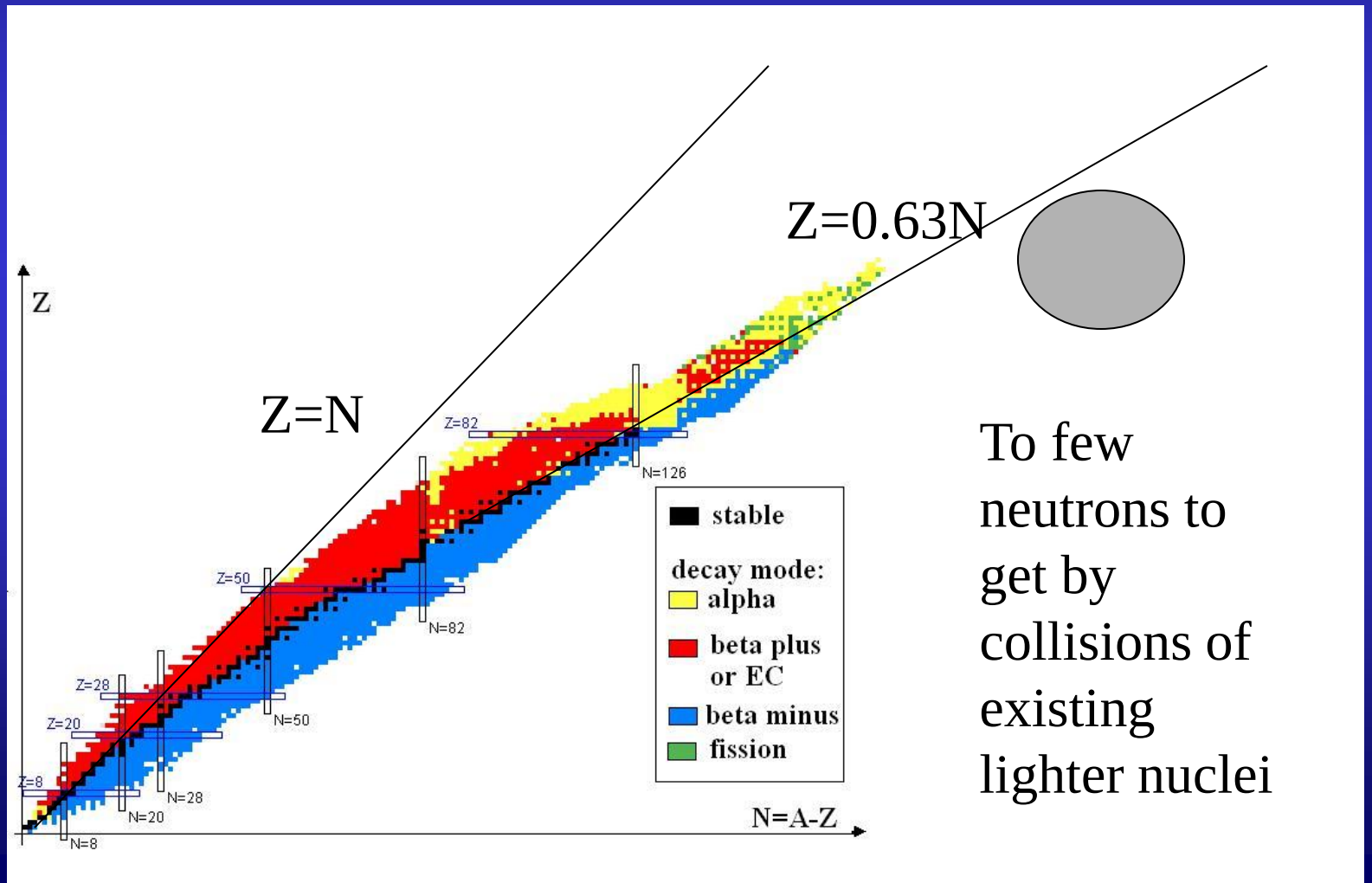
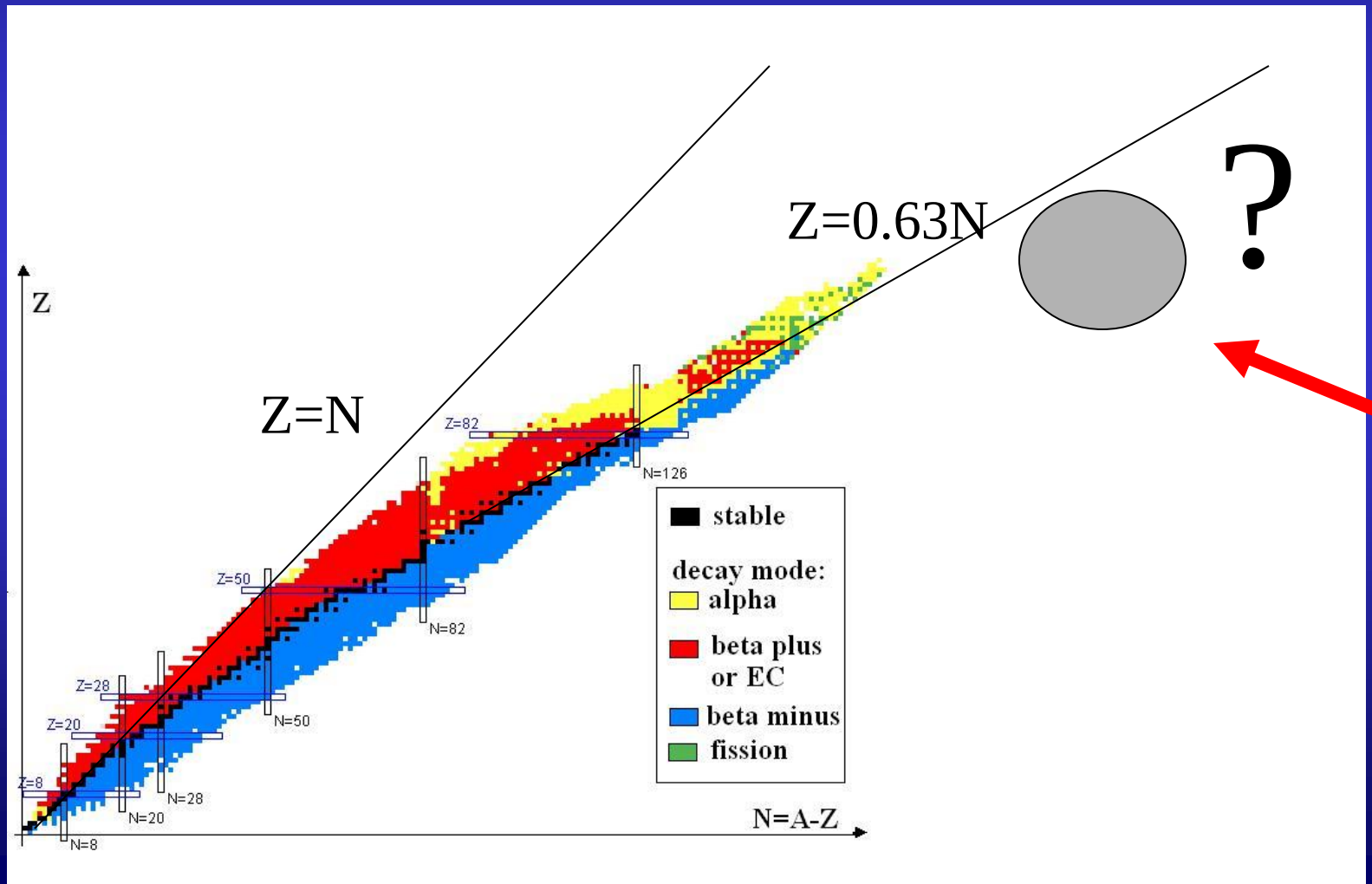
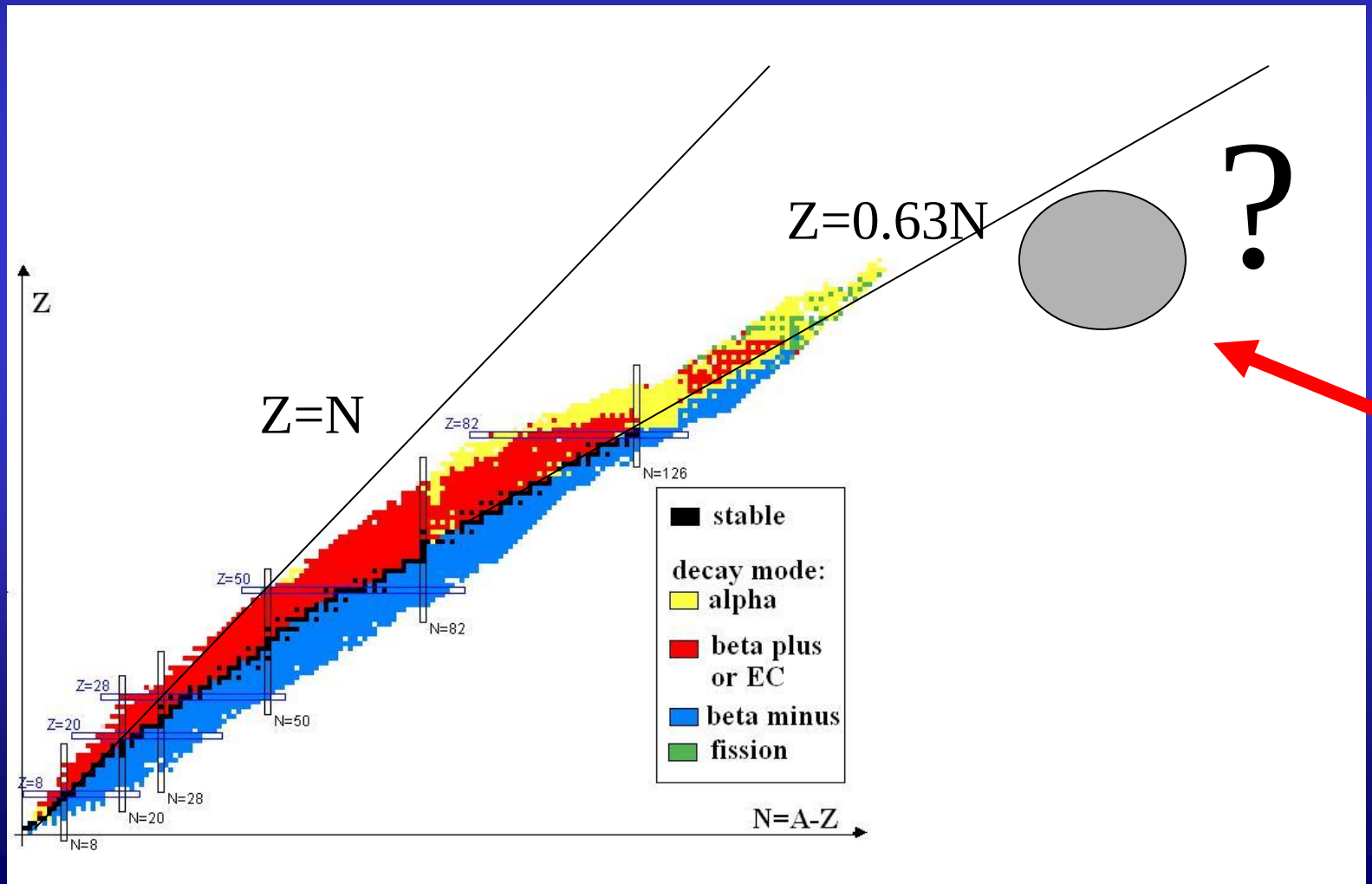


To few neutrons to get by collisions of existing lighter nuclei

How one can get to island of stability?



How reach island of stability from that side?



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Thank you for your attention…