

ОБ ОТРИЦАТЕЛЬНОЙ ОБКЛАДКЕ ЗЕМНОГО КОНДЕНСАТОРА

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ИЯИ РАН

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ИНЭОС РАН

Семинар ОЭФ ИЯИ РАН 9 ноября 2017, Троицк

Atmospheric electricity

According to Ch. Wilson the Earth and ionosphere compose spherical capacity charged by thunder clouds. Potential difference between them is a source of Earth electric field.

Мы живём во время когда

- Модель «Силикатная Земля (BSE)»

заменяется на

Модель «Богатая водородом Земля (HE)»

Geoneutrinos

Experimental results

- ^{238}U , ^{235}U , ^{232}Th , ^{40}K decays in the Earth body are the source of geoneutrinos and heat.
- $^{238}\text{U} \rightarrow ^{206}\text{Pb} + 8\alpha + 6e + 6\tilde{\nu}_e + 51,7 \text{ MeV}$ (47,7)
- $^{232}\text{Th} \rightarrow ^{208}\text{Pb} + 6\alpha + 4e + 4\tilde{\nu}_e + 42,8 \text{ MeV}$ (40,4)
- $^{40}\text{K} \rightarrow ^{40}\text{Ca} + e + \tilde{\nu}_e + 1.32 \text{ MeV}$ (0,598) prob. 0,89
 $\rightarrow ^{40}\text{Ar} + \gamma + \nu_e + 1.5 \text{ Mev}$ (1.46) prob. 0,1066

Looking for antineutrino flux from ^{40}K with large liquid scintillator detector

Looking for antineutrino flux from ^{40}K with large liquid scintillator detector

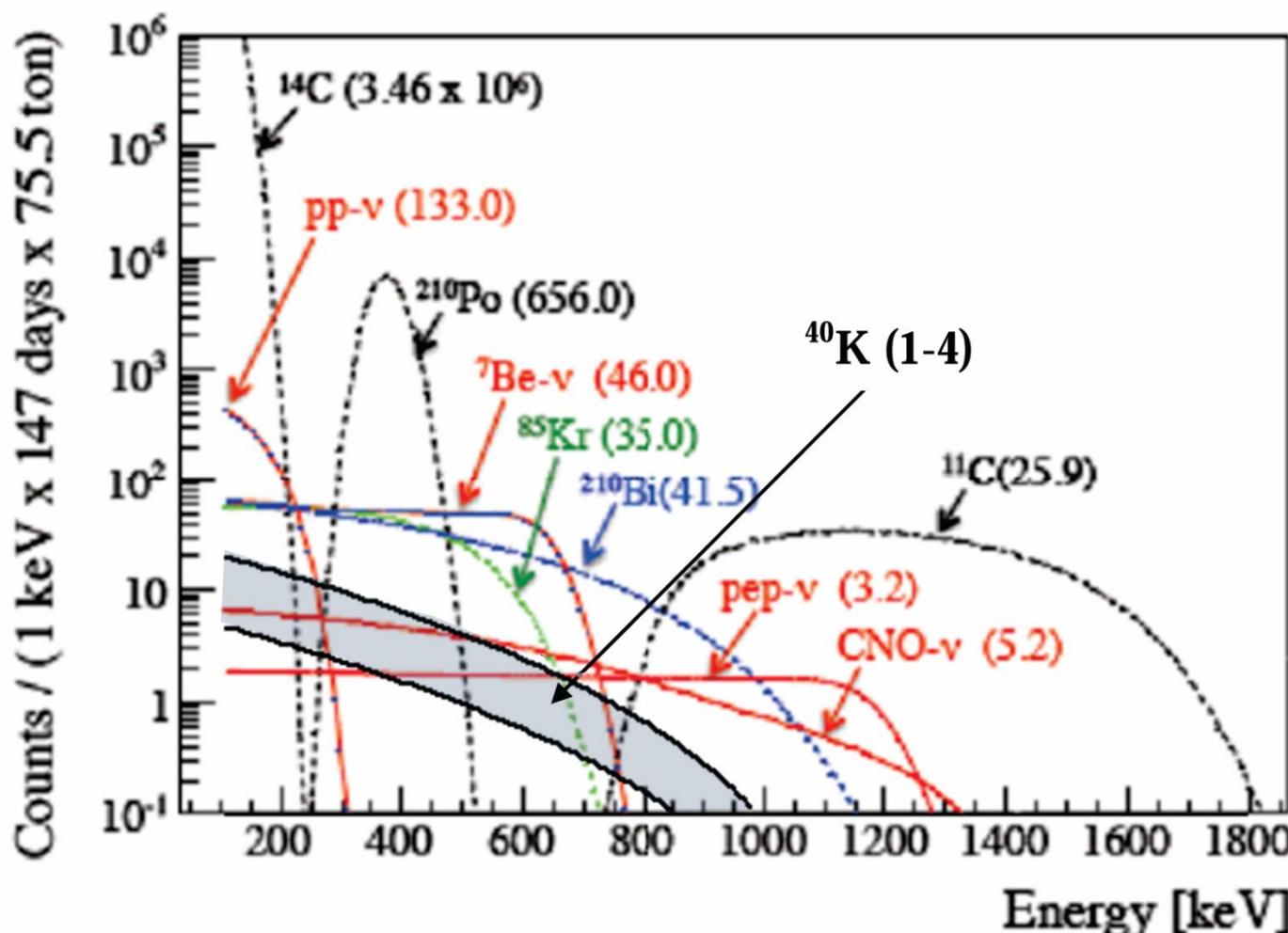
V.V. Sinev, L.B. Bezrukov (Moscow, INR), E.A. Litvinovich, I.N. Machulin, M.D. Skorokhvatov (Kurchatov Inst., Moscow & Moscow Phys. Eng. Inst.), S.V. Sukhotin (Kurchatov Inst., Moscow).

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Conference: C14-01-26 Proceedings, Valday
e-Print: arXiv:1405.3140 [physics.ins-det]

Recoil electrons spectrum from ^{40}K in BOREXINO $\nu_e + e \rightarrow \nu_e + e$



Conclusion. GeoV. Exp.

- The fluxes of U and Th GeoV are recorded.
U and Th BSE concentrations can be changed slightly by putting some U and Th in the Earth mantel and the core → the upper limit

$$H_U + H_{Th} \approx 40 \text{ TW}$$

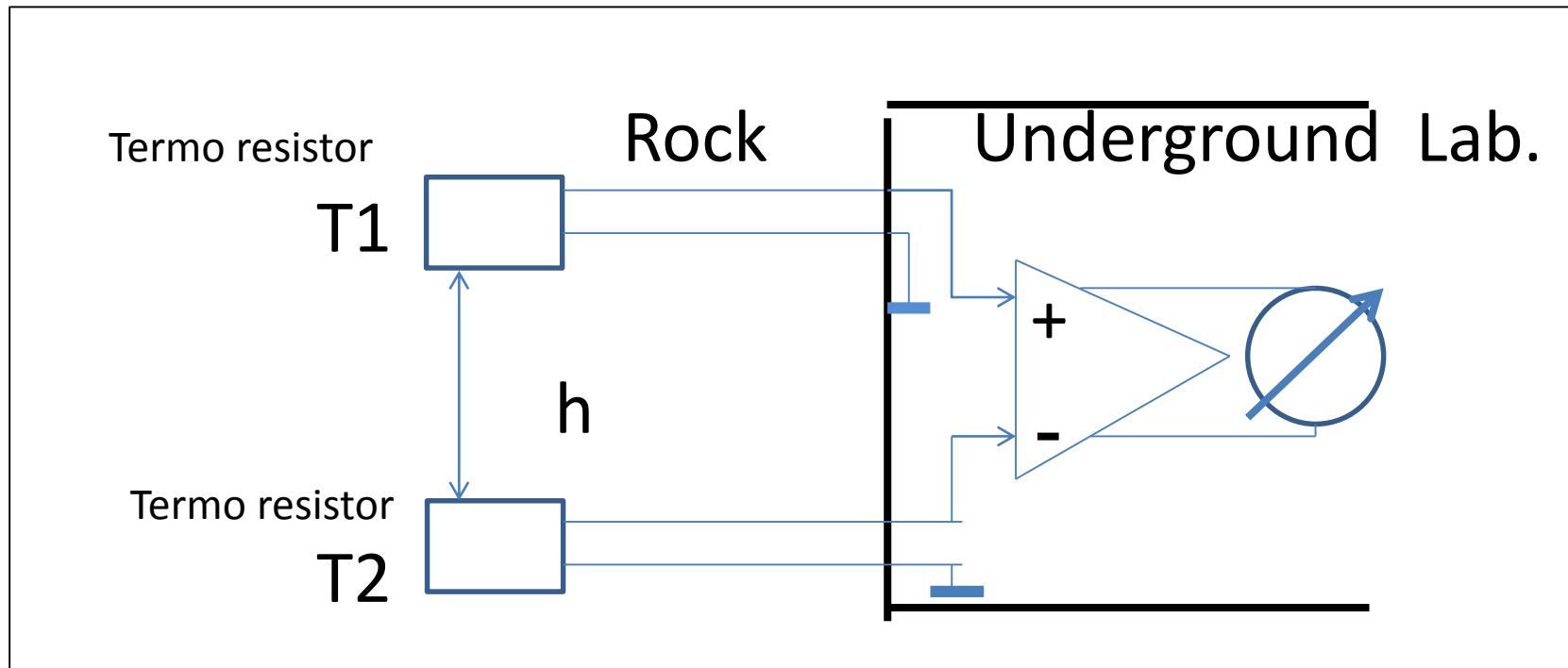
- There is no K GeoV signal. The upper limit on K concentration in the Earth:

$$2\% \div 4\% \rightarrow H_K = 300 \div 600 \text{ TW}$$

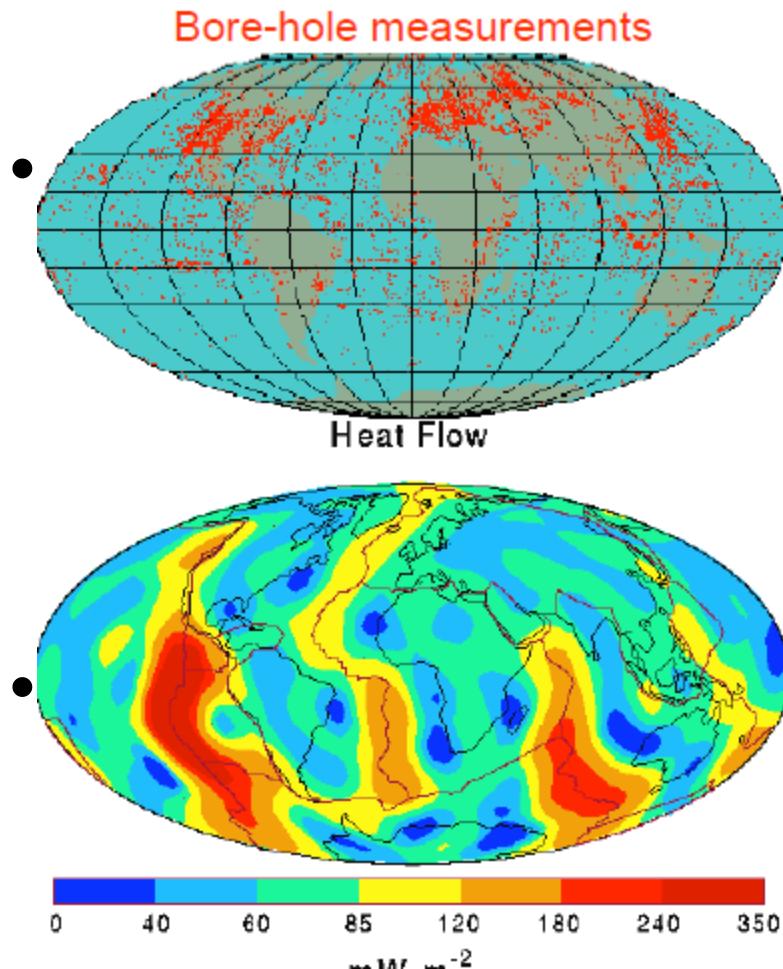
Intrinsic Earth heat. Exp.

- ^{238}U , ^{235}U , ^{232}Th , ^{40}K decays in the Earth body are the source of heat and geoneutrinos.
- $^{238}\text{U} \rightarrow ^{206}\text{Pb} + 8\alpha + 6e + 6\tilde{\nu}_e + 51,7 \text{ MeV} (47,7)$
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 $\rightarrow ^{40}\text{Ar} + \gamma + \nu_e + 1.5 \text{ Mev} (1.46) \text{ prob.} 0,1066$

Conductive Heat Flux: $F = \alpha \Delta T / h$



Surface heat flux



Global Heat Flow Data (Pollack et al.)

- Conductive heat flow from bore-hole temperature gradient;
- **Total surface heat flux:**
 $31 \pm 1 \text{ TW}$ (Hofmeister&Criss 2005)
 $46 \pm 3 \text{ TW}$ (Jaupart et all 2007)
 $47 \pm 2 \text{ TW}$ (Davis&Davies 2010)
(same data, different analysis)

SYSTEMATIC ERRORS

Different assumptions concerning the role of fluids in the zones of mid ocean ridges.

The way of heat transfer in HE model: the gas carries up the binding energy

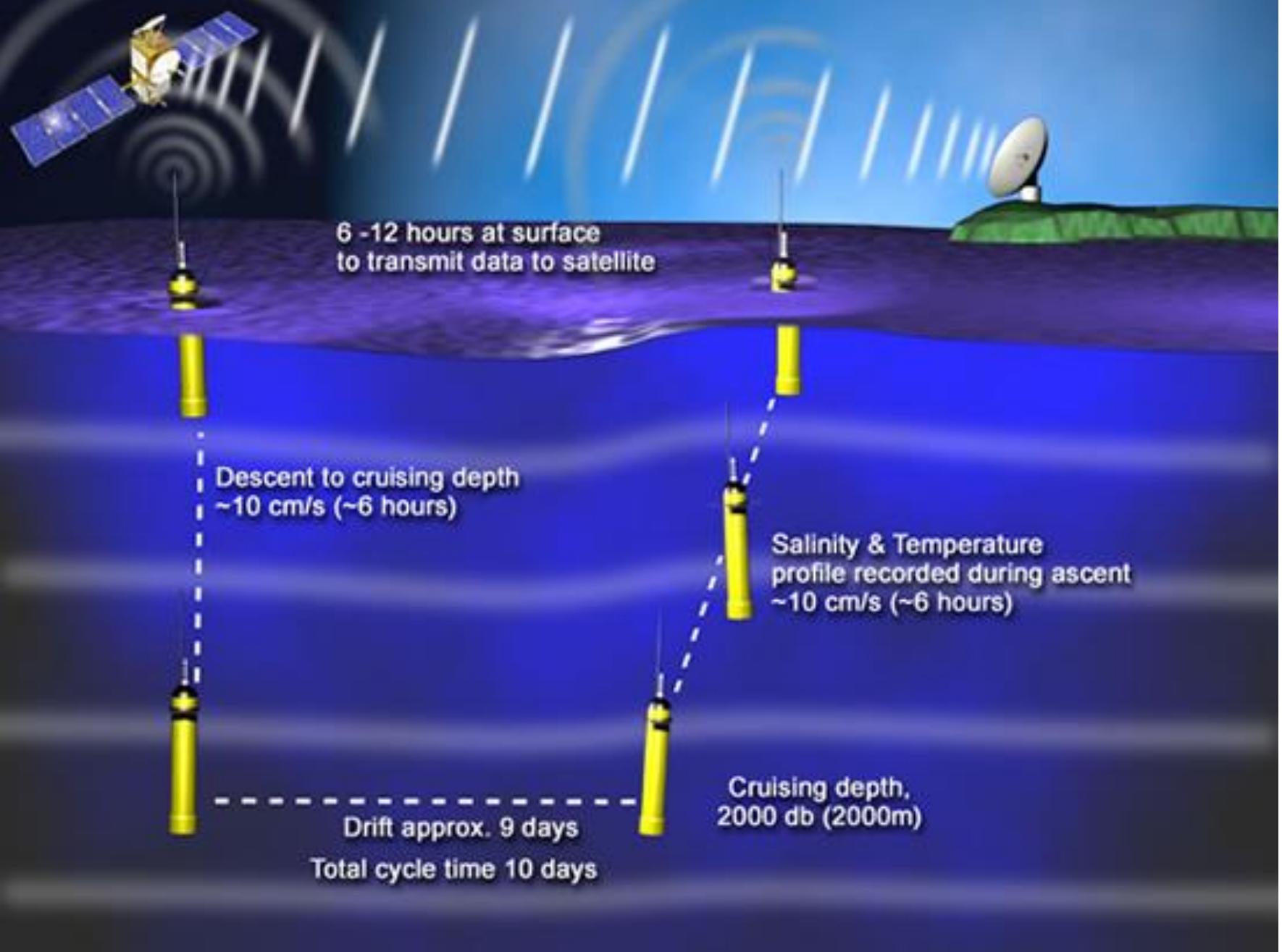
- Silane - SiH_4 - gas from -112 to 450 °C



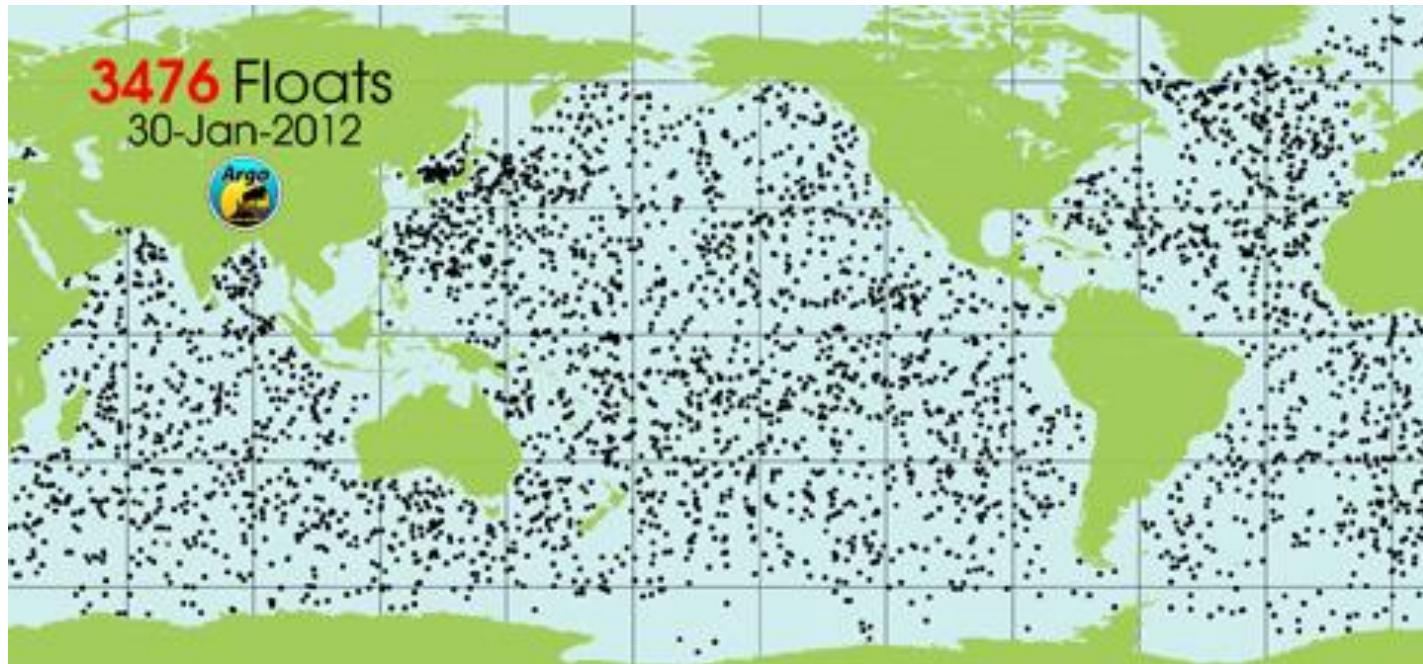
SiH_4 slowly dissolves in water and the decomposition reaction goes slowly under normal conditions – 20% per day.

ARGO PROJECT: Global array of free-drifting profiling floats that will measure the temperature of the upper 2000 m of the ocean in real-time





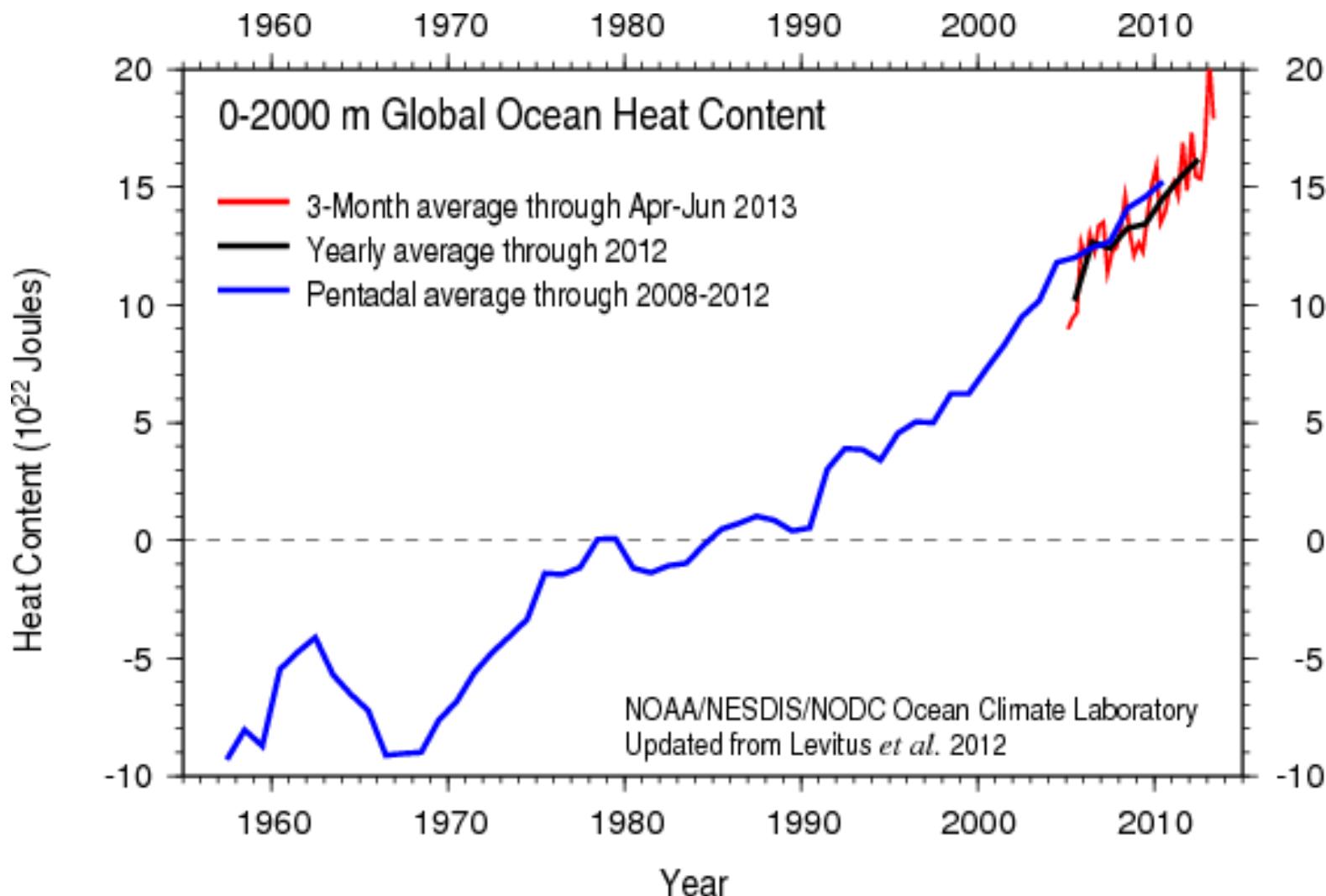
Argo Project

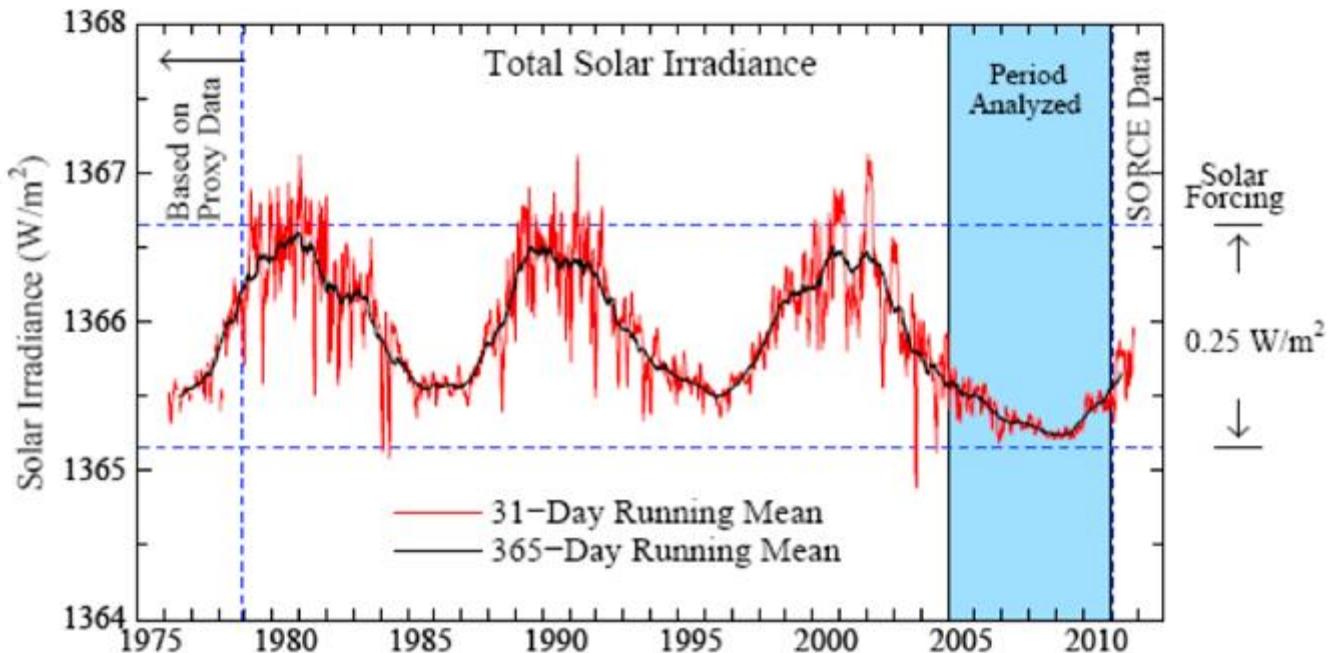


Positions of the floats that have delivered data within the last 30 days : 3476 Floats

$$H = \rho c_p \int_{h2}^{h1} T(z) dz$$

ρ - water density, C_p - sea water specific heat capacity,
 $h2$ - bottom depth, $h1$ - top depth, $T(z)$ - temperature profile.





- A graph of the sun's total solar irradiance shows that in recent years irradiance dipped to the lowest levels recorded during the satellite era. The resulting reduction in the amount of solar energy available to affect Earth's climate was about .25 watts per square meter, less than half of Earth's total energy imbalance.*

Earth's energy imbalance

Atmos. Chem. Phys., 11, 13421-13449, 2011

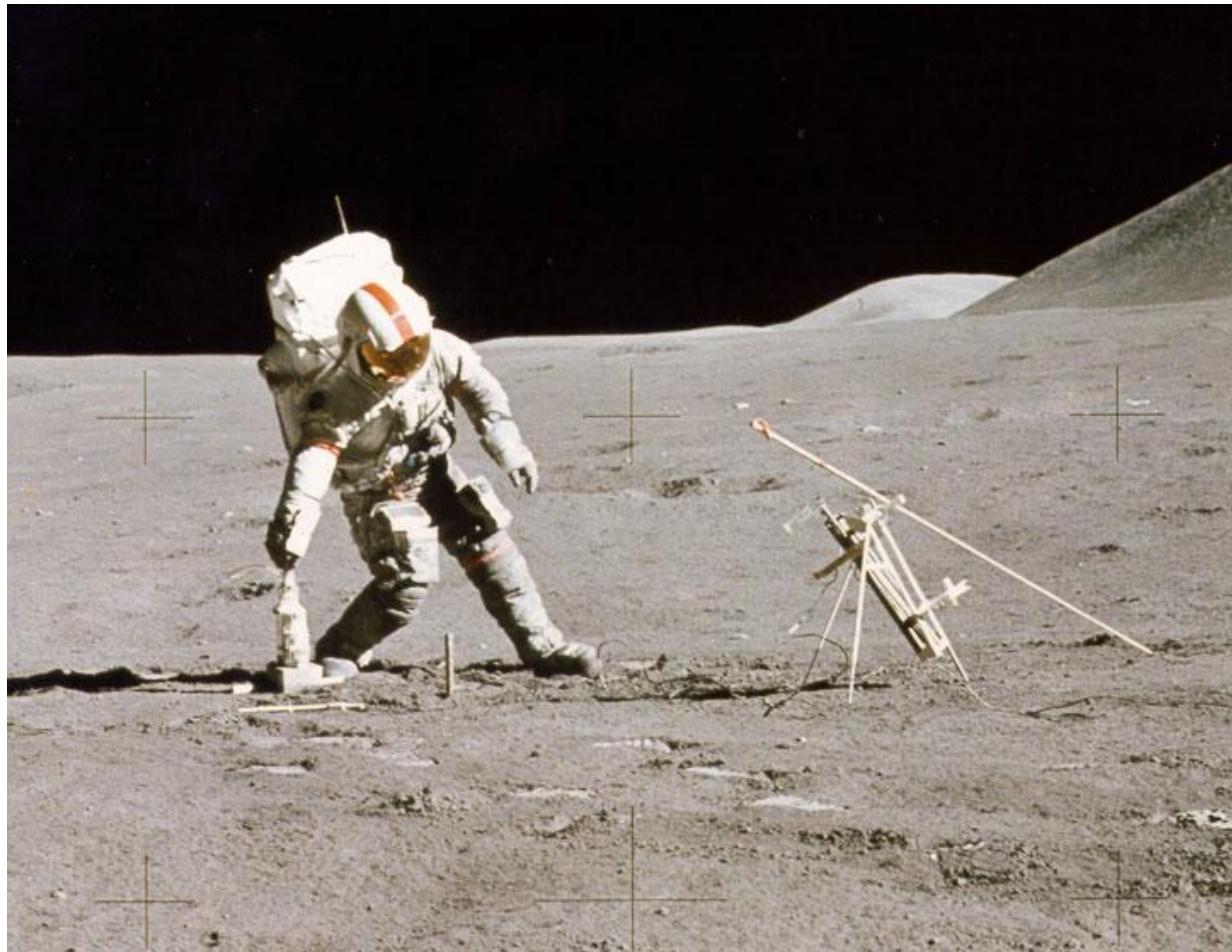
www.atmos-chem-phys.net/11/13421/2011/

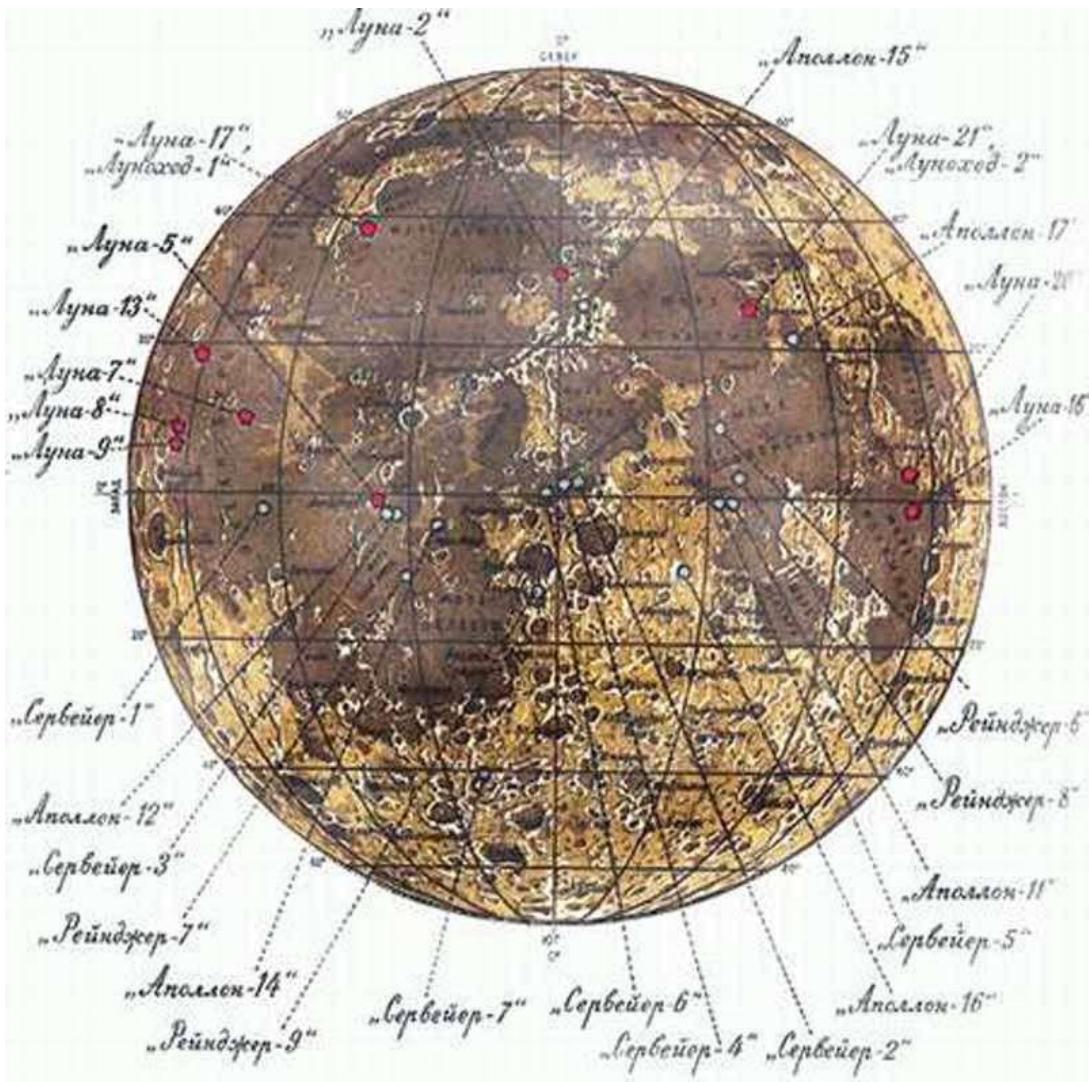
- **J. Hansen^{1,2}, M. Sato^{1,2}, P. Kharecha^{1,2}, and K. von Schuckmann³**
¹NASA Goddard Institute for Space Studies, New York, NY 10025, USA
²Columbia University Earth Institute, New York, NY 10027, USA
³Centre National de la Recherche Scientifique, LOCEAN Paris, hosted by Ifremer, Brest, France
- Improving observations of ocean heat content show that Earth is absorbing more energy from the Sun than it is radiating to space as heat, even during the recent solar minimum. The inferred planetary energy imbalance is $0.58 \pm 0.15 \text{ W m}^{-2}$ during the 6-yr period 2005–2010
- $H_{\text{Earth}} = 0.58 \text{ W m}^{-2} \cdot 5.1 \cdot 10^{14} \text{ m}^2 = 3 \cdot 10^{14} \text{ W} = 300 \pm 76 \text{ TW}$

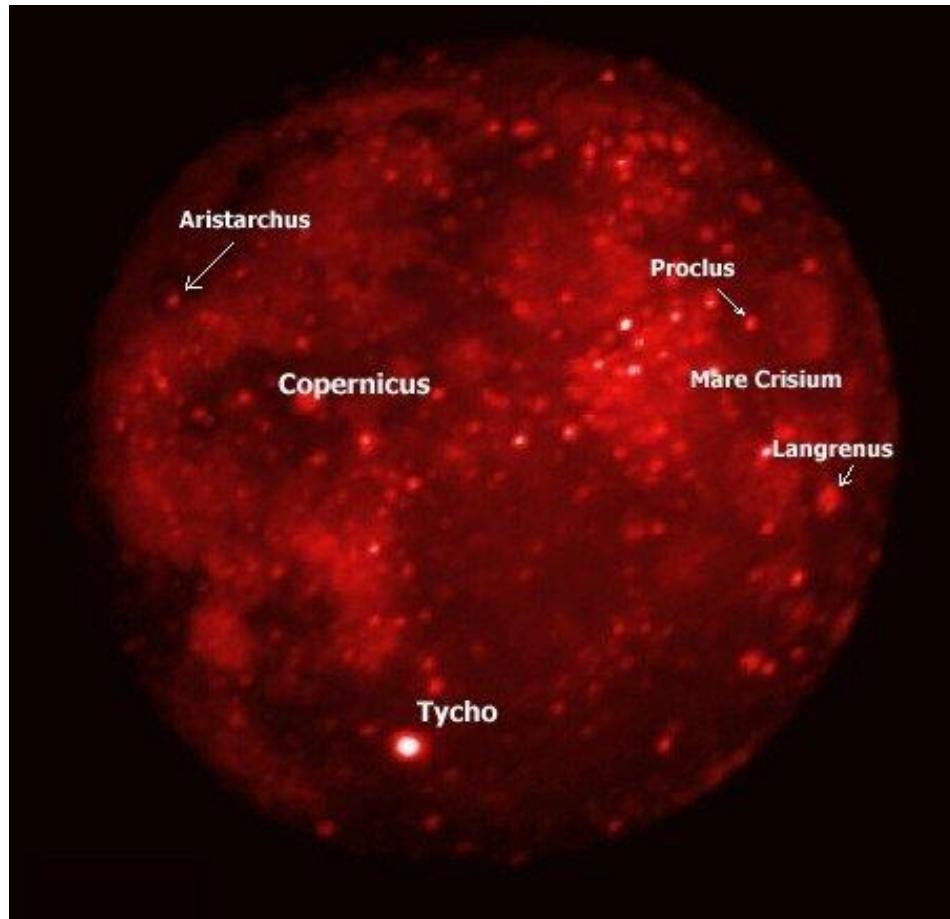
Under conditions that the element composition of Moon and Earth is just the same the Earth intrinsic heat flux is:

$$H_{\text{Earth}} = H_{\text{Moon}} \cdot M_{\text{Earth}} / M_{\text{Moon}}$$

Photo of the Apollo 15 CDR setting up a deep drill. Drilling and extraction on the moon was very difficult and must have caused significant heating. Unless dark drill segments were immediately placed in the shade they would have been substantially heated. NASA photo AS15-87-11847.





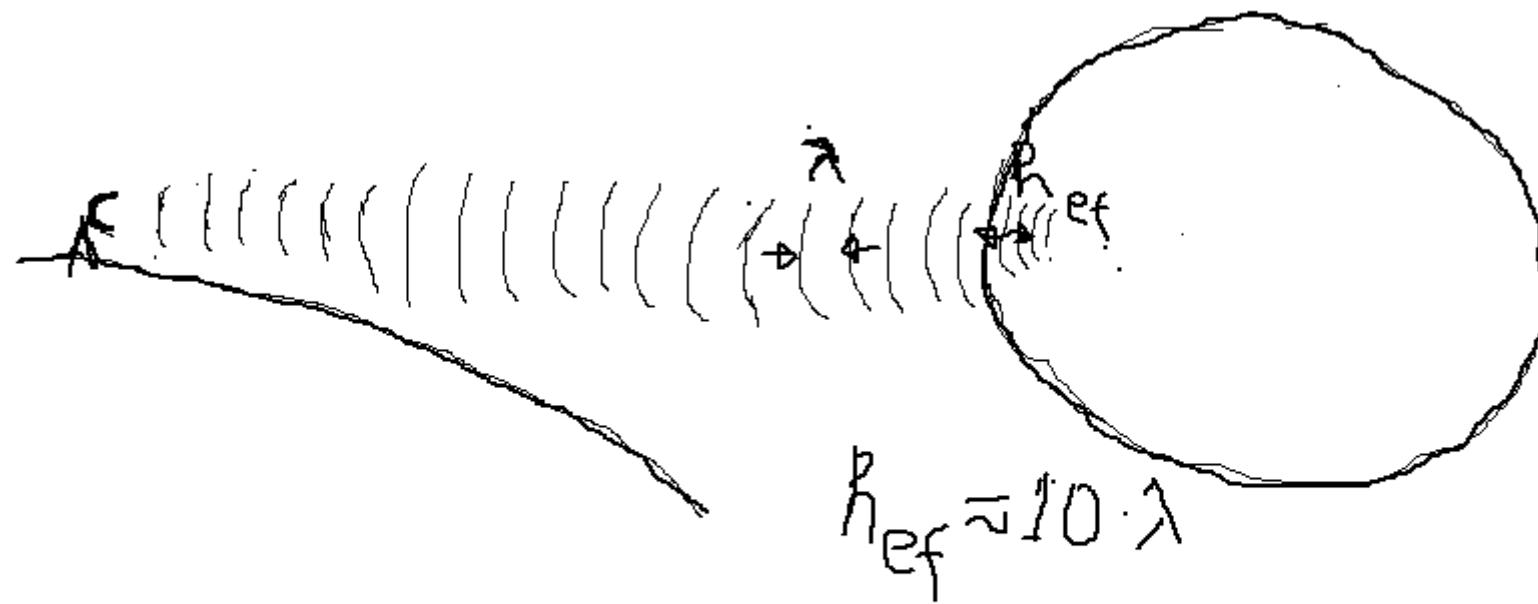


Apollo 15, Apollo 17

$$H_{\text{Earth}} = H_{\text{Moon}} \cdot M_{\text{Earth}} / M_{\text{Moon}} = 43 - 65 \text{ TW}$$

- The measurements were done at the places with low heat fluxes.

Effective radiowave emission depth of black body radiation from Moon regolith

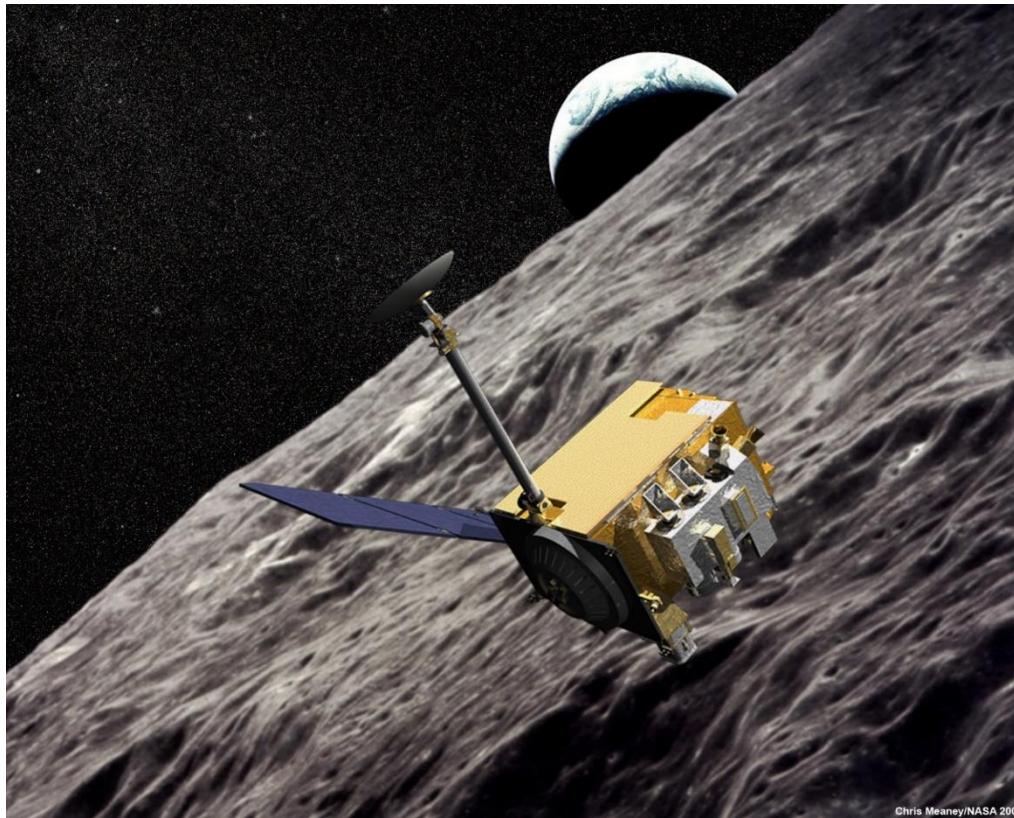


Krotikov V.D., Troitskyi V.S. Radio emission and nature of the Moon. Soviet Phys. Uspekhi. 1964. V.6. pp841-871.

- $\lambda_1 = 10 \text{ cm}, \lambda_2 = 20 \text{ cm}$
- $H_{\text{Earth}} = H_{\text{Moon}} \cdot M_{\text{Earth}} / M_{\text{Moon}} = 170 \text{ TW}$

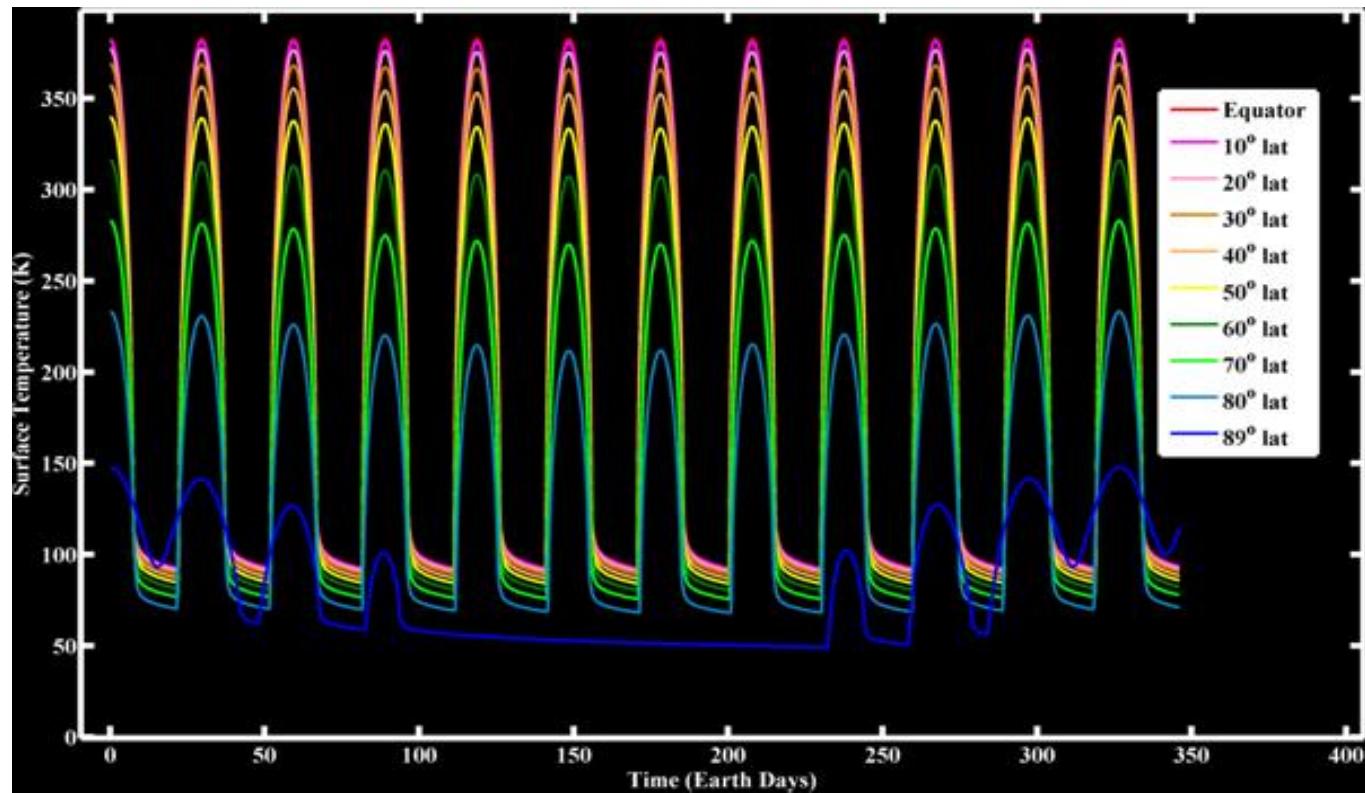
This result depends on assumption that Moon crust is non-conductor. If the crust contains metals this result is the low bound of heat flux.

Lunar Reconnaissance Orbiter. 2009



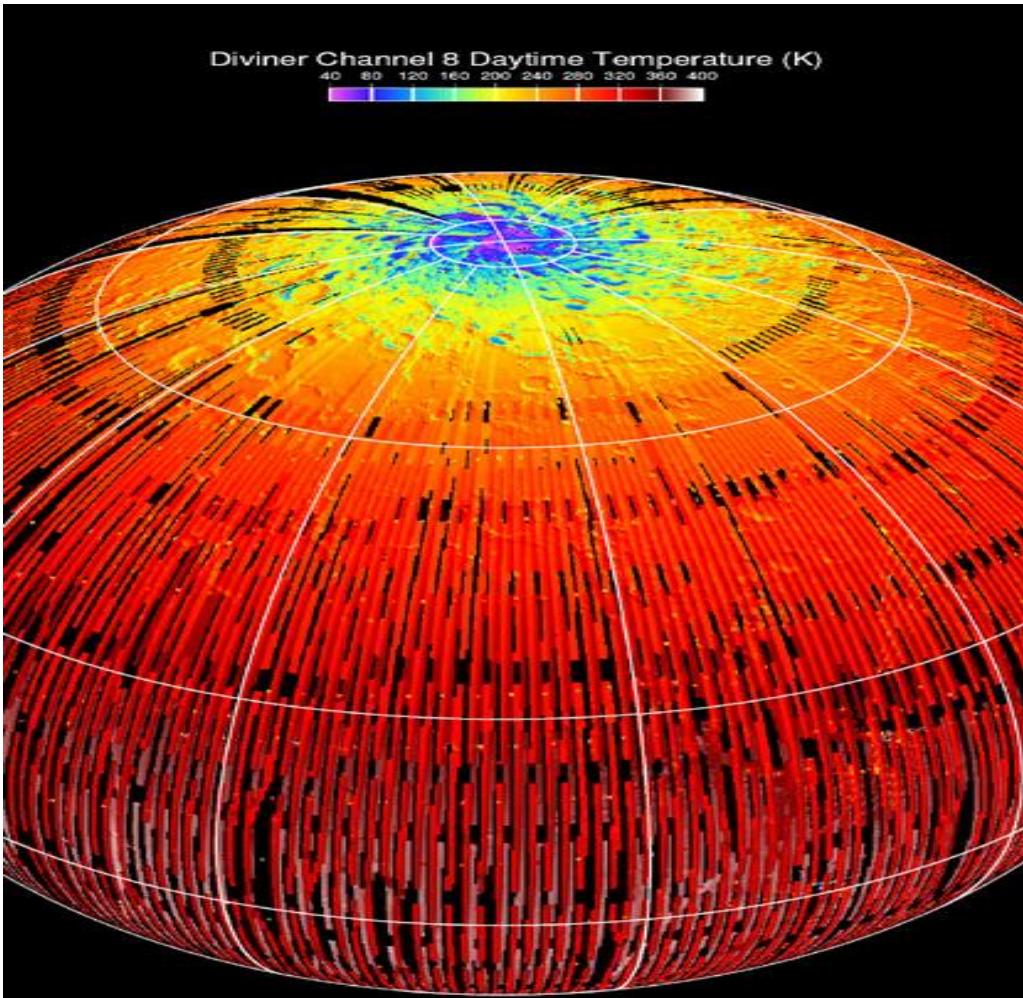
Chris Meaney/NASA 2008

The Diviner Lunar Radiometer Experiment is one of seven instruments aboard [NASA's Lunar Reconnaissance Orbiter](#), which launched on June 18 2009. It is the first instrument to create detailed day and night surface temperature maps of the Moon.

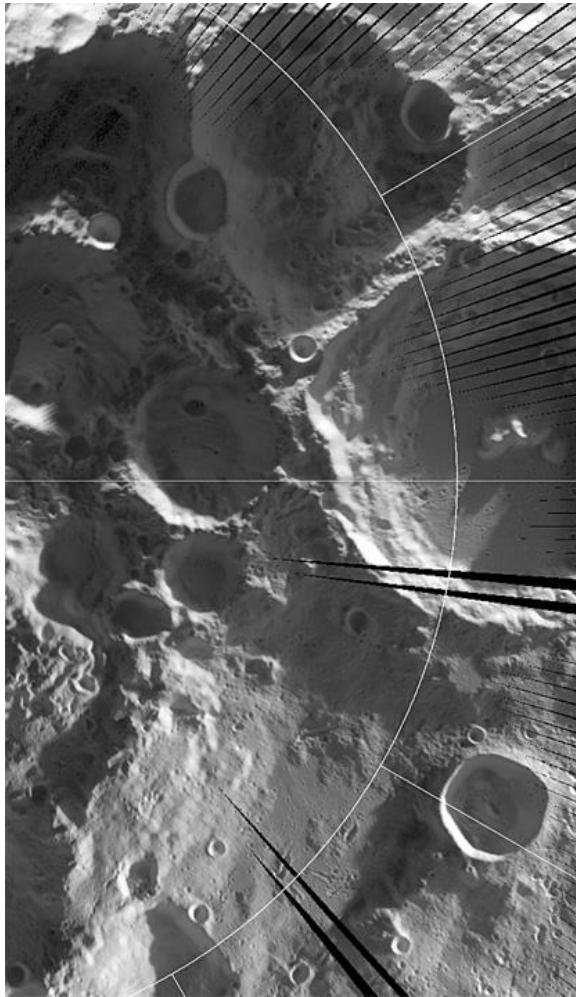


Diviner Daytime Temperature (K) on South Pole.

$$T_{\min} = 40 \text{ K}$$

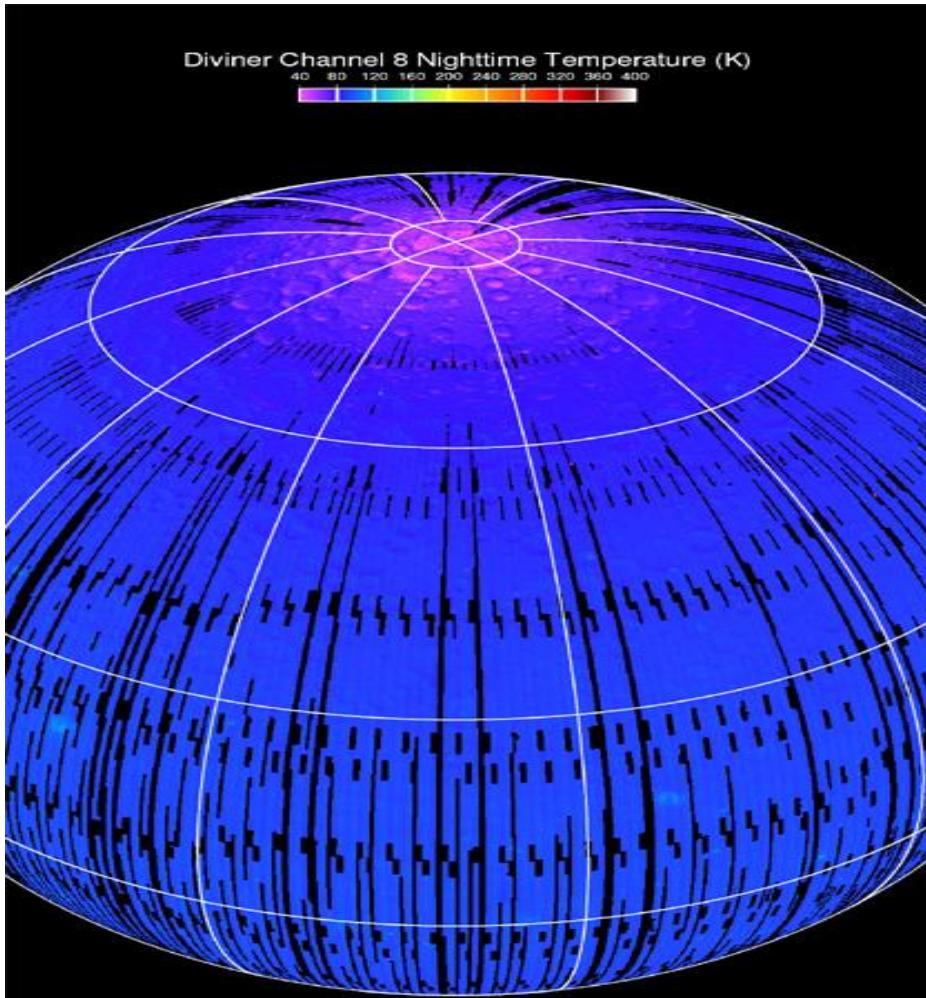


Diviner photo. Permanent dark places in South Luna Pole.



Diviner Nighttime Temperature (K) on South Pole.

$$T_{\min} = 40K$$



Equilibrium condition for the permanent dark places on Lunar surface

$$F_{\text{rad}} = \epsilon \cdot \sigma \cdot T^4$$

F_{rad} – radiogenic heat flux,

$\epsilon = 0,95$ – emissivity of lunar surface,

$\sigma = 5,67 \cdot 10^{-8} \text{ W} \cdot \text{m}^{-2} \cdot \text{K}^{-4}$ - Stefan-Boltzmann constant.

$$F_{\text{rad}} (T=40\text{K}) = 0,138 \text{ W} \cdot \text{m}^{-2}$$

$$H_{\text{Moon}} = F_{\text{rad}} (T=40\text{K}) \cdot S_{\text{Moon}} = 5,2 \text{ TW}$$

$$H_{\text{Earth}} = H_{\text{Moon}} \cdot M_{\text{Earth}} / M_{\text{Moon}} = 420 \text{ TW}$$

Summary

Earth

- Bore-hole temperature gradient 47 ± 2 TW
- ARGO Earth's energy imbalance 300 ± 76 TW

Moon recalculated to Earth heat flux

- Apollo 15, 17 drilling 43-65 TW
- Russian radio emission exp. 170 TW
- LRO temperature map 420 TW

We consider the value of **300 TW** as the most favorable to explain the all experimental data.

300 ± 76 TW

Can we find the Earth model which can help to understand such huge value as

300 TW

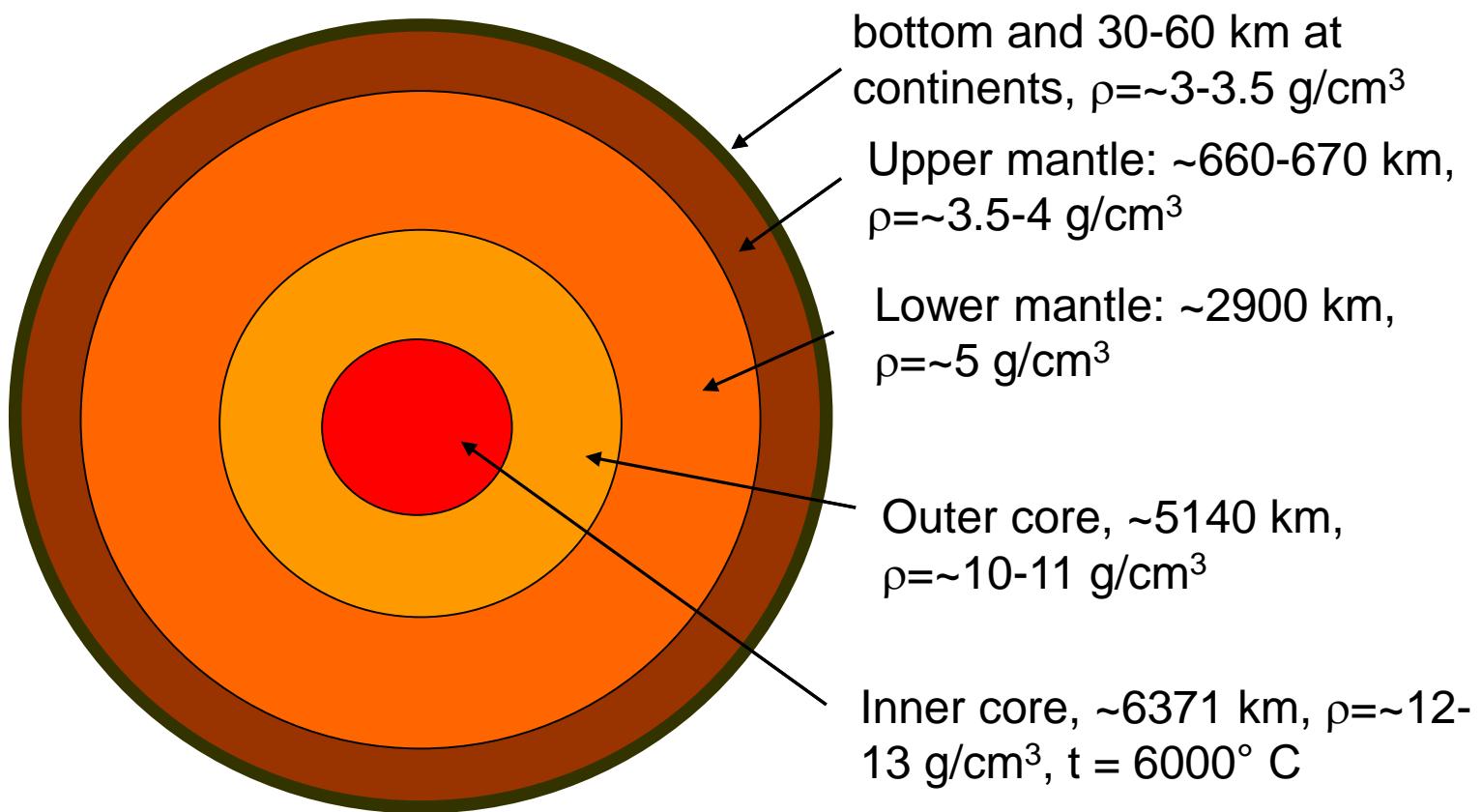
and

the values of measured geoneutrino fluxes simultaneously?

We found:

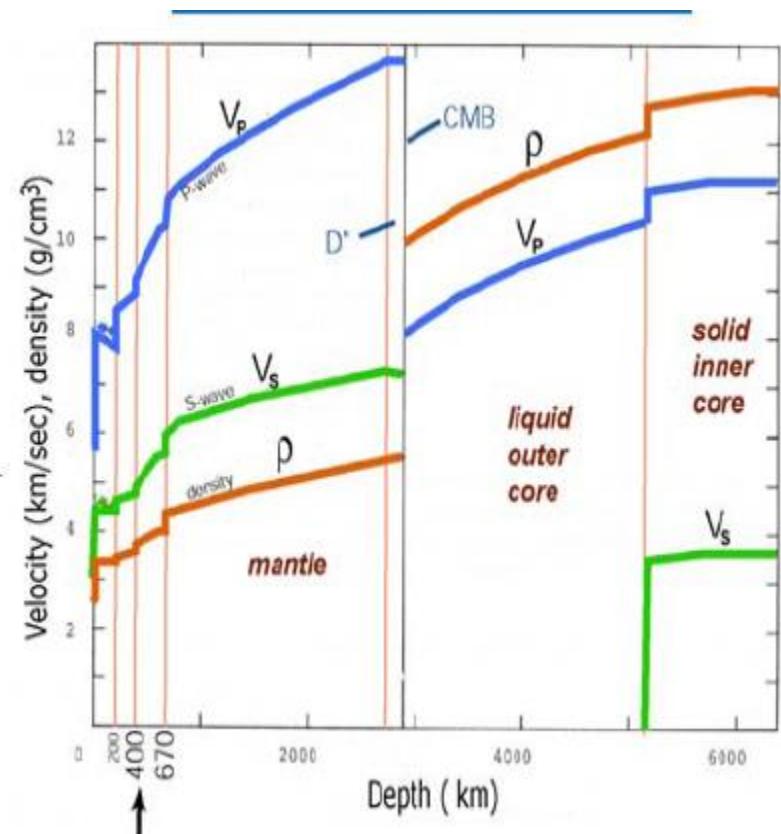
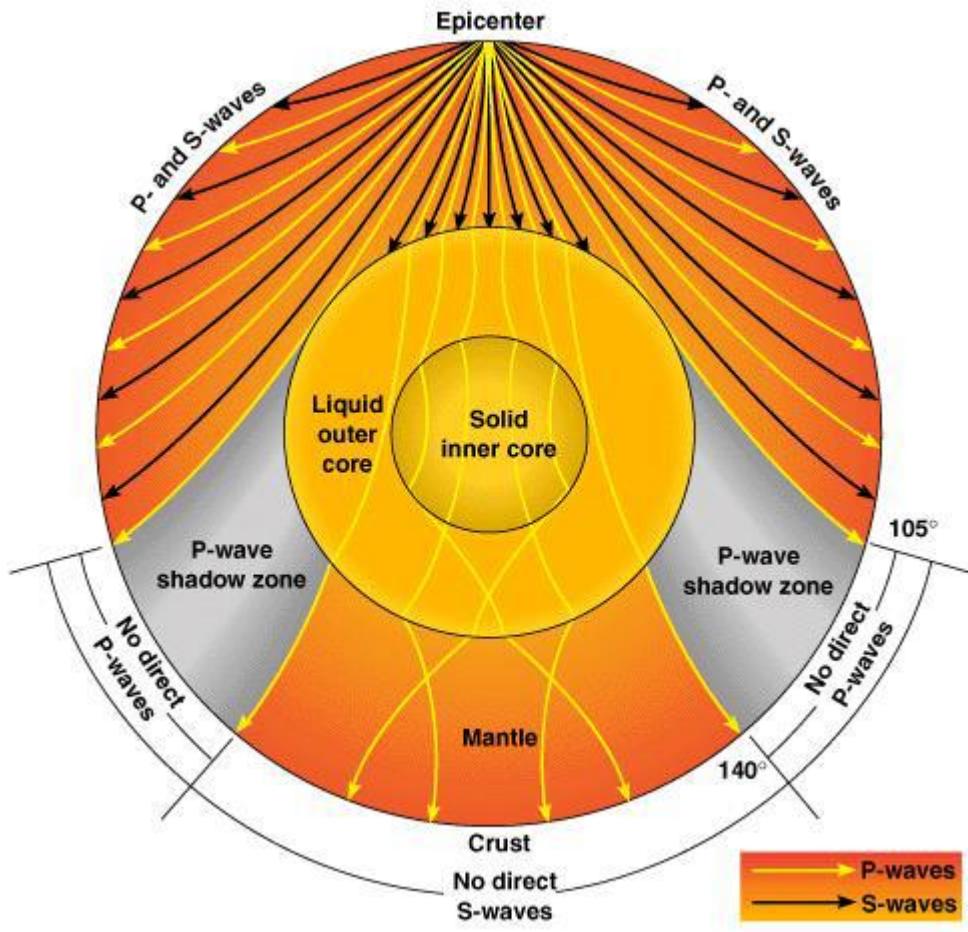
Hydride Earth or Primordial Hydrogen rich planet (HE)

Earth structure



At site <http://igppweb.ucsd.edu/~gabi/> data for $2^\circ \times 2^\circ$ were available. (Now $1^\circ \times 1^\circ$)

Seismology



P – primary, longitudinal waves

S – secondary, transverse/shear waves

Bulk Silicate Earth (BSE)

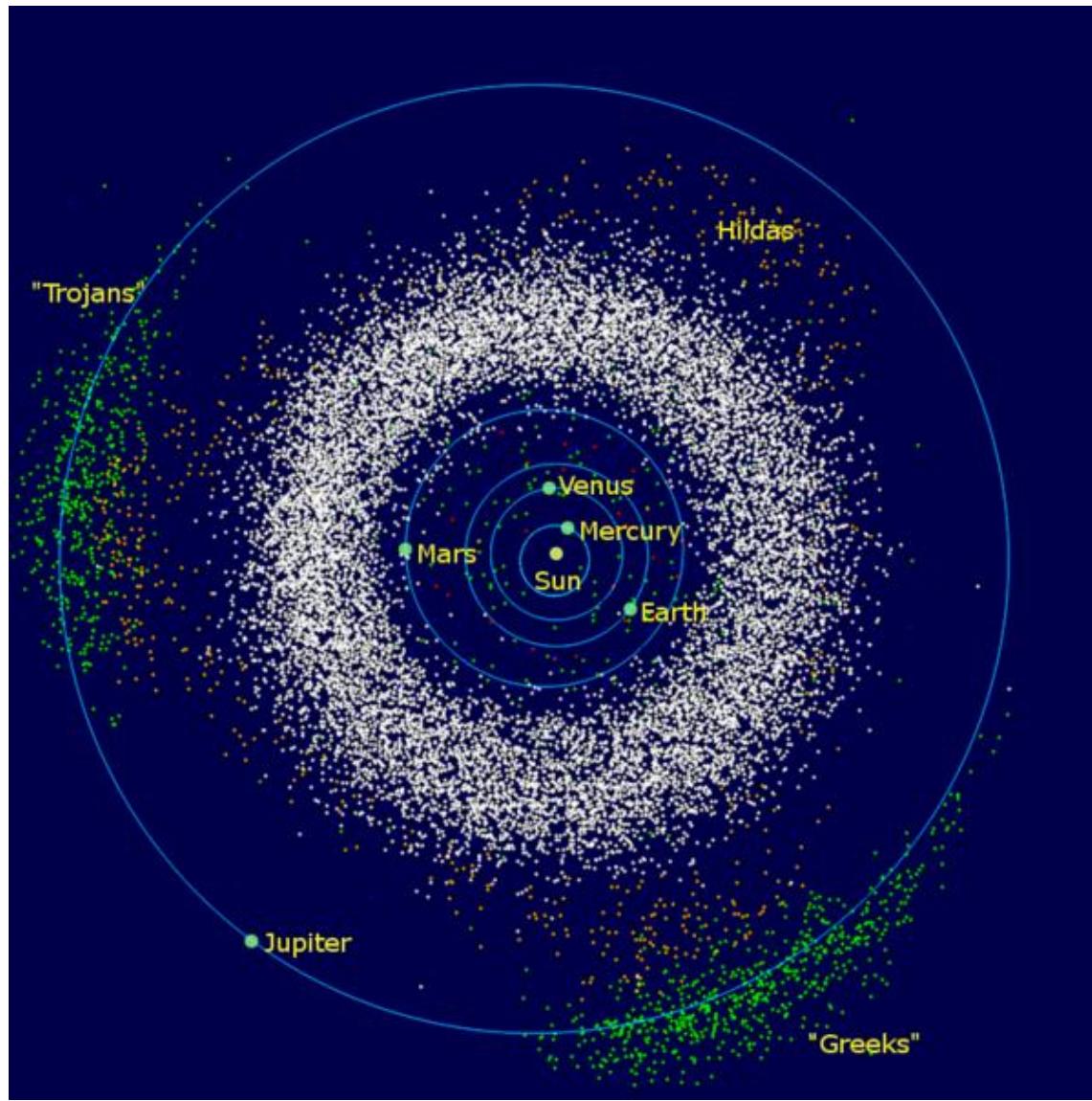
Basic idea:

**Earth chemical composition ≡
meteorite chemical composition ≡
Asteroid Belt (AB) chemical
composition**

Bulk Silicate Earth (BSE)

- There are no any U, Th, K in Lower mantle and Core
- Mantle → oxides
- Core → Fe
- BSE introduced the problem: The calculated radiogenic heat 20 TW is not enough to explain the experimentally measured one 47 TW

The asteroid belt (shown in white) is located between the orbits of Mars and Jupiter.



Hydride Earth (HE) model (primordially Hydrogen-Rich Planet)

was born 40 years ago and does not killed up to now

- Basic idea:

Planet chemical composition depends on distance from the Sun.

Earth chemical composition \neq Asteroid Belt (AB) chemical composition.

Исходный состав Земли

При формировании протопланетного диска (по Хойлу), вещества, сброшенное с протосолнечной небулы, должно было двигаться попарек магнитных силовых линий. Ионизированные частицы не могут пересекать магнитные силовые линии (если у частиц «тепловые» скорости), поэтому они должны были захватываться магнитным полем и останавливаться в околосолнечном пространстве, тогда как нейтральные атомы свободно проходили через магнитное поле и уходили в более удаленные зоны. Иными словами, если Хойл прав, то при формировании протопланетного диска в магнитном поле небулы происходило разделение элементов в зависимости от их потенциалов ионизации.

В начале 70-ых XX века нам были известны составы: фотосфера Солнца, внешней оболочки Земли (примерно, до глубины 150 км), внешней оболочки Луны и пояса астероидов (по коллекциям метеоритов), который отстоит от Солнца в 3 раза дальше Земли. Сопоставление этих составов (в парах: Земля/Солнце, Луна/Земля, астероиды/Земля) выявило четкую зависимость распространенности химических элементов в Солнечной системе от их потенциалов ионизации. Следовательно, Ф. Хойл был прав. Но самое главное в том, что на основе выявленной мною «закисимости» появилась возможность определить исходный состав Земли. Согласно этому определению [сделанному на основе фактических данных], содержание кислорода в теле планеты не должно превышать 1% от всей её массы, преобладающими элементами являются Si, Mg и Fe; далее (по убывающей) – Ca, Al, Na; концентрации прочих не превышают десятых и сотых долей процента. Вместе с тем, более половины всех атомов (60%) в изначальной Земле принадлежали водороду (4,5% по массе).

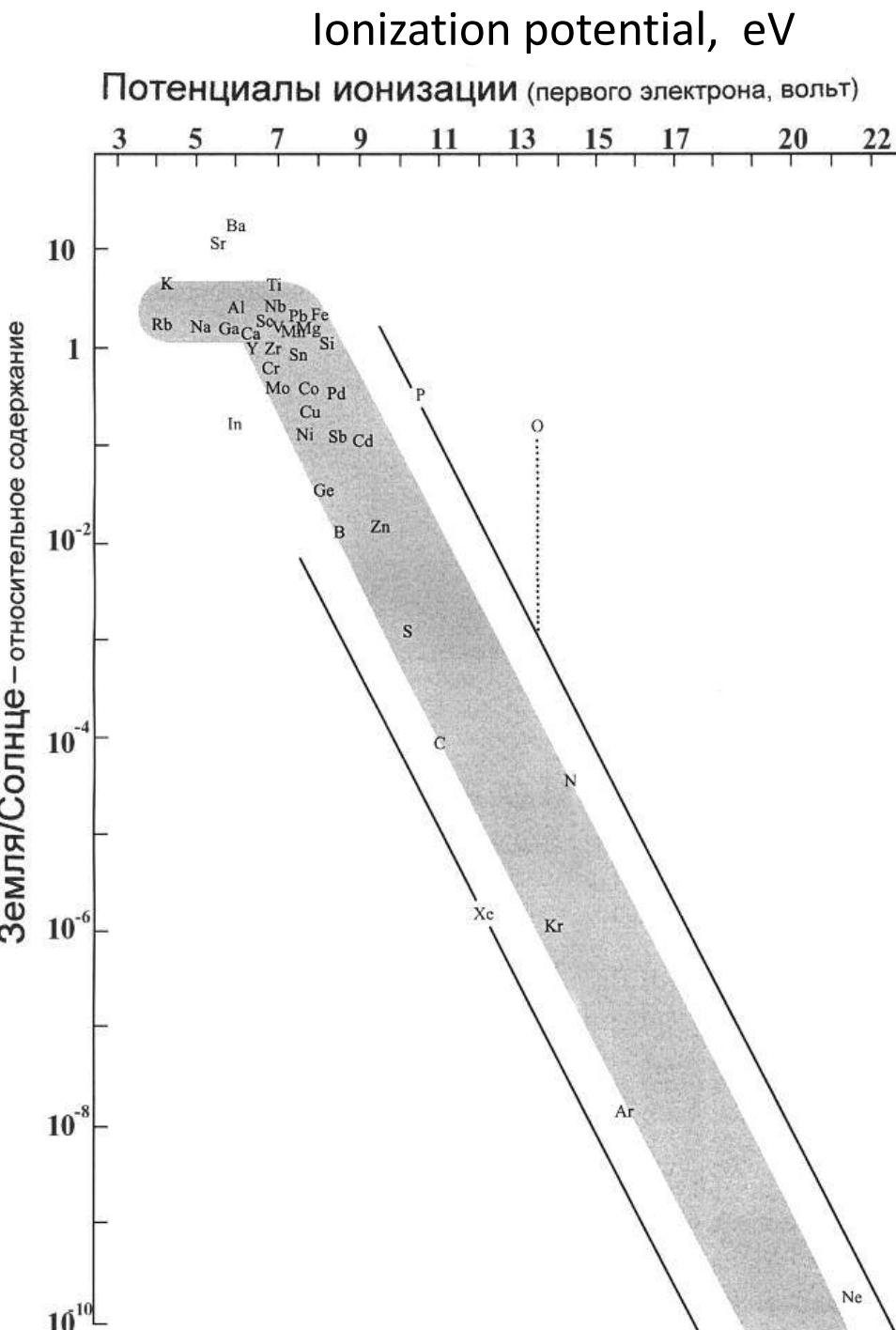
Hydride Earth

Hydrid Earth model can explain the hydrogen degassation of the Earth.

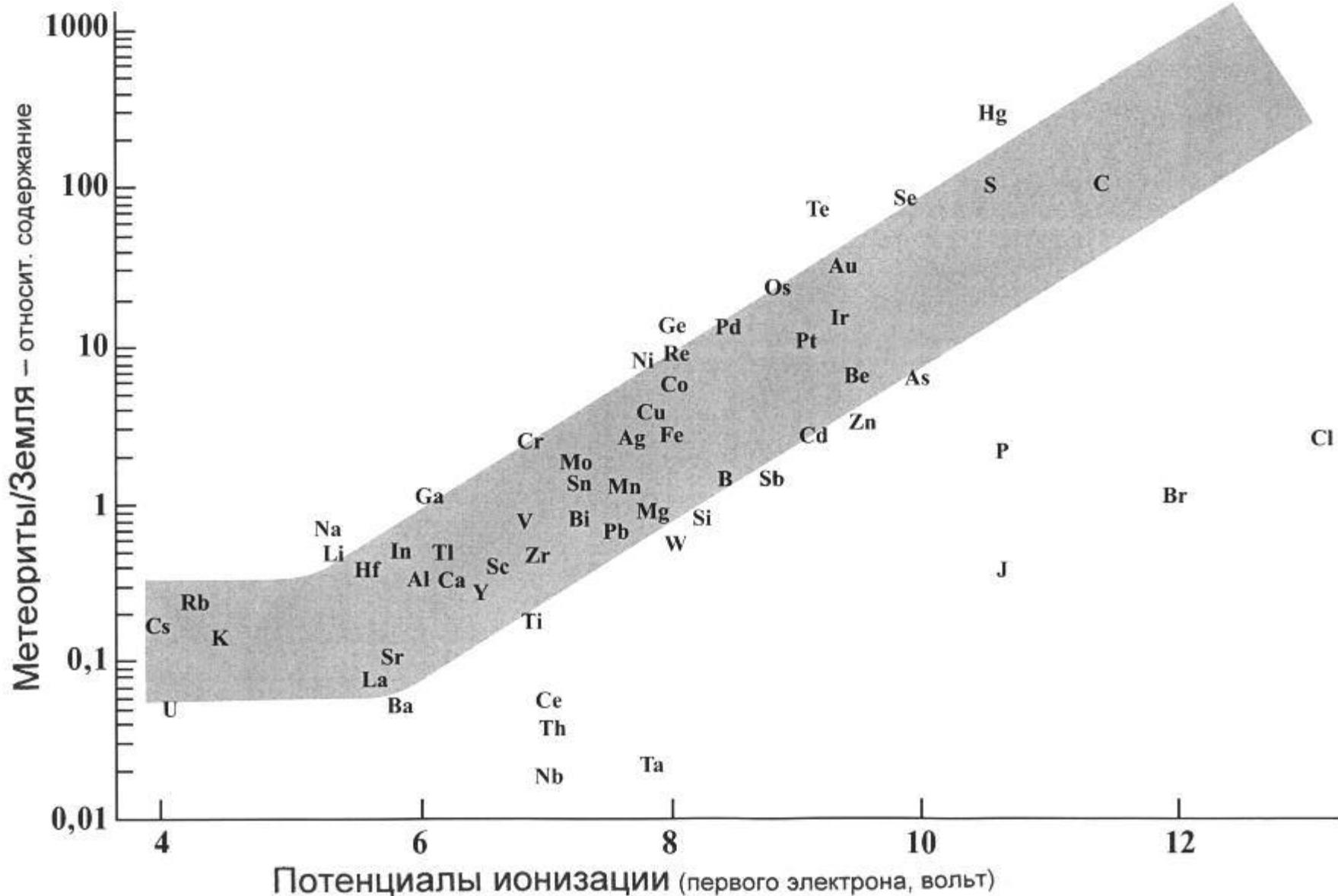
The Earth hydrogen degassation – the hydrogen starts from surface of the Earth core and goes to the cosmos space through the long chain of processes.

1. Ларин В.Н. Гипотеза изначально гидридной Земли (новая глобальная концепция). М., «Недра», 1975, 101 с., (АН СССР. Министерство геологии СССР. ИМГРЭ).
2. Ларин В.Н. Гипотеза изначально гидридной Земли. 2-е изд., перераб. и доп.. - М., Недра. 1980, 216 с
3. Ларин В.Н. Наша Земля (происхождение, состав, строение и развитие изначально гидридной Земли). М. «Агар» 2005, 248 с.
4. Larin,V. N., ed. C. Warren Hunt. Hydridic Earth: the New Geology of Our Primordially Hydrogen-Rich Planet. Polar Publishing, Calgary, Alberta, Canada, 1993.

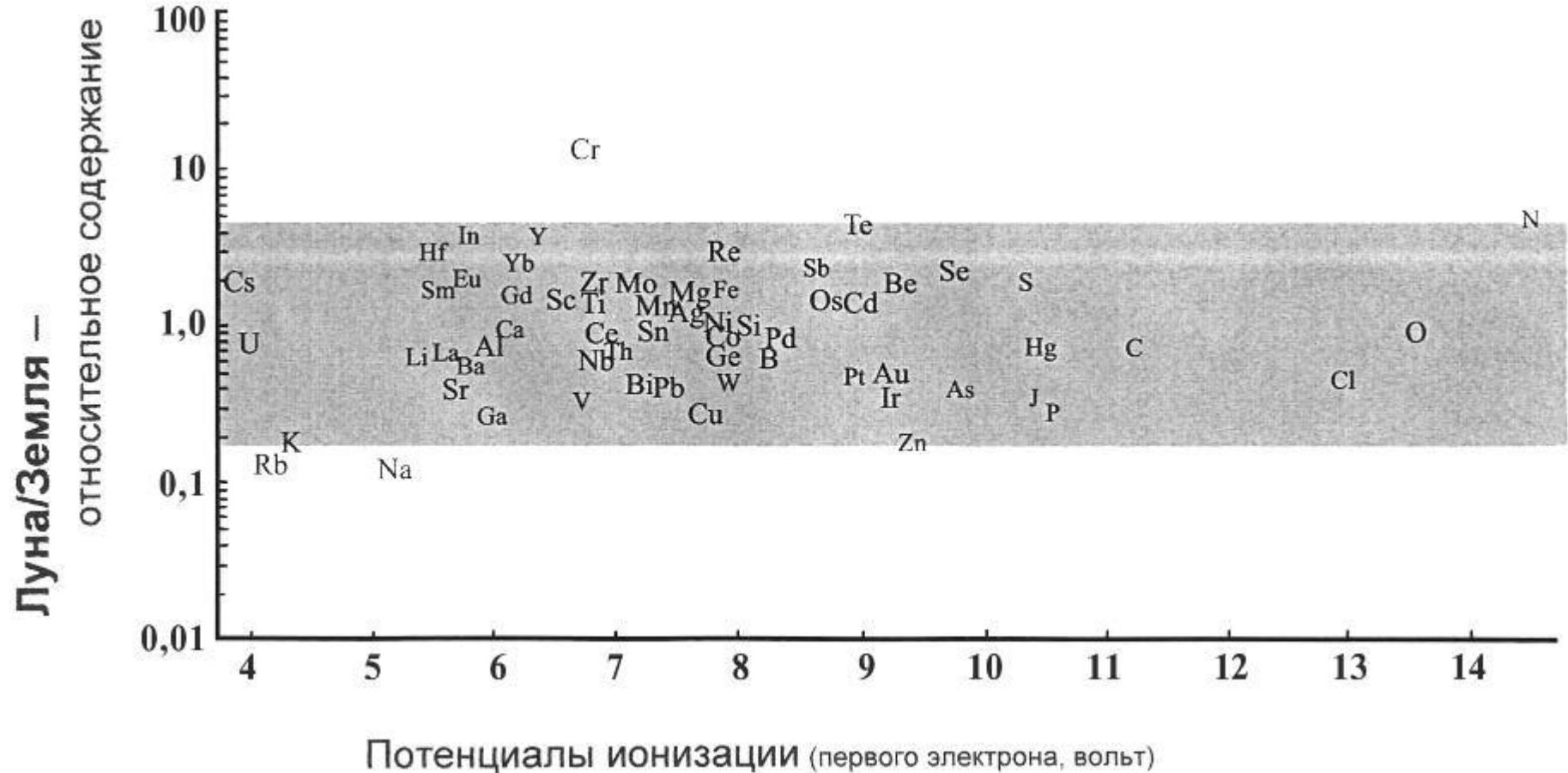
Ratio of Earth crust
chemical element abundances
to Sun
chemical element abundances
versus
first ionization potential
of these elements
(normalize to Si)



ratio of meteorite chemical element abundances to Earth crust chemical element abundances



Ratio Moon /Earth



Predicted overall initial composition of the Earth. Major elements are typed in bold
 (mass fraction larger than 0.1%).

[Chemical differentiation of planets: a core issue.](#) [Herve Toulhoat](#), [Valerie Beaumont](#), [Viacheslav Zgennik](#),
[Nikolay Larin](#), [Vladimir N. Larin](#). Aug 2012. 15 pp. e-Print: [arXiv:1208.2909](#) [astro-ph.EP]

Element	wt %	mol %	Element	wt %	mol %	Element	wt %	mol %
H	1.830E+01	87.43	Mg	1.389E+01	2.75	Sc	3.601E-03	<0.01
He	1.856E-05	<0.01	Al	8.769E+00	1.57	Ti	2.100E-01	0.02
B	4.220E-05	<0.01	Si	9.028E+00	1.55	V	2.329E-02	<0.01
C	7.550E-01	0.30	P	5.715E-03	<0.01	Cr	1.046E+00	0.10
N	5.562E-03	<0.01	S	3.793E-01	0.06	Mn	4.518E-01	0.04
O	1.391E-01	0.04	Cl	4.210E-04	<0.01	Fe	1.942E+01	1.67
F	1.260E-07	<0.01	Ar	1.883E-04	<0.01	Co	6.153E-02	0.01
Ne	2.675E-06	<0.01	K	3.760E+00	0.46	Ni	1.627E+00	0.13
Na	1.341E+01	2.81	Ca	8.792E+00	1.06			
				Balance			1,00E+02	100

Geochemical model of primordial Earth (following to Vladimir Larin)

- | Geosphere | Depth range, km | Composition |
|---------------|-----------------|---|
| External core | 0 - 100 | $\text{MgH}_{0,1}; \text{SiH}_{0,1}; \text{FeH}_{0,1}$
$+ \text{MgH}_n; \text{SiH}_n; \text{FeH}_n (n = 10)$ |
| Core | 100 - 3730 | $\text{MgH}_n; \text{SiH}_n; \text{FeH}_n$
$(n = 10)$ |

Geochemical model of modern Earth (following to Vladimir Larin)

Geosphere	Depth range, km	Composition
Lithosphere	0 - 150	CaO;MgO; Al ₂ O ₃ ; SiO ₂ ;Na ₂ O; Fe ₂ O ₃ ;H ₂ O
Asthenosphere	150	Thin layer of Metalsphere with high hydrogen concentration
Metalsphere	150 - 2900	Mg ₂ Si : Si : FeSi = 6 : 3 : 1
External core	2900 - 5000	MgH _{0,1} ; SiH _{0,1} ; FeH _{0,1} +MgH _n ; SiH _n ; FeH _n (n = 10)
Internal core	5000 - 6371	MgH _n ; SiH _n ; FeH _n (n = 10)

Hydride Earth (HE)

- There are U, Th, K in Lower mantle and Core
- Mantle → metallic
- Core → $\text{FeH}_{10} + \text{MgH}_{10} + \text{NaH}_{10} + \dots$
- Percentage of K in Earth mass is 2 %– 4 %
- HE model can explain experimentally observed value of Earth heat flux 300 TW. ^{40}K decay give the main contribution in Earth heat flux. Leonid Bezrukov. Geoneutrino and Hydridic Earth model. Preprint INR 1378/2014. arXiv:1308.4163
- HE model predicts that Earth heat flux is not stationary.

Our choice

- $K \rightarrow 2\%$
- $H = 300 \text{ TW}$
- Hydride Earth model

Can HE model help to explain the other unusual experimental results and to give unusual predictions?

Yes

- We have developed New model of Earth electric field on the base of HE, which can explain all exp. data and can predict the new facts.
- We observed the predicted fact: The Earth crust (continents and ocean) saturates by positive ions (protons).
- The Pierre Auger telescope registration of Earthquake is the example of unusual result which HE model helps to explain.

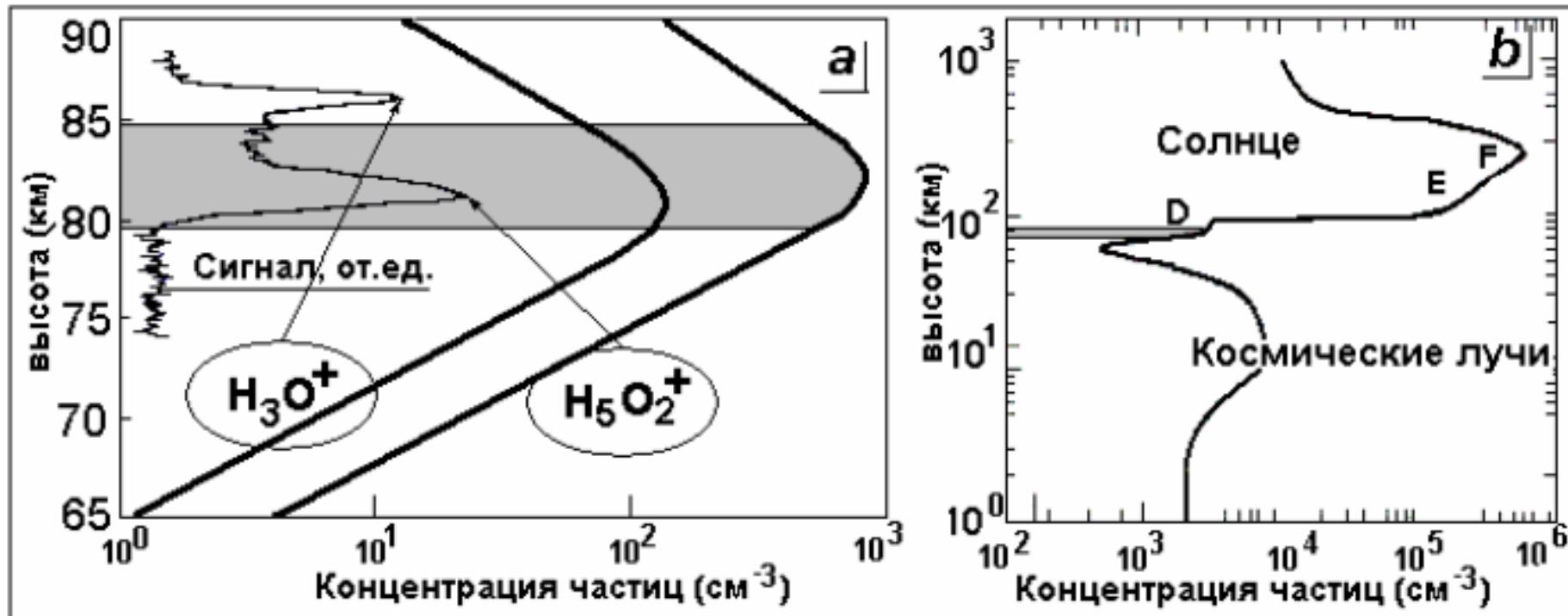
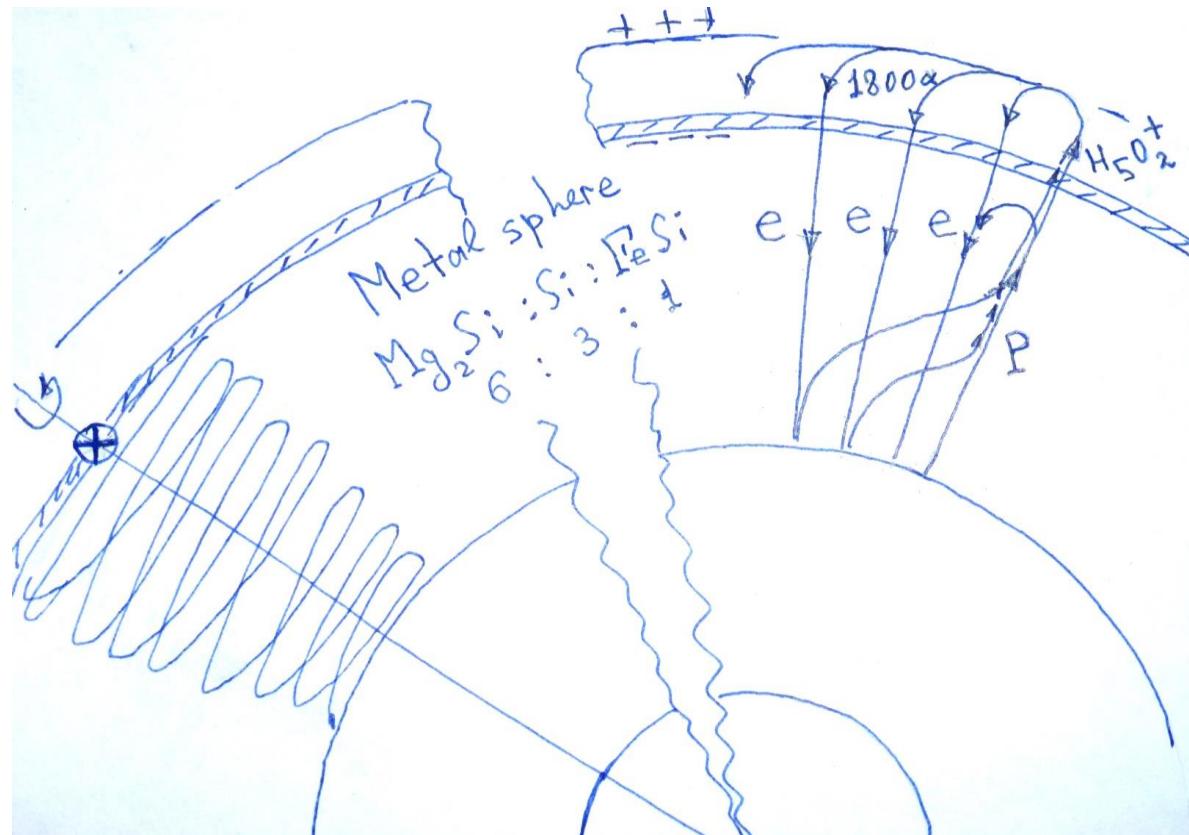


Рис. 20-2. Сигнал (в от ед.) зарегистрированный при ракетных измерениях АЭП (Shimogawa, Holzworth, 2009); вертикальные профили плотности: водных кластеров H_5O_2^+ и H_3O^+ , и ионизированных частиц в атмосфере: (Ferguson, Fehsenfeld, 1969) – a, Концентрация частиц по высоте (Marsh, Svensmark, 2000) – b.

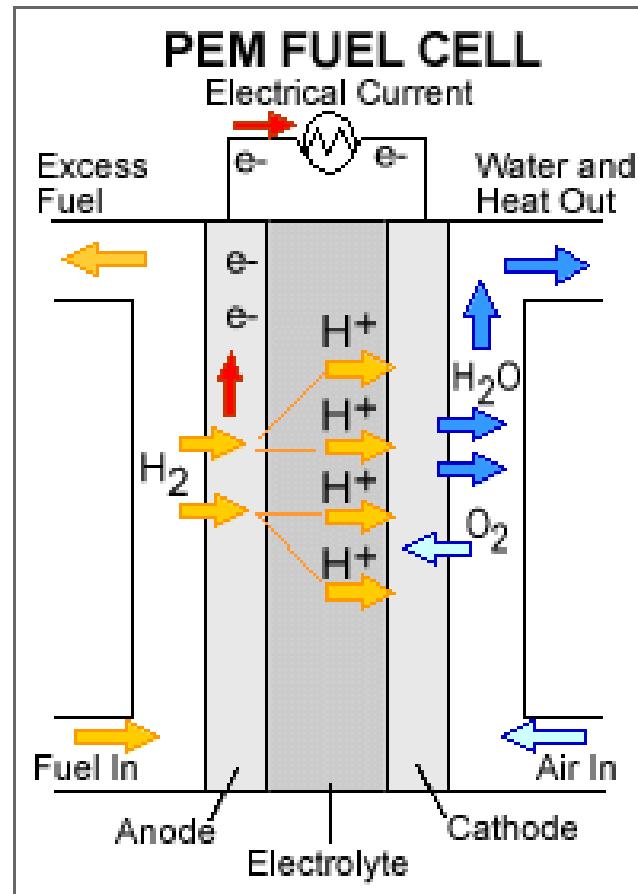
Earth electrical currents in the HE model



Окклюзия

- Окклюзия (позднелат. *occlusio* — запирание, скрывание, от лат. *occludo* — запираю, закрываю), поглощение вещества из газовой среды твёрдыми телами или расплавами. При О. газы поглощаются не поверхностным слоем, а всем объёмом поглотителя. В этом смысле О. подобна абсорбции — растворению газов в жидкостях. Наиболее характерна О. газов металлами, например водорода металлами VIII группы периодической системы элементов. Так, при комнатной температуре 1 объём иридия поглощает более 800, а палладия — более 700 объёмов водорода. Окклузированный газ даёт с металлами твёрдый раствор; иногда часть поглощённого газа образует с ними химические соединения (гидриды, нитриды и др.).

Proton exchange membrane fuel cell

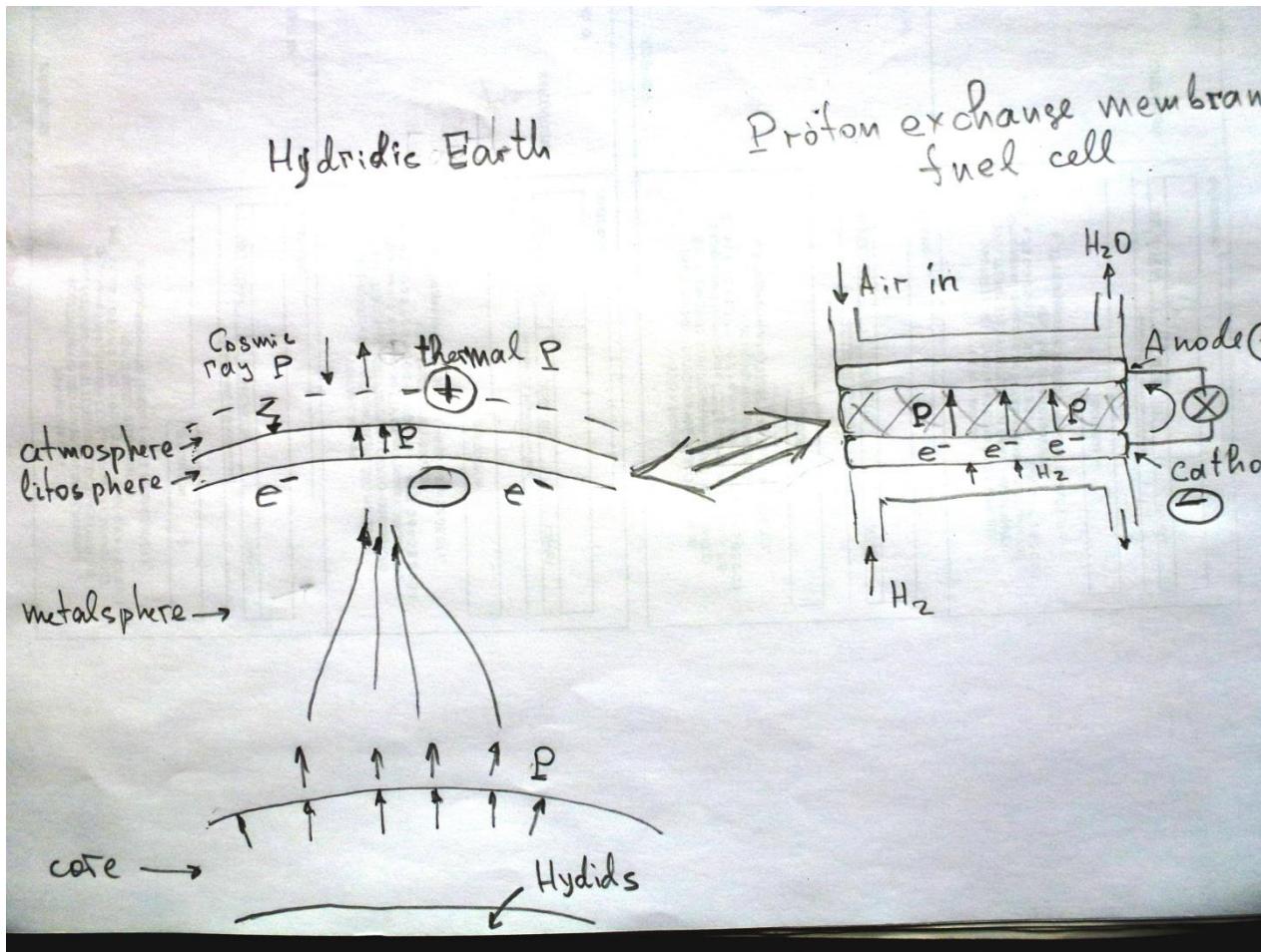


Negative charge is under litosphere

The International Astroparticle Physics Workshop

July 22 - 27, 2012

Ulan-Ude, Baikal, Russia



Hydroxonium ions are created in atmosphere as a result of chemical reactions

- $O_2^+ + (H_2O)_n \rightarrow O_2^+(H_2O)_n$
- $NO^+ + (H_2O)_n \rightarrow NO^+(H_2O)_n$

- $O_2^+(H_2O)_n \rightarrow H_3O^+(OH\cdot)(H_2O)_{n-2} + O_2$
- $NO^+(H_2O)_n \rightarrow H_3O^+(H_2O)_{n-2} + HNO_2$

Mozumander, Y.Hatano Charged particles and photon interactions with matter, CRC Press 2003.

H.Dolezalek, R.Reiter Electrical Processes in atmospheres: proceedings of the fifth international held at Garmisch-Partenkirchen (Germany), 2–7 September 1974 pp 45-52.

Hans Volland, Handbook of atmospheric electrodynamics, t.1, CRC Press, 1995.

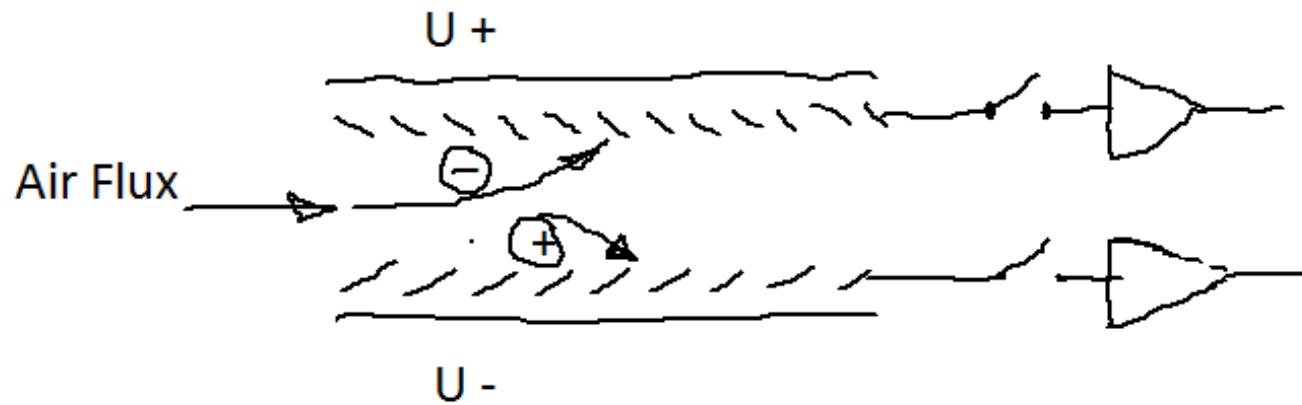
Origing of Earth electric field

- Earth electric field is a result of hydrogen degassation of the Earth.
- The separation of the positive and negative charges takes place in the bottom Lithosphere. So, negative charge takes place under Lithosphere and positive charge - on the top of atmosphere.

Hydridic theory of Earth electricity

- The negative charge of “Earth capacitor” locates under Earth crust.
- The Earth crust (continents and ocean) saturates by positive ions (protons).
- The gases goes up from the Earth crust to atmosphere by narrow beams. This gases are positive charged and can charge the “Earth capacitor”.

Observation of exceeding positive ions concentrations in under ground rooms by use of Air ions counter «Сапфир 3М»



INR underground lab. Moscow



INR underground lab. Moscow



Air ion counter is in Verkkaranta near open window
Number of positive ions – $0.29 \cdot 10^3$ ion/cm³



Air ion counter is in Pyhasalmi deep underground laboratory
Number of positive ions – $4.79 \cdot 10^3$ ion/cm³



Air ion counter is in Pyhasalmi deep underground laboratory
Number of positive ions – $2,63 \cdot 10^3$ ion/cm³





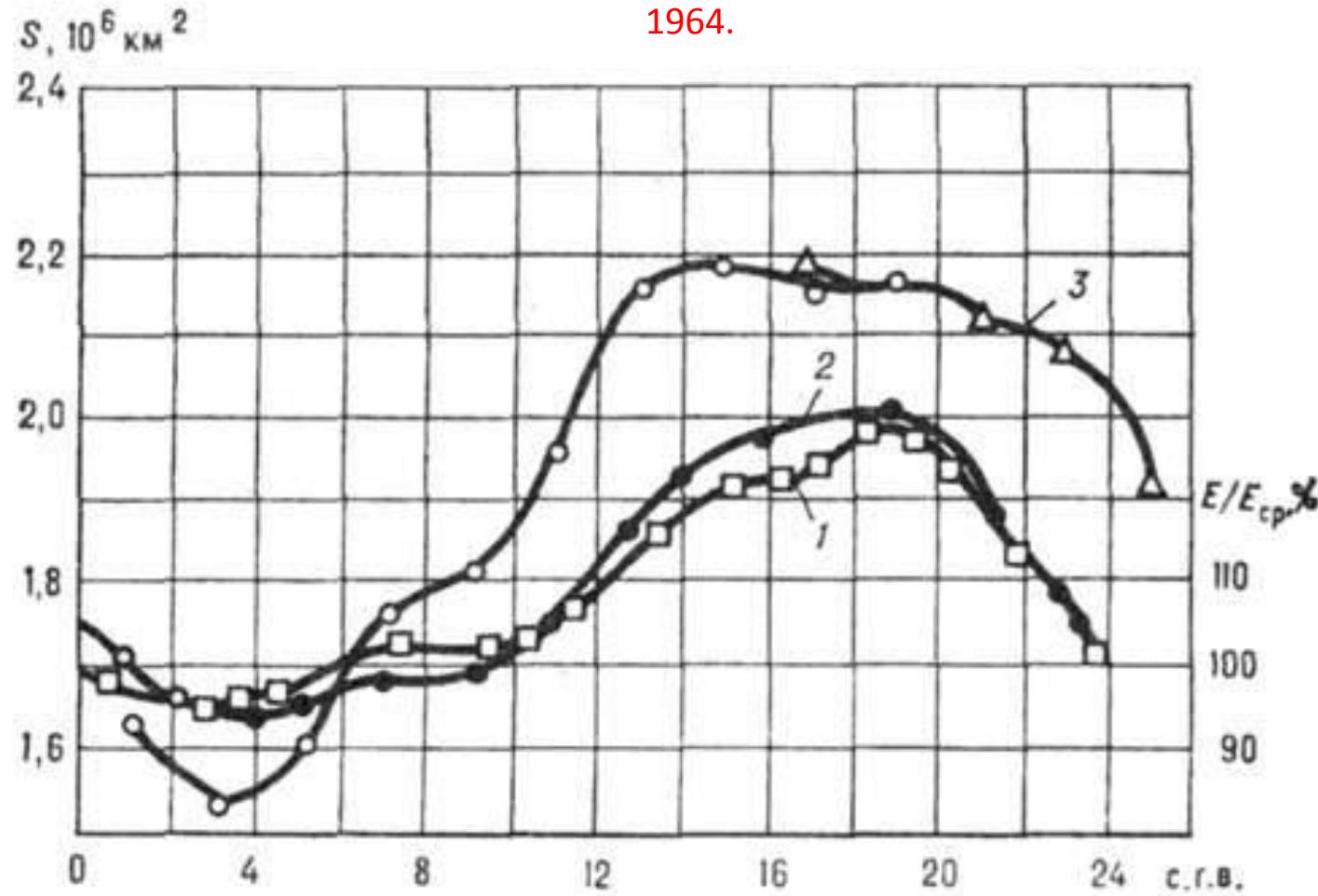


Degassing of the Earth through the ocean

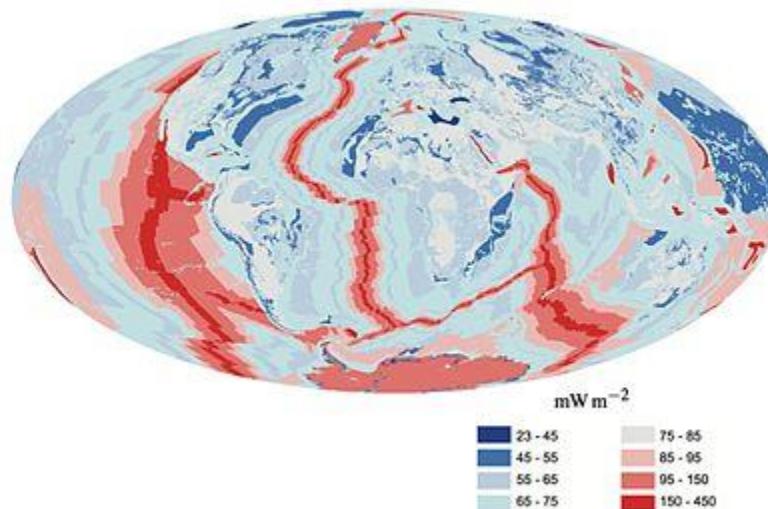


One day unitary variation of electric field tension as a function of Greenwich time: ocean surface (1), poles (2) and area of thunderstorms (3).

R. Feynman, R. Leighton and M. Sans. The Feynman lectures on physics. V. 2. Electricity and Magnetism. Addison-Wesley Publishing company, Inc. Reading, Massachusetts, Palo Alto, London, 1964.



Global map of the flow of heat, in mW m^{-2} , from Earth's interior to the surface. Higher heat flows are observed at the locations of [mid-ocean ridges](#), and [oceanic crust](#) has relatively higher heat flows than [continental crust](#).



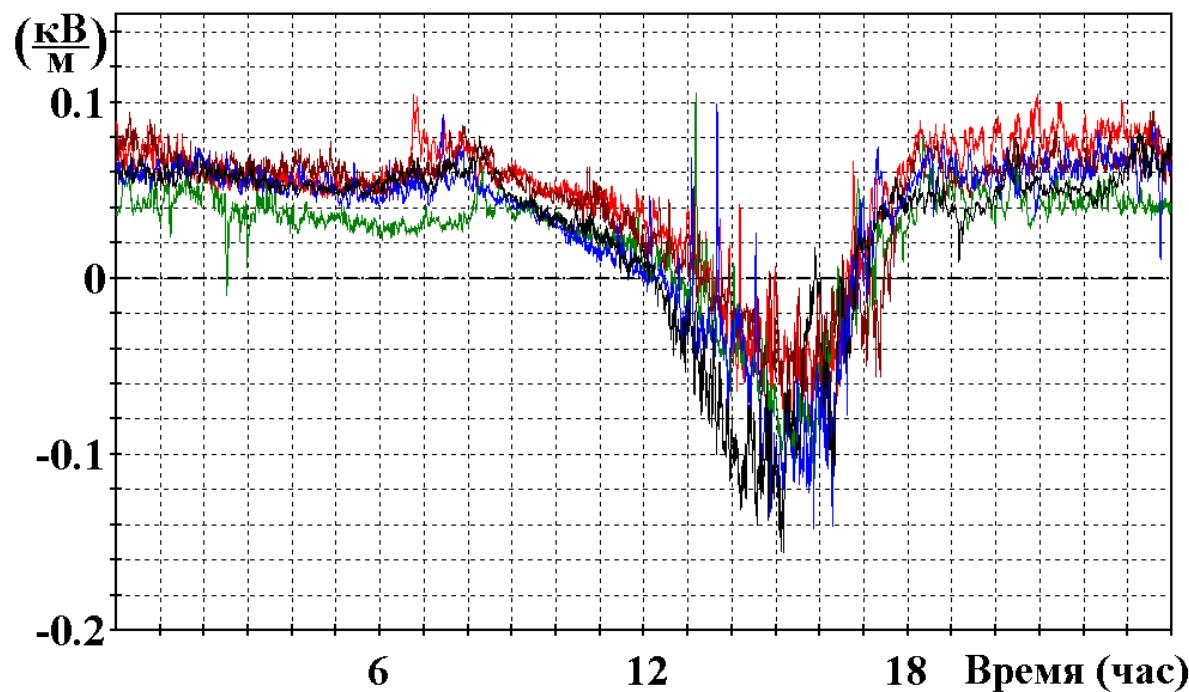
Abnormal daily wave of «good weather field» in mountain valley

A. S. Lidvansky, N. S. Khaerdinov

Institute for Nuclear Research, Moscow

VII Russian Proceedings of Conference on
atmospheric electricity, September, 24-28,
2012, S-Petersburg, Russia, p. 155-157

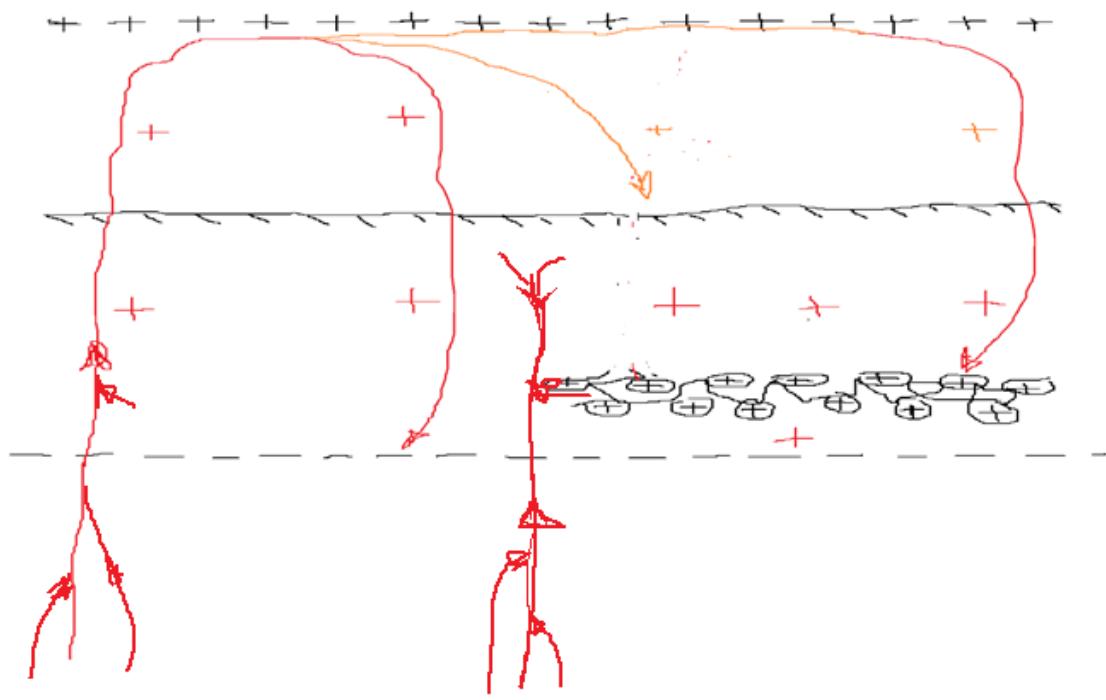
Earth electric field at BNO in good weather 19, 20, 21, 22, 23, 27 September 2007. Local time. Averaging on 20sc.

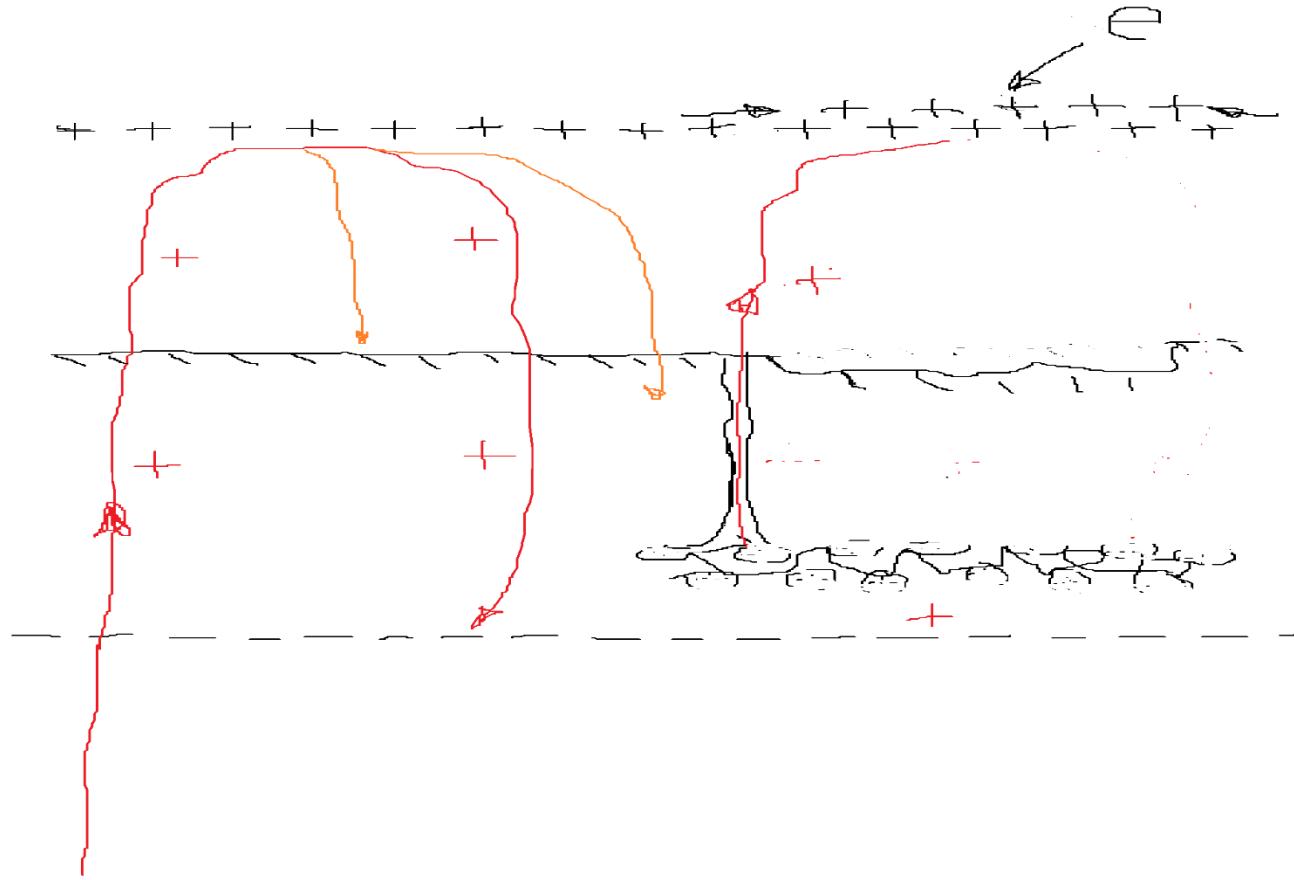


Kola (Russia) Superdeep Borehole

Deepest point: 12 262 meters. This is a record.

- Main problem: Higher-than-expected-temperature. 180°C instead of expected 100°C.
- With the deepening the rocks do not get denser and their porosity does not decrease. On the contrary, the rocks at the multi-kilometer depth are penetrated by multiple pores and broken by cracks.
- A large quantity of hydrogen gas.
The mud that flowed out of the hole was described as “boiling with hydrogen”.





Craters at Yamal

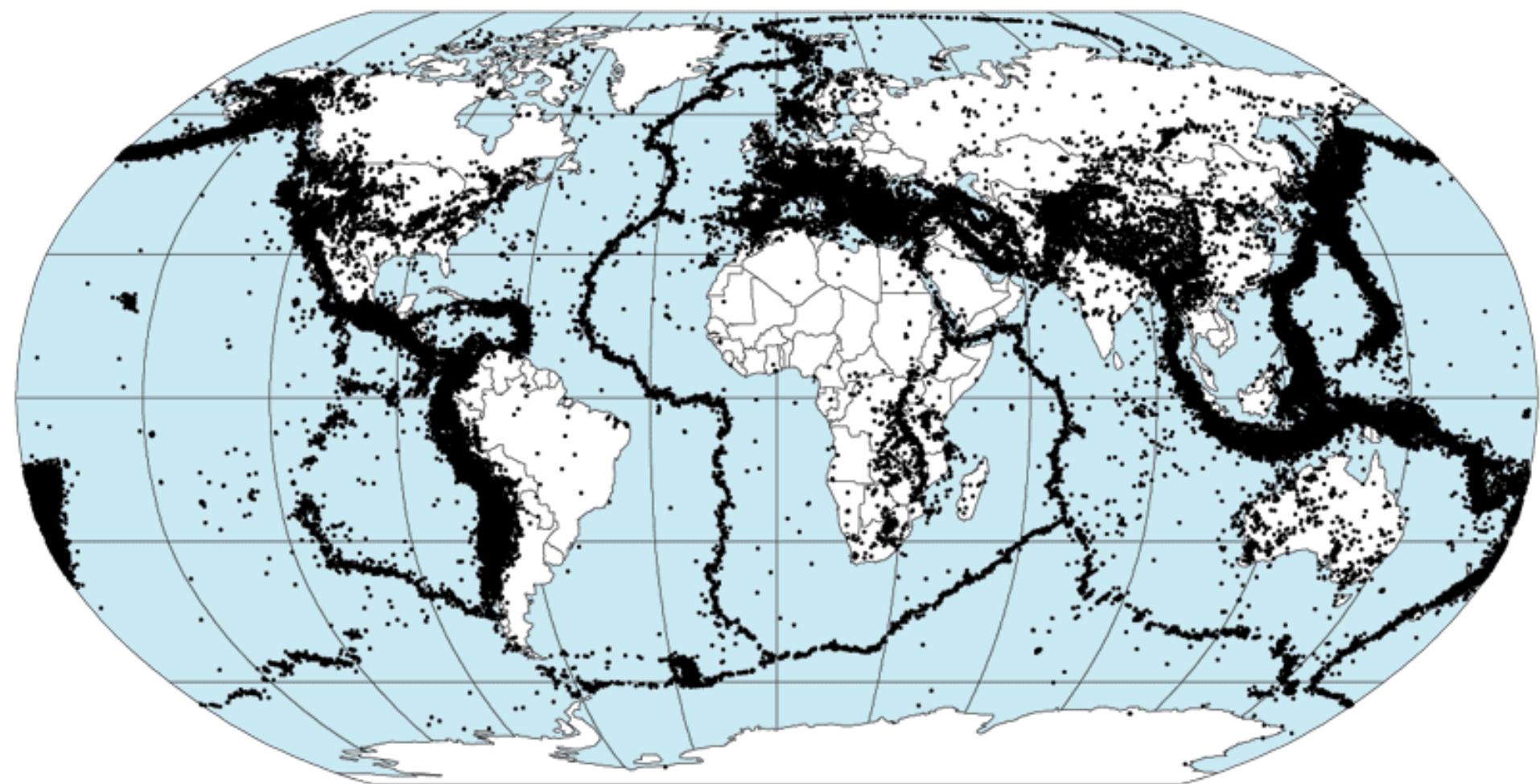


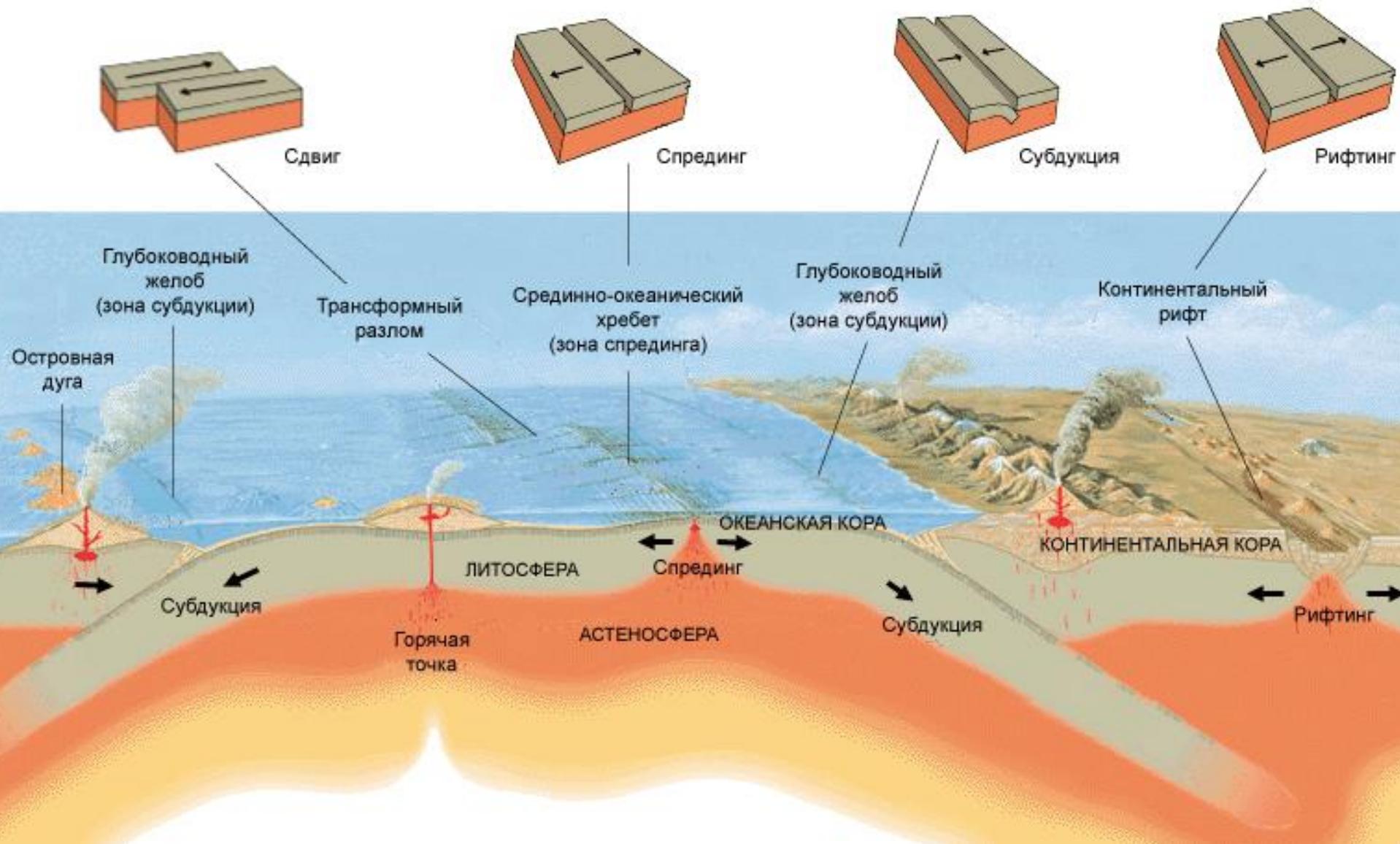
Earthquake

- The rocks at the multi-kilometer depth are penetrated by multiple pores and broken by cracks. These pores are full of gases. Then gases escape from the pores and collapses.
- The gases are positively charged. So, the earthquake begins after gases escape from the pores and positive charge does not screen the negative.

Preliminary Determination of Epicenters

358,214 Events, 1963 - 1998





Proceedings of ICRC 2011. Vol.11, 467- 470

32ND INTERNATIONAL COSMIC RAY CONFERENCE, BEIJING 2011



Measurement of Low Energy Cosmic Radiation with the Water Cherenkov Detector Array of the Pierre Auger Observatory

HERNÁN ASOREY¹ FOR THE PIERRE AUGER COLLABORATION²

¹*Centro Atómico Bariloche (CNEA), U. N. de Cuyo and U. N. de Río Negro, Bariloche, Río Negro, Argentina*

²*Observatorio Pierre Auger, Av. San Martín Norte 304, 5613 Malargüe, Argentina*

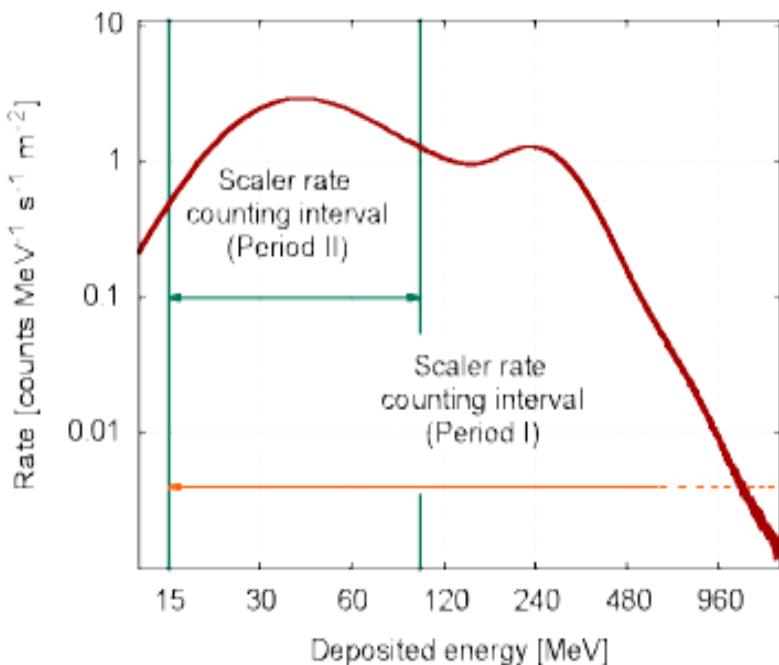
The Surface Detector Array



**One of the 1 660 water-Cherenkov detectors (WCD) of the Pierre Auger Observatory, located near Malargüe, Argentina
(69.3° W, 35.3° S, 9.5 GV) at 1400 m a.s.l.**

- 3 000 km² array
- 1 660 water-Cherenkov detectors (WCD)
(16 600 m² of detection area)
- triangular grid with 1 500 m spacing
- Cherenkov detector:
 - 12 m³ of high purity water
 - three 9" photomultipliers (PMT)
 - Detection of e^\pm and γ : calorimetric
 - μ^\pm signals: proportional to track length.

Low energy cosmic ray measurements using individual detectors



Charge histogram of the signals of one PMT, with the corresponding counting intervals of the scaler mode:

- Period I (orange): $15 \leq (E_d/\text{MeV}) < \infty \rightarrow 380 \text{ m}^{-2} \text{s}^{-1}$
- Period II (green): $15 \leq (E_d/\text{MeV}) \leq 100 \rightarrow 200 \text{ m}^{-2} \text{s}^{-1}$

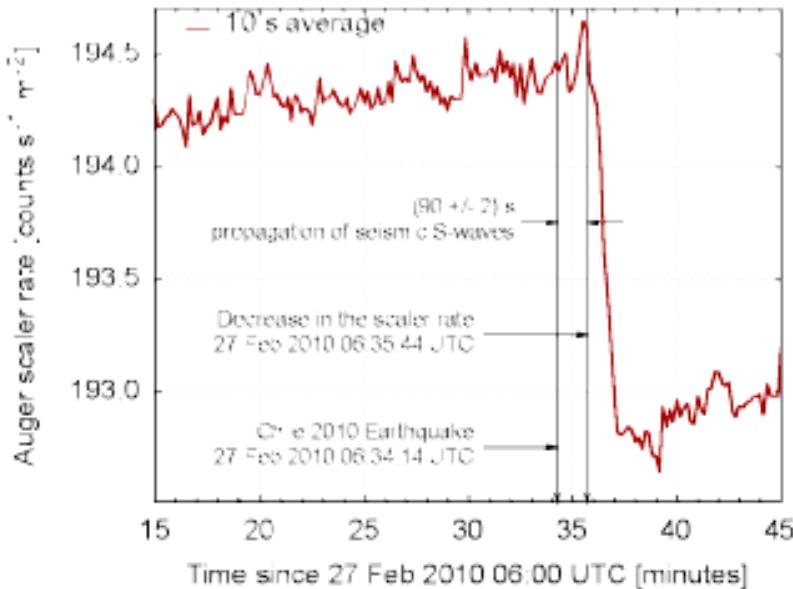
Scaler mode

- Counting event rate between two thresholds;
- period I: Mar to Sep 2005, period II: After Sep 2005.
- rate excess → search for astrophysical transients:
 - Gamma Ray Bursts
 - Forbush decreases
 - Soft Gamma Repeaters

Histogram mode

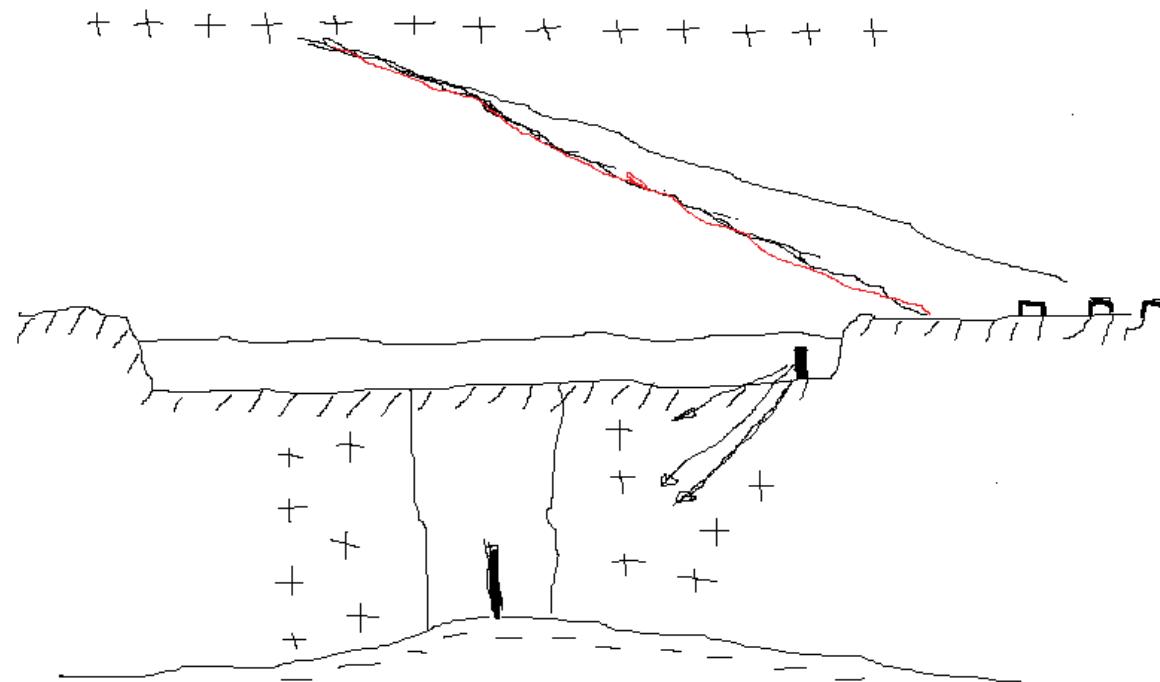
- Every WCD constantly records one-minute histograms of signals (amplitude and total charge).
- 2nd peak → (1.03 ± 0.02) of the energy deposited (E_d) by a vertical muon ($E_d \simeq 240 \text{ MeV}$).
- ~ 10 one-minute histograms are registered at the central DAQ every minute.

Chile Feb 2010 earthquake

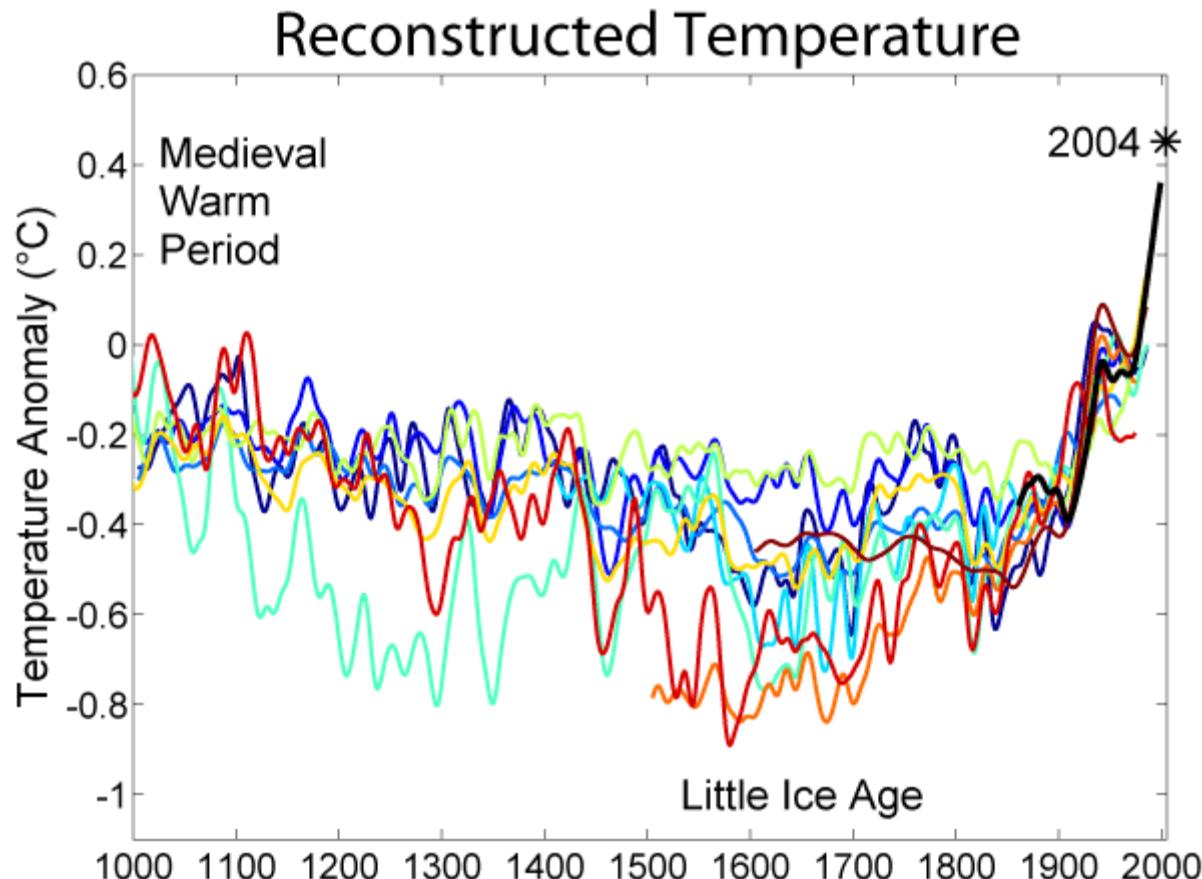


- Magnitude 8.8 on Richter scale
- epicentre at 300 km SW from array
- seismic S-waves propagation observed
- 24σ decrease, recovery time: 6 hours

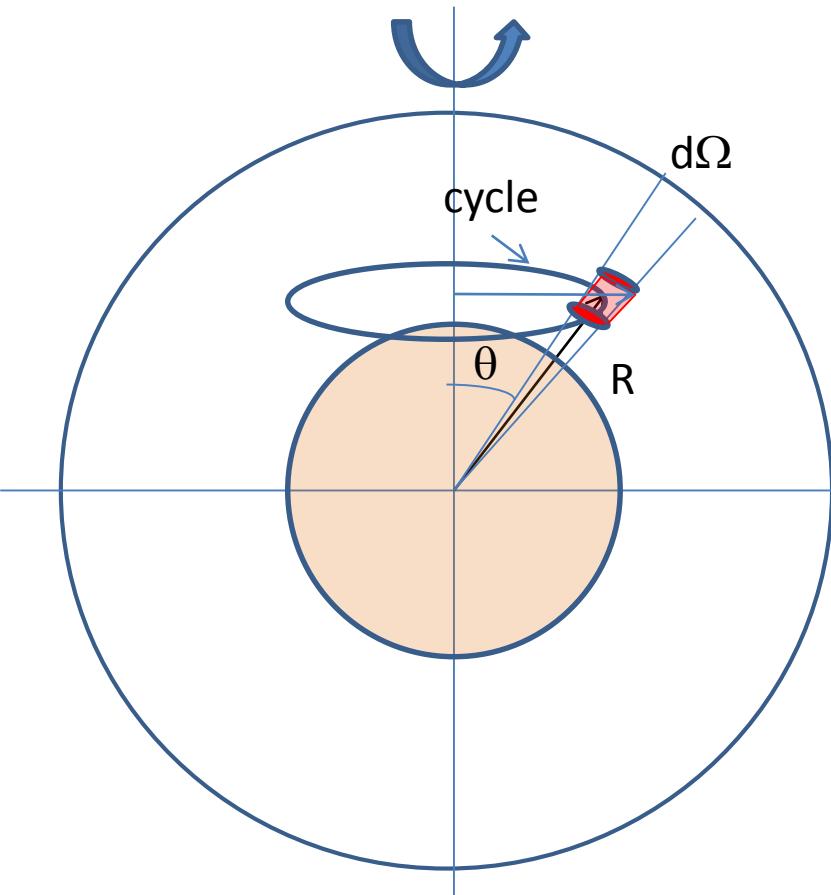
Увеличение атмосферного электрического поля при землетрясении.



http://upload.wikimedia.org/wikipedia/commons/b/bb/1000_Year_Temperature_Comparison.png



1. Коротаев С.М., Шнеер В.С., Гайдаш С.П., Буднев Н.М., Миргазов Р.Р., Халезов А.А., Панфилов А.И. Эффект и предвестники землетрясения 27.08.2008 в вертикальной компоненте электрического поля в озере Байкал // Доклады Академии наук. 2011. Т. 438. № 5. С. 683-686.
2. Коротаев С.М., Буднев Н.М., Сердюк В.О., Зурбанов В.Л., Миргазов Р.Р., Мачинин В.А., Киктенко Е.О., Бузин В.Б., Панфилов А.И. Новые результаты мониторинга вертикальной компоненты электрического поля в озере Байкал на базе поверхность-дно // Геомагнетизм и аэрономия. 2015. Т. 55. № 3. С.406-418.



$$I = 1800 \text{ A}$$

$$i_R = I/4\pi d\Omega$$

$$dq/dR = i_R / v$$

$$dq = I/4\pi v d\Omega dR$$

$$i_{cyc} = dq/T, T - \text{day}$$

$$dH = i_{cyc}/2R\sin\theta$$

$$H = \frac{I}{4\pi} \frac{1}{T} \frac{1}{2} \int \frac{d\Omega dR}{R \sin \theta}$$

$$H = \frac{I}{2vT} \int_0^{\pi/2} \frac{d\theta}{\sin \theta} \int_{R1}^{R2} \frac{dR}{R}$$

$$H = \frac{I}{2vT} \ln \frac{R2}{R1} \ln | \operatorname{tg} \frac{\pi}{4} |$$

$$H = H_+ - H_- = C \left(\frac{1}{v_+} - \frac{1}{v_-} \right), C = 0.00378$$

Larin's law.

- $(X_M/X_{Si})_{\text{Earth}} = (X_M/X_{Si})_{\text{Sun}} \cdot F(E_{IP}(M))$;

where X_M is the mass fraction in the planet mass of the chemical element with atomic number M,
 $E_{IP}(M)$ is the ionization potential of the chemical element with atomic number M in eV,

$F_{\text{Earth}}(E_{IP}(M))$ is the law of chemical element differentiation for the Earth.

- $F(E_{IP}(M)) = A \cdot \exp\{-B \cdot E_{IP}(M)\}$

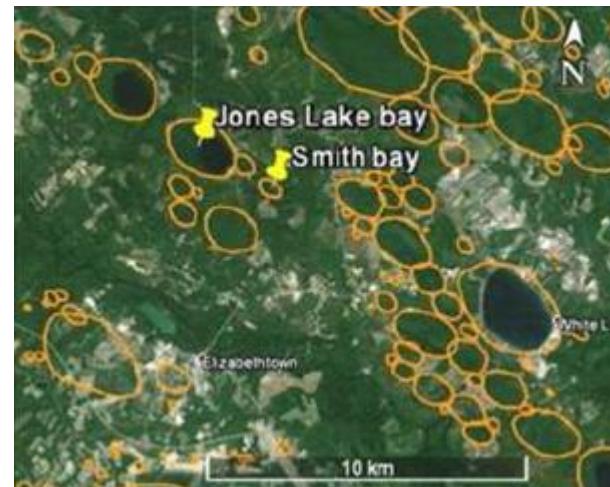
[Chemical differentiation of planets: a core issue. Herve Toulhoat, Valerie Beaumont, Viacheslav Zgonnik, Nikolay Larin, Vladimir N. Larin. Aug 2012. 15 pp. e-Print: arXiv:1208.2909 \[astro-ph.EP\]](#)

**Comments on the
Paper "Earth's energy imbalance and implications" by J. Hansen, M. Sato,
P. Kharecha, and K. von Schuckmann**

[arXiv:1203.1289v2](https://arxiv.org/abs/1203.1289v2) [physics.ao-ph]

- [Gerhard Kramm, Ralph Dlugi](#)
- Abstract: In our comments we explicitly acknowledge the attempt of Hansen et al. to assess various uncertainties inherent in geophysical data being based on different measuring concepts and observation methods. However, with regard to the planetary energy budget, this paper offers some vulnerable points. We will focus our comments on these vulnerable points only. We will show that the energy imbalance of the entire Earth-atmosphere system is, indeed, based on these inherent uncertainties. We will demonstrate that the accuracy in the quantification of the global energy flux budget as claimed by Hansen et al. is, by far, not achievable in case of the entire Earth-atmosphere system. Using the value of the solar constant of $S_0 = 1361 \text{ W/m}^2$ recently determined on the basis of total-solar-irradiance (TSI) observation by three different satellite projects (ACRIMSAT/ACRIM3 launched in 2000, SORCE/TIM launched in 2003, and PICARD/PREMOS launched in 2010) we will document that the planetary **energy imbalance of $F = 0.58 \pm 0.15 \text{ W/m}^2$ calculated by Hansen et al. does not exist.** Consequently, the implications related to this planetary energy imbalance have no basis.

Examples of these areas were studied in Russia and Carolina in the US
herein called the "Carolina Bays" (Fig. 1). The measured hydrogen fluxes are between 200 and 4400 m³/day/km² [Beaumont et al., 2015].



- Introduction – Geology of hydrogen reservoirs
- Hydrogen, having high calorific potential and being convertible to electricity and heat, is considered as an
- efficient energy carrier capable of transporting and storing energy [Panfilov, 2010]. The main application of
- hydrogen is the mobility sector, and it can also be injected into the natural gas grid. Large-scale hydrogen
- accumulations exist underground in the form of natural underground hydrogen reservoirs (UHR) in thermal
- aquifers.

UHR's have been discovered recently in all the parts of the world.