БОЛИДНЫЕ ЯВЛЕНИЯ В АТМОСФЕРЕ И ПАДЕНИЯ НА ЗЕМЛЮ КОСМИЧЕСКИХ ТЕЛ В НЕДАВНЕЕ ИСТОРИЧЕСКОЕ И ГЕОЛОГИЧЕСКОЕ (ГОЛОЦЕН) ВРЕМЯ

ATMOSPHERIC AIRBLASTS AND COSMIC IMPACTS IN THE RECENT HISTORICAL AND GEOLOGICAL (HOLOCENE) TIME

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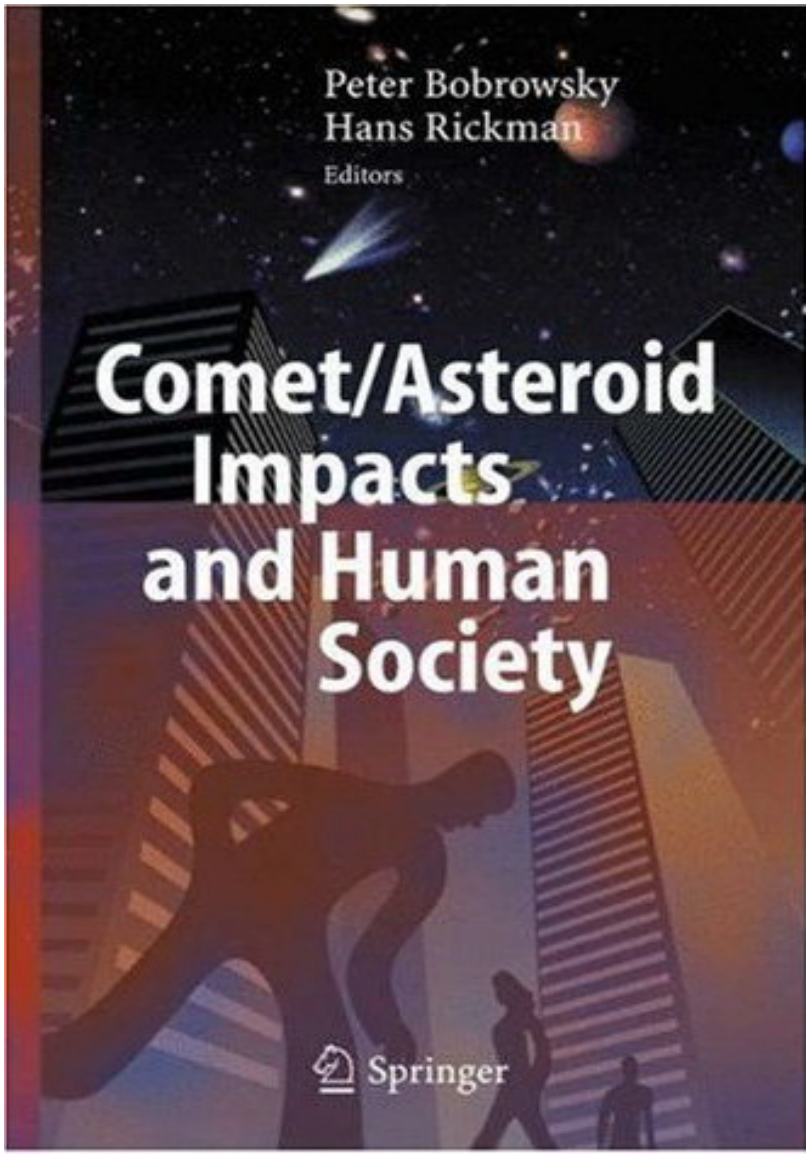
Падение Челябинского метеорита 15 февраля 2013 года породило чрезвычайную ситуацию федерального уровня

Тунгусский взрыв 1908 года с тротиловым эквивалентом 5-15 Мт является отнюдь не уникальным событием в ряду подобного рода явлений

Астероидно-кометная опасность: стратегия противодействия. Под общ. ред. В.А. Пучкова. М.: ФГБУ ВНИИ ГОЧС (ФЦ), 2015. - 272 с.



Comet/Asteroid Impacts and Human Society. An Interdisciplinary Approach. P.Bobrowsky, H.Rickman (Eds.) Springer-Verlag, Berlin – Heidelberg, 2007, - 546 pp.

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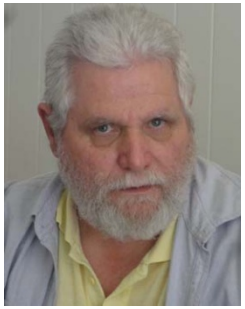

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Главная задача: Вероятностная оценка космической опасности на современном этапе геологической истории Земли

Наиболее надежный путь решения: Изучение исторических случаев падений на Землю космических тел

«Если хочешь узнать, что случится, взгляни на то, что уже произошло» Никколо Макиавелли

“Whoever wishes to foresee the future, must consult the past» Niccolo Machavelli (1469-1527)

Some factsheet about cosmic (comet-asteroid) hazard

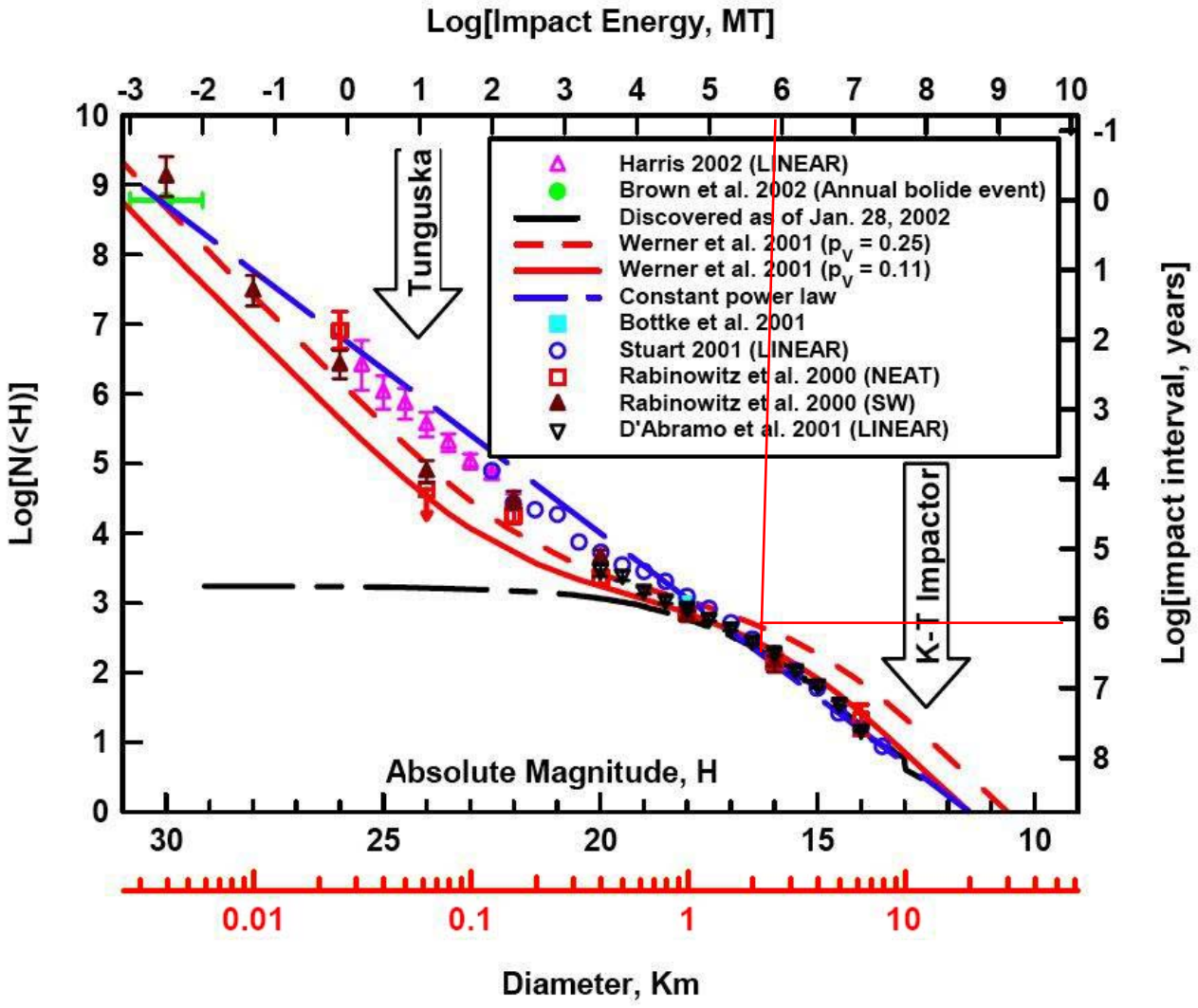
Globally catastrophic impact, capable of killing 1/4 of Earth population and triggering global climate change, starts at 10^6 Mt. It can be produced by 2.9-km asteroid.

Even 1-km asteroid ($5*10^4$ Mt) is capable to terminate the development of modern human civilization.

Modelled average interval between events of that scale is roughly 1 million years.

Ordinary stone (chondrite) converts into TNT at the speed of 2.4 km/sec

Frequency – size relation

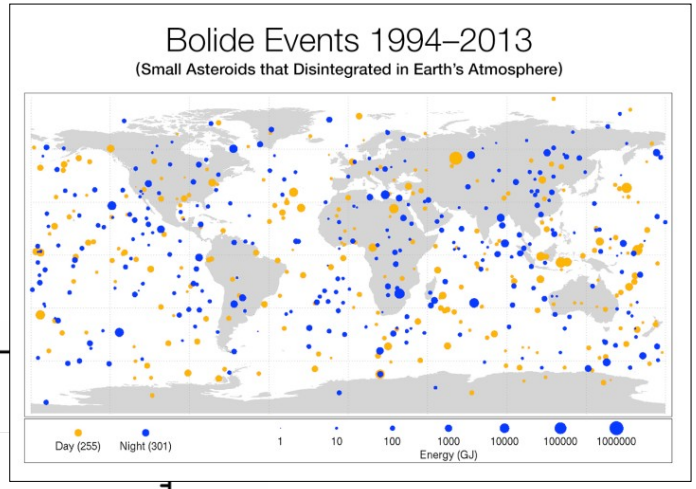


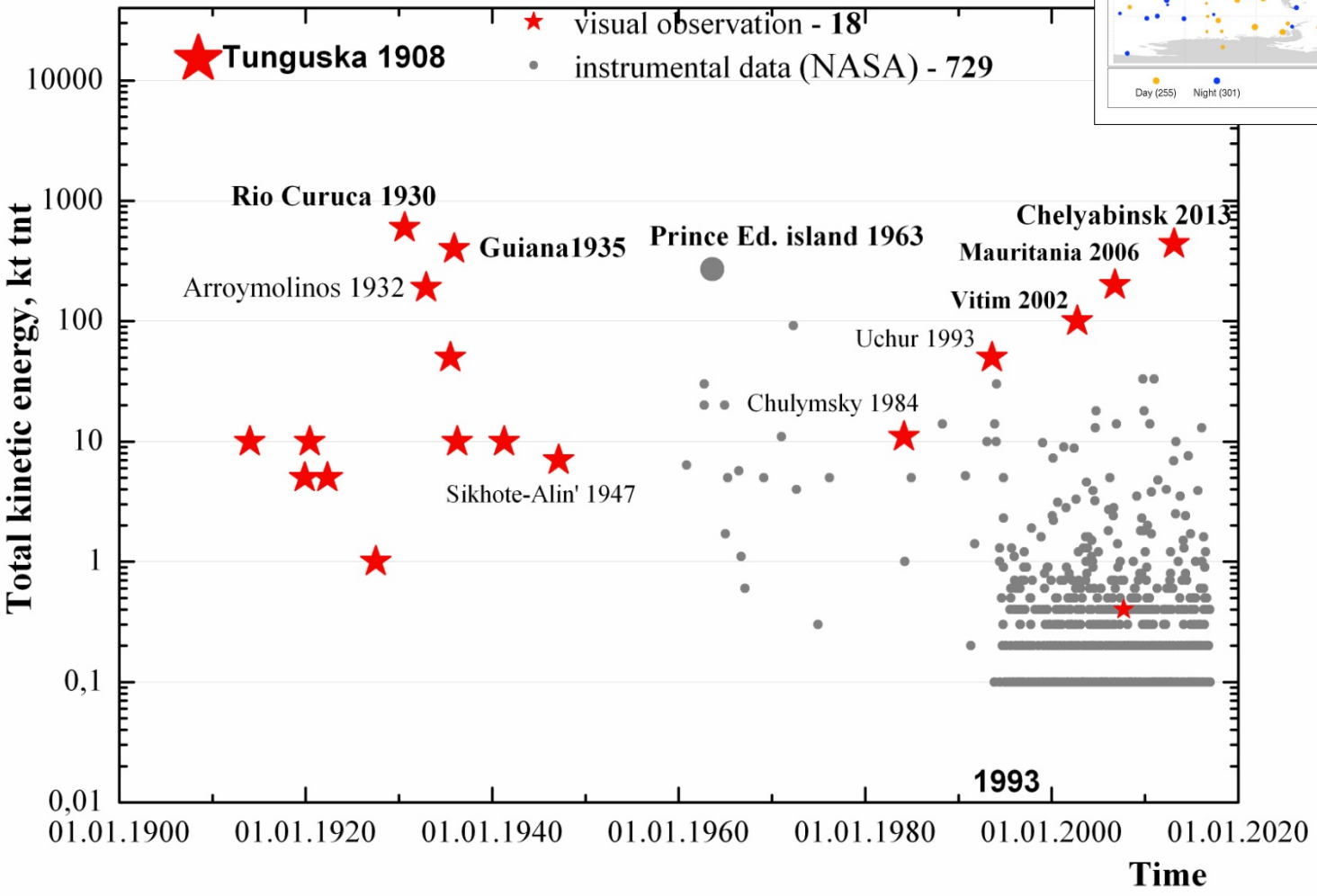
Source: 2003 NASA Study to determine the feasibility of extending the search for near-Earth objects to smaller limiting diameters

Data on atmospheric airblasts and meteorite impacts since 1900 up to present

Основной массив наблюдений получен со спутников и международной инфразвуковой сети NASA за 1994-2016

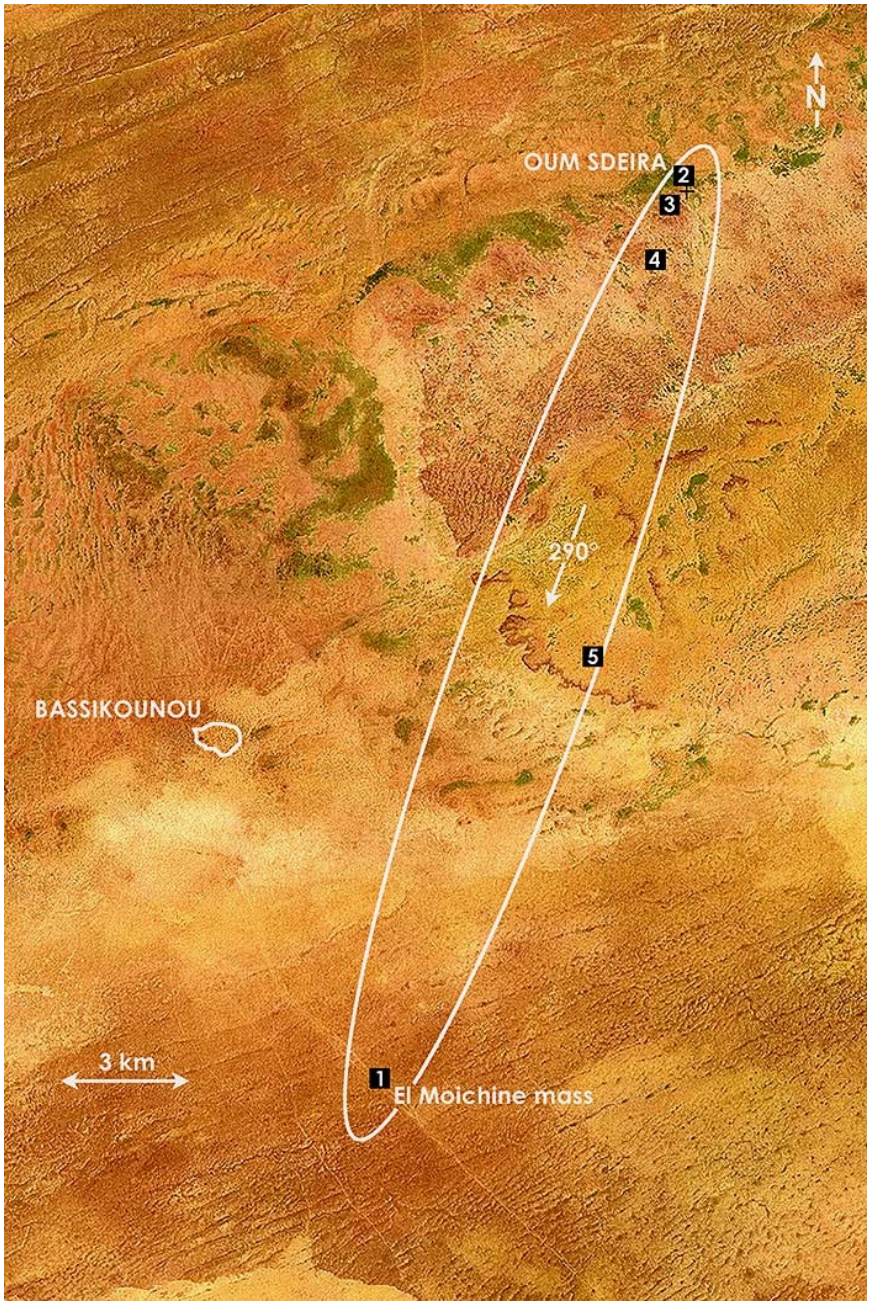
(около 650 событий с энергией 0.05-440 кт тнт).



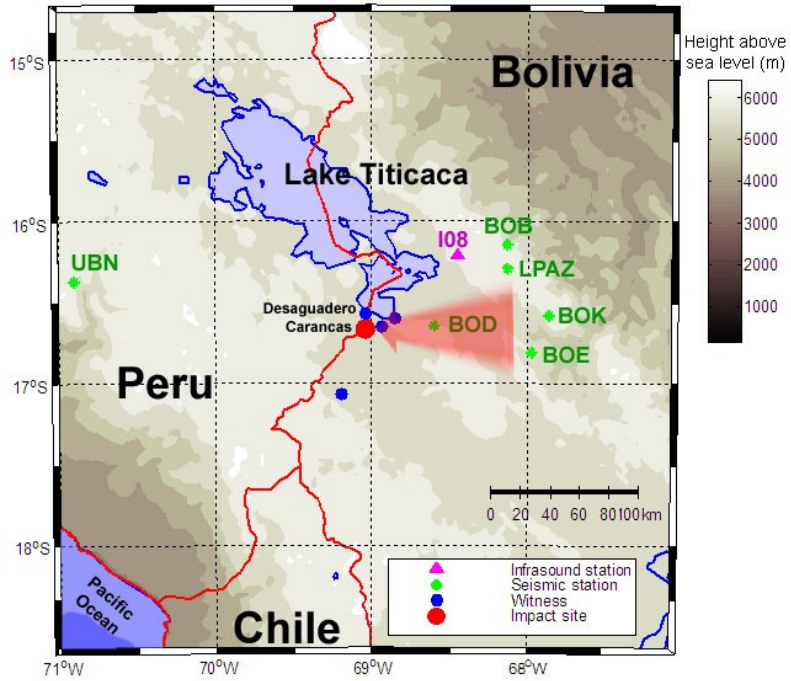


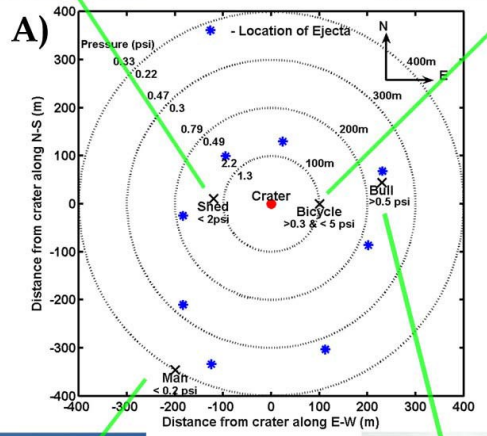
. Fireball and Bolide Reports.
neo.jpl.nasa.gov/fireballs/

Болид и метеориты Бассикуну (Мавритания) 16 октября 2006 года



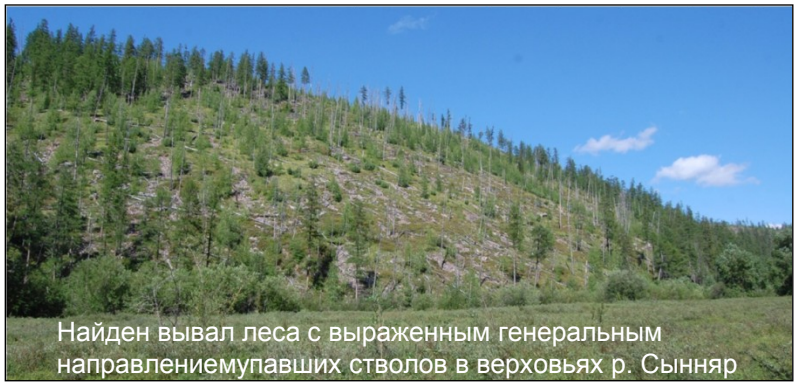
16 октября 2006 года яркий болид наблюдался рано утром (в 4 часа утра) в юго-западной Мавритании, вблизи границы с Мали. Жители небольшого мавританского городка **Bassikounou** были разбужены яркой вспышкой и последовавшим грохотом. **Многим показалось, что наступил "конец света".** Впоследствии в области размером **25x5 км** были собраны несколько сот фрагментов **каменного метеорита**, общим весом более 100 кг. Ввиду удаленности места, событие до весны 2007 года оставалось **практически неизвестным для остального мира**. **Наличие кратеров неизвестно**, район до сих пор не обследовался

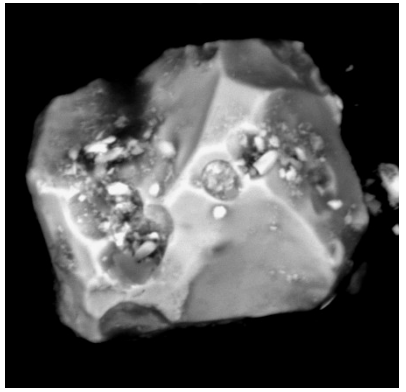


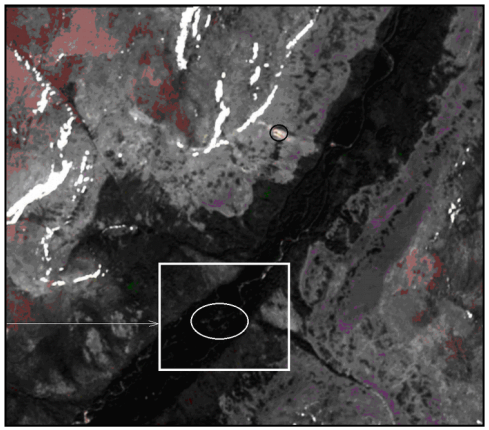


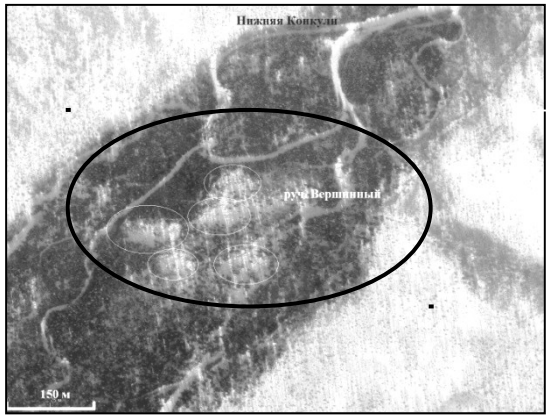
Метеорит в Каранкасе (Перу) 15.09.2007 г. M=7-12т, d=2 m, D= 13.5 m, V = 12-17 km/s, угол 45-60°, Ек=0.2-0.4 kT ТНТ, Ei=1-3т ТНТ. Тип - H4–5 ordinary chondrite. H=3824 m.

Учурский болид 03.08.1993

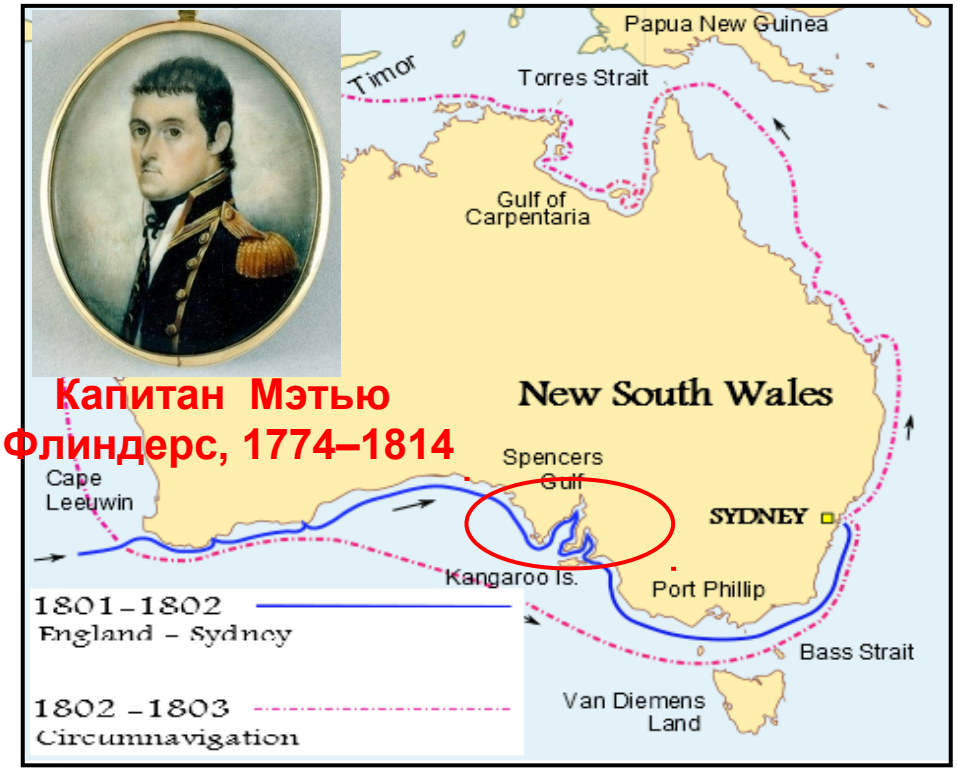

Найден вывал леса с выраженным генеральным направлениемупавших стволов в верховьях р. Сынняр







Австралийская Тунгуска - вторая половина XVIII века



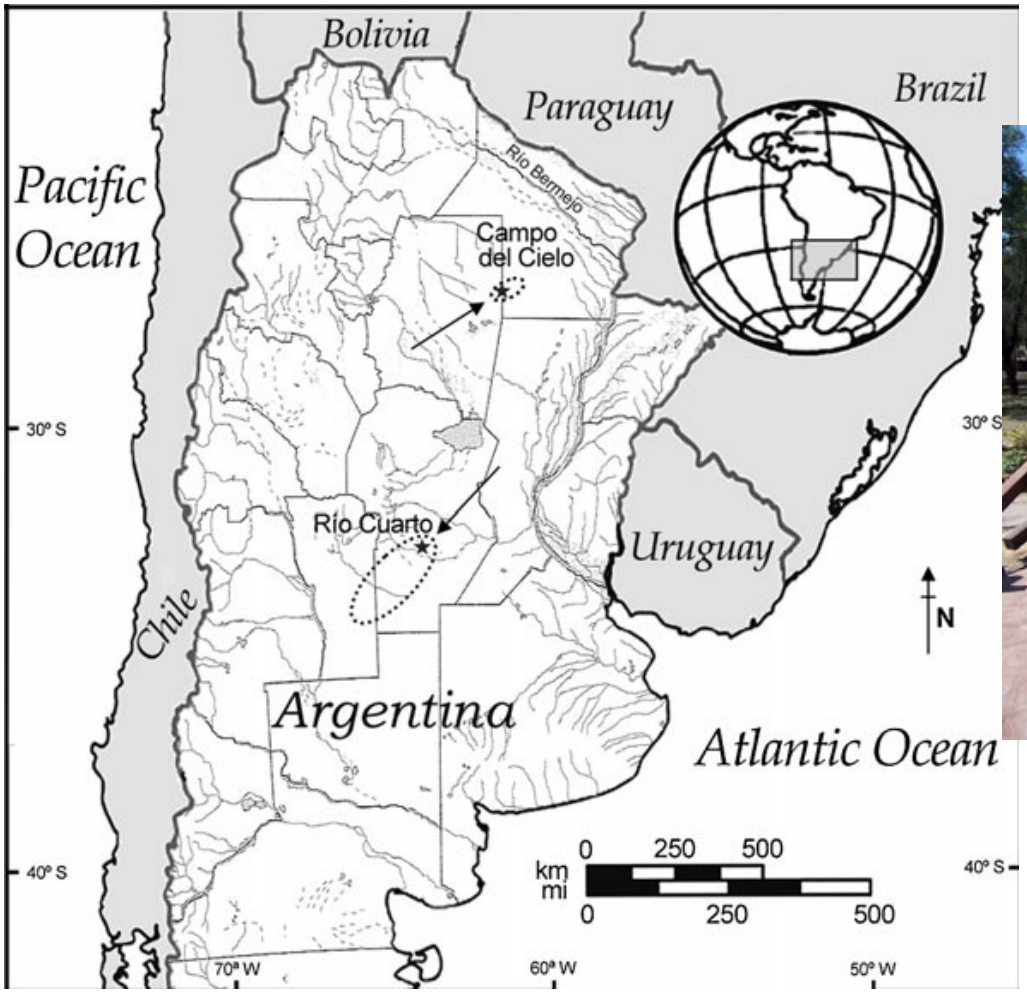
Большой взрыв, поваливший лес на площади около 8,000км^2, произошел на южном австралийском побережье в районе о-ва Кангаруу во второй половине XVIII в.

Kangaroo Island:
A thick wood covered almost all that part of the island, but the trees in a vegetating state were not equal in size to the generality of those lying on the ground, nor to the dead trees standing upright. Those on the ground were so abundant that in ascending the higher land a considerable part of the walk was made upon them. They lay in all directions, and were nearly of the same size and in the same progress towards decay

Thistle Island : Signs of extinguished fire existed everywhere; but they bespoke a conflagration of the woods, of remote date

Boston Island:
There were abundant marks of fire; they had the appearance, as at Thistle's Island, of having been caused by some conflagration of the woods several years before

Matthew Flinders (1814) A voyage to Terra Australis. vol. 1



Кратерное поле (3x19 км) Кампо-дель-Сиело (Аргентина), 4800-4100 лет т.н.. E ~ 2 Мт. Более 25 кратеров, наибольший диаметр 115 м. Железный метеорит (Barrientos, Masse, 2014).

Кратерное поле (250x60 км) Рио-Кварто (Аргентина), 6000-3000 лет т.н.. E ~ 100-1000 Мт. Более 15 вытянутых кратеров, размером до 3500 м. Обыкновенный хондрит. Импактный кварц, оплавленные стекла. Открыто в 1990 году. (Barrientos, Masse, 2014).

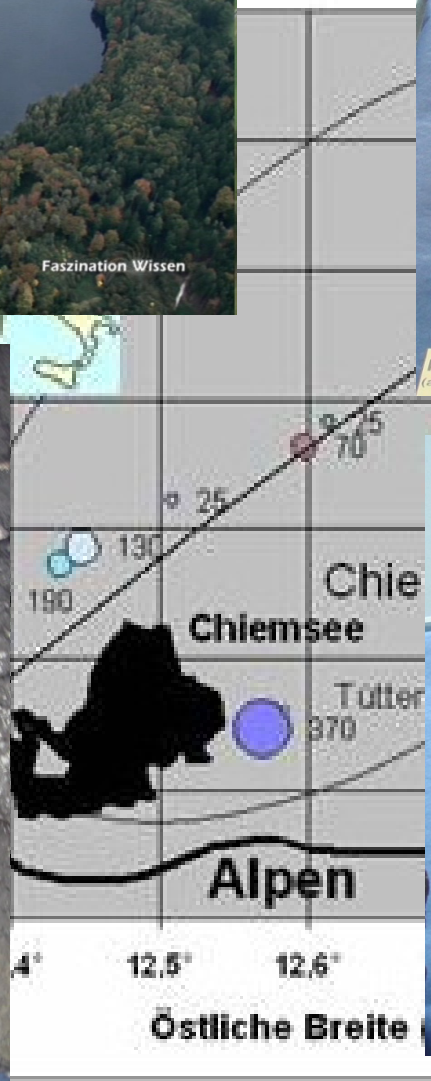
Молодые (голоценовые) кратеры с доказанным импактным генезисом

Wabar, Saudi Arabia, D~ 115m, A= 350 yr BP

Kaali, Estonia B=110 m, A~ 800-2000 yr BP

Henbury, Australia, D=170 m, A~4000 yr BP

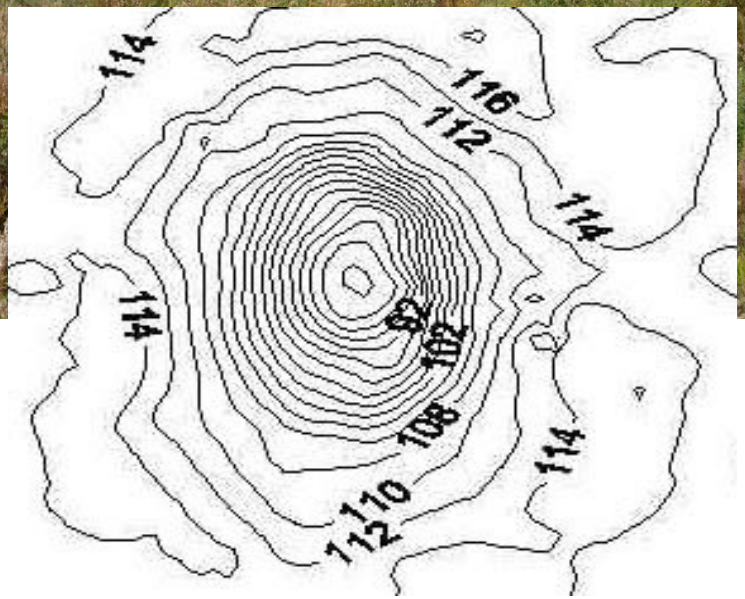
Macha, Yakutia, D=350 m, A=7,315±80 yr BP



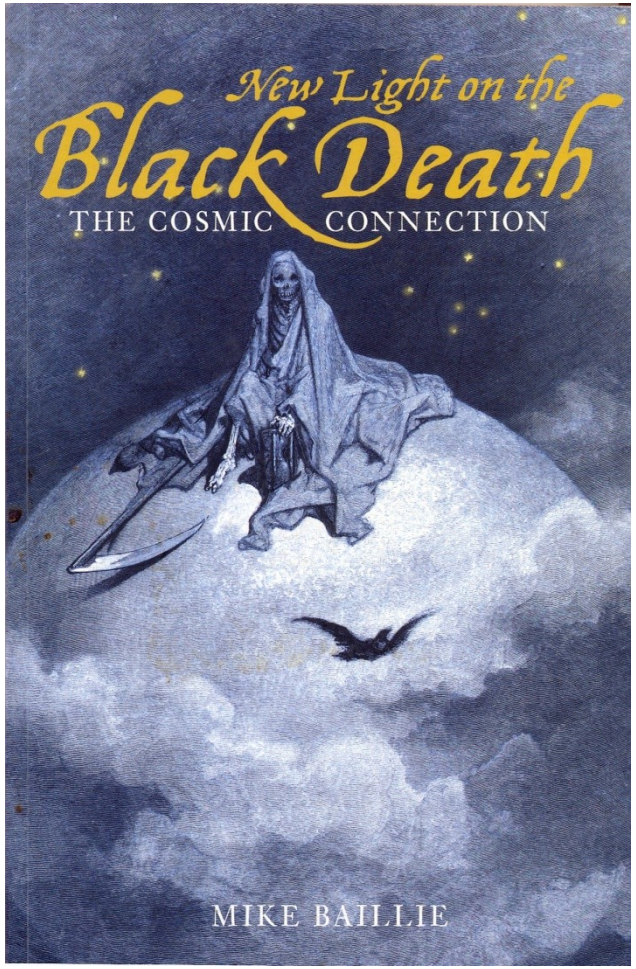
tabsgetreu aber in den relativen Größenverhältnissen gezeichnet.
Die Zahlen an einigen Kratern bezeichnen die tatsächlichen Durchmesser (in Metern).

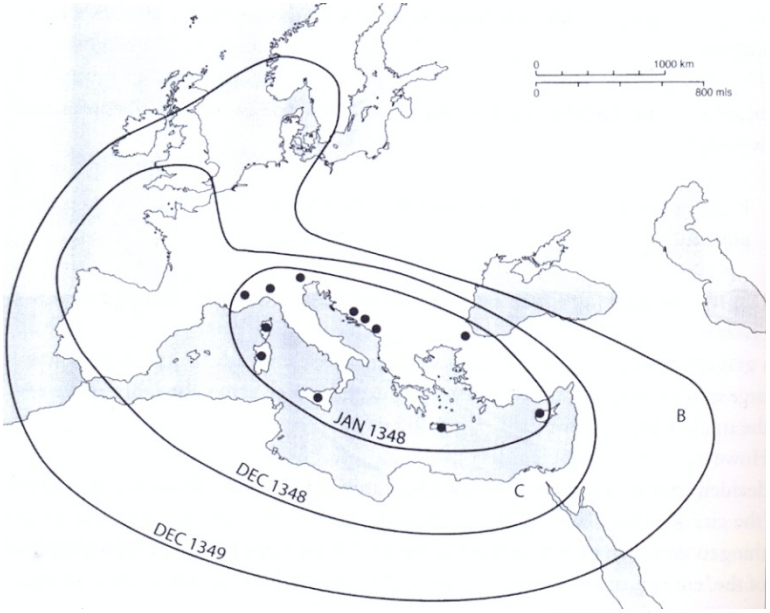
Озеро Смердячье, Шатурский район Московской области, Диаметр (по гребню вала) – 380 m, максимальная глубина -- 26 m

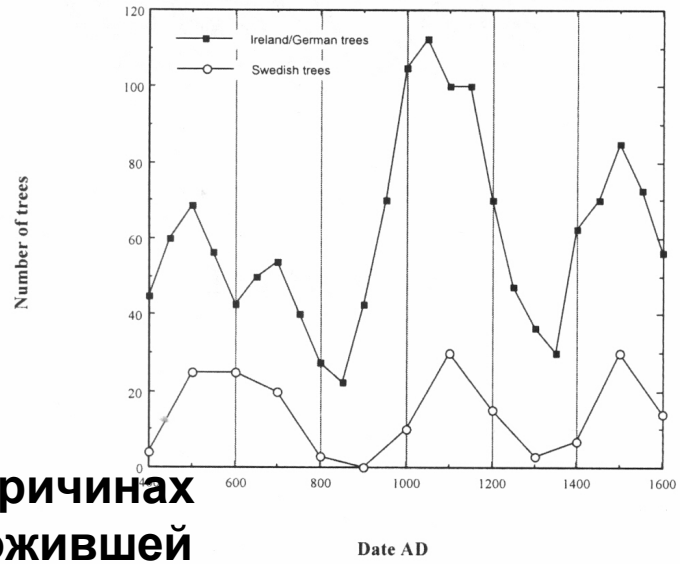
Обломочный материал (окремневанные известняки) из толщи краевого вала



Батиметрическая карта дна озера

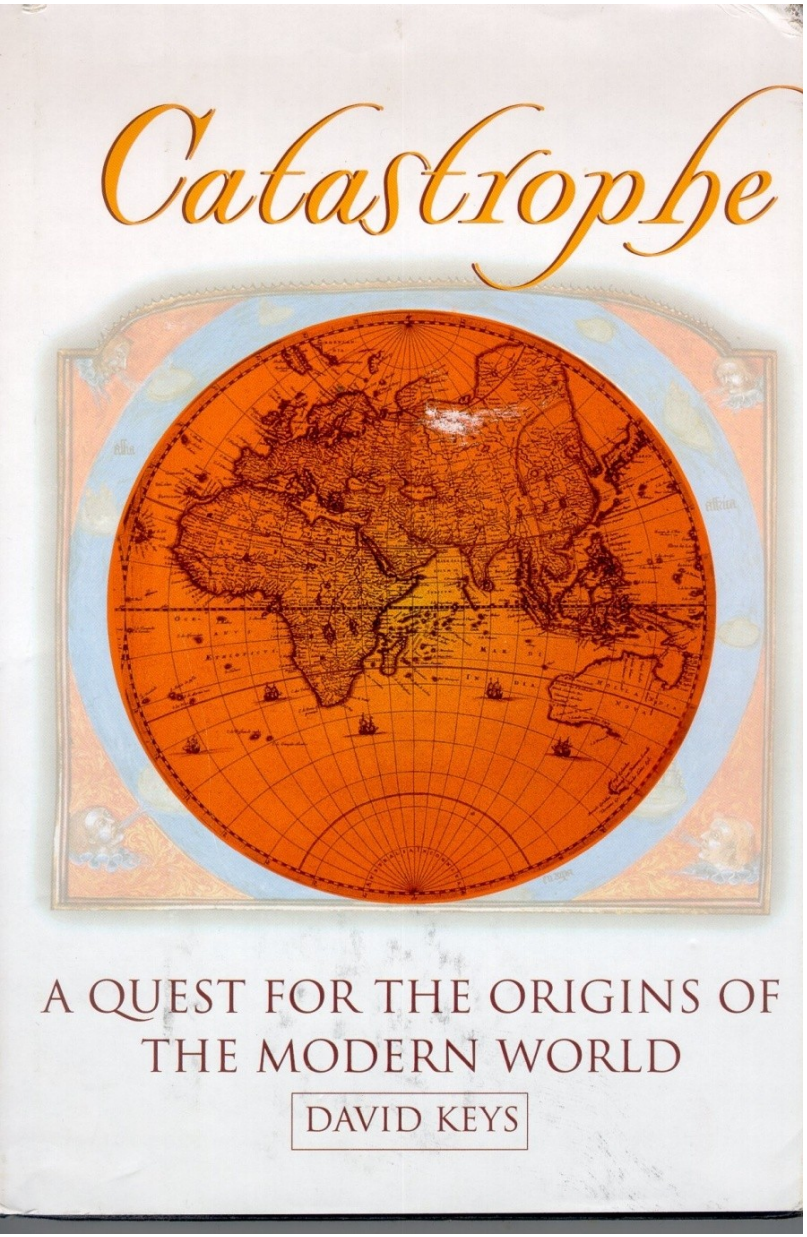




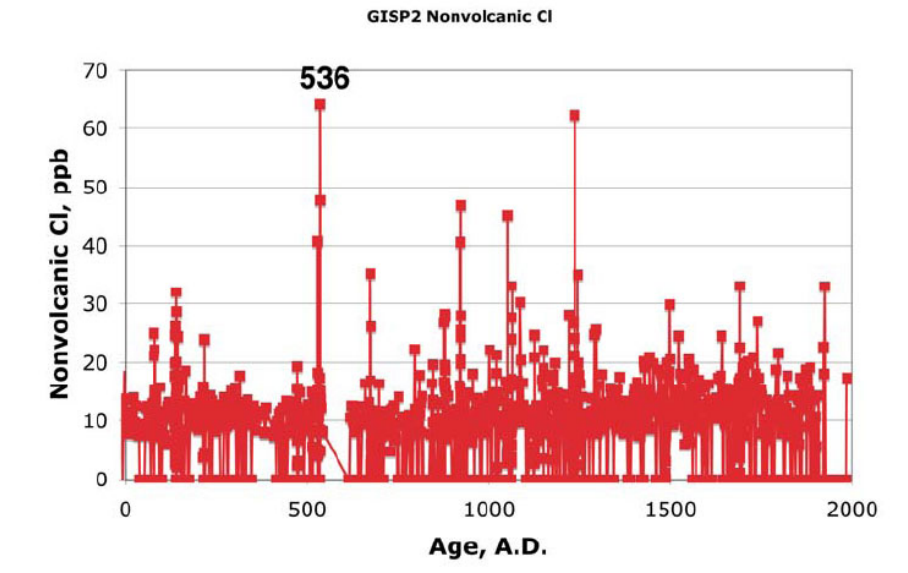


Гипотеза М.Байлеу о возможных космических причинах эпидемии необычной легочной болезни, уничтожившей четверть населения Европы в 1248-1249 гг.

Климатическая катастрофа 536-540 гг.н.э.

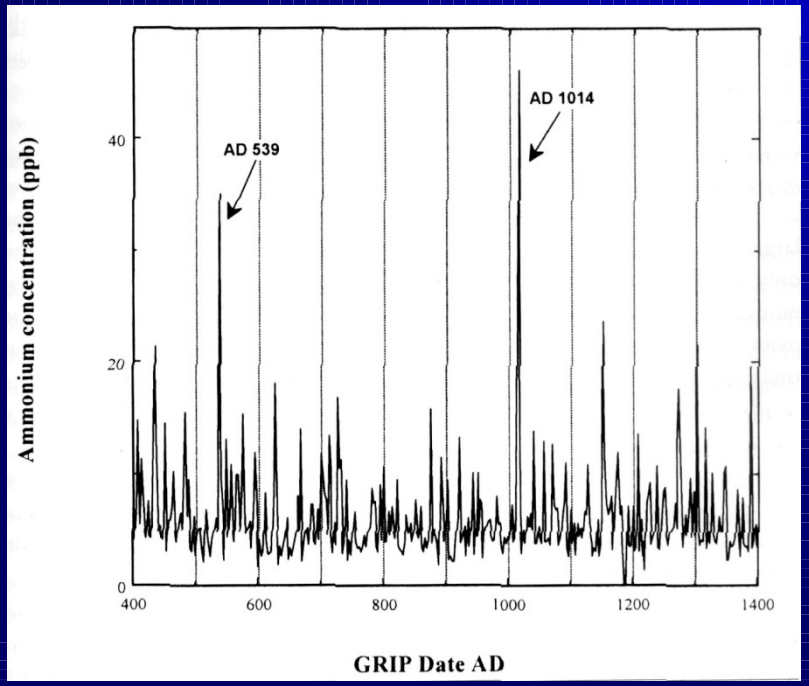


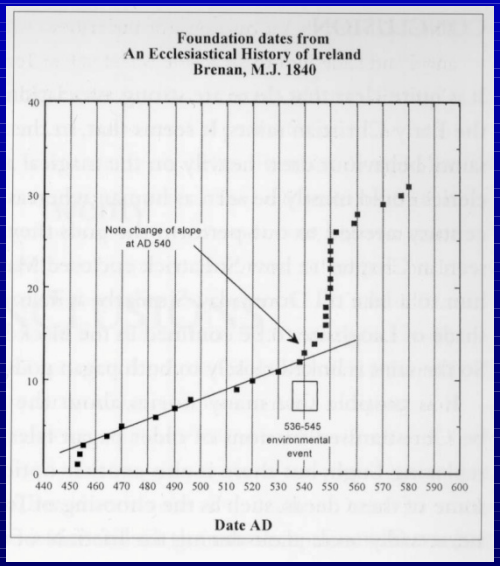
- It was a catastrophe without precedent in recorded history: suddenly, with no warning or apparent cause, the ***sun failed to shine starting in AD 535***. **For months on end, a strange, dusky haze plunged much of the earth into semi-darkness. Crops failed in Asia and the Middle East as global weather patterns radically altered. Bubonic plague, exploding out of Africa, wiped out entire populations in Europe. Flood and drought brought ancient cultures to the brink of collapse. In a matter of decades, the *old order died and a new world*— essentially the modern world as we know it today—emerged.**
- *D.Keys (1999)*



Вариации содержания хлора (вверху) и аммония (внизу) в колонке GRIP в Гренландии

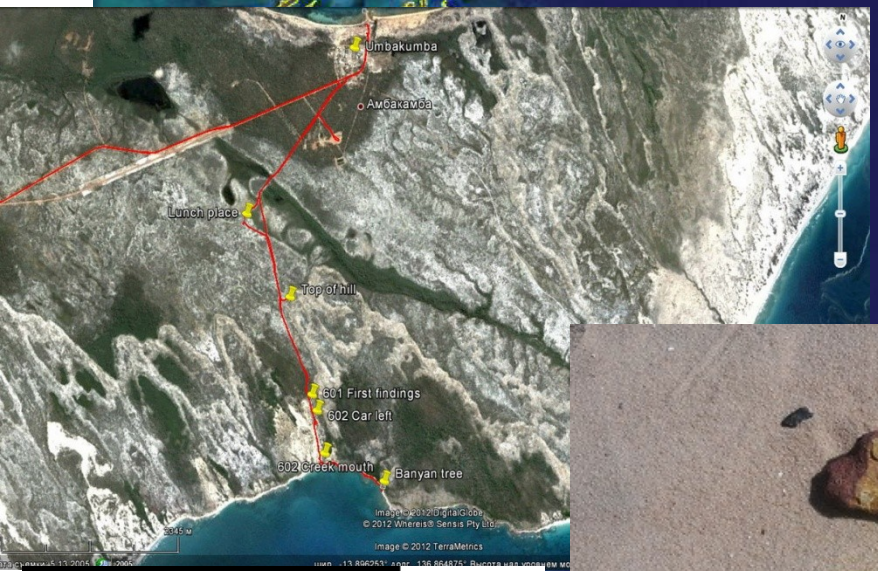
Исчезновение годичного кольца сосны во внутренней Монголии на рубеже 536/537 г. н.э.





Даты оснований церквей в Ирландии с 440 по 600 год н.э.

Crater-candidates Kanmare (11 km) and Tabban (9 km)



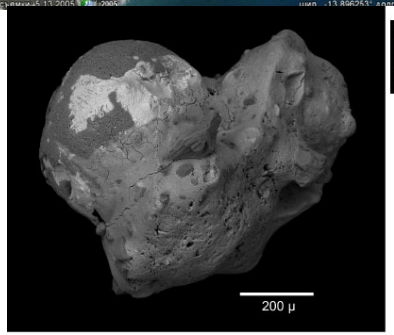


Figure 5: Magnetite spherule (upper left) melting out of a siderite grain.

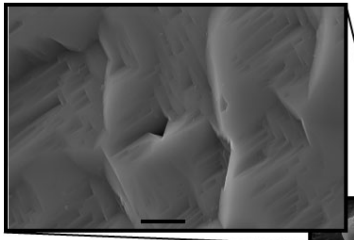
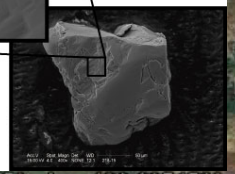


Figure 6: Shocked quartz has multiple planes of deformation. Here, at least 3 planes are present. Bar for scale is 2 microns.



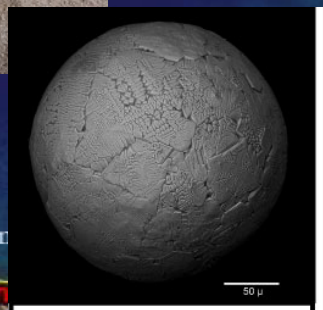
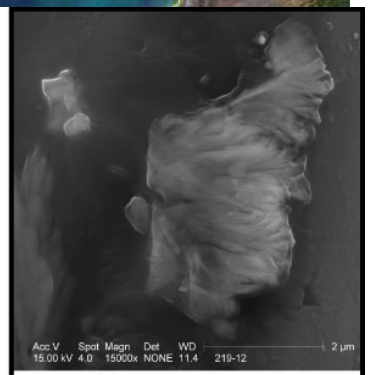


Figure 3: Magnetite spherule with distinctive quench texture indicative of rapid cooling. A bimodal distribution at 85 and 125 microns suggests multiple craters. Bar for scale is 50 microns.



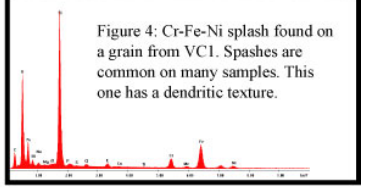


Figure 4: Cr-Fe-Ni splash found on a grain from VC1. Spashes are common on many samples. This one has a dendritic texture.

Hot Water From Sky (or Ground)

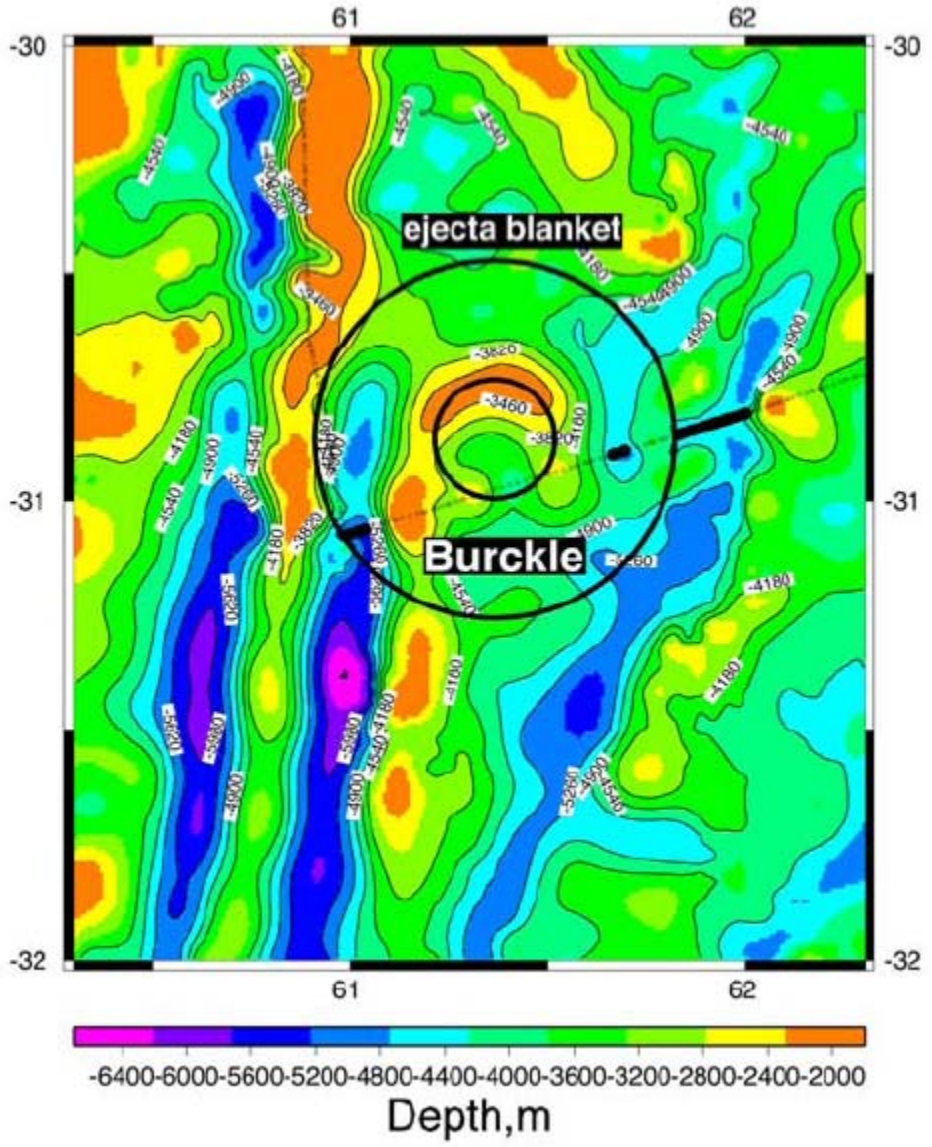
Fire and Intense Heat Immediately Prior to Flo

Direction Flood Storm Moving

Location of Flood Myth

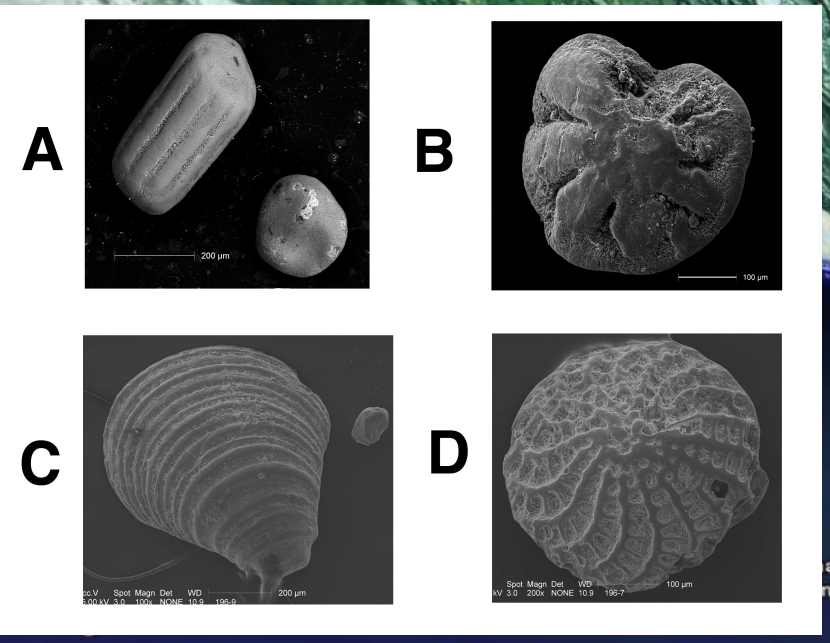
Hypothesized Splash Ejecta Ring

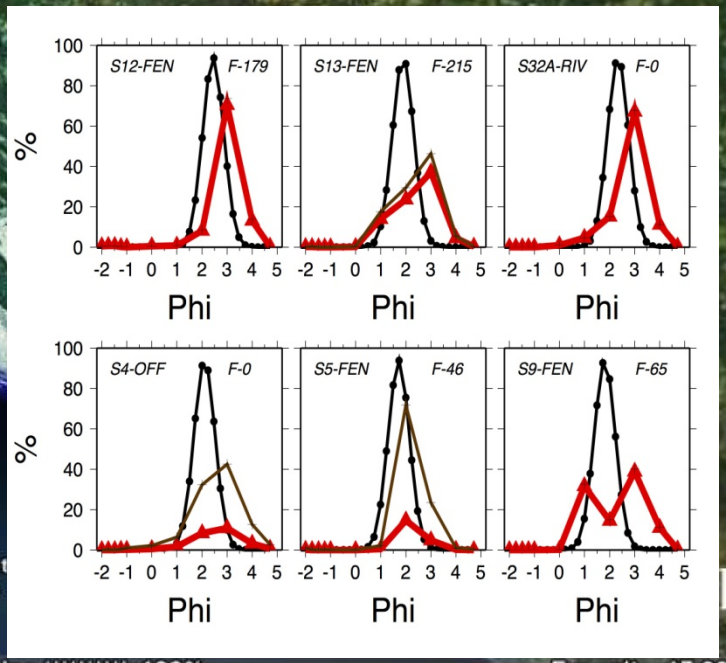
Hypothesized General Location for Impact Site



FLOOD COMET ca. 2807 B.C.

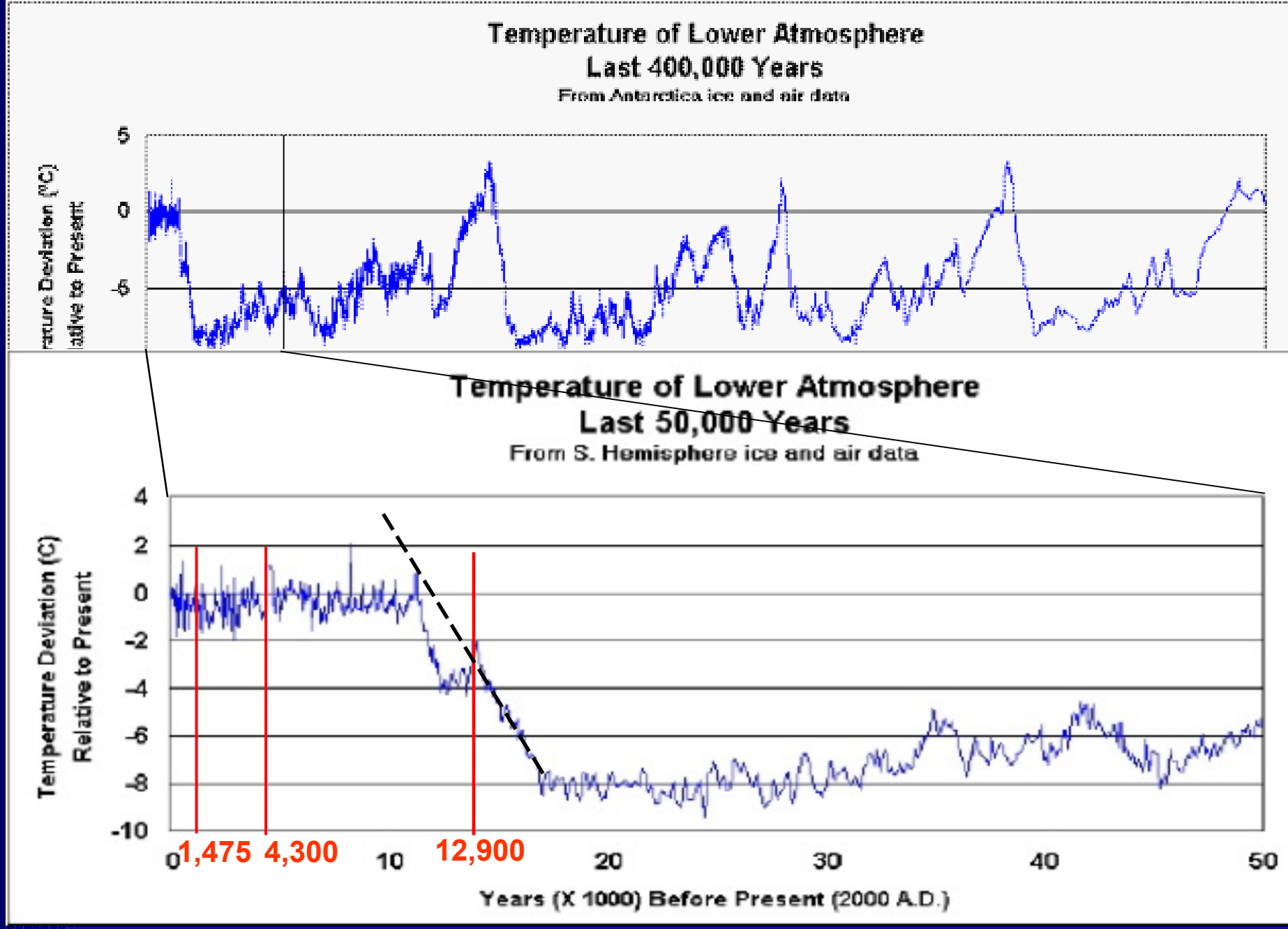
Hypothetical position of an impact site, proposed by B.Masse in 2004 (on the left) and actual position of submarine crater-candidate Burckle, some 1500 km SE of Madagascar found by D.Abbott in 2005 (Abbott et al, 2005) (on the right). Дендрохронологическя датировка события Великого Потопа 2354-2345 до н.э.



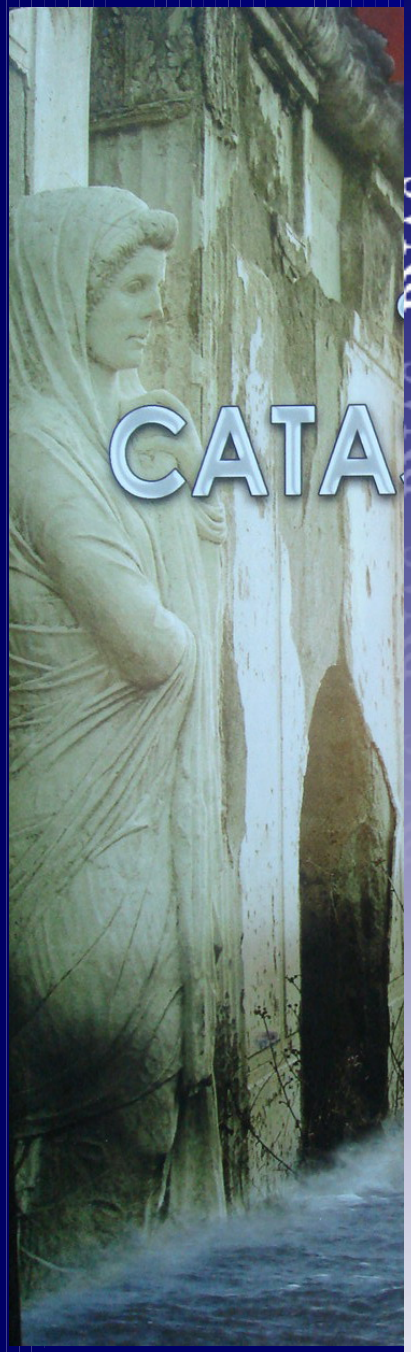


Pointer 25°15'34.79" S 44°41'37.22" E elev 390 ft Streaming 100% Eye alt 17.28 mi

Fenambosy chevron. Max run-up – up to 205 m, in-land penetration – up to 35 km.



Изменения глобального климата на Земле за последние 400 и 50 тысяч лет, полученные по результатам измерения соотношения изотопов O^{16}/O^{18} в колонках бурения льдов Антарктиды



Evidence for an extraterrestrial impact 12,900 years ago that contributed to the megafaunal extinctions and the Younger Dryas cooling

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A carbon-rich black layer, dating to ≈12.9 ka, has been previously identified at ≈50 Clovis-age sites across North America and appears contemporaneous with the abrupt onset of Younger Dryas (YD) cooling. The *in situ* bones of extinct Pleistocene megafauna, along with Clovis tool assemblages, occur below this black layer but not within or above it. Causes for the extinctions, YD cooling, and termination of Clovis culture have long been controversial. In this paper, we provide evidence for an extraterrestrial (ET) impact event at ≈12.9 ka, which we hypothesize caused abrupt environmental changes that contributed to YD cooling, major ecological reorganization, broad-scale extinctions, and rapid human behavioral shifts at the end of the Clovis Period. Clovis-age sites in North American are overlain by a thin, discrete layer with varying peak abundances of (*i*) magnetic grains with iridium, (*ii*) magnetic microspherules, (*iii*) charcoal, (*iv*) soot, (*v*) carbon spherules, (*vi*) glass-like carbon containing nanodiamonds, and (*vii*) fullerenes with ET helium, all of which are evidence for an ET impact and associated biomass burning at ≈12.9 ka. This layer also extends throughout at least 15 Carolina Bays, which are unique, elliptical depressions, oriented to the northwest across the Atlantic Coastal Plain. We propose that one or more large, low-density ET objects exploded over northern North America, partially destabilizing the Laurentide Ice Sheet and triggering YD cooling. The shock wave, thermal pulse, and event-related environmental effects (e.g., extensive biomass burning and food limitations) contributed to end-Pleistocene megafaunal extinctions and adaptive shifts among PaleoAmericans in North America.

comet | iridium | micrometeorites | nanodiamonds | spherules

A carbon-rich black layer, dating to ≈12.9 ka (12,900 calendar years B.P.) (1), has been identified by C. V. Haynes, Jr. (2), at >50 sites across North America as black mats, carbonaceous silts, or dark organic clays [supporting information (SI) Fig. 5]. The age of the base of this black layer coincides with the abrupt onset of Younger Dryas (YD) cooling, after which there is no evidence for either *in situ* extinct megafaunal remains or Clovis artifacts. Increasing evidence suggests that the extinction of many mammalian and avian taxa occurred abruptly and perhaps catastrophically at the onset of the YD, and this extinction was pronounced in North America where at least 35 mammal genera disappeared (3), including mammoths, mastodons, ground sloths, horses, and camels, along with birds and smaller mammals. At Murray Springs, AZ, a well known Clovis site, mammoth bones and Clovis-age stone tools lie directly beneath the black layer where, as described by Haynes (4): "[T]he sudden extinction of the Pleistocene megafauna would be dramatically revealed by explaining that all were gone an instant before the black mat was deposited."

The cause of this extinction has long been debated and remains highly controversial due, in part, to the limitations of available data but also because the two major competing hypotheses, human overkill (5) and abrupt cooling (6), fall short of explaining many observations. For example, Grayson and Meltzer (7) summarized serious problems with the overkill hypothesis, such as the absence of kill sites for 33 genera of extinct mammals, including camels and sloths. In addition, although abrupt cooling episodes of magnitudes similar to the YD occurred often during the past 80 ka, none are known to be associated with major extinctions. The possibility of pandemic disease also has been suggested (8), but there is no evidence for that in the Pleistocene record. Thus, the end-Pleistocene extinction event is unique within the late Quaternary and is unlikely to have resulted only from climatic cooling and human overkill. The extinctions were too broad and ecologically deep to support those hypotheses.

Extraterrestrial (ET) catastrophes also have been proposed. For example, LaViolette (9) suggested that a large explosion in our galactic core led to the extinctions. Brakenridge (10) postulated that a supernova killed the megafauna and caused the worldwide deposition of the black layer. Clube and Napier (11) proposed multiple encounters with remnants of the mega comet progenitor of the Taurid meteor stream and Comet Encke. Although ET events have long been proposed as a trigger for mass extinctions, such as at the K/T (≈65 Ma) (12) and P/T (≈250 Ma) (13), there has been no compelling evidence linking impacts to the late Pleistocene megafaunal extinctions and YD cooling.

In the 1990s, W. Topping (14) discovered magnetic microspherules and other possible ET evidence in sediment at the Goiney

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The authors declare no conflict of interest.

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Abbreviations: YD, Younger Dryas; YDB, YD boundary; ET, extraterrestrial.

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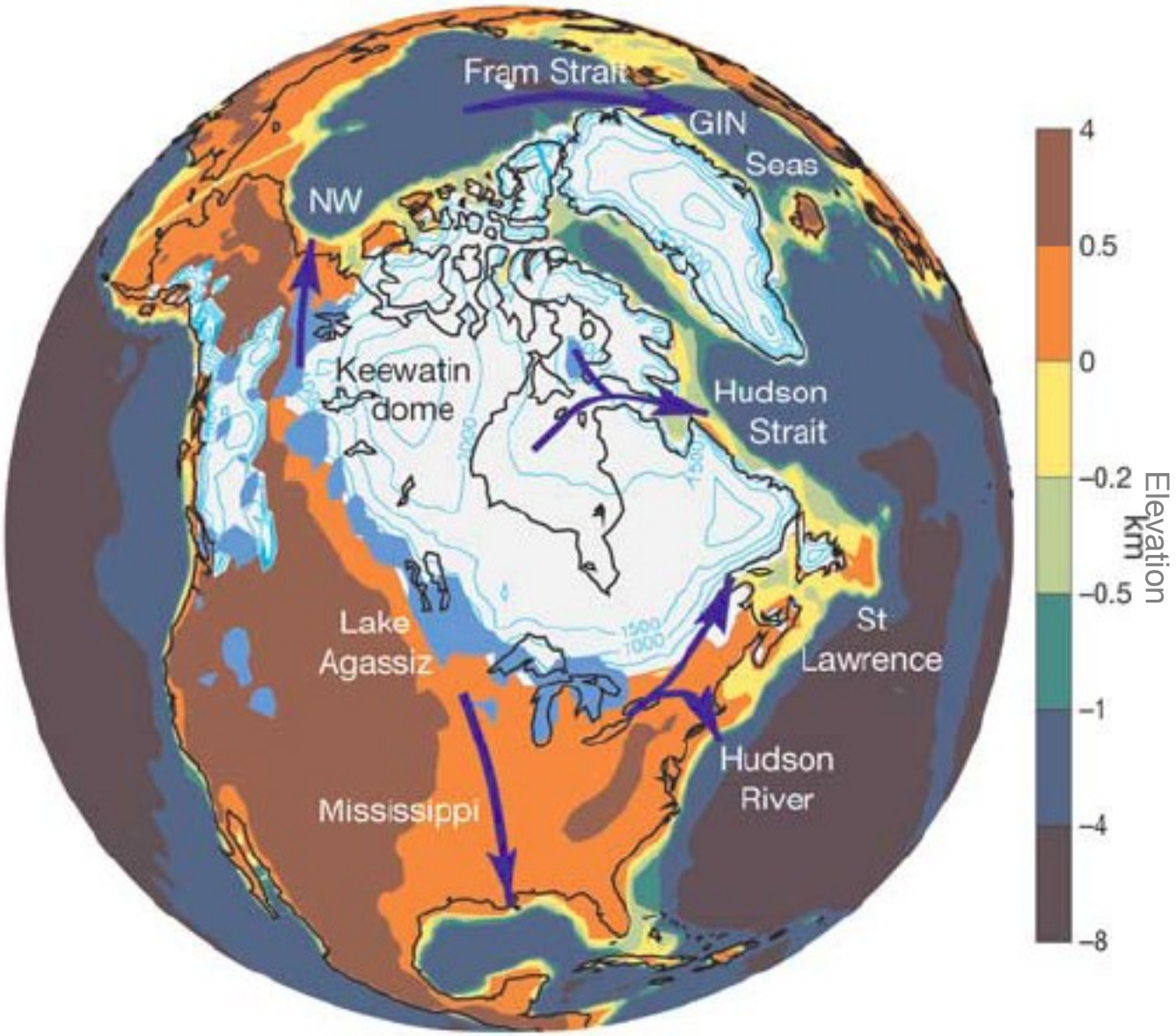
Abrupt outflow switch from south at 12.9 ka



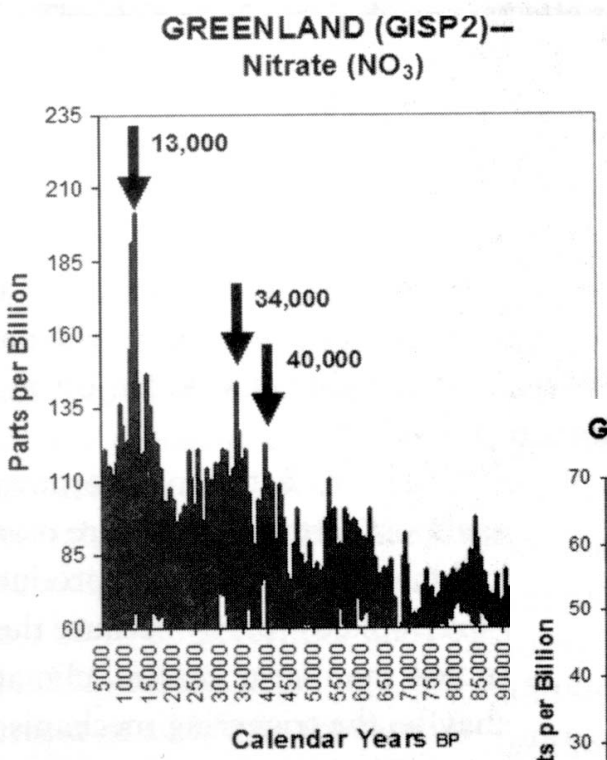
Tarasov and Peltier, 2005

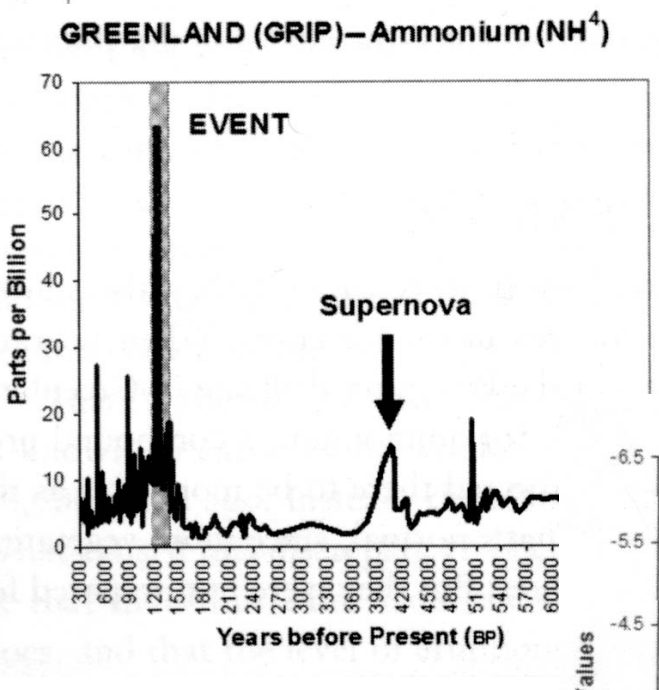
«Переход от плейстоцена к голоцену отмечен серией природных явлений, столь значительных по охвату биосферы и геосферы, по пространственному масштабу и скорости изменений и по их глобальным последствиям, что всю совокупность этих явлений можно назвать ***последней природной катастрофой*** в истории Земли»

«Новейшие материалы свидетельствуют о ***необратимости и уникальности*** плейстоцен/голоценовой перестройки и коренном отличии ее от более ранних переходных фаз от оледенений к межледниковью»

(А.В.Шер, 1997)

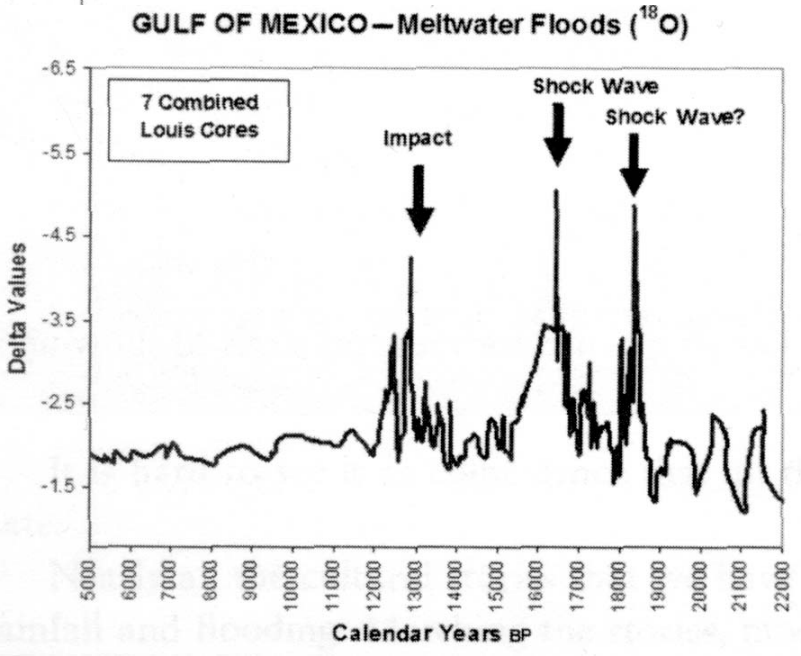
Слева: вариации концентрации нитрата азота NO_3 (вызывает «коричневый смог») во льдах Гренландии за последние 110 т.л.





Справа: концентрация аммония (сажа) в колонке бурения льдов Гренландии (непосредственно коррелирует с числом пожаров на Земле)

Внизу: вариации водного стока в Мексиканский залив



Заключение

Реальные падения космических тел (комет и астероидов) на Землю в недавнем геологическом прошлом происходили значительно чаше, чем это моделируется астрономами и астрофизикам и приводили к резким изменениям климата и условий жизни человека как на региональном, так и на глобальном масштабах.

Каждый такой случай нуждается в тщательном и непредвзятом изучении специалистами из различных дисциплин.

Facts that demand explanations

Massive boulders at the top of 35-m vertical cliff, south-east Australian coast near Wollongong


Спасибо за внимание

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