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NOTA DE FALECIMENTO

A Sociedade Brasileira de Geologia comunica com profundo pesar, o falecimento do Prof. Dr. AKIHISA MOTOKI na noite do último domingo (19/abril), sócio da SBG desde 1994 e professor Universidade do Estado do Rio de Janeiro, Faculdade de Geologia, Departamento de Mineralogia e Petrologia Ígnea.

A SBG manifesta condolências à família e amigos.

Atenciosamente,

Sociedade Brasileira de Geologia

Secretaria

GEOLOGANDO

<http://www.geologypage.com/2013/05/unique-chemistry-reveals-eruption-of.html>

Unique Chemistry Reveals Eruption of Ancient Materials Once at Earth's Surface



New study supports theory that Earth's earliest crust was folded back into its mantle and returned to the surface in volcanoes

An international team of researchers, including Scripps Institution of Oceanography, UC San Diego, geochemist James Day, has found new evidence that material contained in oceanic lava flows originated in Earth's ancient Archean crust. These findings support the theory that much of the Earth's original crust has been recycled by the process of subduction, helping to explain how the Earth has formed and changed over time.

The Archean geologic eon, Earth's second oldest, dating from 3.8 to 2.5 billion years ago, is the source of the oldest exposed rock formations on the planet's surface. (Archean rocks are known from Greenland, the Canadian Shield, the Baltic Shield, Scotland, India, Brazil, western Australia, and southern Africa.) Although the first continents were formed during the Archean eon, rock of this age makes up only around seven percent of the world's current crust.

"Our new results are important because they provide strong evidence not only to tie materials that were once on Earth's surface to an entire cycle of subduction, storage in the mantle, and return to the surface as lavas, but they also place a firm time constraint on when plate tectonics began; no later than 2.5 billion years ago," said Day. "This is because mass independent sulfur signatures have only been shown to occur in the atmosphere during periods of low oxygenation prior to the rise of oxygen-exhaling organisms."

The new study, which will be published in the April 24 issue of the journal *Nature*, adds further support to the theory that most of the Archean crust was subducted or folded back into the Earth's mantle, evidence of which is seen in the presence of specific sulfur isotopes found in some oceanic lava flows.

According to the researchers, because terrestrially fractionated (MIF) sulfur-isotope signatures were generated exclusively through atmospheric photochemical reactions until about 2.5 billion years ago, material containing such isotopes must have originated in the Archean crust. In the new study, the researchers found MIF sulfur-isotope signatures in olivine-hosted sulfides from relatively young (20-million-year-old) ocean island basalts (OIB) from Mangaia, Cook Islands (Polynesia), providing evidence that the mantle is the only possible source of the ancient Archean materials found in the Mangaia lavas.

"The discovery of MIF-S isotope in these young oceanic lavas suggests that sulfur—likely derived from the hydrothermally-altered oceanic crust—was subducted into the mantle more than 2.5 billion years ago and recycled into the mantle source of the Mangaia lavas," said Rita Cabral, the study's primary author and a graduate student in Boston University's Department of Earth and Environment.

The data also complement evidence for sulfur recycling of ancient sedimentary materials to the subcontinental lithospheric mantle previously identified in diamond inclusions.

Other study co-authors are Matthew G. Jackson of Boston University; Estelle F. Rose-Koga and Kenneth T. Koga of Université Blaise Pascal in Clermont-Ferrand, France; Martin J. Whitehouse of the Swedish Museum of Natural History and Stockholm University, Stockholm, Sweden; Michael A. Antonelli and James Farquhar of the University of Maryland; and Erik H. Hauri of the Carnegie Institution of Washington in Washington, D.C.

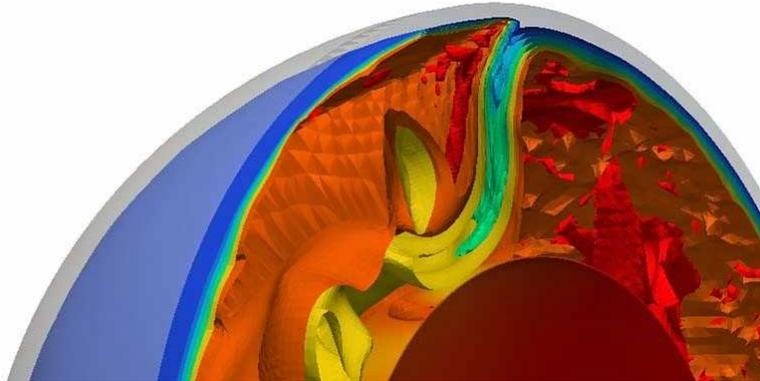
Note : The above story is reprinted from materials provided by University of California

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[Voyage from Earth's crust to its mantle and back again](#)



A numerical simulation shows how Earth's crust (blue) is subducted and transported into the mantle (orange).

Credit: Graphics: ETH Zurich/ Geophysical Fluid Dynamics

Uranium isotopes leave a distinct 'fingerprint' in the sources of volcanic rocks, making it possible to gauge their age and origin. Geologists have gained a new understanding of how Earth's crust is recycled back into its interior based on these uranium isotopes. From the beginning of time, uranium has been part of Earth and, thanks to its long-lived radioactivity, it has proven ideal to date geological processes and deduce Earth's evolution. Natural uranium consists of two long-lived isotopes uranium-238 and the lighter uranium-235. A new study of the global cycle of these uranium isotopes brings additional perspectives to the debate on how Earth has changed over billions of years as revealed in a recently published study in the journal Nature.

From early Earth history, the continental crust (Earth's thick solid outer skin that we live on) has accumulated mass from the underlying hot mantle. Most of the newly formed crust, however, is lost again. At mid-ocean ridges at the bottom ocean, where plates drift apart, new oceanic crust is constantly produced as basaltic rocks when hot volcanic lava emerges from the mantle and solidifies. The oceanic crust moves away from the mid-ocean-ridges and ultimately gets transported back into the underlying mantle through "subduction" at ocean trenches.

Uranium is enriched in the rocks of the continental crust; however, at Earth's surface, different environments over time have influenced its mobility. In an oxygen-free atmosphere, as prevailed on early Earth, uranium stayed immobile in rocks as tetravalent uranium (IV). Only after atmospheric oxygen was formed did uranium become oxidised to its mobile hexavalent uranium (VI). This more mobile uranium may then be released during the weathering and break-down of rocks and transported to the oceans in aqueous form. As the cooling oceanic crust moves away from the mid-ocean-ridges in the oceans, seawater eventually percolates through cracks in its rock and in the process uranium gets incorporated into the oceanic crust, in a similar way that a sponge takes up water.

"The radioactive nature of uranium isotopes has long been key in reconstructing early Earth history, but we now see that they also have another story to tell" explains Morten Andersen, a geochemist in the Department of Earth Sciences at ETH Zurich.

Uranium isotopes form specific signatures

For this work, conducted at the University of Bristol including Morten Andersen (now Earth Science, ETH Zurich) along with researchers from the Durham (UK), Wyoming and Rhode Island (US), used the 'fingerprint' carried in the ratio of the two uranium isotopes. The specific "fingerprint" derived from the ratio of the uranium isotopes, relates to uranium oxidation processes at Earth's surface. In particular, the researchers found that a higher ratio of uranium-238 to uranium-235 is incorporated into the modern oceanic crust, when compared to the uranium isotope signature found in meteorites. The meteorites represent Earth's "building blocks" and, thus, yield the original uranium isotope composition of Earth as a whole, and also the undisturbed mantle. This uranium isotope "fingerprint" of the altered oceanic crust provides a way to trace uranium that has moved from the surface and back into Earth's interior through subduction.

In order to examine the uranium cycle (and the rock cycle), the researchers analysed mid-ocean ridge basalts (MORBs), the hot volcanic lava that is produced from the upper and well-mixed part of the mantle. The ratio of the uranium isotopes in MORBs can be compared with those found in ocean island basalts in places such as Hawaii and the Canary Islands. These islands are so-called "hot-spots" with lava formed from hot mantle plumes that up-well beneath the oceanic crust. Compared to the MORB mantle, the island basalts are made up of material transported to the surface from a much deeper, less well-mixed, mantle sources.

Heavy uranium from surface to the deep

The isotope ratios for uranium-238 to uranium-235 are significantly greater for MORBs than for ocean island basalts. The ratios are also higher than that found in meteorites. This suggests that the MORBs contain a "fingerprint" of the uranium from the oceanic crust, drawn down from the surface and into the upper part of Earth's mantle through subduction, according to Andersen.

Through convection -- slow movements of material in the upper mantle -- the material was eventually mixed around and carried to the area of the mid-ocean ridges and transported back to the surface in the lavas that make up MORBs.



A drill core of altered oceanic crust near a mid-ocean ridge with uranium-bearing in-fillings (rust-brown areas) (Photo: IODP)

In contrast, the island basalts' ratios of uranium-238 to uranium-235 correspond to those of the meteorites used in the study and showed that these rocks could not have the same mantle source as the MORBs. The researchers explain that ocean island lavas come from a deeper, less mixed, mantle source and therefore any uranium added from the surface originates from a much earlier time in Earth's history, when the surface environment was very different from today.

Study co-author Heye Freymuth of the University of Bristol explains: "Although uranium was incorporated into the oceanic crust since the initial rise in atmospheric oxygen about 2.4 billion years ago, the ocean crust did not incorporate higher amounts of uranium-238 as the oceans did not yet have adequate supplies of oxygen."

Only during the second marked increase in atmospheric oxygen content 600 million years ago did the deep ocean become fully oxidised, which allowed the oceanic crust to gain the "fingerprint" of high uranium-238. So, despite the oceanic crust having been transported into Earth's mantle for a long time, the uranium isotope ratio of the subducted oceanic crust first differed from Earth's mantle only after the full oxidation of the oceans.

"An important result of this study is how changing conditions on Earth's surface and the increase of oxygen in the atmosphere influenced the composition of deep Earth. Our results suggest that due to changes over the past 600 million years, uranium was mobilised from the surface, transported into Earth's interior and distributed within the mantle," says Andersen.

Hot debate about Earth's early days

The study of uranium and the crust's cycle brings new perspectives to the debate about how the face of Earth has changed over billions of years. "This is currently one of the hottest research topics for Earth scientists," Andersen points out. Particularly lively debates take place on how the concentration of oxygen in the atmosphere evolved; after all, it is associated with many other geological weathering processes, including the fate of uranium. The current study is mainly fundamental research in a relatively young research area. The identified uranium isotope signatures could in future be used commercially to detect unknown uranium deposits and help understand processes of uranium mobility. The first basic scientific work pointing to the potential of uranium-238 to uranium-235 variation on Earth was published in 2007. The study by Andersen and his colleagues is the first to use the uranium isotope ratio for the examination of igneous rock and apply it to the recycling process in deep Earth.

Reference:

Morten B. Andersen, Tim Elliott, Heye Freymuth, Kenneth W. W. Sims, Yaoling Niu, Katherine A. Kelley. The terrestrial uranium isotope cycle. *Nature*, 2015; 517 (7534): 356 DOI: [10.1038/nature14062](https://doi.org/10.1038/nature14062)

Note : The above story is based on materials provided by ETH Zürich. The original article was written by Peter Rüegg.

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<http://www.more-water.ch/en/orbicular-granites>

Orbicular Granites

Orbiculites are a special form of granite or related rock which contain spheres built up in layers. The spheres are so strongly bound to the matrix rock (granite, gneiss, andesite, etc.) that they cannot be separated out from them, or only with difficulty. Their size varies between several up to about 20 cm (some exceptions up to 40 cm). They have often undergone ductile deformation. The layers contain, concentrated, the same minerals (plagioclase, alkali feldspar, quartz, mica, hornblende) as the matrix material. These sorts of orbiculites, which display strong evidence of differentiation, growth, deformation and re-dissolving, are found in only a few

Orbicular rocks:



(Orbicular rock from Pengonpohja, Kuru, Finland, polished slab)

This is a short guide to help you here (www.kristallin.de).

There are three pages about orbicular rocks with the navigation at the top.

left: "Einführung in das Thema" means "introduction",
 middle: "ausgewählte Kugelgesteine" means "selected rocks",
 right: "Vergleich mit Rapakivis" means "compared with Rapakivis".

The page in the middle ("ausgewählte Kugelgesteine") presents a collection of rocks and will lead you to each single description of an orbicular rock. These descriptions were not translated but you will find a short summary in English at the end.

You will see a lot of interesting photos. Please note: The red button "Großaufnahme" (large picture) next to the pictures opens them one in a really big size. The data volumes are between 500 and 1400 KB. You need a high speed connection otherwise you will have to be patient for about a minute. These pictures magnify the rocks and show a lot of details. You will find no other pictures of this quality at the web at the moment.

(You can buy the complete website at CD. [For details click here](#))

The rocks are mostly from Finland, one is from Sweden (Slättemossa quartz monzonit) and one from Norway (Romsås orbicular norit).

The first and the second presented rocks I present are boulders. These boulders were found in northern Germany (near "Buxtehude") and in The Netherlands (nearby "Nieuw Schoonebeek") in glacial drift. There is no doubt that their origin lies somewhere in Scandinavia, but the exact places are unknown. The northern part of Central Europe is completely covered with glacial debris transported from the North by the ice during glaciations. The guiding line of this website (kristallin.de) is to describe these Scandinavian rocks to recognise them here in Germany in glacial deposits.

The section "Vergleich mit Rapakivis" is written to show the difference between the orbicular rocks and the Rapakivis. Both kinds of rocks are quite different but often mixed up. [The English summary is here:](#)

What is an orbicular rock?

Orbicular rocks are rare textural varieties of magmatic (plutonic) rocks.

They occur in all types of composition from granitic to mafic, ultramafic and carbonatic rocks. Most of them are composed of the same minerals as lots of plutonic rocks: K-feldspar and plagioclase, quartz, dark minerals like hornblende or biotite and some other minerals.

The typical features of orbicular rocks are round bodies, called "orbicules" or sometimes just "orbs". These orbicules show a wide variation in size and composition. Some of them are elongated due to deformation.

All of them contain a core in the middle surrounded by radially grown crystals. The outer part of an orbicule shows concentric lines - called "shells".

Some rocks have only got one single shell, but most of the rocks contain a lot of concentric shells.

The composition of the cores can be quite different:

- Cluster of small crystals or
- single large crystals (or pieces of them), called "nucleus" or
- Xenoliths – pieces of the host rock.

These cores are always surrounded by radially grown minerals with a transition to the shells. These shells are composed of different layers of crystals. Some layers are of radially grown crystals (often plagioclase), some are tangential and others are composed just of small grains without any orientation.

The visible drawing of the shells - concentric lines - does not always correspond with the mineral texture, which can be seen in thin sections.

The typical texture of an orbicular rock looks like this:



(Orbicular rock from Pengonpohja/Kuru, Finland, same occurrence as above, with reddish outer microcline shell)

If the core consists of an agglomeration of small mineral grains, the beginning of the radial growth is hard to see, sometimes the transition is not visible at all. See above.

The first visible line above the core that follows the shape of the orbicule, is often the outer rim of the inner shell.

The following scheme is from:

Hans Peter Meyer: [Zur Petrologie von Orbiculiten, \(Karlsruhe 1989\).](#)

The drawing shows the typical texture of an orbicule from Pengonpohja/Kuru. The Orbicul is dominated by shells that show different ways of texture.

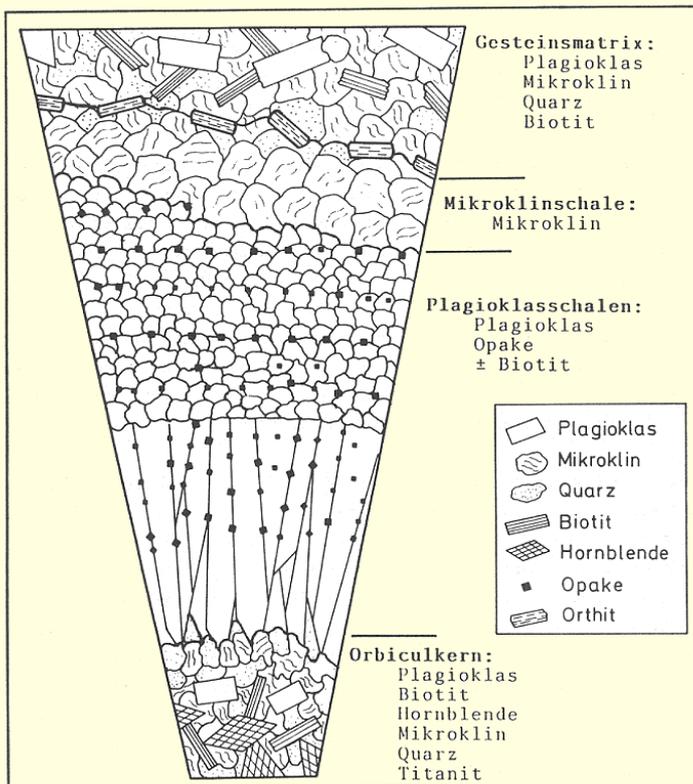


Abb. 54. Kuru: Schematische Darstellung des Orbiculaufbaus beim Orbiculittyp B. Für die einzelnen Teilbereiche des Gesteins wurden jeweils nur die wichtigsten gesteinsbildenden Minerale berücksichtigt. Weitere Erläuterungen siehe Text.

Shape and size of orbicules in one outcrop are often very similar. Visible difference is mostly caused by different levels of sections through the orbicules.

But sometimes different kinds of orbicules indeed occur at the same outcrop.

The following two examples are from the same place - the orbicular rock occurrence near Virvik, Porvoo, Finland. (Specimen from the collection: "Nordischen Sammlung" at the University of Greifswald.

Cohen und Deecke 1895 legit. The white mineral is mostly plagioclase.)



The next piece of the same occurrence is dominated by shells.



(Picture taken at the collection in front of the GTK at Espoo, Finland)

Some orbicules contain a crystal inside the core - called "nucleus".

The picture below shows such an example of a K-feldspar inside.

At the right you see, that the outer shell is broken and starts to separate. It proves that orbicules pass a phase, when plastical deformation was possible.

(Ruskiavuori orbicular granite. Savitaipale, south eastern Finland. Polished slab.

The coin has a diameter of 26 mm, approx. 1 inch)



The size of the orbicules is related to the chemistry of the rock.

The big orbicules (diameters more than 10 cm up to 40 cm) are found only in silicatic rocks with a high amount of feldspar and quartz. Mafic rocks show smaller orbicules and the smallest ones are found in ultramafic, peridotitic or carbonatic rocks

The main mineral of all silicatic orbicular rocks is plagioclase and most of the orbicular rocks are of intermediate composition. Dioritic, gabbroic or monzonitic to quartz-monzonitic rocks are common, true granites (more than 20% Quartz and K-feldspar > plagioclase) are also found but they are not dominating. Mafic rocks show also orbicular texture. The strangest rock was found in a drill core: the [carbonatite orbicular rock](#) from SOKLI, northern Finland.

As said above – orbicular rocks are rare. One reason for that is the tiny size of their occurrences. Nearly all orbicular rocks are located at small dykes and lenses at the margin of magmatic intrusions. The average size of such an occurrence is about some ten meters (!) in length and 3-5 meters in width. Bigger outcrops may be found but they are extremely rare. On the other hand a couple of very little occurrences is known and some of them are smaller than 5 meters in diameter.

Most of the orbicular rocks found are boulders of unknown origin. In some cases even intensive search failed. One of the most beautiful rocks is only known from boulders. Several attempts were made to find the outcrop – without success. It is the orbicular rock of Kuohenmaa near Kangasala in Finland:
Kuohenmaa/Kangasala. Collection of the GTK, Espoo, Finland. Polished slab:



Nearly all occurrences of orbicular rocks in Scandinavia are protected.

These rocks have to be kept from any damage. Rockhunting at these outcrops is prohibited. In some cases it is not even allowed to enter the area where the outcrop is located.

Only the beautiful Ruskiavuori orbicular rock is quarried and can be bought. If you are interested, please [click here](#).

On this website you will see some specimen of orbicular rocks. These pieces were collected in the years between 1890 and 1895 by Deecke and Cohen in Sweden and in Finland.

The specimen are part of the collection "Nordische Sammlung" at the University of Greifswald in Germany.

To see some orbicular rocks, please [click here](#). The next page is in German but you will find a short summary in English at the end of each description.

The last pictures show mafic rocks with a surface, which seems to look similar to orbicular rocks.

These forms are caused by weathering and are no orbicular textures at all.

(Tenerife, roadcut at TF-24 southwest of San Cristobal de la Laguna)



The width of the photographed area is about 1m

The same place, overview:



Literature:

- Lahti, Seppo, I.(ed.) 2005: Orbicular rocks in Finland, With contributions by Paula Raivio and Ilkka Laitakari. [Geological Survey of Finland](#). 177 pages, 195 figures and 16 tables.

This book can be ordered at GTK: <http://en.gtk.fi/Geoinfo/Publications/Publicationsales.html>

- Hans-Peter Meyer: Zur Petrologie von Orbiculiten. Dissertation (thesis), Karlsruhe 1989

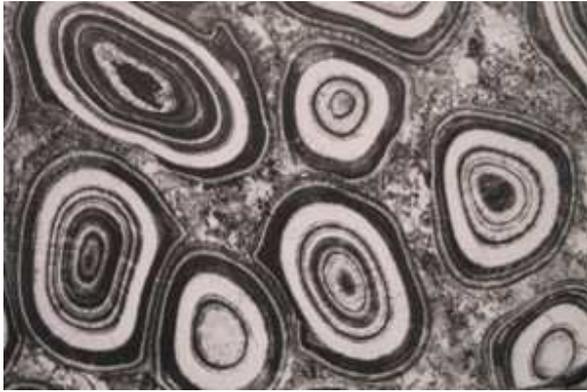
- Hans-Peter Meyer at the internet: Orbiculite - [Faszinierende granitoide Gesteine](#)

- Anders Lindh - Helena Näsström: Crystallization of orbicular rocks exemplified by the Slättemossa occurrence, southeastern Sweden (Geol. Mag. 143 (5), 2006, pp. 713–722.

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dozen quarry locations on earth, often in the border regions between granite, gneiss, diorite or other crystalline complexes. Some come from middle and south Finland from the Baltic shield (Archaen and Proterozoic). The orbiculite usually is confined to small areas, and is only occasionally extracted, generally for geological rarity pieces for collections and museums. In part they are protected by law. The small-sphered Rapakivi granite does not belong to the genuine orbicular granites. It is found over wide stretches of east Finland,

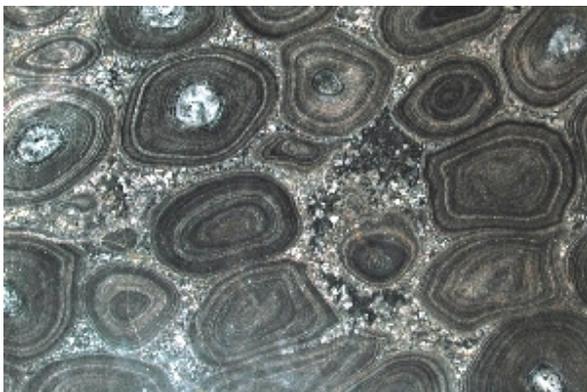
and is sold by the natural stone industry. The present-day science has had great difficulty explaining orbicular granite. There is one theory of origin at present which is somewhat satisfying, but when compared to certain phenomena still leaves an uncertainty. These phenomena will be discussed here. . Orbiculite from Finland (Kangasala). One should note the rock fragments, which can form the cores of spheres, and the broken or dissolved shell on the right-hand picture, through which the granite has been pressed in from outside.



Left: Finland (Kangasala). An unusual combination of core fragment, a separate small sphere and numerous layers. Right: Finland (Savitaipale). Lighter zone with larger crystallization which had penetrated the border of one sphere.



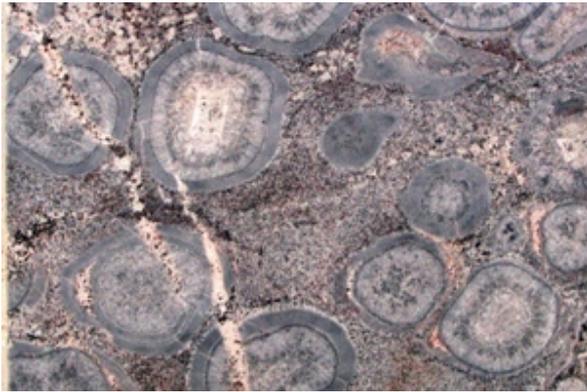
Finland (Virvik - Porvoo). On the right with strong signs of dissolving



Finland (Pengonpohja - Kuru). Strong ductile deformation, reddish orthoclase layers, in part loosened shell fragments.



Finland (Pallokivilevyt). Separated shell sections, individual spheres with feldspar core.



Origin in Scandinavia, found in glacially-transported material in Lower Saxony, Germany.



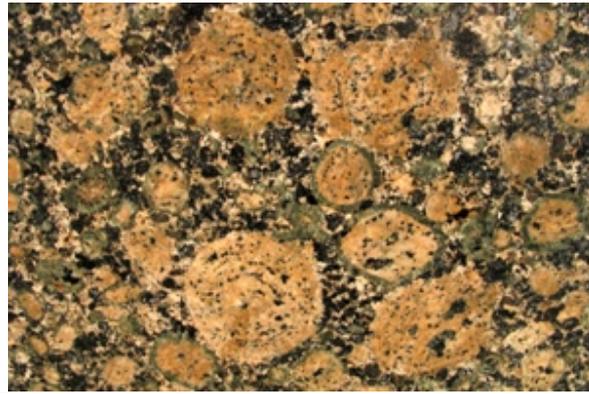
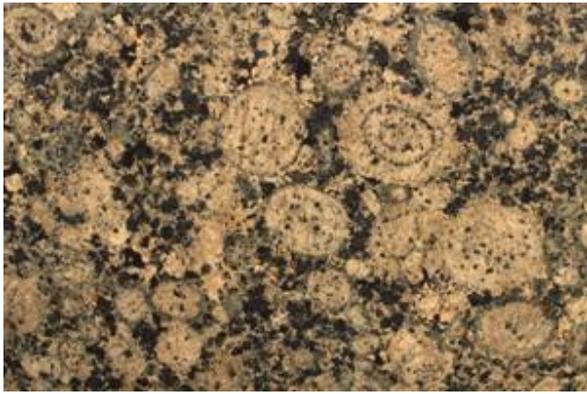
Left: Australia.



Right: Chile (Caldera)



Finland. Rapakivi granite, obtained commercially (spheres up to approx. 5 cm) actually not a true orbicular granite.



The details in the pictures indicate soft, ductily-deformed structures, in part broken off, so that the outer material could flow in, or the inner material out. In part the outer shells come loose, and can float as fragments in the surrounding matrix. Individual spheres have centers composed of fragments of the shells of other spheres, or pieces of gneiss. To some extent one can discern a series of growth and dissolution phases.

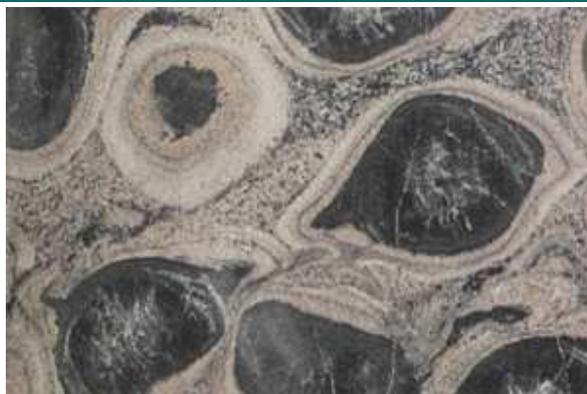
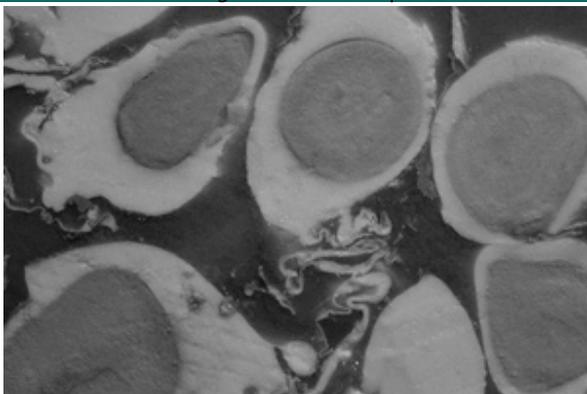
Orbiculites were early to come under scientific scrutiny, and numerous published articles have attempted to explain the phenomena. In 1966 the American D.J. Leveson brought together numerous works and undertook his own researches, reaching finally, among others, the following conclusion: the spheres originated in magmatic plutons which have intruded cooler rock complexes, under particular physical and chemical conditions. They can exhibit very different features in chemically-similar rock formations, and likewise those found in formations with very different chemistry can be quite similar. Deformed and partly-dissolved spheres led Leveson to the conclusion that their rarity may be due to their frequently dissolving shortly after their formation. He also drew a connection to the experiments of R.E. Liesegang, who in 1896 produced concentric ring formations with silver nitrate in colloidal gels. Leveson nevertheless did not conclude that the orbiculite matrix was colloidal, but rather that the Liesegang-effect might possibly also take place in magmatic-plutonic melts and solutions.

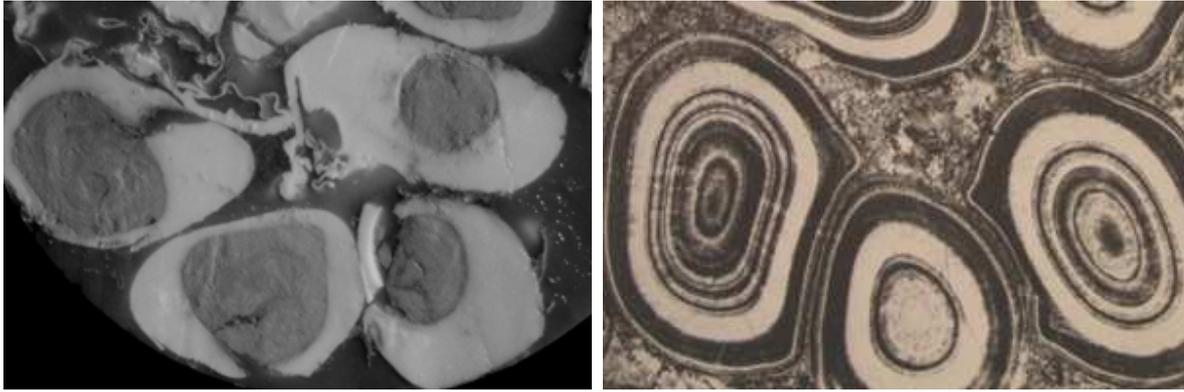
At the end of the 1980's H.P. Meyer of Heidelberg, described a precise model of origin in his dissertation. He described the occurrences in the vicinity of the growing orbicules with the model "undercooling with heterogeneous seed-formations and growth controlled by diffusion". According to this, quickly-cooled magma intruded into a foreign rock body, whereby certain substances crystallized out in radial "starlike" form from a multiplicity of crystallization centers, which led to a local thinning-out of these slowly-diffusing substances in the magma. At a particular point in time the thinning-out is so strong, that the predominance of another substance leads to its crystallization around the growing orbicule, creating a second step. After a certain time-period, the balance swings in the other direction, leading to a third layer, and so on. In comparison with earlier models, this one appears able to reconcile itself to the phenomena, and has thus become generally recognized.

Despite this, one can have the impression that certain aspects of the phenomena have not been taken sufficiently into account: puzzling are above all the peeling off and floating of outer shells (comparable to the same phenomena in certain agates), the breaking-open of spheres with the subsequent penetration by the surrounding matrix material, and not least the soft deformation caused by spheres pressing against one another. With conventional crystallization, one would expect spheres bordering on one another to either grow together or simply form rigid contact surfaces.

At this point one can make the thought-experiment of trying to understand the phenomena of orbiculites under the presupposition of a colloidal-gelatinous consistency of the "pluton". One must thereby take the step from a magmatic pluton to a hot, nearly "gelatinous" mineral mass. The "diffusion-controlled crystallization" postulated by Meyer would then become a diffusion-controlled layered deposition in a colloidal groundmass, which will also be described in the section dealing with agates. The actual crystallization, resulting in the present condition of the orbiculites, would then have occurred later, after the complete forming and frequent ductile deformation of the orbicules.

The photos on the left show experiments with eggs, which have hardened in a colloidal material under pressure, and on the right sections of orbicular granites for comparison.





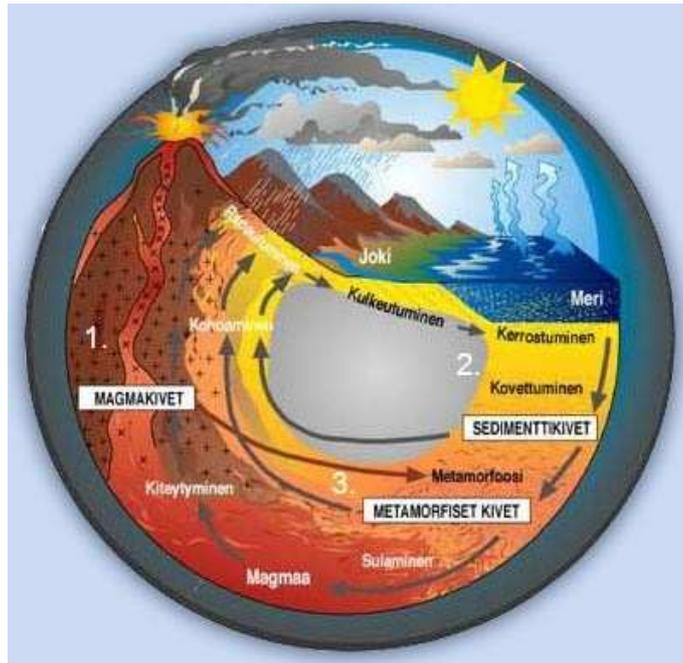
Concerning the orbiculite matrix, one could perhaps think of a substance somewhere between the two conditions of "magmatic" and "colloidal", of a hot, colloid-like, watery-silicious rock precursor. It must be assumed, to be sure, that under the present chemo-physical conditions of the earth such a substance is hardly possible, and also hardly to be reproduced in experiments. It is perhaps significant that no orbiculites of this type are found in younger rocks, and that the phenomenon seems restricted to a particular period of the earth's history (late Archaen, Proterozoic, a few from the Paleozoic). In later sections, for example *Self-organization*, the question will be gone into of whether certain processes of rock formation are strongly conditioned by time and also irreversible.

http://www.geocaching.com/geocache/GC3R3NK_pallograniitti-ja-verikivi-kangasala

Orbicular rock

Magma (from Greek μάγμα "mixture") is a mixture of molten or semi molten rock, volatiles and solids that is found beneath the surface of the Earth, and is expected to exist on other terrestrial planets. Besides molten rock, magma may also contain suspended crystals and dissolved gas and sometimes also gas bubbles. Magma often collects in magma chambers that may feed a volcano or turn into a **pluton**. Magma is capable of intrusion into adjacent rocks, extrusion onto the surface as lava, and explosive ejection as tephra to form pyroclastic rock. Magma is a complex high-temperature fluid substance. Temperatures of most magmas are in the range 700 °C to 1300 °C (or 1300 °F to 2400 °F), but very rare carbonatite melts may be as cool as 600 °C, and komatiite melts may have been as hot as 1600 °C. Most are silicate mixtures. Environments of magma formation and compositions are commonly correlated. Environments include subduction zones, continental rift zones, mid-ocean ridges and hot spots. Despite being found in such widespread locales, the bulk of the Earth's crust and mantle is not molten. Rather, most of the Earth takes the form of a rheid, a form of solid that can move or deform under pressure. Magma, as liquid, preferentially forms in high temperature, low pressure environments within several kilometers of the Earth's surface. Magma compositions may evolve after formation by fractional crystallization, contamination, and magma mixing. By definition rock formed of solidified magma is called **igneous rock**. While the study of magma has historically relied on observing magma in the form of lava outflows, magma has been encountered in situ three times during drilling projects—twice in Iceland, and once in Hawaii.

A pluton in geology is a body of intrusive igneous rock (called a plutonic rock) that crystallized from magma slowly cooling below the surface of the Earth. Plutons include batholiths, stocks, dikes, sills, laccoliths, lopoliths, and other igneous bodies. In practice, "pluton" usually refers to a distinctive mass of igneous rock, typically several kilometers in dimension, without a tabular shape like those of dikes and sills. Batholiths commonly are aggregations of plutons. Examples of plutons include Cardinal Peak and Mount Kinabalu. The most common rock types in plutons are granite, granodiorite, tonalite, monzonite, and quartz diorite. Generally light colored, coarse-grained plutons of these compositions are referred to as granitoids.



Birth of rocks ,key:

magma kivet=igneous rocks, sedimenttikivet=sedimentary rocks, metamorfiset kivet=metamorphic rocks, kiteytymisen=crystallization, kulkeutuminen=diversion, kerrostuminen=sedimentation, kovettuminen=hardening, rapautuminen=erosion, kohoaminen=rising

Orbicular granite (also known as orbicular rock or orbiculite) is an uncommon plutonic rock type which is usually granitic in composition. These rocks have a unique appearance due to orbicules - concentrically layered, spheroidal structures, probably formed through nucleation around a grain in a cooling magma chamber. Almost one third of known orbicular rock occurrences are from Finland. The occurrences are usually very small.

Orbicular rocks are a rare variety of magmatic rocks. Orbicular rocks occur in different types of rocks, such as granite, gabbro and diorite. Most of them are composed of the same minerals as lots of plutonic rocks: K-feldspar and plagioclase, quartz, dark minerals like hornblende and biotite and some other minerals. The typical features of orbicular rocks are round bodies, called "orbicules". These orbicules show a wide variation in size and composition. Some of them are elongated due to deformation. All of the orbicular rocks contain a core in the middle surrounded by radially grown crystals. The outer part of an orbicule shows concentric lines - called "shells". Some rocks have only got one single shell, but most of the rocks contain a lot of concentric shells. Orbicular rocks are probably formed through nucleation around a grain in a cooling magma chamber.

The typical features of orbicular rocks are round bodies, called "orbicules" or sometimes just "orbs". These orbicules show a wide variation in size and composition. Some of them are elongated due to deformation. All of them contain a core in the middle surrounded by radially grown crystals. The outer part of an orbicule shows concentric lines - called "shells". Some rocks have only got one single shell, but most of the rocks contain a lot of concentric shells.

The composition of the cores can be quite different:

- Cluster of small crystals or
- single large crystals (or pieces of them), called "nucleus" or
- Xenoliths - pieces of the host rock.

These cores are always surrounded by radially grown minerals with a transition to the shells. These shells are composed of different layers of crystals. Some layers are of radially grown crystals (often plagioclase), some are tangential and others are composed just of small grains without any orientation. The visible drawing of the shells - concentric lines - does not always correspond with the mineral texture, which can be seen in thin sections.

The following scheme is from:

Hans Peter Meyer: Zur Petrologie von Orbiculiten, (Karlsruhe 1989). The drawing shows the typical texture of an orbicule from Pengonpohja/Kuru. The Orbicul is dominated by shells that show different ways of texture.

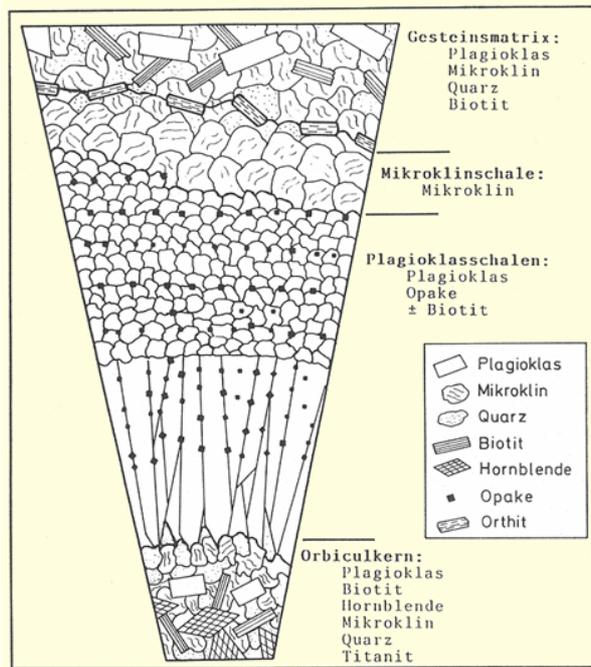


Abb. 54. Kuru: Schematische Darstellung des Orbiculaufbaus beim Orbiculittyp B. Für die einzelnen Teilbereiche des Gesteins wurden jeweils nur die wichtigsten gesteinsbildenden Minerale berücksichtigt. Weitere Erläuterungen siehe Text.

texture of Orbicule ,key:
culkern=core, schale=shell

If the core consists of an agglomeration of small mineral grains, the beginning of the radial growth is hard to see, sometimes the transition is not visible at all. The first visible line above the core that follows the shape of the orbicule, is often the outer rim of the inner shell.

As said above – orbicular rocks are rare. One reason for that is the tiny size of their occurrences. Nearly all orbicular rocks are located at small dykes and lenses at the margin of magmatic intrusions. The average size of such an occurrence is about some ten meters (!) in length and 3-5 meters in width. Bigger outcrops may be found but they are extremely rare. On the other hand a couple of very little occurrences is known and some of them are smaller than 5 meters in diameter. Most of the orbicular rocks found are boulders of unknown origin. In some cases even intensive search failed. One of the most beautiful rocks is only known from boulders. Several attempts were made to find the outcrop – without success.

ARTIGO DA SEMANA

<http://www.geologyin.com/2015/04/greatest-mass-extinction-driven-by.html>
 Greatest mass extinction driven by acidic oceans
 Earth History, ocean 8:14 PM

image: <http://4.bp.blogspot.com/-d6HIiLdP-cE/VtFWZMvToI/AAAAAAAAAE-g/bphNYgeZInI/s1600/Greatest%2Bmass%2Bextinction%2Bdriven%2Bby%2Bacidic%2Boceans%2C%2Bstudy%2Bfinds.jpg>



Field work in the United Arab Emirates. Credit: D.Astratti

Changes to the Earth's oceans, caused by extreme volcanic activity, triggered the greatest extinction of all time, a study suggests. The event, which took place 252 million years ago, wiped out more than 90 per cent of marine species and more than two-thirds of the animals living on land.

It happened when Earth's oceans absorbed huge amounts of carbon dioxide from volcanic eruptions, researchers say. This changed the chemical composition of the oceans - making them more acidic - with catastrophic consequences for life on Earth, the team says.

The study, co-ordinated by the University of Edinburgh, is the first to show that highly acidic oceans were to blame. The findings are helping scientists understand the threat posed to marine life by modern-day ocean acidification. The amount of carbon added to the atmosphere that triggered the mass extinction was probably greater than today's fossil fuel reserves, the team says. However, the carbon was released at a rate similar to modern emissions. This fast rate of release was a critical factor driving ocean acidification, researchers say.

The Permian-Triassic Boundary extinction took place over a 60,000 year period, researchers say. Acidification of the oceans lasted for around 10,000 years.

Ocean acidification was the driving force behind the deadliest phase of the extinction, which dealt a final blow to an already unstable ecosystem, researchers say. Increased temperatures and widespread loss of oxygen in the oceans had already put the environment under pressure.

Oceans can absorb some carbon dioxide but the large volume released - at such a fast rate - changed the chemistry of the oceans, the team says.

The mass extinction of both marine and land-based animals demonstrates that extreme change took place in all of Earth's ecosystems, the team says.

The team analysed rocks unearthed in the United Arab Emirates - which were on the ocean floor at the time - to develop a climate model to work out what drove the extinction. The rocks preserve a detailed record of changing oceanic conditions at the time.

The study, published in the journal *Science*, was carried out in collaboration with the University of Bremen, Germany, and the University of Exeter, together with the Universities of Graz, Leeds, and Cambridge.

Funding was provided by the International Centre for Carbonate Reservoirs, Natural Environment Research Council, The Leverhulme Trust, German Research Foundation and the Marsden Fund.

Dr Matthew Clarkson, of the University of Edinburgh's School of GeoSciences, who co-ordinated the study, said: "Scientists have long suspected that an ocean acidification event occurred during the greatest mass extinction of all time, but direct evidence has been lacking until now. This is a worrying finding, considering that we can already see an increase in ocean acidity today that is the result of human carbon emissions."

Professor Rachel Wood, of the University of Edinburgh's School of GeoSciences, said: "This work was highly collaborative and the results were only possible because we assembled a unique team of geochemists, geologists and modellers to tackle an important and long-standing problem."

Provided by [University of Edinburgh](http://www.ed.ac.uk/geo)

Read more at <http://www.geologyin.com/2015/04/greatest-mass-extinction-driven-by.html#tQB8jMQxOCQGVYGz.99>

<http://www.geologyin.com/2014/12/some-facets-of-geology-of-diamonds.html>

Some Facets of the Geology of Diamonds

image: http://1.bp.blogspot.com/-JHN0MQwsA7s/VISmk7luq4I/AAAAAAAAACqo/oqoCAPH2W9M/s1600/canadian_diamonds.jpg



Geoscientists can't say if diamonds are forever, but they can say that some are already billions of years old. They form in a place we'll never reach: the deep earth, hundreds of kilometres under our feet. Diamonds tell us much about this hidden world and how it is linked to the surface - and life - in surprising ways.

Diamonds are made of carbon atoms which are densely packed into a structure that is extremely strong. On earth they form only under extreme pressures - under conditions very unfamiliar to us surface-dwellers. Some form in the sudden shock-waves created when material from space hits the earth. The global impact layer found suspiciously close in time to the extinction of the dinosaurs contains countless tiny diamonds. Impact diamonds are rare. Most diamonds, certainly any big enough to put in an engagement ring, form slowly within the deep earth.

Imagine a slab of concrete - about 5cm thick - resting on your chest. The pressure is small, but tangible. The pressure found in the deepest ocean is equivalent to some 80,000 of such slabs. Diamonds form at pressures that are at least 45 times greater still, equivalent to millions of slabs or hundreds of kilometres of rock. The earth's deep interior is a place where even rocks are transformed by the massive pressure.

Natural diamonds don't form, Superman-style, by the application of pressure directly to other solid forms of carbon (such as coal). They grow by the interaction between a carbon bearing fluid and rock - typically involving redox reactions such as the breakdown of CO₂ or

methane. Diamonds show complex patterns that suggest they grow gradually. Studies of diamonds from a single area often show a wide distribution of ages, from over 3 billion years old to a few hundred million.

Diamonds form within the earth's mantle, the thick layer between the thin crust and earth's metal core. They are particularly associated with parts of the mantle that are stuck to the bottom of long-lived continental crust. Here the mantle forms stable 'keels' and doesn't take part in the convection-driven movements that happen lower down. The portions of stable crust with keels are called cratons – the largest are found in North America, Africa and Australia – all areas rich in diamond mines.

Cratonic keels are very stable, but are not totally insulated from the dramatic events in the rest of the dynamic earth. Subduction at the edge of cratonic plates allows oceanic crust to sink deep into the mantle underneath the craton. Carbon-bearing fluids from the sinking oceanic crust rise into the cratonic keel and may cause a phase of diamond formation. Mantle plumes, columns of hotter rock rising from the base of the mantle can do likewise.

In contrast to how they form, the way diamonds reach the surface involves one of the quickest and dramatic geological events we know. Most diamonds reach the surface brought up within an odd type of molten rock called Kimberlite. This magma forms at great depth in cratonic keels and is rich in volatile elements such as CO₂ which makes it highly pressured. If it is able, it will rise to the surface extremely quickly through vertical fractures. At the surface it forms a carrot-shaped pipe which nowadays is often the site of a large circular diamond mine.

Diamonds and other deep minerals are brought to the surface as fragments within the kimberlite magma. Diamonds are able to survive the rough-and-tumble of the eruption very well, but it helps that the eruption events are very quick. Not just geologist-quick, but normal-folk quick. Estimates are that diamonds travel to the surface in at most months but maybe as quick as a few hours. Diamonds are only stable under surface conditions because they are too cold to change their structure. The speed with which they reach the surface and cool down keeps them beautiful and prevents them from turning into worthless graphite on the way up.

Some diamonds are not conventionally beautiful. They contain blemishes, tiny blebs of fluid or inclusions of other minerals that dim their brilliance. But to geologists these are the most attractive diamonds of all. Listen to them carefully and they will whisper secrets about a place we'll never reach – the deep earth.

The deep earth is only a few hundred kilometres below your feet, but is completely inaccessible. The deepest hole ever drilled is a puny 12.2 kilometers. At diamond depths the rocks are at temperatures over 1000°C – few man-made materials can survive such conditions. Fortunately we can tell a lot remotely. Seismologists gather information on the way waves created by earthquakes pass through the earth and they can dimly make out structures at great depths. This 'seismic tomography' applies the same principles that PET or MRI scanners use to study a human body. Such tools are useful, but in medicine as in geology, sometimes direct sampling of the interior is required: kimberlites act like biopsies, making samples of the interior available for detailed study.

A tremendous range of experimental techniques have been used to study diamonds and their inclusions. Some have poetic-sounding names ("Raman spectroscopy") but many do not ("combustion analysis", "laser ablation ICPMS"). Most are used to measure the elemental composition of the minerals or the isotopic makeup of those elements. These data are not just of interest to chemists. The chemistry of mineral inclusions can yield information about the pressures and temperatures at which they (and the diamond) formed. Radioactive isotopes can be used to estimate the age of formation.

Stable isotopes tell some of the most remarkable stories in the earth sciences. Particular processes create distinctive isotopic signatures that may be preserved through a whole range of subsequent events. One isotopic signature only forms when ultraviolet light interacts with sulphur in an oxygen-poor environment. This signature has been found in diamonds, meaning that they contain material that was once at the surface (rock is a very good sun-block, so UV reactions do not occur inside the earth). Also, the sulphur was at the surface very early in Earth history, before photosynthesis caused atmospheric Oxygen levels to rise.

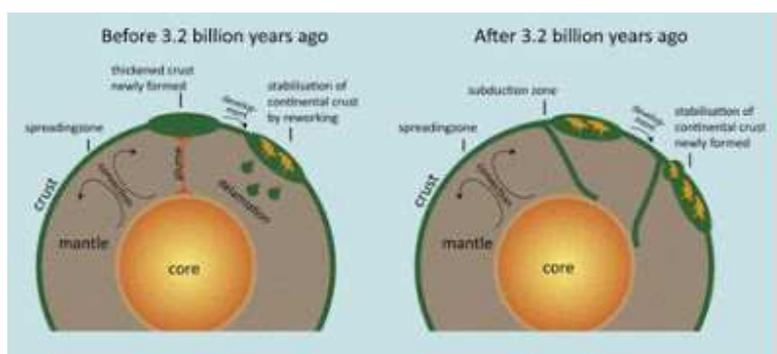
Photosynthesis has its own distinctive isotope signature, affecting carbon. Some diamonds contain this 'light carbon', meaning they are formed from life itself. They are the most amazing type of 'fossil' imaginable. Some living organism ended its life as a smear of black carbon in a sedimentary rock. It was then buried deep by subduction. Some of its atoms rose up again, first in fluid and then as part of a diamond, suddenly flung to the surface for us to find and marvel at. This deep loop of the carbon cycle is small in terms of volume but conceptually it is enormous. The cycling of carbon between plants, animals and the atmosphere is well known. Uncomfortably, we are becoming more aware of the additional link between buried coal, atmospheric carbon and climate. But the far deeper cycling of carbon into the mantle, demonstrated by diamonds is only recently proven. We can never reach the deep earth, yet it is intimately linked to surface via the subduction of oceanic crust.

Not all diamonds form from surface material. Carbon has been part of the mantle since the formation of the earth and this carbon forms diamonds too. Tracing types of mineral inclusions, it is possible to distinguish diamonds formed from subducted material from other types. This reveals an interesting pattern: diamonds that are older than 3 billion years show no trace of subducted material. This suggests – consistent with other evidence – that plate tectonics as we know it was not active in the very early earth. Subduction may only have started 3 billion years ago.

Most diamonds form in the upper reaches of the mantle but some come from deeper down. These 'sub-lithospheric diamonds' form in the part of the mantle that slowly circulates in convection currents. This lower mantle forms the majority of the earth by volume, yet is poorly understood. At these depths only exotic minerals are stable, traces of which are found as tiny inclusions within diamonds. The only other place we can see these materials is in the laboratory. Here 'anvils' are used to squeeze tiny samples to tremendous pressures. The material they are made of is very strong, but also transparent, so that observations can be made and lasers fired through it to heat the samples. What are these special anvils made of? Diamonds, of course. These are precious stones indeed.

Read more at <http://www.geologyin.com/2014/12/some-facets-of-geology-of-diamonds.html#KIQzp5UcpV8lyxX4.99>

<http://www.geologypage.com/2012/06/plate-tectonics-cannot-explain-dynamics.html#ixzz3XfT8BQs2>
[Plate Tectonics Cannot Explain Dynamics of Earth and Crust Formation More Than Three Billion Years Ago](http://www.geologypage.com/2012/06/plate-tectonics-cannot-explain-dynamics.html#ixzz3XfT8BQs2)



"Plate tectonics theory can be applied to about 3 billion years of the Earth's history. However, the Earth is older, up to 4.567 billion years old. We can now demonstrate that there has been a significant shift in the Earth's dynamics. Thus, the Earth, under the first third of its history, developed under conditions other than what can be explained using the plate tectonics model," explains Tomas Næraa. (Credit: Image courtesy of University of Copenhagen)

The current theory of continental drift provides a good model for understanding terrestrial processes through history. However, while plate tectonics is able to successfully shed light on processes up to 3 billion years ago, the theory isn't sufficient in explaining the dynamics of Earth and crust formation before that point and through to the earliest formation of planet, some 4.6 billion years ago. This is the conclusion of Tomas Næraa of the Nordic Center for Earth Evolution at the Natural History Museum of Denmark, a part of the University of Copenhagen. His new doctoral dissertation has just been published by the journal *Nature*.

"Using radiometric dating, one can observe that Earth's oldest continents were created in geodynamic environments which were markedly different than current environments characterised by plate tectonics. Therefore, plate tectonics as we know it today is not a good model for understanding the processes at play during the earliest episodes of Earth's history, those beyond 3 billion years ago. There was another crust dynamic and crust formation that occurred under other processes," explains Tomas Næraa, who has been a PhD student at the Natural History Museum of Denmark and the Geological Survey of Denmark and Greenland -- GEUS.

Plate tectonics is a theory of continental drift and sea floor spreading. A wide range of phenomena from volcanism, earthquakes and undersea earthquakes (and pursuant tsunamis) to variations in climate and species development on Earth can be explained by the plate tectonics model, globally recognized during the 1960's. Tomas Næraa can now demonstrate that the half-century old model no longer suffices.

"Plate tectonics theory can be applied to about 3 billion years of the Earth's history. However, the Earth is older, up to 4.567 billion years old. We can now demonstrate that there has been a significant shift in the Earth's dynamics. Thus, the Earth, under the first third of its history, developed under conditions other than what can be explained using the plate tectonics model," explains Tomas Næraa. Tomas is currently employed as a project researcher at GEUS.

Central research topic for 30 years

Since 2006, the 40-year-old Tomas Næraa has conducted studies of rocks sourced in the 3.85 billion year-old bedrock of the Nuuk region in West Greenland. Using isotopes of the element hafnium (Hf), he has managed to shed light upon a research topic that has puzzled geologists around the world for 30 years. Næraa's instructor, Professor Minik Rosling of the Natural History Museum of Denmark considers Næraa's dissertation a seminal work:

"We have come to understand the context of the Earth's and continent's origins in an entirely new way. Climate and nutrient cycles which nourish all terrestrial organisms are driven by plate tectonics. So, if the Earth's crust formation was controlled and initiated by other factors, we need to find out what controlled climate and the environments in which life began and evolved 4 billion years ago. This fundamental understanding can be of great significance for the understanding of future climate change," says Minik Rosling, who adds that: "An enormous job waits ahead, and Næraa's dissertation is an epochal step."

Note : The above story is reprinted from materials provided by University of Copenhagen.

Read more : <http://www.geologypage.com/2012/06/plate-tectonics-cannot-explain-dynamics.html#ixzz3Xnut29cN>

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<http://www.nature.com/nature/journal/v485/n7400/full/nature11140.html>

Hafnium isotope evidence for a transition in the dynamics of continental growth 3.2 Gyr ago

- [T. Næraa](#),
- [A. Scherstén](#),
- [M. T. Rosling](#),
- [A. I. S. Kemp](#),
- [J. E. Hoffmann](#),
- [T. F. Kokfelt](#)
- & [M. J. Whitehouse](#)

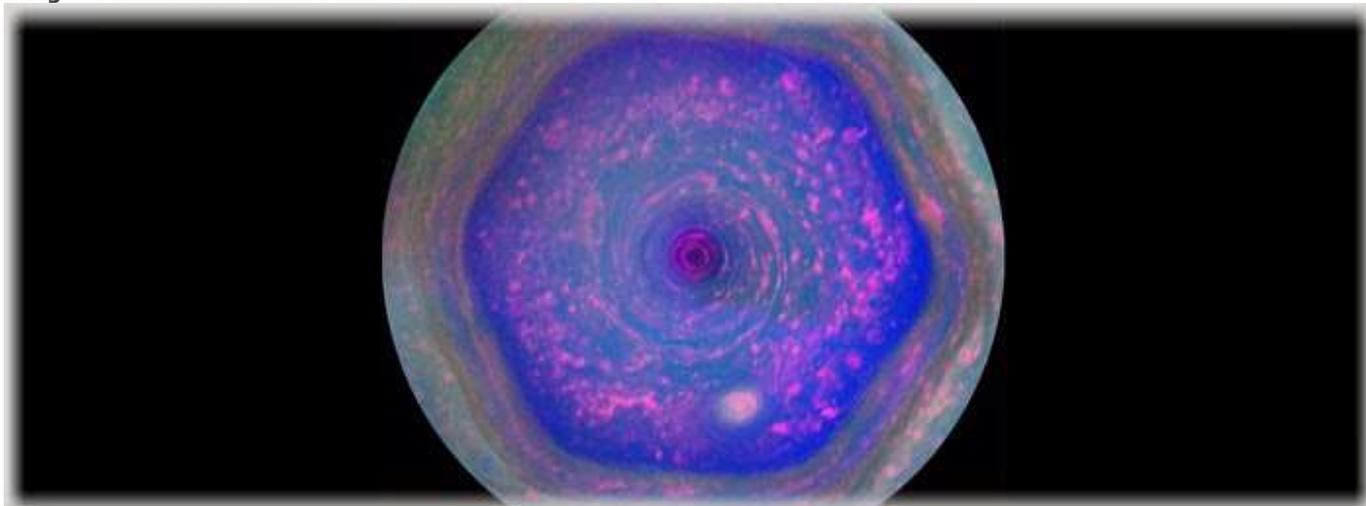
Earth's lithosphere probably experienced an evolution towards the modern plate tectonic regime, owing to secular changes in mantle temperature^{1,2}. Radiogenic isotope variations are interpreted as evidence for the declining rates of continental crustal growth over time^{3,4,5}, with some estimates suggesting that over 70% of the present continental crustal reservoir was extracted by the end of the Archaean eon^{3,5}. Patterns of crustal growth and reworking in rocks younger than three billion years (Gyr) are thought to reflect the assembly and break-up of supercontinents by Wilson cycle processes and mark an important change in lithosphere dynamics⁶. In southern West Greenland numerous studies have, however, argued for subduction settings and crust growth by arc accretion back to 3.8 Gyr ago^{7,8,9}, suggesting that modern-day tectonic regimes operated during the formation of the earliest crustal rock record. Here we report *in situ* uranium-lead, hafnium and oxygen isotope data from zircons of basement rocks in southern West Greenland across the critical time period during which modern-like tectonic regimes could have initiated. Our data show pronounced differences in the hafnium isotope-time patterns across this interval, requiring changes in the characteristics of the magmatic protolith. The observations suggest that 3.9–3.5-Gyr-old rocks differentiated from a >3.9-Gyr-old source reservoir with a chondritic to slightly depleted hafnium isotope composition.

In contrast, rocks formed after 3.2 Gyr ago register the first additions of juvenile depleted material (that is, new mantle-derived crust) since 3.9 Gyr ago, and are characterized by striking shifts in hafnium isotope ratios similar to those shown by Phanerozoic subduction-related orogens^{10, 11, 12}. These data suggest a transitional period 3.5–3.2 Gyr ago from an ancient (3.9–3.5 Gyr old) crustal evolutionary regime unlike that of modern plate tectonics to a geodynamic setting after 3.2 Gyr ago that involved juvenile crust generation by plate tectonic processes

NEWS METEORITICA DA SEMANA

<http://www.galeriadometeorito.com/2014/02/video-o-hexagono-de-saturno-como-voce-nunca-viu.html#.VTjS2iGqqkq>

O Hexágono de Saturno como você nunca viu



05/02/14 - Qual é a explicação para o curioso fenômeno? O que os cientistas dizem?

A missão Cassini da NASA obteve um ponto de vista incrível, e registrou um vídeo com a mais alta resolução das correntes de jatos de seis lados do pólo norte de Saturno. Essa formação é conhecida como o "Hexágono de Saturno". Este filme, feito a partir de imagens obtidas por câmeras da Cassini, é o primeiro a mostrar o hexágono em filtros de cor, e o primeiro a mostrar uma visão completa do pólo norte, até cerca de 70 graus de latitude norte.

Abrangendo cerca de 30,000 km de diâmetro, o hexágono é uma corrente de jatos com ventos que atingem cerca de 322 quilômetros por hora, com uma enorme tempestade girando no centro. Até o momento, esse tipo de configuração só foi observada em [Saturno](#). Um furacão na Terra normalmente dura uma semana, mas este em Saturno tem durado décadas, ou quem sabe, até séculos. Padrões climáticos da Terra são interrompidos quando se deparam com a fricção de relevo ou calotas. Os cientistas suspeitam que a estabilidade do hexágono tem algo a ver com a falta de relevo sólidos em Saturno, que é essencialmente uma [bola gigante de gás](#). Assim como ocorre com [a grande mancha vermelha de Júpiter](#), esse grande furacão em Saturno não encontra montanhas ou relevos, e por isso, eles duram décadas e séculos... não há nada para interromper esses ventos.

"À medida que nos aproximamos do solstício de verão de Saturno, em 2017, as condições de iluminação em seu pólo norte irão melhorar, e estamos animados para acompanhar as mudanças que devem ocorrer dentro e fora do limite do hexágono", disse Scott Edgington, cientista do Laboratório de Propulsão a Jato da NASA e integrante da missão Cassini.

A sonda Cassini foi lançada em 1997 e chegou a Saturno em 1 de julho de 2004. Sua missão está programada para terminar em setembro de 2017. A missão Cassini-Huygens é um projeto cooperativo entre a NASA, a Agência Espacial Europeia (ESA) e a Agência Espacial Italiana. A NASA gerencia a missão a partir do Centro de Missões em Washington. O veículo orbital Cassini possui duas câmeras a bordo. A base da equipe de imagens da missão é localizada no Instituto de Ciência Espacial em Boulder, Colorado, EUA.

Fonte: NASA

Vídeo: NASA / JPL

www.nature.com/nature/journal/v466/n7305/full/nature09274.html

Lunar apatite with terrestrial volatile abundances

- [Jeremy W. Boyce](#),
 - [Yang Liu](#),
 - [George R. Rossman](#),
 - [Yunbin Guan](#),
 - [John M. Eiler](#),
 - [Edward M. Stolper](#)
 - & [Lawrence A. Taylor](#)
- Nature
466,
466–469
(22 July 2010)
doi:10.1038/nature09274

The Moon is thought to be depleted relative to the Earth in volatile elements such as H, Cl and the alkalis^{1, 2, 3}. Nevertheless, evidence for lunar explosive volcanism^{4, 5} has been used to infer that some lunar magmas exsolved a CO-rich and CO₂-rich vapour phase before or during eruption^{6, 7, 8}. Although there is also evidence for other volatile species on glass spherules⁹, until recently¹⁰ there had been no unambiguous reports of indigenous H in lunar rocks. Here we report quantitative ion microprobe measurements of late-stage apatite

from lunar basalt 14053 that document concentrations of H, Cl and S that are indistinguishable from apatites in common terrestrial igneous rocks. These volatile contents could reflect post-magmatic metamorphic volatile addition or growth from a late-stage, interstitial, sulphide-saturated melt that contained ~1,600 parts per million H₂O and ~3,500 parts per million Cl. Both metamorphic and igneous models of apatite formation suggest a volatile inventory for at least some lunar materials that is similar to comparable terrestrial materials. One possible implication is that portions of the lunar mantle or crust are more volatile-rich than previously thought.

<http://noticias.uol.com.br/ciencia/ultimas-noticias/efe/2015/04/16/pesquisa-determina-a-partir-de-meteoritos-que-lua-tem-447-bilhoes-de-anos.htm>

Pesquisa determina a partir de meteoritos que Lua tem 4,47 bilhões de anos

- Laurent Gillieron/Efe



Lua cheia aparece atrás dos Alpes Suíços, vista de Charrat, no sul do país

Um grupo de cientistas conseguiu determinar que a Lua tem 4,47 bilhões de anos com uma inovadora análise dos meteoritos que foram expelidos no momento da criação do satélite, cujos destroços acabaram aterrissando na Terra, segundo um estudo publicado nesta quinta-feira na revista "Science".

Um grupo multidisciplinar de cientistas da Nasa, Universidade do Arizona e Instituto Superior de Estudos Teológicos (ISET) descobriu marcas do momento de criação da Lua nos destroços dos meteoritos rochosos que chegaram na Terra há milhões de anos.

Os especialistas concluíram que a Lua se formou a partir do "maior impacto" da história do Sistema Solar, quando um protoplaneta (pequeno corpo celeste considerado um embrião planetário) colidiu com o corpo celeste que mais tarde se transformaria na Terra. Não se sabe exatamente quando aconteceu este impacto, pois os cientistas seguem debatendo a idade das amostras de solo e rochas lunares que os astronautas trouxeram de volta à Terra das missões Apollo.

No entanto, os pesquisadores descobriram que, no momento do choque, meteoritos de mais de um quilômetro de comprimento colidiram com velocidade acima da normal em um cinturão de asteroides.

A superfície dos meteoritos se aqueceu acima do normal e deixou atrás de si "um registro permanente do impacto", que permitiu aos cientistas determinarem que a Lua se formou há 4,47 bilhões de anos, como apontavam outros estudos anteriores.

"O antigo impacto lunar gravou a si próprio", afirmaram os pesquisadores, que puderam decifrar as marcas do tempo medindo e analisando os meteoritos produzidos após as colisões com o cinturão de asteroides.

"Esta pesquisa está nos ajudando a definir nossas escalas de tempo para saber quando se passou o que no Sistema Solar", disse Bill Bottke, aluno do Laboratório Lunar e Planetário da Universidade do Arizona.

Os cientistas estão avaliando a possibilidade de utilização destes novos conhecimentos para saber como se formaram outros antigos corpos celestes, como o asteroide gigante Vesta, que se encontra no cinturão de asteroides entre as órbitas de Marte e Júpiter e que abriga centenas de corpos celestes.

A sonda Dawn, da Nasa, visitou durante 14 meses, entre 2011 e 2012, este asteroide gigante, e conseguiu registrar mais de 30 mil imagens para fornecer aos especialistas dados sobre a composição e a história geológica do Vesta, que tem um diâmetro meio de 525 quilômetros.

ÍNDICE DE NOTÍCIAS JORNAL DA CIÊNCIA

<http://www.jornalciencia.com/meio-ambiente/vida-microscopica/4757-mais-antiga-evidencia-de-vida-na-terra-esta-errada-fosseis-de-34-bilhoes-de-anos-eram-apenas-pilhas-de-minerais-na-argila>

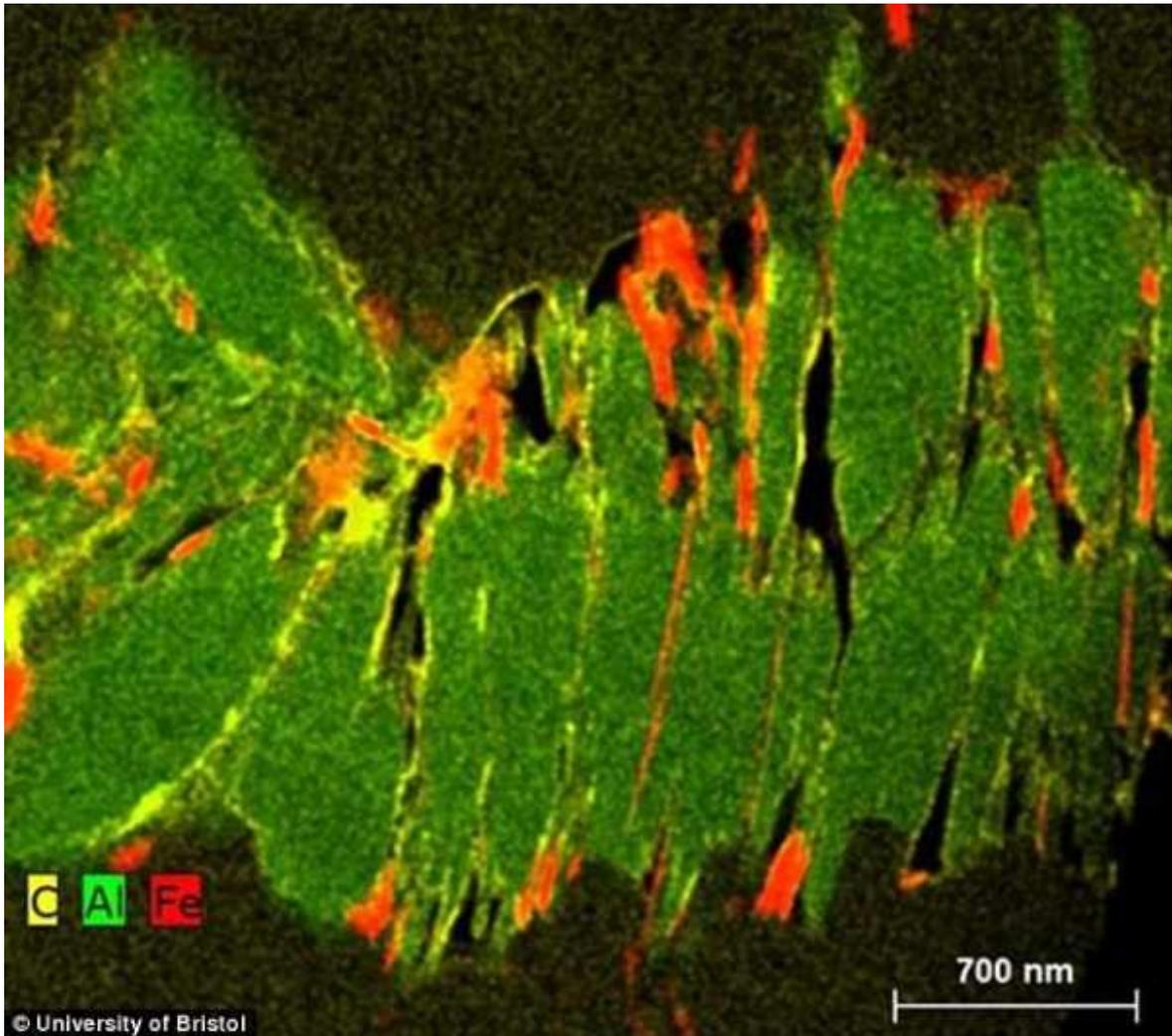
Mais antiga evidência de vida na Terra está errada! "Fósseis" de 3,4 bilhões de anos eram apenas pilhas de minerais na argila

QUA, 22 DE ABRIL DE 2015 08:46

BRUNO RIZZATO

ACESSOS: 989

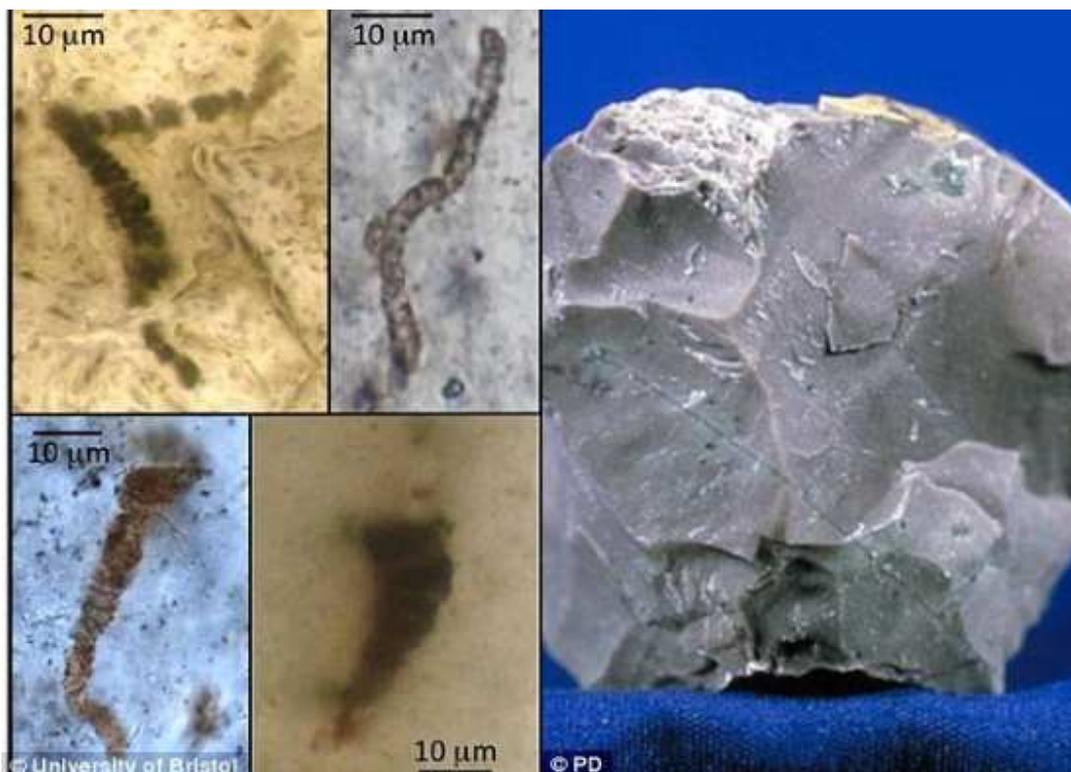




Análise dos que eram chamados 'fósseis mais antigos do mundo' - os microfósseis de 3,4 bilhões de anos de Apex chert - sugere que eles, na verdade, não são fósseis. De acordo com os pesquisadores, pilhas de minerais apenas deram essa aparência dentro das rochas.

Estes microfósseis são frequentemente rotulados como a mais antiga evidência de vida na Terra. Agora, os livros didáticos podem ser reescritos com base nestas novas reivindicações.

David Wacey, um curador na Universidade da Escola de Ciências da Terra de Bristol, trabalhou em colaboração com o falecido professor Brasier. Eles revelaram os novos dados, publicados na revista Proceedings, da Academia Nacional de Ciências dos EUA, que mostraram que os microfósseis de Apex chert compreendem pilhas de minerais de argila em forma de placa, dispostos em cadeias semelhantes a vermes ramificadas e cônicos. O carbono foi absorvido para as bordas destes minerais durante a circulação de fluidos, dando uma falsa impressão de vida fossilizada.



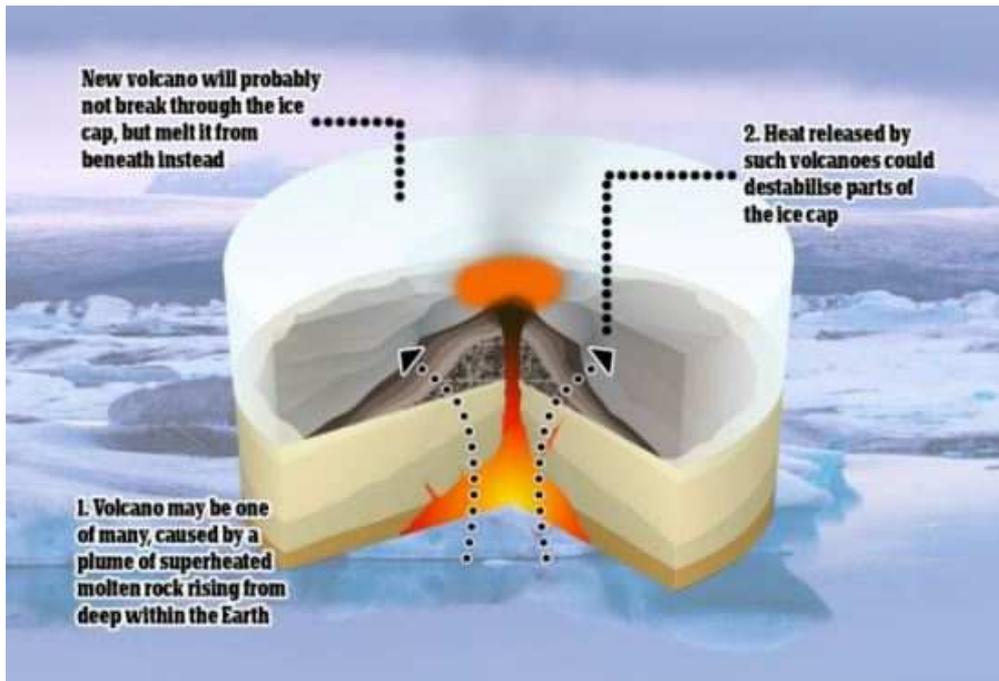
Wacey e sua equipe examinaram fatias ultrafinas de candidatos a 'microfósseis', para construir mapas em nanoescala de seu tamanho, forma, química e distribuição de carbono mineral. "Logo ficou claro que a distribuição de carbono era diferente de todas as outras observadas em microfósseis autênticos", disse ele. "A falsa aparência de compartimentos celulares é dada por vários pratos de minerais de argila que têm uma química inteiramente compatível com um ambiente hidrotermal de alta temperatura". Ele disse que, em alta resolução, ficou claro que os "microfósseis" 'pareciam ter uma morfologia espetada', que era devido aos cristais de argila revestidos de ferro e carbono.

Antes de sua morte, o professor Brasier comentou: *"Esta investigação deve, finalmente, proporcionar um capítulo final para o debate do microfóssil de Apex. Essas discussões têm nos encorajado a refinar tanto as perguntas e as técnicas necessárias para procurar vida remota no tempo e no espaço, incluindo os sinais de Marte ou além. Espera-se que os livros didáticos e sites agora se concentrem nas descobertas recentes e mais robustas de microfósseis de idade semelhante aos de 'Western Austrália', também por nós examinados no mesmo artigo."*

<http://www.jornalciencia.com/meio-ambiente/diversos/3905-cientistas-descobriram-vulcao-gigante-embaixo-do-gelo-da-antartida-podendo-afetar-todo-o-planeta-se-entrar-em-erupcao->

[Cientistas descobriram vulcão gigante embaixo do gelo da Antártida podendo afetar todo o planeta se entrar em erupção](http://www.jornalciencia.com/meio-ambiente/diversos/3905-cientistas-descobriram-vulcao-gigante-embaixo-do-gelo-da-antartida-podendo-afetar-todo-o-planeta-se-entrar-em-erupcao-)

PRISCILA NAYADE



Pesquisadores descobriram um vulcão debaixo do gelo em Marie Byrd, Antártida, após criarem dispositivos para medir a atividade tectônica.

Os cientistas tinham a intenção de usar as máquinas sismográficas para ajudá-los em seus estudos com alguns tremores recentes, e foi quando descobriram que o motivo era um vulcão se formando debaixo do gelo.

A atividade vulcânica foi descoberta acerca de 30 km do vulcão mais alto da Antártida, o Monte Sidley, e, apesar de uma erupção, que seria improvável conseguir romper a camada de gelo, o calor que a acompanha poderia ter um efeito sobre a paisagem e afetar o clima mundial.



Uma erupção sub-glacial seria capaz de derreter o gelo, criando grandes quantidades de água que poderiam ir em direção ao mar, acelerando o fluxo marinho e aumentar potencialmente a perda dos blocos de icebergs.

"Existem numerosos vulcões em Marie Byrd, uma região serrana do oeste da Antártida", disse Amanda Lough, da Universidade de Washington, representante da equipe sobre o assunto. "O fluxo de calor elevado pode influenciar a estabilidade do manto de gelo da Antártida Ocidental".



A camada de gelo da Antártida é uma das duas calotas polares da Terra e ocupa uma área de 5,4 milhões de quilômetros quadrados, cerca de 98 por cento do continente, tornando-se a maior massa de gelo compactada na Terra. A pesquisadora ainda acrescentou: "Erupções neste local não são susceptíveis de penetrar o gelo sobrejacente, com 1,2 a 2 km de espessura, mas geram grandes volumes de água de degelo que poderiam afetar significativamente o fluxo de corrente de gelo"

AMBIENTE BRASIL

24 / 04 / 2015 [WWF calcula valor dos oceanos em US\\$ 24 trilhões](#)

O cálculo da ONG é baseado na riqueza produzida pelos países mais desenvolvidos e na exploração excessiva dos oceanos.

24 / 04 / 2015 [Nível do Cantareira fica estável pelo terceiro dia consecutivo](#)

O volume armazenado está em 197,1 bilhões de litros de água para o abastecimento de 5,4 milhões de pessoas na região metropolitana de São Paulo.

24 / 04 / 2015 [Ministério do Meio Ambiente estuda criar norma nacional de reúso de água](#)

Izabella Teixeira destacou importância de regulamentar reutilização. Indústria cobra normatização para comércio de recurso desperdiçado.

24 / 04 / 2015 [Mais de 500 mil pessoas morrem a cada ano vítimas da malária](#)

Maior parte das vítimas morre na África, apesar de esforços contra doença. Em 2013 foram registrados 198 milhões de casos de malária no mundo.

24 / 04 / 2015 [Alimentação, não exercício, é 'chave para combater obesidade'](#)

Em artigo científico, médicos criticam 'mito' de que exercício pode compensar efeitos adversos de alimentação ruim.

24 / 04 / 2015 [Cheia no Amazonas deixa 17 cidades em situação de emergência](#)

A Defesa Civil do Amazonas já totaliza 363 toneladas de alimentos não perecíveis enviadas às cidades afetadas pelas cheias.

24 / 04 / 2015 [Ebola matou mais de 10.800 pessoas desde 2014](#)

Atual epidemia registrou mais de 26 mil casos. Guiné, Libéria e Serra Leoa concentraram maioria dos casos.

24 / 04 / 2015 [Saguís aprendem a não interromper os pais, assim como os bebês humanos](#)

A descoberta ajudará os cientistas a entender as origens da linguagem humana. Como nenhum primata, além dos humanos, é um aprendiz vocal, ou seja, tem a capacidade de ouvir um som e imitá-lo, a habilidade de esperar que uma frase termine antes de emitir algum som pode ser considerada uma etapa importante no desenvolvimento da conversa.

24 / 04 / 2015 [Estiagem força racionamento de água rigoroso em municípios do Agreste](#)

Programação valerá por no mínimo quatro meses, a partir de maio. Santa Cruz do Capibaribe é o caso mais sério: já são dois dias com e 28 sem.

24 / 04 / 2015 [Pela primeira vez, cientistas 'editam' DNA de embrião humano](#)

Pesquisadores chineses tentaram modificar gene que levaria a doença. Publicação dos resultados levantou discussões éticas.

24 / 04 / 2015 [Remédio homeopático pode auxiliar no combate ao câncer de próstata](#)

Medicamento foi desenvolvido por pesquisadora da UFRN. Câncer de próstata é o segundo mais comum entre os homens.

24 / 04 / 2015 [Pesquisa indica por que mosquitos picam algumas pessoas mais que outras](#)

Genes que controlam o odor corporal poderiam atrair mosquitos, segundo pesquisa.

24 / 04 / 2015 [Em epidemia, Sumaré/SP registra 6.208 casos de dengue e três mortes](#)

Número representa aumento de 46% em relação ao último balanço. Exército vai às ruas para ajudar no combate a partir do dia 28 de abril.

24 / 04 / 2015 [Egito irá recuperar 135 peças antigas que foram contrabandeadas para os EUA](#)

Entre essas antiguidades estão vários ataúdes de madeira, duas pedras esculpidas, estátuas, exemplos de embarcações, uma seleção de 99 moedas e a mão de uma múmia, segundo a nota do ministério egípcio.

24 / 04 / 2015 [Cinzas do vulcão chileno Calbuco podem chegar a Santiago](#)

As cinzas do vulcão chileno Calbuco – que depois de meio século de inatividade entrou em erupção duas vezes, em menos de 24 horas – cruzaram a Cordilheira dos Andes e chegaram à Patagônia argentina, afetando alguns dos destinos turísticos prediletos dos brasileiros: Bariloche, Villa La Angostura e San Martín de los Andes.

22 / 04 / 2015 [Desmate da Amazônia Legal aumenta 195% em março, aponta Imazon](#)

Dado se refere ao mesmo mês de 2014; monitoramento é não-oficial. Desmatamento se concentrou no Mato Grosso e no Amazonas.

22 / 04 / 2015 [Zoológico de Itatiba tem primeiro filhote de lêmure nascido no Brasil](#)

Animal já está em exposição para os visitantes do parque. Espécie corre risco de extinção na ilha de Madagascar, na África.

22 / 04 / 2015 [Erradicar a malária até 2030 custará 93 bilhões de euros, estimam especialistas](#)

O Dia Mundial da Malária será lembrado em 25 de abril. A RBM, composta, entre outros órgãos, pela OMS e pelo Fundo das Nações Unidas para a Infância (Unicef), alertou não só para os avanços na luta contra a doença, mas também para tudo que ainda precisa ser feito.

22 / 04 / 2015 [Nível do Cantareira fica estável em 15,5% da capacidade](#)

Descontado o volume morto, o Cantareira está 9,3% abaixo do nível mínimo de captação das bombas utilizado antes da crise de abastecimento no estado.

22 / 04 / 2015 [Novo estudo reforça a inexistência de vínculos entre vacinas e autismo](#)

Estudo envolveu a análise de 95 mil jovens. Rumores sobre vínculo entre vacina e autismo começaram em 1998.

22 / 04 / 2015 [Misteriosos pontos de luz reaparecem no planeta anão Ceres](#)

Fenômeno voltou a ser registrado por sonda da Nasa, que agora fará observação minuciosa para entender ciência por trás destes locais na superfície do pequeno mundo.

22 / 04 / 2015 [Arqueólogos descobrem 43 ovos de dinossauro fossilizados no sul da China](#)

Por enquanto não se sabe a que espécie de dinossauro pertencem os ovos encontrados, que foram transferidos ao museu arqueológico local para serem examinados com melhores condições de conservação.

22 / 04 / 2015 [Brasileira cria app que poupa água e ganha bolsa em universidade na Nasa](#)

Mineira de 23 anos criou aplicativo para tornar plantações 'inteligentes'. Tecnologia reduz em até 60% consumo de água na irrigação.

22 / 04 / 2015 [Formação rápida dificulta previsão de tornados, diz meteorologista](#)

Especialistas explicam motivo de fenômeno ser raro no Brasil. No entanto, área na região sul é mais propícia a ter formação climática.

22 / 04 / 2015 [Mais de 10 mil pessoas foram atingidas por tornado em Xanxerê/SC](#)

Mais de mil pessoas estão desabrigadas e um balanço preliminar informa que 2,6 mil imóveis foram afetados. A Defesa Civil divulgou também que mais de 300 pessoas receberam atendimentos médicos e 120 foram hospitalizadas.

22 / 04 / 2015 [Filhotes de crocodilo chegam a Cuba da Suécia em esforço de conservação](#)

Fidel Castro deu casal de crocodilos a cosmonauta soviético nos anos 1970. 'Trata-se da espécie de crocodilo mais rara e bonita que existe', diz tratador.

22 / 04 / 2015 [Torre de controle aéreo 'à distância' começa a funcionar na Suécia](#)

Uma torre de controle começou nesta terça-feira a regular o tráfego aéreo em um aeroporto sueco a partir de outro a 150 km de distância, anunciou a direção de aviação civil deste país (LFV), uma primícia mundial.

22 / 04 / 2015 [Maioria das baleias jubarte está fora do risco de extinção nos EUA](#)

A baleia jubarte tem sido considerada uma espécie em risco de extinção, mas o governo dos Estados Unidos anunciou na segunda-feira (20) que a população do animal se recuperou na maioria das regiões e já não precisa de proteção.

22 / 04 / 2015 [Relógio atômico bate recorde de precisão](#)

Dispositivo não varia nem um segundo em 15 bilhões de anos. Precisão deste novo pêndulo mais do que triplicou em comparação a 2014.

21 / 04 / 2015 [Descoberta de 400 geoglifos na Amazônia ajuda a desvendar mistério](#)

A descoberta ensina mais sobre a forma como foram feitos e os hábitos dos povos que os construíram há mais de 1.000 anos. Pelo que se sabe, os geoglifos foram feitos por índios Aruaques que habitaram a Amazônia séculos atrás para servirem de campo para rituais religiosos.

21 / 04 / 2015 [OMS admite falhas na forma de lidar com o ebola e promete reforma](#)

Comunicado listou oito lições aprendidas com a crise. O surto registrou 25 mil casos e 10 mil mortes.

21 / 04 / 2015 [Nível do Cantareira volta a subir](#)

Segundo a Sabesp, o sistema ficou na segunda-feira com 15,5% de sua capacidade.

21 / 04 / 2015 [Aumento do preço da água para limitar uso acarreta risco social](#)

A tarifação da água é uma questão sensível em termos sociais, políticos e econômicos, apesar da ameaça de uma crise global a médio prazo.

21 / 04 / 2015 [Exploração ilegal coloca em risco modelo de extrativismo na reserva](#)

Reserva enfrenta problemas como desmatamento e avanço da pecuária. Brasil tem 89 reservas extrativistas, onde vivem 53 mil famílias.

21 / 04 / 2015 [Extrativismo gera renda para famílias que vivem na Reserva Chico Mendes](#)

Trabalho de exploração é feito com a preservação da floresta Amazônica. Maior reserva extrativista do país foi criada há 27 anos.

21 / 04 / 2015 [Champanhe de 170 anos em perfeito estado é mais velho já degustado](#)

O carregamento de 168 garrafas foi descoberto a 50 metros de profundidade em 2010, explicaram os pesquisadores franceses que analisaram a composição química do espumante e tiveram o prazer de degustar o conteúdo.

21 / 04 / 2015 [Japão planeja realizar sua primeira aterrissagem na lua em 2018](#)

O objetivo da missão é analisar a resistência de determinados materiais sobre a superfície lunar para avaliar se podem ser utilizados em futuras missões tripuladas.

21 / 04 / 2015 [Sul do Japão tem alerta de tsunami após tremor de 6,8 na escala Richter](#)

O aviso, emitido na sequência do terremoto registrado na pequena ilha de Yonaguni, que faz parte do arquipélago de Okinawa, foi dirigido a várias ilhas, lembrando a possibilidade da ocorrência de ondas de até 1 metro.

21 / 04 / 2015 [Rio retira 53,1 toneladas de peixes mortos da Lagoa Rodrigo de Freitas](#)

A espécie que está morrendo na lagoa é a das savelhas e ainda não há uma explicação para o fato. Segundo a Secretaria Municipal de Meio Ambiente, a causa da morte pode ter relação com variações ambientais, já que a espécie é extremamente sensível a essas mudanças.

21 / 04 / 2015 [Brasil foi o país com maior número de ambientalistas assassinados em 2014](#)

ONG Global Witness registrou 116 mortes, das quais 29 foram no Brasil. Mortes estão relacionadas a conflitos na agricultura, mineração e energia.

21 / 04 / 2015 [Nova espécie de rã transparente é encontrada na Costa Rica](#)

Anfíbio de 2,5 cm é caracterizado pela pele translúcida, que permite ver seus órgãos internos; cientista diz que descoberta indicador de 'boa saúde do ecossistema'.

21 / 04 / 2015 [Costa oeste dos EUA fica lotada de animal parecido com água-viva](#)

Ventos fortes levaram a grande concentração de 'Velella velella' em praias. Espécie de hidrozoário tem coloração azulada e mede cerca

de 7 cm.

20 / 04 / 2015 [Costa Rica se aproxima este ano de 100% de energia obtida de fontes limpas](#)

Apenas 2,9% da geração demandará o consumo de combustíveis fósseis, um avanço importante com relação a 2014, quando a energia térmica representou 10,3% do total.

20 / 04 / 2015 [Exposição 'Olhar Indígena' reúne fotos em museu de Cuiabá/MT](#)

Evento conta com exposições fotográficas, shows musicais e oficinas. A exposição terá entrada gratuita e ficará aberta até o dia 30 de abril.

20 / 04 / 2015 [Baleia jubarte encontrada morta é enterrada em praia do litoral do PR](#)

Animal foi enterrado no balneário Guacyara, em Matinhos, no sábado (18). Moradores estimam que animal tinha entre 6 e 8 metros de comprimento.

20 / 04 / 2015 [Dia do Índio é comemorado com música e pintura corporal no Rio](#)

Evento na Zona Sul da cidade teve participação de índios de doze etnias. Pinturas étnicas atraíram crianças e adultos durante comemorações.

20 / 04 / 2015 [Chicago/EUA enfrenta epidemia de gripe de cães](#)

Autoridades acreditam que vírus veio da Ásia; mil cachorros já foram infectados e seis já morreram.

20 / 04 / 2015 [Brasil precisa recuperar orgulho de sua origem, dizem indígenas](#)

Demarcação das terras indígenas e reconhecimento dos brasileiros sobre a importância dos índios para o país ainda continuam sendo os desafios principais do Dia do Índio, comemorado no domingo (19).

20 / 04 / 2015 [Nível do Cantareira permanece estável, mesmo com fortes chuvas em São Paulo](#)

Descontado o uso do volume morto, a água está 9,3% abaixo do nível de captação das bombas, usado antes da crise de abastecimento no estado.

20 / 04 / 2015 [John Kerry visitará o Ártico em meio a preocupações com o clima](#)

O aquecimento global ocorre duas vezes mais rápido no Ártico do que em qualquer outro lugar do mundo e muitos temem não só um impacto devastador do aquecimento, mas da influência das pessoas e da indústria neste ambiente intocável, de vida selvagem e cultura inuit.

20 / 04 / 2015 [Agricultores do Alto Tietê devem fazer o Cadastro Ambiental Rural](#)

Prazo para a inscrição das propriedades é até maio. Produtores de Salesópolis e Suzano contam com ajuda para o cadastro.

20 / 04 / 2015 [MT tem 140 índios na universidade: 'Temos que conhecer as leis'](#)

Para estudante de psicologia, conflitos por terras ainda é o maior problema. Soilo avalia que índios não podem estar sujeitos às leis do 'homem branco'.

20 / 04 / 2015 [Não há "maior ameaça" do que a mudança climática, garante Obama](#)

"A mudança climática já não pode ser negada ou ignorada", disse Obama em seu discurso semanal, lembrando que 2014 foi o ano mais quente já registrado no mundo desde 1880.

20 / 04 / 2015 ['Chuva' misteriosa de minhocas no inverno intriga a Noruega](#)

O fenômeno é raro, mas não é uma novidade. Em abril de 2011, uma escola na cidade de Galashiels, ao sul de Edimburgo, na Escócia, teve de cancelar uma aula de educação física quando minhocas começaram a cair sobre o campo.

20 / 04 / 2015 [Em Santarém, nível do Rio Tapajós ultrapassa cota de alerta de 7,30m](#)

Neste domingo (19), nível chegou a 7,34, segundo a Marinha. Cota de alerta foi ultrapassada no sábado (18).

18 / 04 / 2015 [Estudo com tribo amazônica mostra como vida moderna está mudando as bactérias nos humanos](#)

Os índios yanomami, afastados do mundo exterior até 2009, possuem a coleção mais diversificada de bactérias já encontrada em pessoas, inclusive algumas jamais detectadas em humanos, disseram cientistas cuja pesquisa foi divulgada no periódico Science Advances.

18 / 04 / 2015 [Desertos podem ser usados para produzir eletricidade limpa](#)

A ideia, apresentada em Viena durante a reunião da União Europeia de Geociências que terminou nesta sexta-feira, parte do fato que as zonas áridas são as que mais radiação solar recebem e, ao mesmo tempo, não competem pelo espaço com a agricultura ou outras atividades humanas.

18 / 04 / 2015 [Apicultor inventa método simples para combater ácaro que extermina abelhas](#)

Na República Tcheca, o Verroa já aniquilou 35% das abelhas e há três décadas é o principal inimigo dos apicultores.

18 / 04 / 2015 [Fundo Amazônia assina primeiro contrato elaborado por indígenas](#)

O projeto objetiva promover o manejo e a produção agroflorestal nas comunidades, com o propósito de constituir alternativa econômica sustentável ao desmatamento, além de apoiar iniciativas de monitoramento e controle do território e de fortalecimento da organização local, na região do Alto Juruá, no Acre.

18 / 04 / 2015 [Cientistas dos EUA propõem uso de CO2 capturado para produzir energia limpa](#)

A ideia desenvolve a já existente técnica de captura de dióxido de carbono emitido pelas usinas termoelétricas, na qual o gás é injetado a grandes profundezas em açudes naturais onde fica preso pela rocha impermeável que o cobre.

18 / 04 / 2015 [Março de 2015 teve a maior temperatura para o mês desde 1880](#)

Superfícies do mar e do solo no planeta ficaram 0,85°C acima da média. Dados foram divulgados pela NOAA, agência dos Estados Unidos.

18 / 04 / 2015 [Ministra visita ExpoLondrina e pede que região Sul acelere o CAR](#)

Com prazo até 05 de maio de 2015, o Cadastro Ambiental Rural tem, até o momento, 13% no Paraná, 0,4% no Rio Grande do Sul e 23% em Santa Catarina.

18 / 04 / 2015 [Cápsula Dragon da SpaceX chega à Estação Espacial Internacional](#)

Equipamento contém alimentos e outros itens para os astronautas em órbita. Dragon saiu da Terra na última terça-feira a bordo do foguete Falcon 9.

18 / 04 / 2015 [Brasileiro vence concurso internacional de fotografia](#)

Hélder Santana, de 23 anos, e a italiana Francesca Negrini, de 17, foram os grandes vencedores do certame organizado pelo Secretariado da Convenção de Ramsar.

18 / 04 / 2015 [Aiea inicia nova missão para analisar situação de Fukushima](#)

Uma equipe de peritos da Agência Internacional da Energia Atômica (Aiea) iniciou na sexta-feira (17), no Japão, uma nova avaliação da situação na Central Nuclear de Fukushima sobre a gestão dos resíduos radioativos.

18 / 04 / 2015 [Mandado de consórcio interrompe licitação para nova estação antártica](#)

Certame estava parado há 2 meses e seria retomado nesta semana. Consórcio entre Brasil e Chile questiona habilitação de grupo chinês para obra.

18 / 04 / 2015 [Mancha no rio São Francisco foi causada por invasão alga marinha, diz laudo](#)

A boa notícia é que a mancha se dissipou um pouco nos últimos dias devido a um aumento temporário da vazão do rio São Francisco. Com isso, o abastecimento de água foi restabelecido nas cidades onde estava suspenso.

18 / 04 / 2015 [Com pouca chuva, nível do Cantareira fica estável pelo sexto dia seguido](#)

O acumulado de chuva nesse manancial está abaixo de um quinto do total esperado para todo o mês abril, somando 15,7 mm, o equivalente a 17,6% da média histórica do mês (89,1 mm).

18 / 04 / 2015 [Cientistas brasileiros sugerem usar o acafrão contra o mosquito da dengue](#)

Condimento misturado à água eliminou larvas em experimento realizado. Propriedades fotodinâmicas naturais induzem reações tóxicas no mosquito.

18 / 04 / 2015 [Como bebês, cães usam olhar para conquistar humanos](#)

Cães sempre buscam o contato visual para conquistar os donos.

13 / 04 / 2015 [Gado e pastagens invadem reserva extrativista Alto Juruá/AC](#)

Proposta era melhorar a extração do látex para produzir borracha. O retorno era baixo e os moradores buscaram outras fontes de produção.

13 / 04 / 2015 [México detecta dois focos de gripe das aves e sacrifica 524 aves](#)

Casos em Tehuacán e Santiago Yaitepec foram controlados, diz governo. Gripe das aves é uma doença infecciosa viral de potencial pandêmico.

13 / 04 / 2015 [Programa de gestão da água de Itaipu é apresentado como solução para São Paulo](#)

A iniciativa, desenvolvida pela empresa Itaipu Binacional, recuperou municípios da região da usina hidrelétrica, na bacia hidrográfica Paraná 3, no oeste do estado.

13 / 04 / 2015 [Aldeia no México virou 'cápsula do tempo' de civilizações antigas](#)

Retomada após décadas, investigação arqueológica da área revela traços da vida cotidiana dos primeiros povos do continente.

13 / 04 / 2015 [Empresas iniciam trabalhos para retirar material poluente de incêndio em Santos](#)

Não há como calcular o volume de líquido a ser retirado por bombas de sucção, porque muita espuma e água foram usadas no combate ao fogo.

13 / 04 / 2015 [O tráfico de chifres que valem mais que ouro](#)

Pobreza alimenta caça ilegal de rinocerontes na fronteira da África do Sul com Moçambique, enquanto veterinários tentam salvar animais feridos.

13 / 04 / 2015 [Mundo deve seguir exemplo brasileiro de proteção de florestas, diz Nature](#)

Editorial da revista Nature destacou iniciativas brasileiras bem-sucedidas no combate ao desmatamento na Amazônia como exemplos para outros países em desenvolvimento.

13 / 04 / 2015 [Marco da Biodiversidade entra em fase final de análise pelo Senado](#)

Os três pontos que estão pendentes tratam de uma das questões mais relevantes do projeto: a repartição de benefícios com índios, agricultores e comunidades tradicionais como ribeirinhos e quilombolas, que compartilhem seus conhecimentos com as indústrias e empresas que vão explorar o patrimônio genético de plantas e animais brasileiros.

13 / 04 / 2015 [Cúpula no Panamá expõe disputa de potências por rota marinha](#)

Apoiado pelos EUA, governo anfitrião usa evento para promover Canal do Panamá e minimizar ameaças de via interoceânica que China constrói na Nicarágua.

13 / 04 / 2015 [Rio registra três vezes mais casos de dengue do que no ano passado](#)

A região do Médio Paraíba concentra 90% dos casos de dengue registrados no Rio de Janeiro este ano, sendo 60% do total no município de Resende. De acordo com o superintendente, a taxa de incidência hoje no estado é relativamente baixa e não caracteriza um processo epidêmico.

13 / 04 / 2015 [Fóssil de jabuti gigante do AC pode ser espécie desconhecida para ciência](#)

Pesquisador crê em relação entre o animal e tartarugas de Galápagos. 'Possui um gênero, mas não possui espécie ainda', diz cientista.

13 / 04 / 2015 [Noruega vetará acesso de empresas poluidoras a fundo de investimento](#)

País tem o maior fundo de riqueza soberano do mundo. Proposta não menciona nominalmente nenhuma companhia.

13 / 04 / 2015 [Após Nobel, Malala ganha nome em asteroide](#)

Malala foi baleada após defender direito de mulheres à educação. Cientista que descobriu asteroide decidiu homenageá-la.

13 / 04 / 2015 [Acidificação matou 90% da vida marinha há 252 mi de anos](#)

A Grande Morte, como o período é conhecido, matou de 93% a 97% das espécies marinhas.

13 / 04 / 2015 [Reservas extrativistas permitem exploração sustentável da natureza](#)

Ao todo, existem 89 reservas extrativistas no Brasil, em 17 estados.

14 / 04 / 2015 [Robô que explorava reator 1 de Fukushima é dado como perdido](#)

Dispositivo examinaria radiação de reator, mas ficou preso em obstáculo. Aparelho conseguiu coletar dados de 14 dos 18 pontos previstos.

14 / 04 / 2015 [Província de Ontário, no Canadá, cria bolsa de gases de efeito estufa](#)

Região irá limitar emissões lançadas pelas empresas da região. Objetivo é ajudar o Canadá a cortar gases e cumprir meta para a COP 21.

14 / 04 / 2015 [Indústria nuclear japonesa pressiona para reabertura de reatores](#)

A pressão da indústria se choca com uma opinião pública japonesa que ainda segue profundamente preocupada pela segurança, mais de quatro anos depois do tsunami que provocou o colapso da central de Fukushima e o vazamento de radiação, que obrigou milhares de pessoas a abandonar seus lares em vários quilômetros.

14 / 04 / 2015 [Uso de esgoto tratado aumenta produtividade na agricultura](#)

Estudos comprovam alta produtividade e economia de água nas lavouras. No entanto, uso no Brasil requer regulamentação que nunca foi feita.

14 / 04 / 2015 [Pastoral da Terra mostra aumento de 26% nos conflitos por água no país](#)

A Pastoral da Terra classifica os conflitos em três categorias: apropriação particular, disputa pela construção de barragens e açudes e os relacionados ao uso e à preservação da água.

14 / 04 / 2015 [Nova espécie de macaco é descoberta no sudeste do Tibete](#)

O Macaca leucogenys vive nas florestas do estado de Modog. De acordo com os pesquisadores, ele havia sido confundido com outra espécie, mas fotos revelaram diferenças no pênis do animal.

14 / 04 / 2015 [Viaagem de peixes-boi de Pernambuco para ilha do Caribe é adiada](#)

Cinco animais devem ser emprestados para repovoar Antilhas Francesas. Decisão é questionada por pesquisadores de entidades nacionais.

14 / 04 / 2015 Começa na Coreia do Sul o Fórum Mundial da Água

O Fórum Mundial da Água (FMA) começou nesta segunda-feira (13) sua agenda de sessões na Coreia do Sul com o objetivo de buscar formas de combater a escassez de água no planeta e seus problemas relacionados, desde a gestão dos recursos hídricos até o aquecimento global.

14 / 04 / 2015 Veículo da Nasa reacende esperança de achar água em Marte

Em imagem feita pelo robô Curiosity, dois tons de minerais são encontrados em um local chamado "Cidade Jardim" no Monte Sharp, montanha localizada no centro da cratera Gale, no planeta Marte. A área tem aproximadamente 2,5 centímetros de largura.

14 / 04 / 2015 Austrália quer cortar benefícios de pais que não vacinam os filhos

Crescimento de movimento antivacina faz com que governo decida tornar mais rígidas as sanções.

14 / 04 / 2015 Ceres, o planeta-anão, permanece um mistério para a ciência

Mini-planeta de 970 km de diâmetro é maior objeto no cinturão de asteroides. Sonda Dawn, da Nasa, orbita planeta desde março deste ano.

14 / 04 / 2015 Cantareira fica estável e acumulado de chuva é o menor para abril desde 2005

De acordo com os dados da Sabesp, foram captados apenas 11,2 milímetros (mm), representando 12,5% do total esperado para todo o mês (89,8 mm). Em 2005, a pluviometria registrada no período foi 8 mm.

14 / 04 / 2015 Cientistas encontram DNA de Neandertal de 150 mil anos

Crânio estava intacto dentro de uma caverna no sul da Itália.

14 / 04 / 2015 Casos de dengue aumentam 240% em 2015; país tem 460,5 mil infectados

Dados foram divulgados nesta segunda-feira pelo Ministério da Saúde. Mortes pela doença aumentaram 29% entre 2015 e 2014.

14 / 04 / 2015 Entidades firmam compromisso para acelerar Cadastro Ambiental Rural

Perto de completar um ano e de terminar o prazo para a inscrição das propriedades, o Cadastro Ambiental Rural ganhou na segunda-feira (13) um compromisso para acelerar o processo e iniciar a consolidação das informações para o planejamento de recuperação, controle e investimento socioambiental nas áreas georreferenciadas.

GSW JOURNAL

Coupling sequential restoration of balanced cross sections and low-temperature thermochronometry: The case study of the Western Carpathians

Ada Castelluccio, Benedetta Andreucci, Massimiliano Zattin, Richard A. Ketcham, Leszek Jankowski, Stefano Mazzoli, and Rafał Szaniawski
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Eocene extension and meteoric fluid flow in the Wildhorse detachment, Pioneer metamorphic core complex, Idaho

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Paleohydrology and 3D Facies Architecture of Ancient Point Bars, Ferron Sandstone, Notom Delta, South-Central Utah, U.S.A

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Precise Relative Earthquake Magnitudes from Cross Correlation

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Temperature- and moisture-dependent powder X-ray diffraction studies of kanemite (NaSi₂O₄(OH)·3H₂O)

Daniela Schmidmair, Volker Kahlenberg, Daniel M. Tobbens, Herwig Schottenberger, Jochem de Wit, Ulrich J. Griesser, and P. Leverett

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Refikite from Krasno, Czech Republic: a crystal- and molecular-structure study

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Thermal expansion behaviour of orthopyroxenes: the role of the Fe-Mn substitution

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L. Scandolo, M. L. Mazzucchelli, M. Alvaro, F. Nestola, F. Pandolfo, and M. C. Domeneghetti
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Daniela Schmidmair, Volker Kahlenberg, Daniel M. Töbrens, Herwig
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LOW-TEMPERATURE THERMOCHRONOLOGY

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PRECAMBRIAN GEOLOGY

Neoproterozoic to early Paleozoic extensional and compressional history
of East Laurentian margin sequences: The Moine Supergroup, Scottish
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SEDIMENTARY GEOLOGY

Interactions between axial and transverse drainage systems in the Late
Cretaceous Cordilleran foreland basin: Evidence from detrital zircons in
the Straight Cliffs Formation, southern Utah, USA
Tyler S. Szwarc, Cari L. Johnson, Lisa E. Stright, and Christopher M.
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ERRATA

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EARTH PAGES

The dinosaur they could not kill: Brontosaurus is back

Posted on [April 20, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

It would be pretty safe to say that everyone has heard of *Brontosaurus*, but in the 1970s the genus vanished from the palaeobiology lexicon. The 'Bone Wars' of post-Civil War US palaeontology stemmed from the astonishing prices that dinosaur skeletons fetched. The frenzy of competition to fill museums unearthed hundreds of specimens, but the financial enthusiasm did not extend to painstaking anatomy. Finding a new genus meant further profit so a slapdash approach to taxonomy might pay well. So it did with the dinosaur family *Diplodocidae* for [Othniel Marsh](#), one of the fossil marauders. He along with his main competitor, Edward Cope, was a wizard fossicker, but lacked incentive to properly describe what he unearthed. In 1877 Marsh published a brief note about a new genus that he called *Apatosaurus*, then hurried off to for more booty. Two years later he returned from the field with another monster reptile, and casually made a brief case for the 'Thunder Lizard', *Brontosaurus*. Unlike his usage of 'Deceptive Lizard' for *Apatosaurus*, the English translation of *Brontosaurus* caught the public imagination and lingers to this day as the archetype for a mighty yet gentle, extinct beast. Yet, professional palaeontologists were soon onto the lax ways of Marsh and Cope, and by 1903 deemed *Brontosaurus* to be taxonomically indistinguishable from *Apatosaurus*, and as far as science was concerned the 'Thunder Lizard' was no more.



Artist's impression of a Brontosaurus . The idea that it was wholly or mostly aquatic is now considered outdated. (credit: Wikipedia)

But, the legacy of frenzied fossil collecting of a century or more ago is huge collections that never made it to display, which form rich pickings for latter-day palaeontologists with all kinds of anatomical tools now at their disposal: the stuff of almost endless graduate studies. Emanuel Tschopp of the New University of Lisbon with colleagues took up the challenge of the Diplodocidae by examining 49 named specimens and 32 from closely related specimens as controls, measuring up to 477 skeletal features (Tschopp, E. *et al.* 2015. A specimen-level phylogenetic analysis and taxonomic revision of Diplodocidae (*Dinosauria, Sauropoda*). *PeerJ*, v. **3**, [doi10.7717/peerj.857](https://doi.org/10.7717/peerj.857)). An unintended consequence was their discovery that 6 specimens of what had become *Apatosaurus excelsus* (formerly Marsh's *Brontosaurus*) differed from all other members of its genus in 12 or more key characteristics. It seems to taxonomists a little unfair that *Brontosaurus* should not be resurrected, and that looks likely.

Had this been about almost any other group of fossils, with the exception perhaps of the ever-popular tyrannosaurs, the lengthy paper would have passed unnoticed except by specialist palaeontologists. In a little over a week the open-access publication had more than 17 thousand views and 3300 copies were downloaded.

See also: Balter, M. 2015. Bully for Brontosaurus. *Science*, v. **348**, p. 168

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[Magma rushed into largest layered intrusion](#)

Posted on [April 10, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

Chances are that the platinum in the catalytic converter that helps prevent your car emitting toxic gases in its exhaust fumes came from a vast igneous intrusion in South Africa known as the Bushveldt complex. The world's most important source of noble metals formed by repeated differentiation of huge volumes of mafic magma to form thin, dense layers rich in sulfides, [platinum group metals](#) and chromium ore set in very thick layers of barren gabbro and other mafic to ultramafic rock. The intrusion is exposed over an area the size of Ireland and formed about 2 billion years ago. Its 370 000 to 600 000 km³ volume suggests that it was the magma chamber that fed flood basalts that erosion has since eroded away. Successive pulses of basaltic magma built up a total thickness of about 8 kilometres of layered rock.



Layered igneous rocks in the Bushveld Complex (credit: Wikipedia)

The final product of the Bushveldt differentiation process was minute pockets of material of more felsic composition trapped within overwhelmingly larger amounts of gabbro. One of the elements that ended up in these roughly granitic inclusions was zirconium that mafic minerals are unable to accommodate while basaltic magma is crystallising. That formed minute crystals of the mineral zircon (ZrSiO_4) in the residual pockets, which in turn locked up a variety of other elements, including uranium. Zircon can be dated using uranium's radioactive decay to form lead isotopes, its refusal to enter chemical reactions after its crystallisation makes U/Pb dates of zircon among the most reliable available for geochronology and the precision of such dates has become increasingly exquisite as mass spectrometry has improved. So, the Bushveldt complex now has among the best records of magma chamber evolution (Zeh, A. *et al.* 2015. The Bushveld Complex was emplaced and cooled in less than one million years – results of zirconology, and geotectonic implications. *Earth and Planetary Science Letters*, v. **418**, p. 103-114).

Like a number of younger large igneous provinces, the Bushveldt complex took a very short time to form, about 950 thousand years at 2055 Ma ago. That is from magma emplacement to final crystallization when the zircon ages were set, so the accumulation of magma probably took only 100 thousand years. This suggests that magma blurted into the lower crust at an average rate of around 5 cubic kilometers per year, and quite probably even faster if the magmatism was episodic. It requires a major stretch of the imagination to suggest that this could have occurred by some passive process. Instead, the authors have suggested that while a plume of mantle material rose from well below the lithosphere a large slab of lower lithosphere, formed from dense eclogite, broke off and literally fell into the deeper mantle. The resulting changes in stress in the lower lithosphere would have acted as a pump to drive the plume upwards, causing it to melt as pressure dropped, and to squirt magma into the overlying continental crust. Although the authors do not mention it, this is reminiscent of the idea of large igneous provinces having sufficient power to eject large masses from the Earth's surface: the Verneshot theory, recently exhumed in late 2014. The main difference is that the originators of the Verneshot theory appealed to explosive gas release.

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A new explanation for banded iron formations (BIFs)

Posted on [March 27, 2015](#) by [Steve Drury](#) | [2 comments](#)

The main source for iron and steel has for more than half a century been Precambrian rock characterised by intricate interlayering of silica- and iron oxide-rich sediments known as banded iron formations or BIFs. They always appear in what were shallow-water parts of Precambrian sedimentary basins. Although much the same kind of material turns up in sequences from 3.8 to 0.6 Ga, by far the largest accumulations date from 2.6 to 1.8 Ga, epitomised by the vast BIFs of the Palaeoproterozoic Hamersley Basin in Western Australia. This peak of iron-ore deposition brackets the time (~2.4 Ga) when world-wide evidence suggests that the Earth's atmosphere first acquired tangible amounts of free oxygen: the so-called 'Great Oxidation Event'. Yet the preservation of such enormous amounts of oxidised iron compounds in BIFs is paradoxical for two reasons: the amount of freely available atmospheric oxygen at their acme was far lower than today; had the oceans contained much oxygen, dissolved ions of reduced Fe-2 would not have been able to pervade seawater as they had to for BIFs to have accumulated in shallow water. Iron-rich ocean water demands that its chemical state was highly reducing.



Oblique view of an open pit mine in banded iron formation at Mount Tom Price, Hamersley region Western Australia (Credit Google earth)

The paradox of highly oxidised sediments being deposited when oceans were highly reduced was resolved, or seemed to have been, in the late 20th century. It involved a hypothesis that reduced, Fe-rich water entered shallow, restricted basins where photosynthetic organisms – probably cyanobacteria – produced localised enrichments in dissolved oxygen so that the iron precipitated to form BIFs. Later work revealed oddities that seemed to suggest some direct role for the organisms themselves, a contradictory role for the co-dominant silica-rich cherty layers and even that another kind of bacteria that does not produce oxygen directly may have deposited oxidised iron minerals. Much of the research focussed on the Hamersley BIF deposits, and it comes as no surprise that another twist in the BIF saga has recently emerged from the same, enormous repository of evidence (Rasmussen, B. *et al.* 2015. Precipitation of iron silicate nanoparticles in early Precambrian oceans marks Earth's first iron age. *Geology*, v. **43**, p. 303-306).

The cherty laminations have received a great deal less attention than the iron oxides. It turns out that they are heaving with minute particles of iron silicate. These are mainly the minerals stilpnomelane $[K(Fe,Mg)_8(Si, Al)_{12}(O, OH)_{27}]$ and greenalite $[(Fe)_{2-3}Si_2O_5(OH)_4]$ that account for up to 10% of the chert. They suggest that ferruginous, silica-enriched seawater continually precipitated a mixture of iron silicate and silica, with cyclical increases in the amount of iron-silicate. Being such a tiny size the nanoparticles would have had a very high surface area relative to their mass and would therefore have been highly reactive. The authors suggest that the present mineralogy of BIFs, which includes iron carbonates and, in some cases, sulfides as well as oxides may have resulted from post-depositional mineral reactions. Much the same features occur in 3.46 Ga Archaean BIFs at Marble Bar in Western Australia that are almost a billion years older than the Hamersley deposits, suggesting that a direct biological role in BIF formation may not have been necessary.

2 Comments

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Anthropocene: what (or who) is it for?

Posted on [March 17, 2015](#) by [Steve Drury](#) | [2 comments](#)

The made-up word chrononymy could be applied to the study of the names of geological divisions and their places on the International Stratigraphic Chart. Until 2008 that was something of a slow-burner, as careers go. It all began with [Giovanni Arduino](#) and Johann Gotlob Lehman in the mid- to late 18th century, during the informal historic episode known as the Enlightenment. To them we owe the first statements of stratigraphic principles and the beginning of stratigraphic divisions: rocks divided into the major segments of Primitive, Secondary, Tertiary and Quaternary (Arduino). Thus stratigraphy seeks to set up a fundamental scale or chart for expressing Earth's history as revealed by rocks. The first two divisions bit the dust long ago; Tertiary is now an informal synonym for the Cenozoic Era; only Quaternary clings on as the embattled Period at the end of the Cenozoic. All 11 Systems/Periods of the Phanerozoic, their 37 Series/Epochs and 85 Stages/Ages in the latest version of the International Stratigraphic Chart have been thrashed out since then, much being accomplished in the late 19th and early 20th centuries. Curiously, the world body responsible for sharpening up the definition of this

system of 'chrononymy', the [International Commission on Stratigraphy](#) (ICS), seems not to have seen fit to record the history of stratigraphy: a great mystery. Without it geologists would be unable to converse with one another and the world at large. Yet now an increasing number of scientists are seriously proposing a new entry at the 4th level of division after Eon, Era and Period: a [new Epoch](#) that acknowledges the huge global impact of human activity on atmosphere, hydrosphere, biosphere and even lithosphere. They want it to be called the [Anthropocene](#), and for some its eventual acceptance ought to relegate the current [Holocene Epoch](#), in which humans invented agriculture, a form of economic intercourse and exchange known as capital and all the trappings of modern industry, to the 5th division or Stage. Earth-pages has been muttering about the Anthropocene for the past decade, as charted in a number of the links above, so if you want to know which way its author is leaning and how he came to find the proposal an unnecessary irritation, have a look at them. Last week things became sufficiently serious for another comment. Simon Lewis and Mark Maslin of the Department of Geography at University College London have summarised the scientific grounds alleged to justify an Anthropocene Epoch and its strict definition in a *Nature* Perspective (Lewis, S.J. & Maslin, M.A. 2015. [Defining the Anthropocene](#). *Nature*, v. **519**, p. 171-180).—, which is interestingly discussed in the same Issue by [Richard Monastersky](#).

Lewis and Maslin present two dates that their arguments and accepted stratigraphic protocols suggest as candidates for the start of the Anthropocene: 1610 and 1964 CE, both of which relate to features that are expressed by geological records that should last indefinitely. The first is a decline and eventual recovery in the atmospheric CO₂ level recorded in high-resolution Antarctic ice core records between 1570 and 1620 CE that can be ascribed to the decline in the population of the Americas' native peoples from an estimated 60 to 6 million. This result of the [impact of European first colonisation](#) – disease, slaughter, enslavement and famine – reduced agriculture and fire use and saw the regeneration of 5 x 10⁷ hectares of forest, which drew down CO₂ globally. It also coincides with the coolest part of the Little Ice Age from 1594-1677 CE. They caution against the start of the Industrial Revolution as an alternative for a 'Golden Spike' since it was a diachronous event, beginning in Europe. Instead, they show that the second proposal for a start in 1964 has a good basis in the record of global anthropogenic effects on the Earth marked by the peak fallout of radioactive isotopes generated by atomic weapons tests during the Cold War, principally ¹⁴C with a 5730 year half life, together with others more long-lived. The year 1964 is also roughly when growth in all aspects of human activity really took off, which some dub in a slightly Tolkienesque manner the 'Great Acceleration'. [There is a growing taste for this kind of hyperbole, e.g. the '[Great Oxygenation Event](#)' around 2.4 Ga and the 'Great Dying' for the [end-Permian mass extinction](#)]. Yet they neglect to note that the geochronological origin point for times past has been defined as 1950 CE when nucleogenic ¹⁴C contaminated later materials as regards radiocarbon dating, which had just become feasible. Lewis and Maslin conclude their Perspective as follows:

To a large extent the future of the only place where life is known to exist is being determined by the actions of humans. Yet, the power that humans wield is unlike any other force of nature, because it is reflexive and therefore can be used, withdrawn or modified. More widespread recognition that human actions are driving far-reaching changes to the life-supporting infrastructure of Earth may well have increasing philosophical, social, economic and political implications over the coming decades.

So the Anthropocene adds the future to the stratigraphic column, which seems more than slightly odd. As Richard Monastersky notes, it is in fact a political entity: part of some kind of agenda or manifesto; a sort of environmental agitprop from the 'geos'. As if there were not dozens of rational reasons to change human impacts to haul society back from catastrophe, which many people outside the scientific community have good reason to see as hot air on which there is never any concrete action by 'the great and the good'. Monastersky also notes that the present Anthropocene record in naturally deposited geological materials accounts for less than a millimetre at the top of ocean-floor sediments. How long might the proposed Epoch last? If action to halt anthropogenic environmental change does eventually work, the Anthropocene will be very short in historic terms let alone those which form the currency of geology. If it doesn't, there will be nobody around able to document, let alone understand, the epochal events recorded in rocks. At its worst, for some alien, visiting planetary scientists, far in the future, an Anthropocene Epoch will almost certainly be far shorter than the 10⁴ to 10⁵ years represented by the hugely more important Palaeozoic-Mesozoic and Mesozoic-Cenozoic boundary sequences; but with no Wikipedia entry.

Not everybody gets a vote on these kinds of thing, such is the way that science is administered, but all is not lost. The final arbiter is the Executive Committee of the International Union of Geological Sciences (IUGS), but first the Anthropocene's status as a new Epoch has to be approved by 60% of the ICS Subcommittee on Quaternary Stratigraphy, if put to a vote. Then such a 'supermajority' would be needed from the chairs of all 16 of the ICS subcommittees that study Earth's major time divisions. But first, the 37 members of the Subcommittee on Quaternary Stratigraphy's '[Anthropocene](#)' working group have to decide whether or not to submit a proposal: things may drag on at an appropriately stratigraphic pace. Yet the real point is that the effect of human activity on Earth-system processes has

been documented and discussed at length. I'll give Marx the last word in this 'The philosophers have only *interpreted* the world, in various ways. The point, however, is to *change* it'. A new stratigraphic Epoch doesn't really seem to measure up to that...

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Genus Homo pushed back nearly half a million years

Posted on [March 10, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

Bill Deller, a friend whose Sunday is partly spent reading the Observer and Sunday Times from cover to cover, alerted me to a lengthy article by Britain's doyen of paleoanthropologists [Chris Stringer](#) of the Natural History Museum. (Stringer, C. 2015. [First human? The jawbone that makes us question where we're from](#). *Observer*, 8 March 2015, p. 36). His piece sprang from two Reports published online in *Science* that describe about 1/3 of a hominin lower jaw unearthed – where else? – in the Afar Depression of Ethiopia. The discovery site of Ledi-Geraru is a mere 30 km from the most hominin-productive ground in Africa: Hadar and Dikika for [Australopithecus afarensis](#) ('Lucy' at 3.2 Ma and 'Selam' at 3.3 Ma, respectively); Gona for the earliest-known stone tools (2.6 Ma); and the previously earliest member of the genus *Homo*, also close to Hadar.

On some small objects mighty tales are hung, and the Ledi-Geraru jawbone and 6 teeth is one of them. It has features intermediate between *Australopithecus* and *Homo*, but more important is its age: Pliocene, around 2.8 to 2.75 Ma (Villmoare, B. And 8 others. Early *Homo* at 2.8 Ma from Ledi Geraru, Afar, Ethiopia. *Science Express* doi: 10.1126/science.aaa1343). The sediments from which Ethiopian geologist Chalachew Seyoum, studying at Arizona State University, extracted the jawbone formed in a river floodplain. Other fossils suggest open grassland rich with game, similar to that of the Serengeti in Tanzania, with tree-lined river courses. These were laid down at a time of climatic transition from humid to more arid conditions, that several authors have suggested to have provided the environmental stresses that drove evolutionary change, including that of hominins (DiMaggio, E.N. and 10 others 2015. Late Pliocene fossiliferous sedimentary record and the environmental context of early *Homo* from Afar, Ethiopia. *Science Express* doi: 10.1126/science.aaa1415).

Designating the jawbone as evidence for the earliest known member of our genus rests almost entirely on the teeth, and so is at best tentative awaiting further fossil material. The greatest complicating factor is that the earliest supposed fossils of *Homo* (i.e. *H. habilis*, *H. rudolfensis* and others yet to be assigned a species identity) are a morphologically more mixed bunch than those younger than 2 Ma, such as *H. ergaster* and *H. erectus*. Indeed, every one of them has some significant peculiarity. That diversity even extends to the earliest humans to have left Africa, found in 1.8 Ma old sediments at Dmanisi in Georgia (*Homo georgicus*), [where each of the 5 well-preserved skulls is unique](#). The Dmanisi hominins have been likened to the type specimen of *H. habilis*, but such is the diversity of both that is probably a shot in the dark.



Replica of OH 7, the deformed type specimen of *Homo habilis*. (credit: Wikipedia)

Coinciding with the new Ethiopian hominin papers a study was published in *Nature* the same week that describes how the type specimen of *H. habilis* (found, in close association with crude stone tools and cut bones, by Mary and [Lewis Leakey](#) at [Olduvai Gorge](#), Tanzania in 1960) has been digitally restored from its somewhat deformed state when found (Spoor, F. *et al.* 2015. Reconstructed *Homo habilis* type OH 7 suggests deep-rooted species diversity in early *Homo*. *Nature*, v. **519**, p. 83-86, doi:10.1038/nature14224). The restored lower jaw and teeth, and part of its cranium, deepened the mysterious diversity of the group of fossils for which it is the type specimen, but boosts its standing as regards probable brain size from one within the range of australopithecines to significantly larger – ~750 ml compared with <600 ml – about half that of modern humans. The *habilis* diversity is largely to do with jaws and teeth: it is the estimated brain size as well as the type specimen's association with tools and their use that elevates them all to human status. Yet, the reconstruction is said by some to raise the issue of a mosaic of early human species. The alternative is an unusual degree of shape diversity (polymorphism) among a single emerging species, which is not much favoured these days. An issue to consider is: what constitutes a species? For living organisms morphological similarity has to be set against the ability for fertile interbreeding. Small, geographically isolated populations of a single species often diverge markedly in terms of what they look like yet continue to be interfertile, the opposite being convergence in form by organisms that are completely unrelated.

Palaeontologists tend to go largely with division on grounds of form, so that when a specimen falls outside some agreed morphological statistics, it crosses a species boundary. Set against that the incontrovertible evidence that at least 3 recent human species interbred successfully to leave the mark in all non-African living humans. What if the first humans emerging from, probably, a well-defined population of australopithecines continued to interbreed with them, right up to the point when they became extinct about 2 Ma ago?

On a more concrete note, the Ledi Geraru hominin is a good candidate for the [maker of the first stone tools](#) found 'just down the road' at Gona!

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Oldest Human Fossil Found, Redrawing Family Tree

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[Wet spells in Arabia and human migration](#)

Posted on [March 8, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

In [September 2014](#), [Earth Pages](#) reported how remote sensing had revealed clear signs of extensive fossil drainage systems and lakes at the heart of the Arabian Peninsula, now the hyper-arid Empty Quarter (Rub al Khali). Their association with human stone artifacts dated as far back as 211 ka, those with affinities to collections from East Africa clustering between 74-90 ka, supported the sub-continent possibly having been an early staging post for fully modern human migrants from Africa. Member of the same archaeological team based at Oxford University have now published late Pleistocene palaeoclimatic records from [alluvial-fan](#) sediments in the eastern [United Arab Emirates](#) that add detail to this hypothesis (Parton, A. *et al.* 2015. Alluvial fan records from southeast Arabia reveal multiple windows for human dispersal. *Geology*, advance online publication doi:10.1130/G36401.1).

The eastern part of the Empty Quarter is a vast bajada formed from coalesced alluvial fans deposited by floods rising in the Oman Mountains and flowing westwards to disappear in the great sand sea of dunes. Nowadays floods during the Arabian Sea monsoons are few and far between, and restricted to the west-facing mountain front. Yet, older alluvial fans extend far out into the Empty Quarter, some being worked for aggregate used in the frantic building boom in the UAE. In one of the quarries, about 100 km south of the [Jebel Faya Upper Palaeolithic tool site](#), the alluvial deposit contains clear signs of cyclical deposition in the form of 13 repeated gradations from coarse to fine waterlain sediment, each capped by fossil soils and dune sands. The soils contain plant remains that suggest they formed when the area was colonized by extensive grasslands formed under humid conditions.

Dating the sequence reveals that 6 of the cycles formed over a 10 thousand-year period between 158 to 147 ka, which coincides with a peak in monsoon intensity roughly between 160 and 150 ka during the glacial period that preceded the last one. Three later cycles formed at times of monsoon maxima during the last interglacial and in the climatic decline leading to the last glacial maximum, at ~128 to 115 ka, 105 to 95 ka, 85 to 74 ka. So, contrary to the long-held notion that the Arabian Peninsula formed a hostile barrier to migration, from time to time it was a well watered area that probably had abundant game. Between times, though, it was a vast, inhospitably dry place.



Satellite view of the Arabian Peninsula. The Oman mountains sweep in a dark arc south eastwards from the Straits of Hormuz at the mouth of the Persian Gulf. The brownish grey area to the south of the arc is the bajada that borders the bright orange Empty Quarter (credit: NOAA)

The authors suggest that the climatic cyclicity was dominated by a 23 ka period. As regards the southern potential migration route out of Africa, via the Straits of Bab el Mandab, which has been highly favoured by palaeoanthropologists lately, opportunities for migration in the absence of boats would have depended on sea-level lows. They do not necessarily coincide with wet windows of opportunity for crossing the cyclically arid Arabian peninsula that would allow both survival and proceeding onwards to south and east Asia. So far as I can judge, the newly published work seems to favour a northward then eastward means of migration, independent of fluctuations in land-ice volume and sea level, whenever the driest areas received sufficient water to support vegetation and game. In fact most of NE Africa is subject to the Arabian Sea monsoons, and when they were at their least productive crossing much of Ethiopia's Afar depression and the coastal areas of Eritrea, Sudan and Egypt would have been almost as difficult as the challenge of the Empty Quarter.

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A tsunami and NW European Mesolithic settlements

Posted on [March 3, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

About 8.2 ka ago sediments on the steep continental edge of the North and Norwegian Seas slid onto the abyssal plain of the North Atlantic. This huge mass displacement triggered a tsunami whose effects manifest themselves in sand inundations at the heads of inlets and fjords along the Norwegian and eastern Scottish coasts that reach up to 10 m above current sea level. At that time actual sea level was probably 10 m lower than at present as active melting of the last glacial ice sheets was still underway: the waves may have reached 20-30 m above the 8.2 ka sea level. So powerful were the tsunami waves in the constricted North Sea that they may have separated the British Isles from the European mainland by inundating [Doggerland](#), the low-lying riverine plain that joined them before global sea level rose above their elevation at around the same time. Fishing vessels plying the sandbanks of the southern North Sea often trawl-up well preserved remains of land mammals and even human tools: almost certainly Doggerland was prime hunting territory during the [Mesolithic](#), as well as an easily traversed link to the then British Peninsula. Mesolithic settlements close by tsunami deposits are known from Inverness in Scotland and Dysvikja north of Bergen in Norway and individual Mesolithic dwellings occur on the Northumberland coast. The tsunami must have had some effect on Mesolithic hunter gatherers who had migrated into a game-rich habitat. The question is: How devastating was it.



Reconstruction of Mesolithic hut based on evidence from two archaeological sites in Northumberland, UK. (credit: Lisa Jarvis; see <http://www.maelmin.org.uk/index.html>)

Hunter gatherers move seasonally with favoured game species, often returning to semi-permanent settlements for the least fruitful late-autumn to early spring season. The dominant prey animals, red deer and reindeer also tend to migrate to the hills in summer, partly to escape blood-feeding insects, returning to warmer, lower elevations for the winter. If that movement pattern dominated Mesolithic populations then the effects of the tsunami would have been most destructive in late-autumn to early spring. During warmer seasons, people may not even have noticed its effects although coastal habitations and boats may have been destroyed.



Stair-step moss (credit: Wikipedia)

Norwegian scientists Knut Rydgren and Stein Bondevik from Sogn og Fjordane University College, Sognda devised a clever means of working out the tsunami's timing from mosses preserved in the sand inundations that added to near-shore marine sediments. (Rydgren, K. & Bondevik, S. 2015. Most growth patterns and timing of human exposure to a Mesolithic tsunami in the North Atlantic. *Geology*, v. **43**, p. 111-114). Well-preserved stems of stair-step moss *Hylocomium splendens* still containing green chlorophyll occur, along with ripped up fragments of peat and soil, near the top of the tsunami deposit which has been uplifted by post-glacial isostatic uplift to form a bog. This moss grows shoots annually, the main growth spurt being at the end of the summer-early autumn growing season. Nineteen preserved samples preserved such new shoots that were as long as or longer than the preceding year's shoots. This suggests that they were torn up by the tsunami while still alive towards the end of the growing season, around late-October. All around the North Sea Mesolithic people could have been returning from warm season hunting trips to sea-shore winter camps, only to have their dwellings, boats and food stores devastated, if indeed they survived such a terrifying event.

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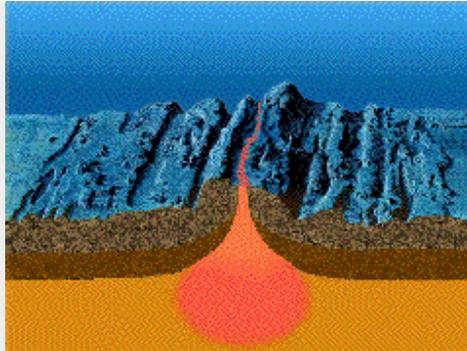
Glacial cycles and sea-floor spreading

Posted on [February 17, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

The *London Review of Books* recently published a lengthy review (Godfrey-Smith, P. 2015. The Ant and the Steam Engine. *London Review of Books*, v. **37**, 19 February 2015 issue, p. 18-20) of the latest contribution to Earth System Science by [James Lovelock](#), the man who almost singlehandedly created that popular paradigm through his Gaia concept of a self-regulating Earth (Lovelock, J. *A Rough Ride to the Future*. Allen Lane: London; ISBN 978 0 241 00476 0). Coincidentally, on 5 February 2015 *Science* published online a startling account of the inner-outer-inner synergism of Earth processes and climate (Crowley, J.W. *et al.* 2015. Glacial cycles drive variations in the production of oceanic crust. *Science* doi:10.1126/science.1261508). In fact serendipity struck twice: the following day a similar online article appeared in a leading geophysics journal (Tolstoy, M. 2015. Mid-ocean ridge eruptions as a climate valve. *Geophysical Research Letters*, doi:10.1002/2014GL063015)

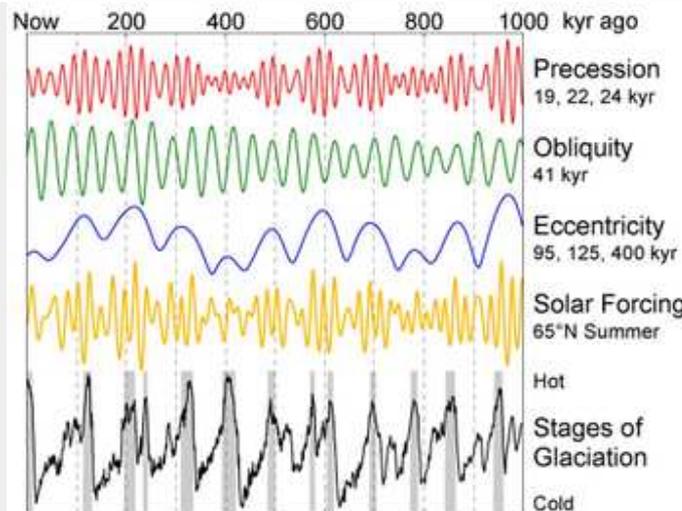
Both articles centred on the most common topographic features on the ocean floor, abyssal hills. These linear features trend parallel to seafloor spreading centres and the magnetic stripes, which chart the progressive additions to oceanic lithosphere at constructive margins. Abyssal hills are most common around intermediate- and fast-spreading ridges and have been widely regarded as fault-tilt blocks resulting from extensional forces where cooling of the lithosphere causes it to sag towards the abyssal plains. However, some have suggested a possible link with variations in magma production beneath ridge axes as pressure due to seawater depth varied with

rising and falling sea level through repeated glacial cycles. Mantle melting beneath ridges results from depressurization of rising asthenosphere: so-called 'adiabatic' melting. Pressure changes equivalent to sea-level fluctuations of around 100-130 m should theoretically have an effect on magma productivity, falls resulting in additional volumes of lava erupted on the ocean floor and thus bathymetric highs.



Formation of mid-ocean ridge topography, including abyssal hills that parallel the ridge axis. (credit: Wikipedia)

A test of this hypothesis would be see how the elevation of the sea floor adjacent to spreading axes changes with the age of the underlying crust. John Crowley and colleagues from Oxford and Harvard Universities and the Korea Polar Research Institute analysed new bathymetry across the Australian-Antarctic Ridge, whereas Maya Tolstoy of Columbia University performed similar work across the Southern East Pacific Rise. In both studies frequency analysis of changes in bathymetry through time, as calibrated by local magnetic stripes, showed significant peaks at roughly 23, 41 and 100 ka in the first study and at 100 ka in the second. These correspond to the well known Milankovitch periods due to precession, changing axial tilt and orbital eccentricity: persuasive support for a glacial control over mid-ocean ridge magmatism.



Periodicities of astronomical forcing and global climate over the last million years (credit: Wikipedia)

An interesting corollary of the observations may be that pulses in sea-floor eruption rates emit additional carbon dioxide, which eventually percolates through the ocean to add to its atmospheric concentration, which would result in climatic warming. The maximum effect would correspond to glacial maxima when sea level reached its lowest, the reduction in pressure stimulating the greatest magmatism. One of the puzzling features of glacial cycles over the last million years, when the 100 ka eccentricity signal dominates, is the marked asymmetry of the sea-level record; slowly declining to a glacial maximum and then a rapid rise due to warming and melting as the Earth changed to interglacial conditions. Atmospheric CO₂ concentrations recorded by bubbles in polar ice cores show a close correlation with sea-level change indicated by oxygen isotope data from oceanic sediments. So it is possible that build-up of polar ice caps in a roundabout way eventually reverse cooling once they reach their greatest thickness and extents, by modulating ocean-ridge volcanism and thereby the greenhouse effect.

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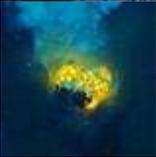
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January 2015 photo of the month

Posted on [February 3, 2015](#) by [Steve Drury](#) | [1 comment](#)



Angular unconformity at Telheiro Beach, Portugal (credit: Gabriela Bruno)

This image posted at [Earth Science Picture of the Day](#) would be hard to beat as the definitive [angular unconformity](#). It shows Upper Carboniferous marine metagreywackes folded during the [Variscan orogeny](#) overlain by Triassic redbeds. Structurally it is uncannily similar to [Hutton's](#) famous unconformity at [Siccar Point](#) on the coast of SE Scotland, although the tight folding there is Caledonian in age and the unconformable redbeds are Devonian in age.

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Human-Neanderthal cohabitation of the Levant

Posted on [February 3, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

The earliest known remains of anatomically modern humans outside of Africa were found unearthed from the [Skhul](#) and Qafzeh caves in what is now northern Israel. Their context was that of deliberate burial at a time when climate was cooling from the last interglacial, between 90 to 120 ka. The Levant was also the repository for a number of well-preserved Neanderthal skeletons, most dating to between 35-65 ka, including ten individuals at [Shanidar](#) in today's northern Iraq, some of whom were also deliberately buried including

one whose grave reputedly contained evidence for a floral tribute. The 25 ka gap between the two populations has previously been regarded as evidence for lack of contact between them. However, the Tabun Cave in modern Israel has yielded tools attributed to Neanderthal Mousterian culture that may indicate their intermittent presence from 200 to 45 ka, and fossils of two individuals dated at ~122 and ~90 ka. The remains at Skhul and Qafzeh are significantly more rugged or robust than African contemporaries and have been considered possible candidates for Neanderthal-modern human hybrids. But whatever their parentage, it seems they became extinct as the climate of the Levant dried to desert conditions around 80 ka.



Entrance to the Shanidar Cave, northern Iraq, occupied by Neanderthals between 35-65 ka (credit: Wikipedia)

A more promising overlap between modern human and Neanderthal occupation comes with the discovery by a group of Israeli, US, Canadian, German and Austrian scientists of a much younger anatomically modern human cranium from the Manot Cave, also in northern Israel (Herschkovitz, I. and 23 others 2015. Levantine cranium from Manot Cave (Israel) foreshadows the first European modern humans. *Nature* (online) doi:10.1038/nature14134). The cranium has a U-Th radiometric age of ~55 ka, well within the time span of Neanderthal occupation. Moreover, Manot Cave is one of a cluster of occupied sites in northern Israel, with separations of only a few tens of kilometres: undoubtedly, this individual and companions more than likely met Neanderthals. The big question, of course, is did the neighbours interbreed? If so the Levant would be confirmed as the probable source of hybridisation to which the DNA of non-African living humans points. There may be an insuperable difficulty in taking this further: it is thought that the high temperatures of the region, despite its dryness, may have destroyed any chance of reconstructing ancient genomes. Yet one of the first Neanderthal bones to yield useful genetic material was from Croatia, which is not a great deal cooler in summer.