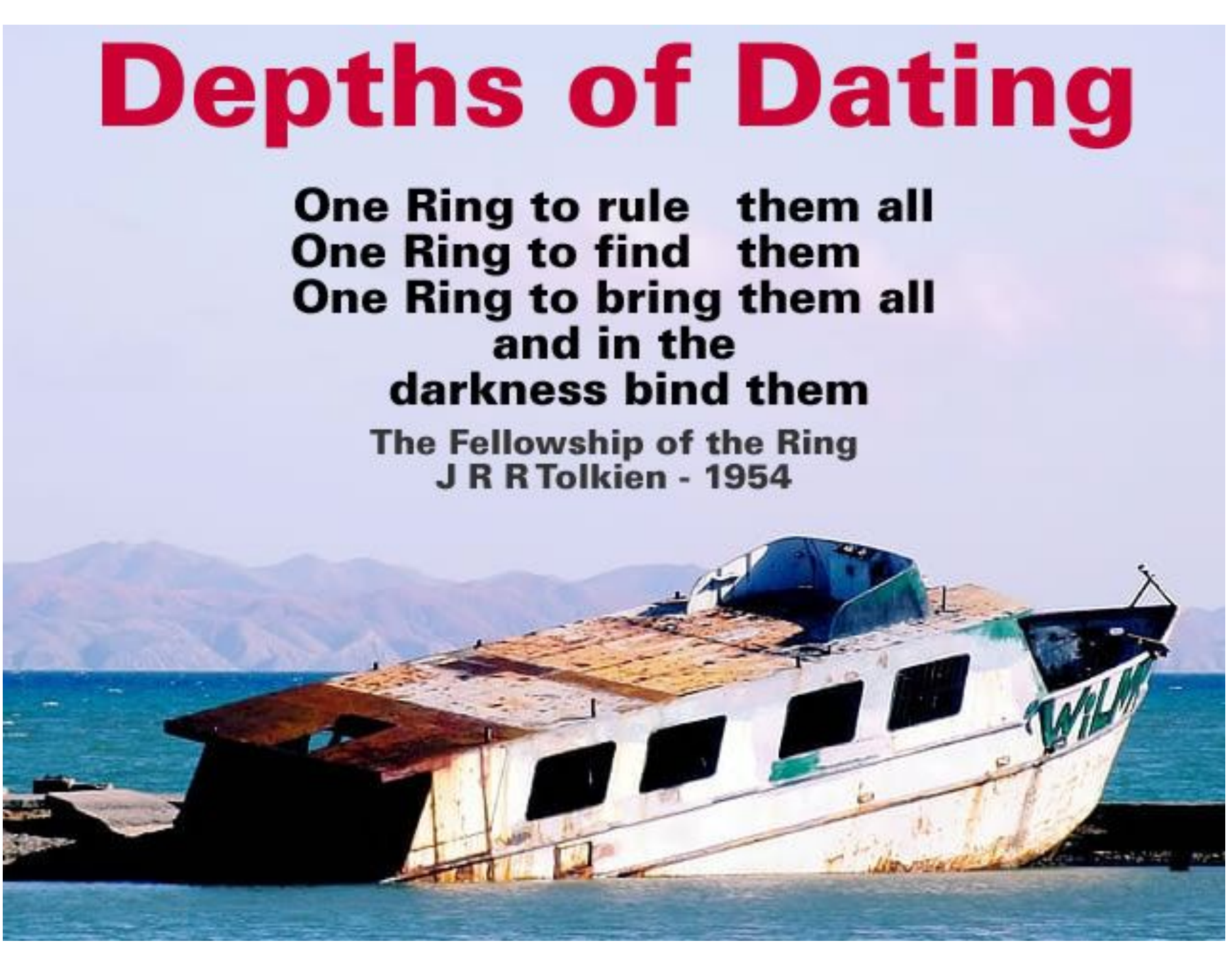


12th April 2024

Good News

We're off to the stunning Caribbean island of ***La Tortuga*** that lies off the north coast of Venezuela.


La Tortuga Island, Venezuela Wikimedia: Baileymay17

La Tortuga Island is an uninhabited island of **Venezuela**, the largest in the Federal Dependencies of Venezuela. It is part of a group of islands that include the Tortuguillos and Cayo Herradura. **Isla La Tortuga** has an area of 156 km^2 (60 sq mi).

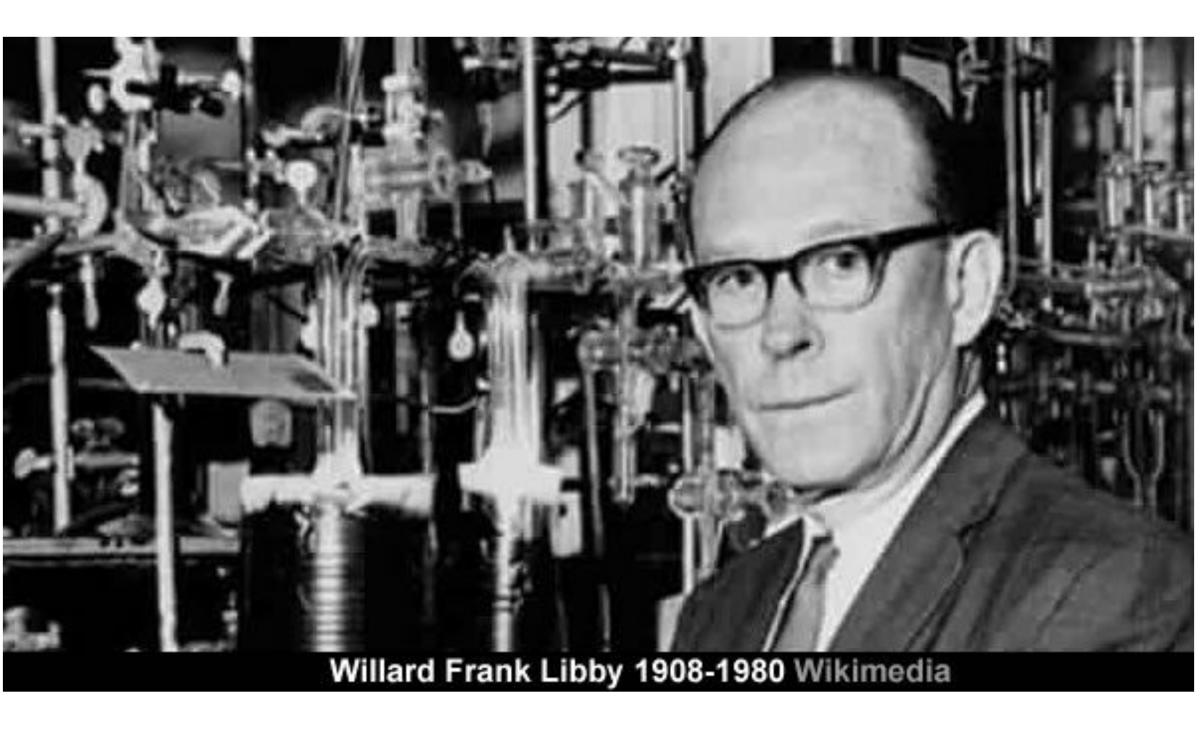
It is not known by which European explorer the island was first seen and named, yet the name derives from the **large numbers of marine turtles** that come to **lay eggs on its long sandy beaches every year** … with the exception of fishermen who visit the island seasonally, the island has remained unpopulated and largely untouched.

Wikipedia - La Tortuga Island
https://en.wikipedia.org/wiki/La_Tortuga_Island

Before finally unravelling **radiocarbon dating** in the Caribbean we gently stroll through a thick forest of ***dendrochronologists*** and enjoy an unexpected ***spin*** in Greenland with the ***glaciologists***.

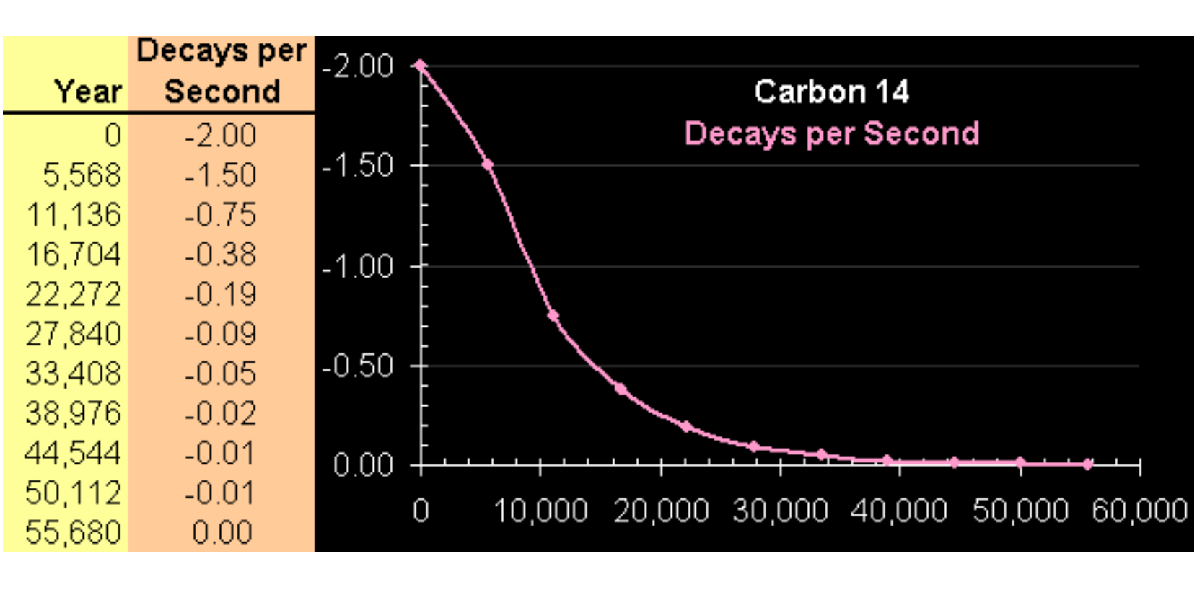
Radiocarbon Dating and Dendrochronology

Malaga Bay has had plenty of ***fun*** analysing the **radiocarbon dating** ***games*** played by *academia.*


Willard Frank Libby 1908-1980 Wikimedia

Willard Frank Libby (1908-1980) was an American physical chemist noted for his role in the **1949 development of radiocarbon dating**, a process which revolutionized archaeology and palaeontology. For his contributions to the team that developed this process, Libby was awarded the Nobel Prize in Chemistry in 1960.

Wikipedia - Willard Libby
https://en.wikipedia.org/wiki/Willard_Libby



Year	Decays per Second
0	-2.00
5,568	-1.50
11,136	-0.75
16,704	-0.38
22,272	-0.19
27,840	-0.09
33,408	-0.05
38,976	-0.02
44,544	-0.01
50,112	-0.01
55,680	0.00

The cautious Willard Libby sensibly decided to limited the accuracy of his model to two decimal places and thus defined the outer limit of ***Radiocarbon Dating*** to be **55,680 years.**

Malaga Bay - Carbon 14 – Willard's World
https://malagabay.wordpress.com/2014/05/22/carbon-14-willards-world/

Radiocarbon dating (also referred to as carbon dating or carbon-14 dating) is a method for determining the age of an object containing organic material by using the properties of radiocarbon, a radioactive isotope of carbon.

The method was developed in the late 1940s at the University of Chicago by **Willard Libby**.

It is **based on** the fact that radiocarbon (**^{14}C**) is constantly being created in the Earth's atmosphere by the interaction of cosmic rays with atmospheric nitrogen.

The resulting ^{14}C combines with atmospheric oxygen to form radioactive carbon dioxide, which is incorporated into plants by photosynthesis; animals then acquire ^{14}C by eating the plants. When the animal or plant dies, it stops exchanging carbon with its environment, and thereafter the amount of ^{14}C it contains begins to decrease as the ^{14}C undergoes radioactive decay.


North Ronaldsay sheep - The Geograph Project: Liz Burke

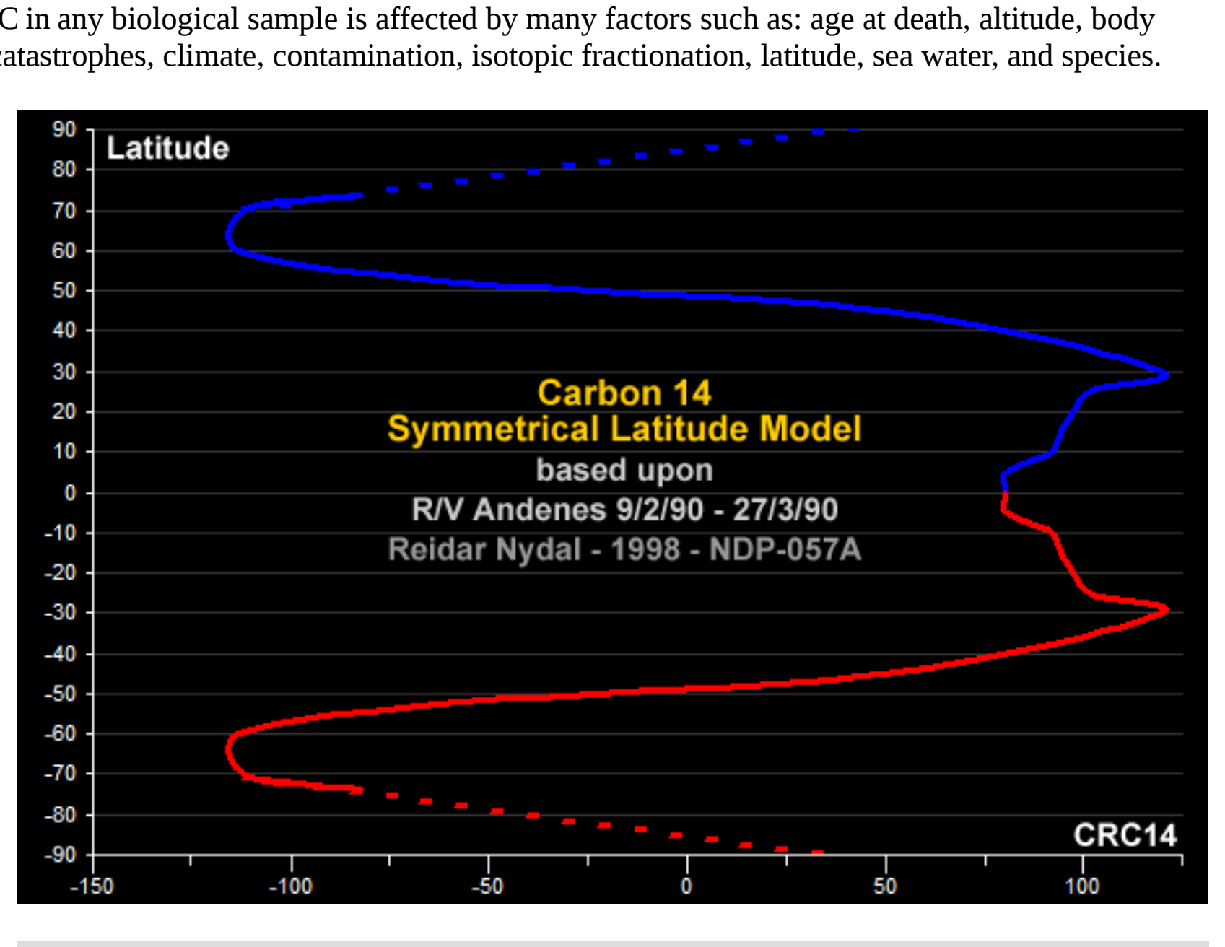
In the winter, these sheep eat seaweed, which has a higher δ^{13}C content than grass; samples from these sheep have a δ^{13}C value of about −13‰, which is much higher than for sheep that feed on grasses.

Wikipedia - Radiocarbon Dating
https://en.wikipedia.org/wiki/Radiocarbon_dating

The fundamental problem with **radiocarbon dating** is that ambient ^{14}C levels vary over time.

Furthermore:

The ^{14}C in any biological sample is affected by many factors such as: age at death, altitude, body part, catastrophes, climate, contamination, isotopic fractionation, latitude, sea water, and species.



Malaga Bay - Carbon 14 – Seeing the Light
https://malagabay.wordpress.com/2014/05/31/carbon-14-seeing-the-light/

CRC14 is the ^{14}C value expressed as ^{14}C in per mille. ^{14}C is corrected for isotopic fractionation using ^{13}C (DC13), and for radioactive decay relative to the ^{14}C reference standard (NIST).

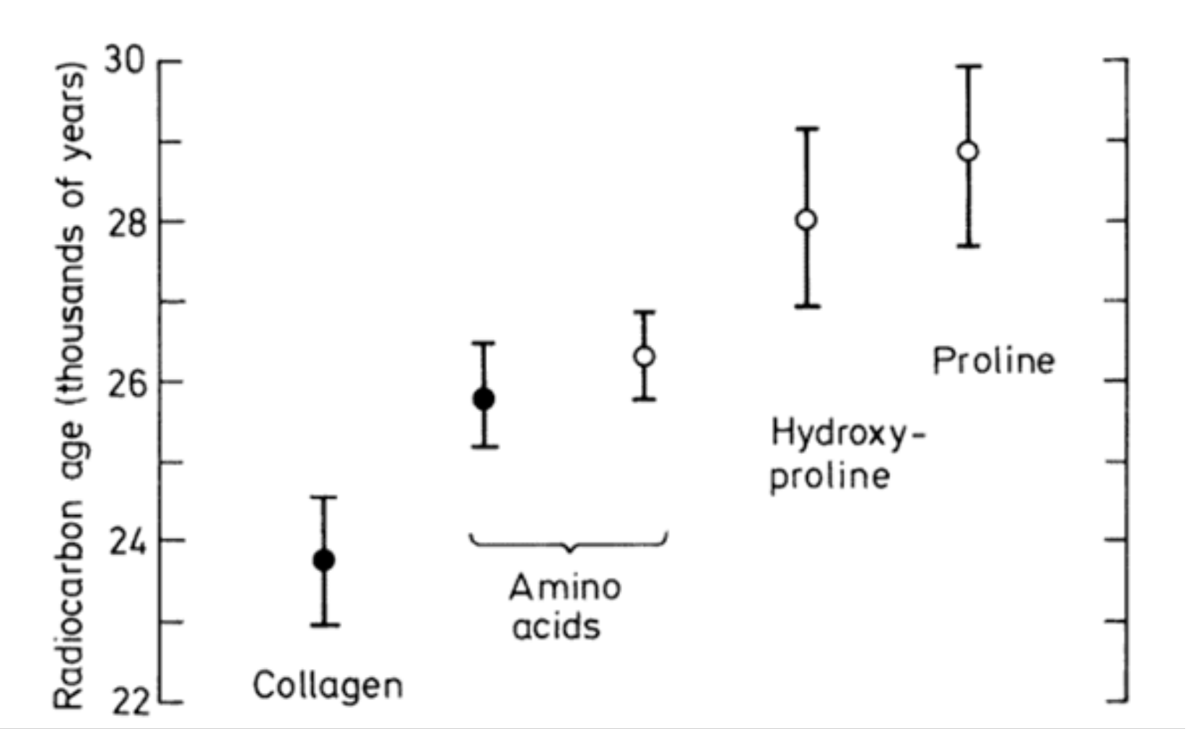
Carbon-14 Measurements in Surface Water CO2 from
the Atlantic, Indian and Pacific Oceans, 1965-1994
Reidar Nydal - NDP057A - March 1998
https://www.ncei.noaa.gov/access/ocean-carbon-acidification-data-system/oceans/

The variation in the ^{14}C/^{12}C ratio in different parts of the carbon exchange reservoir means that a straightforward calculation of the age of a sample based on the amount of ^{14}C it contains will often give an incorrect result.

Wikipedia - Radiocarbon Dating
https://en.wikipedia.org/wiki/Radiocarbon_dating

Variations in ^{14}C production
Isotopic fractionation
Volcanoes
Contamination
… Effect of climatic cycles
… Marine effect
… Hemisphere effect
…
… Effects of human activity …
… Hard water effect …
… Island effect …

Wikipedia - Radiocarbon Dating Considerations
https://en.wikipedia.org/wiki/Radiocarbon_dating_considerations



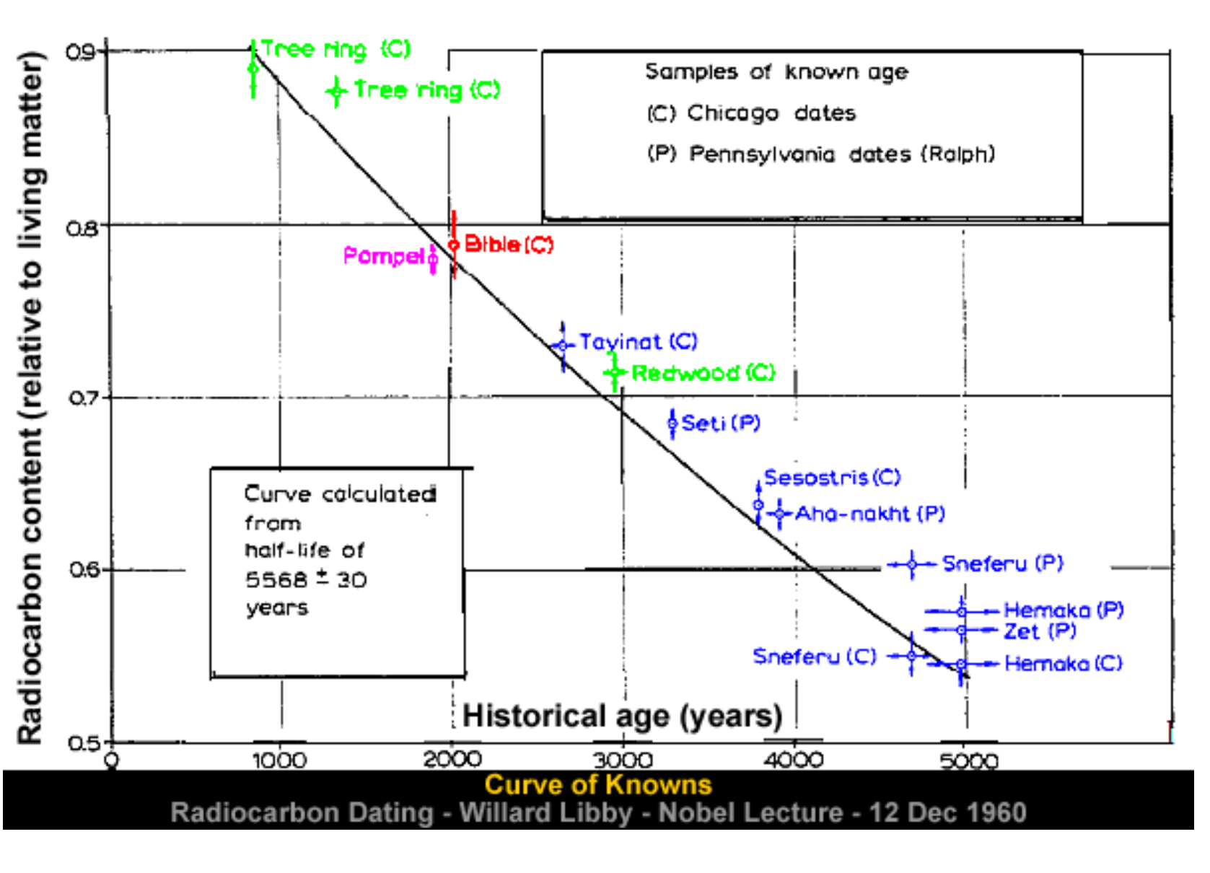
Archaeological Dating using Physical Phenomena
M J Aitken
Reports on Progress in Physics - 62 - 1999

Radiocarbon ages for different constituents extracted from a rhinoceros bone.
The older ages obtained for the proline and hydroxyproline, which are amino acids generally specific to bone, suggest intrusive contamination in the other constituents. Open symbols indicate AMS measurement and closed symbols conventional beta decay counting (from Aitken 1990).

Archaeological Dating using Physical Phenomena - M J Aitken
Reports on Progress in Physics - 62 - 1999
https://iopscience.iop.org/article/10.1088/0034-4885/62/9/202

Originally, to correct the ***known*** errors associated with ***Radiocarbon Dating*** the *experts* invented ***Radiocarbon Calibration*** based upon a ***Curve of Knowns*** that transformed the flawed *science* of ***Radiocarbon Dating*** into a conformist composite ***Belief System*** that based upon:

- A belief in ***gradualism***.
- A belief in the *expert eyes* of ***dendrochronologists*** to construct correct chronologies.
- A belief in ***Roman Chronology*** and [more specifically] the dating of the **Pompei** disaster.
- A belief in the dating of **Biblical** events.
- A belief in the *expert clairvoyancy* of ***Egyptologists*** to accurately date ancient artefacts.



Curve of Knowns
Radiocarbon Dating - Willard Libby - Nobel Lecture - 12 Dec 1960

The Vesuvius eruption of **AD 79** included in **Libby's** ***Curve of Knowns*** that underpins the ***Radiocarbon Calibration*** mechanism that ensures ***Radiocarbon Dating*** doesn't contradict the ***sacrosanct dates*** of approved belief systems [such as ***Egyptian Archaeology***].

Malaga Bay - Edwin Johnson Goes To St Vincent
https://malagabay.wordpress.com/2022/07/04/edwin-johnson-goes-to-st-vincent/

The ***Early Roman Rulers*** adjustment of 1,180 years suggests the **Pompeii brickwork** was laid [in round numbers] sometime **after 1150 CE**.

Malaga Bay - Vesuvius Chronology
https://malagabay.wordpress.com/2021/10/26/vesuvius-chronology/

Radiocarbon dating measurements produce ages in "radiocarbon years", which must be converted to calendar ages by a process called calibration. **Calibration** is needed because the atmospheric ^{14}C:^{12}C ratio, which is a key element in calculating radiocarbon ages, has not been constant historically.

Wikipedia - Radiocarbon Calibration
https://en.wikipedia.org/wiki/Radiocarbon_calibration

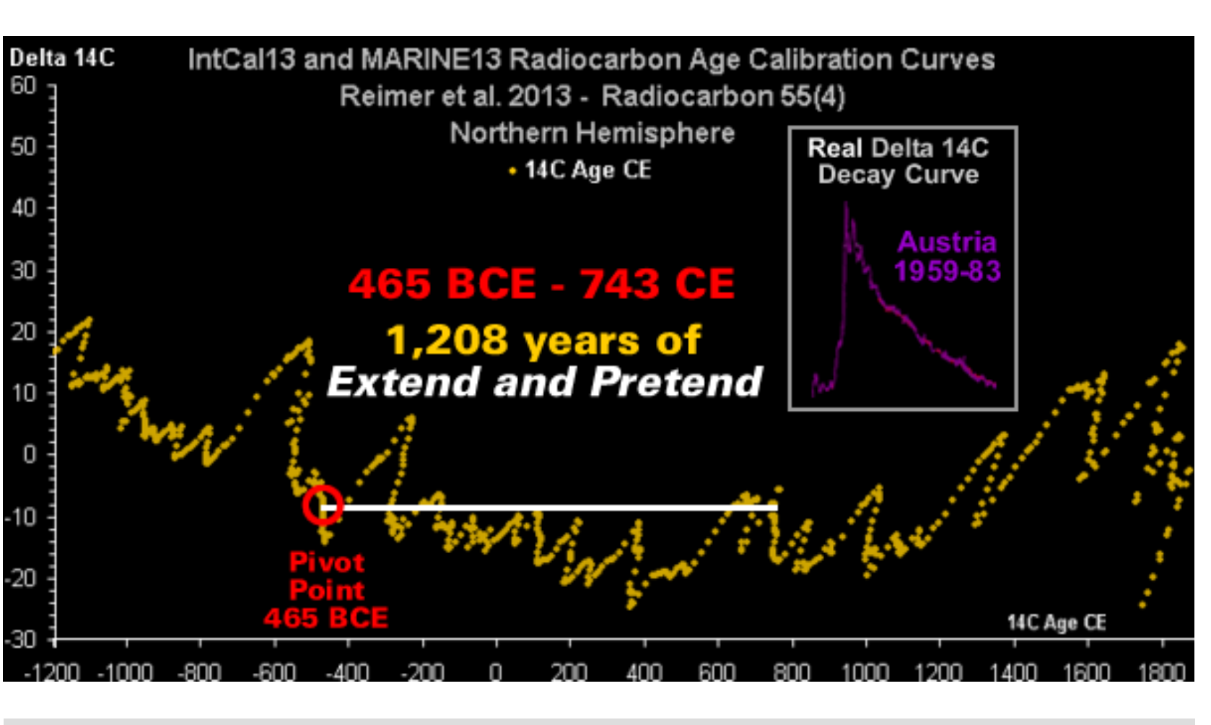
Armed with the results of **carbon-dating** the **tree rings**, it became possible to construct **calibration curves designed to correct the errors** caused by the variation over time in the ^{14}C/^{12}C ratio.

Wikipedia - Radiocarbon Dating Considerations
https://en.wikipedia.org/wiki/Radiocarbon_dating_considerations

Gradualism … is a hypothesis, a theory or a tenet assuming that change comes about gradually or that variation is gradual in nature and happens over time as opposed to in large steps. **Uniformitarianism**, incrementalism, and reformism are similar concepts.

Wikipedia - Gradualism
https://en.wikipedia.org/wiki/Gradualism

Since then the *experts* [acting in ***good faith***] have transformed ***Radiocarbon Dating*** into a colossal ***Radiocarbon Clusterfuck*** that includes **1,208 phantom years** between **465 BC** and **743 AD** which appears to have been inserted by the *inexpert eyes* of the ***dendrochronologists.***



Malaga Bay - Deranged Dating: The Roman Problem
https://malagabay.wordpress.com/2017/11/24/deranged-dating-the-roman-problem/

In human interactions, **good faith** (Latin: *bona fides*) is a sincere intention to be fair, open, and honest, regardless of the outcome of the interaction.

Wikipedia - Good Faith
https://en.wikipedia.org/wiki/Good_faith

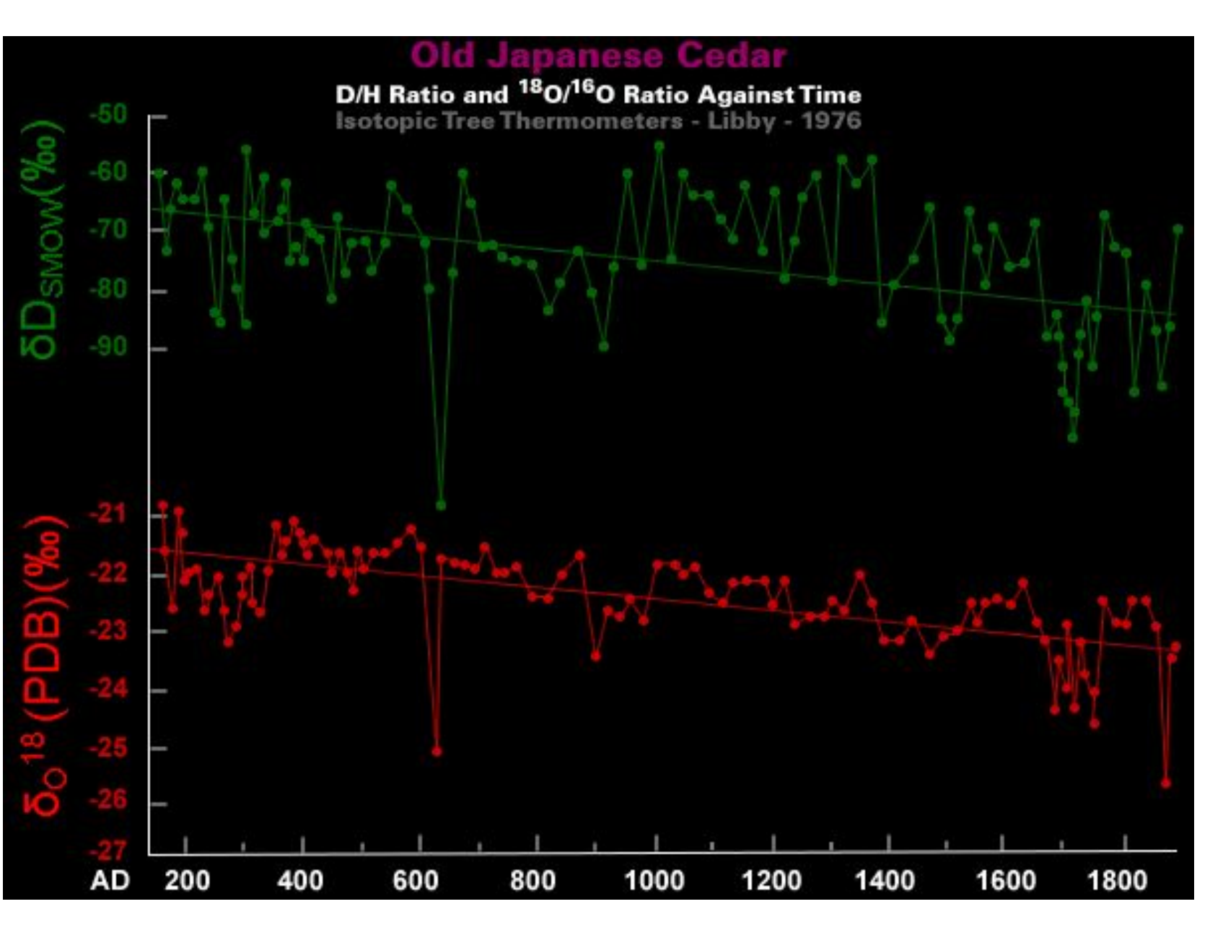
Luckily:

The ***Radiocarbon Clusterfuck*** fathered by **Willard Libby** was redeemed by his wife **Leona Libby**.


Leona Libby 1919-1986 University of Chicago - 1946

In **1976 Leona Libby** introduced the world to **Isotopic Tree Thermometers**.

Libby showed that **the atmospheric ratio of stable hydrogen and oxygen isotopes is preserved in tree-rings** and demonstrated that this isotopic ratio is determined by atmospheric temperatures [at the time of formation].



The isotopic information Libby extracted from an **Old Japanese Cedar** indicated that **temperatures have fallen by about 1.5 °C in the last 1,800 years.**

Malaga Bay - Isotopic Tree Thermometers and The Heinsohn Horizon
https://malagabay.wordpress.com/2015/11/19/isotopic-tree-thermometers/

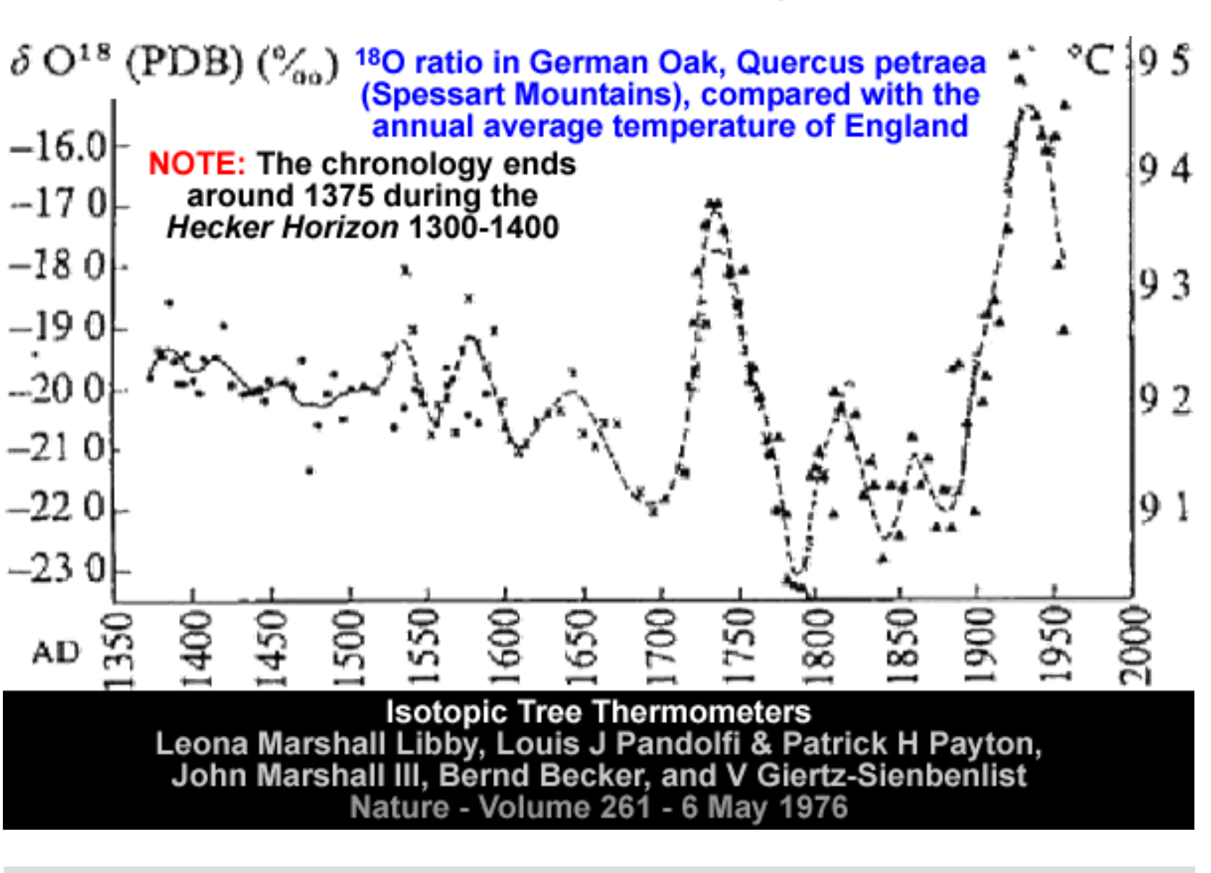
Malaga Bay - Digitised Japanese Isotopic Tree Thermometer
https://malagabay.wordpress.com/2016/04/08/digitised-japanese-isotopic-tree-thermometer/

Leona Harriet Woods (1919-1986) … was an American physicist who helped build the first nuclear reactor and the first atomic bomb.
…
In 1966 she divorced John Marshall and **married** Nobel laureate **Willard Libby**.
…
Now known as **Leona** Marshall **Libby**, she became interested in ecological and environmental issues, and she **devised a method of using the isotope ratios of oxygen-18 to oxygen-16, carbon-13 to carbon-12,** and **deuterium to hydrogen in tree rings** …

Wikipedia - Leona Woods
https://en.wikipedia.org/wiki/Leona_Marshall

Unsurprisingly:

Earth Scientists speedily stuffed the straight science of **Leona Libby** down the ***memory hole***.



Isotopic Tree Thermometers
Leona Marshall Libby, Louis J Pandolfi & Patrick H Payton,
John Marshall III, Bernd Becker, and V Giertz-Sienbenlist
Nature - Volume 261 - 6 May 1976

Isotopic Tree Thermometers
Leona Marshall Libby, Louis J Pandolfi & Patrick H Payton, John Marshall III, Bernd Becker, and V Giertz-Sienbenlist
Nature - Volume 261 - 6 May 1976
https://archive.org/details/dli.calcutta.07283/page/n2/mode/1up

One study on **German oak** produced a reconstructed temperature curve **so similar** to the **Central England Temperature curve as to be almost unbelievable** (**Libby** et al. **1976**).

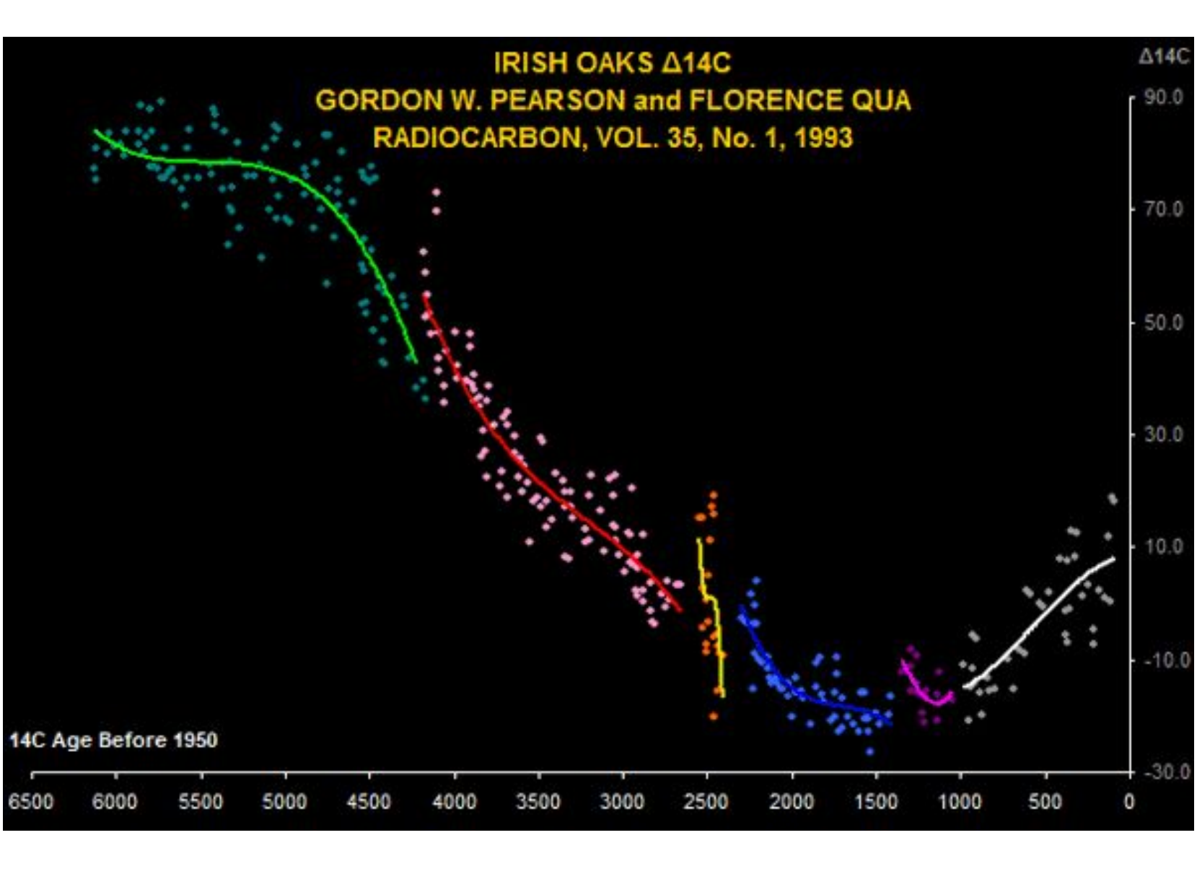
Unfortunately other workers were less than convinced and no attempt appears to have been made to extend the record intci the distant past (Wigley et al. 1978).

The controversy remains and oxygen **isotopes in tree-rings remain one of the great unexplored areas of climatic research.**

Dendrochronology and Past Environmental Change - M. G. L. Baillie
Palaeoecology Centre, The Queen's University, Belfast BT7 1NN, UK
Proceedings of the British Academy, 11, 5-23
https://www.thebritishacademy.ac.uk/documents/4035/77p005.pdf

Proceedings of the British Academy, Volume 77
New Developments in Archaeological Science - Edited by A M Pollard - 1992
https://www.thebritishacademy.ac.uk/publishing/proceedings-british-academy/77/

That's because the straight science of **Leona Libby** highlights where ***chronologies*** and ***bridges*** built by the *inexpert eyes* of ***dendrochronologists*** **are in error** and [to the chagrin of *gradualist*] the easily identifiable catastrophic spikes in **isotope ratios** provide excellent markers that enable a wide variety of [otherwise worthless] chronologies to be accurately aligned and definitively dated.



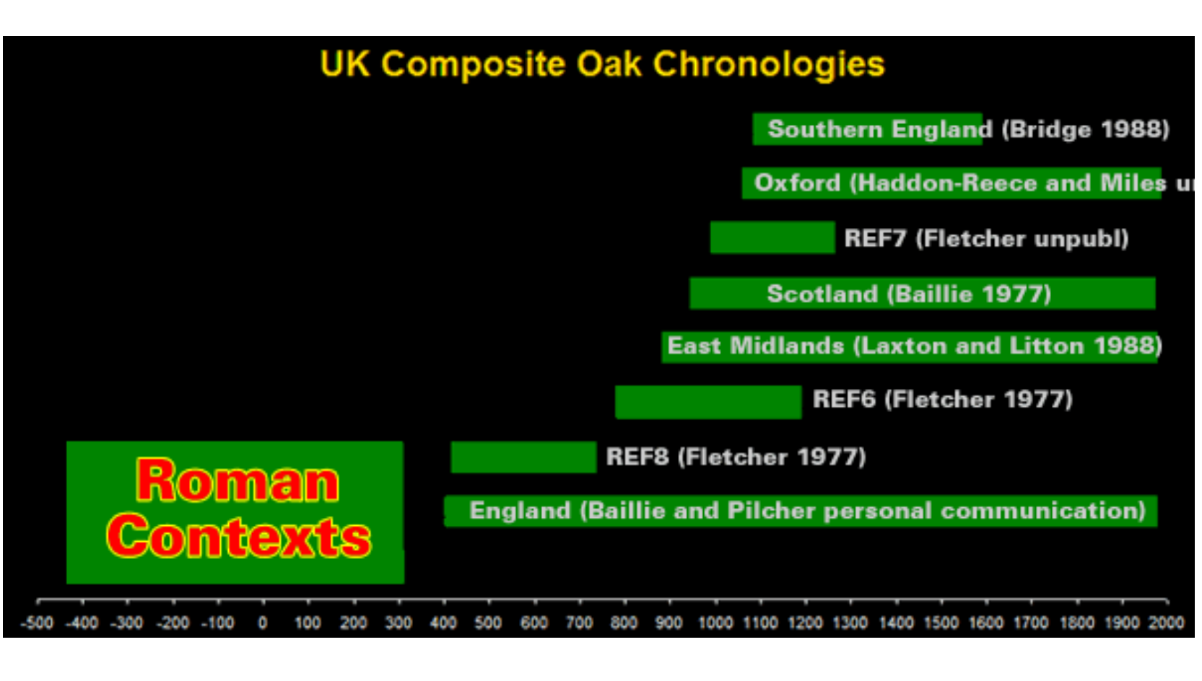
Radiocarbon dating could become self-reliant by dumping dubious ***dendrochronological calibration*** and adopting a self-calibrating technique based upon the Δ14C values …

Malaga Bay - A Carbon-14 Chronology
https://malagabay.wordpress.com/2014/09/08/a-carbon-14-chronology/

Dendrochronologists string together long ***chronologies*** by pattern matching the tree rings of individual wood samples obtained from various sources in a process known as ***bridging.***

Dendrochronologists also create even longer ***composite chronologies*** by pattern matching the tree rings from several ***chronologies*** using the same ***bridging*** technique.

Malaga Bay - Heinsohn and The Missing Trees
https://malagabay.wordpress.com/2015/11/17/heinsohn-and-the-missing-trees/



After 20 years of enthusiastic expansion their ***concrete chronologies*** had more than a few problems and their expansion had **failed** to ***bridge*** the 4th century to their ***Roman Contexts***.

This meant their ***concrete chronologies*** had the unscientific privilege of being **disconnected** from their bizarre ***floating chronologies*** with ***fixed* dates** "covering 434 BC – AD 315".

Malaga Bay - Deranged Dating: The Roman Problem
https://malagabay.wordpress.com/2017/11/24/deranged-dating-the-roman-problem/

The ***Early Roman Rulers*** adjustment of 1,180 years suggests the **Pompeii brickwork** was laid [in round numbers] sometime **after 1150 CE**.

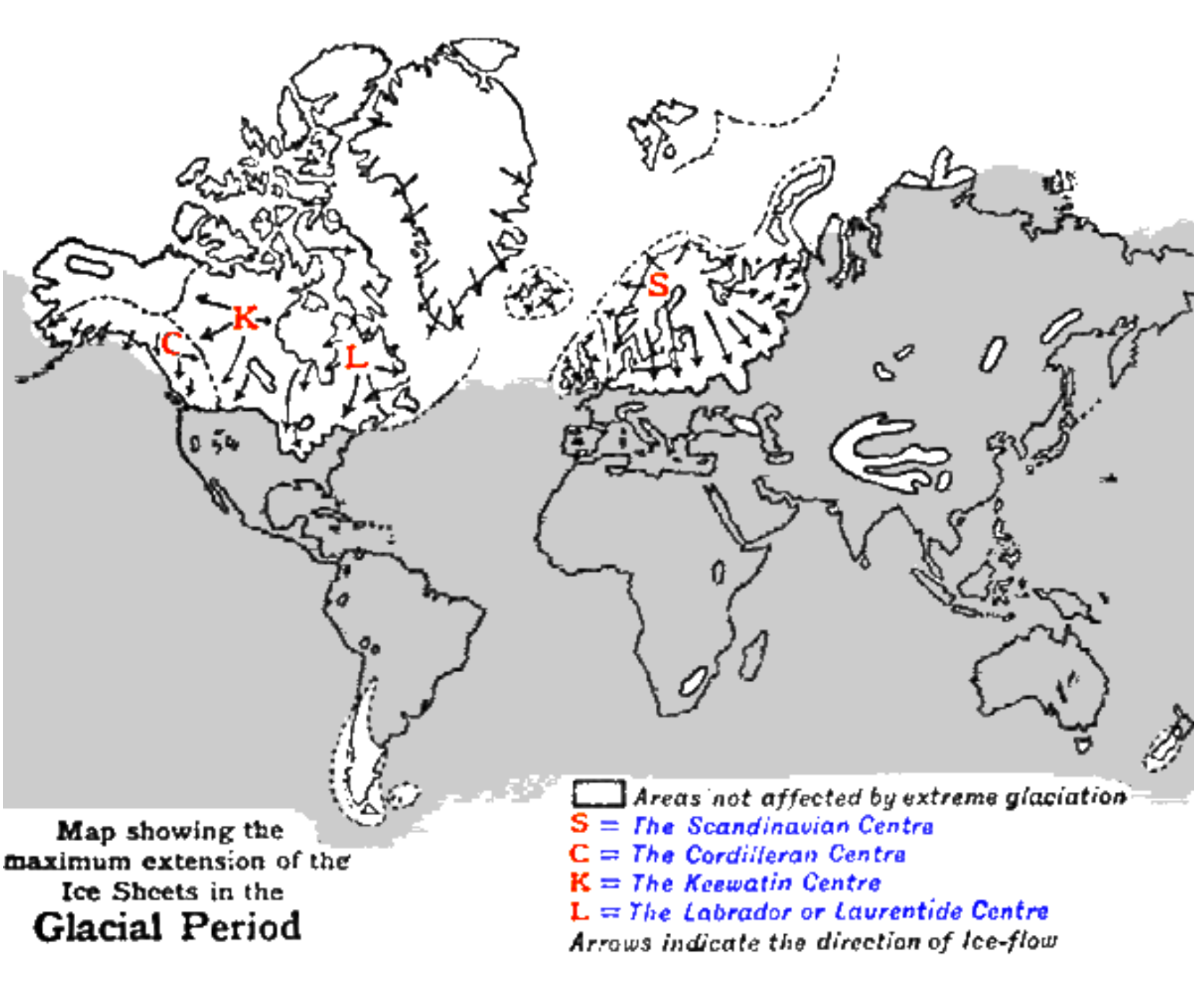
Malaga Bay - Vesuvius Chronology
https://malagabay.wordpress.com/2021/10/26/vesuvius-chronology/

Sadly, ***dendrochronologists*** [like most *mathematical magicians*] **don't remember** that when you ***mix and mash*** your data **too much** you simply end up with a **large brown smelly turd.**

Malaga Bay - Dendrochronology: The Plasticine Effect
https://malagabay.wordpress.com/2014/08/23/dendrochronology-the-plasticine-effect/

Greenland Glaciology

The **undated Glacial Period** [aka **Great Ice Age** aka **Pleistocene**] was formally invented **1839**.



PLEISTOCENE, in geology, the epoch which succeeded the Pliocene, it is the last of the Tertiary periods, and hence the lower subdivision of the quaternary or modern era.

The name was **introduced** by Sir C. Lyell **in 1839**, the rocks of this period containing a higher percentage of living forms than the youngest of the Tertiary formations.

By many writers "Pleistocene" has been regarded as **synonymous with "Glacial Period"** or the "Diluvium" of some geologists. In the northern hemisphere the protracted period of glaciation, with its predominating influence upon modern topography and faunal distribution, was undoubtedly the outstanding feature of the time.

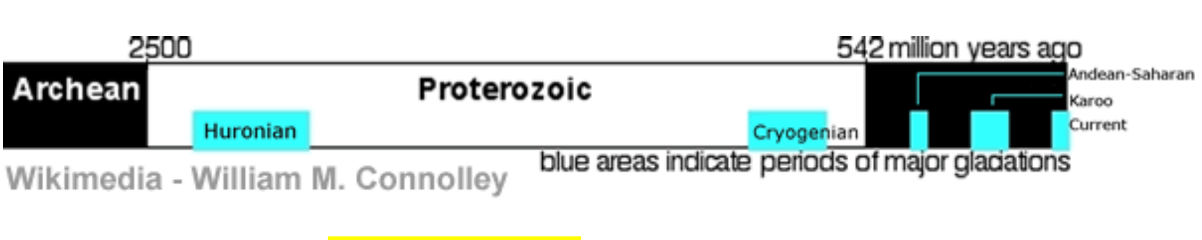
Encyclopædia Britannica - 1911 - Volume 21
Pleistocene - John Allen Howe
https://en.wikisource.org/wiki/1911_Encyclop%C3%A6dia_Britannica/Pleistocene

GLACIAL PERIOD, in geology, the name usually given, by English and American writers, to that comparatively recent time when all parts of the world suffered a marked lowering of temperature, accompanied in northern Europe and North America by glacial conditions, not unlike those which now characterize the Polar regions.

This period, which is **also known as the "Great Ice Age"** (German Die Eiszeit), is **synchronous with the** Pleistocene **period**, the earlier of the Post-Tertiary or Quaternary divisions of geological time.
…
Not until the beginning of the 19th century did the deposits now generally recognized as the result of ice action receive serious attention; the tendency was to regard such superficial and irregular material as mere rubbish. Early ideas upon the subject usually assigned floods as the formative agency, and this view is still not without its supporters
(see Sir H. H. Howorth, The Glacial Nightmare and the Flood).

Encyclopædia Britannica - 1911 - Volume 21
Glacial Period by John Allen Howe
https://en.wikisource.org/wiki/1911_Encyclop%C3%A6dia_Britannica/Glacial_Period

The invention of the **Glacial Period** in **1839** inevitably spawned the invention of other **Ice Ages**.

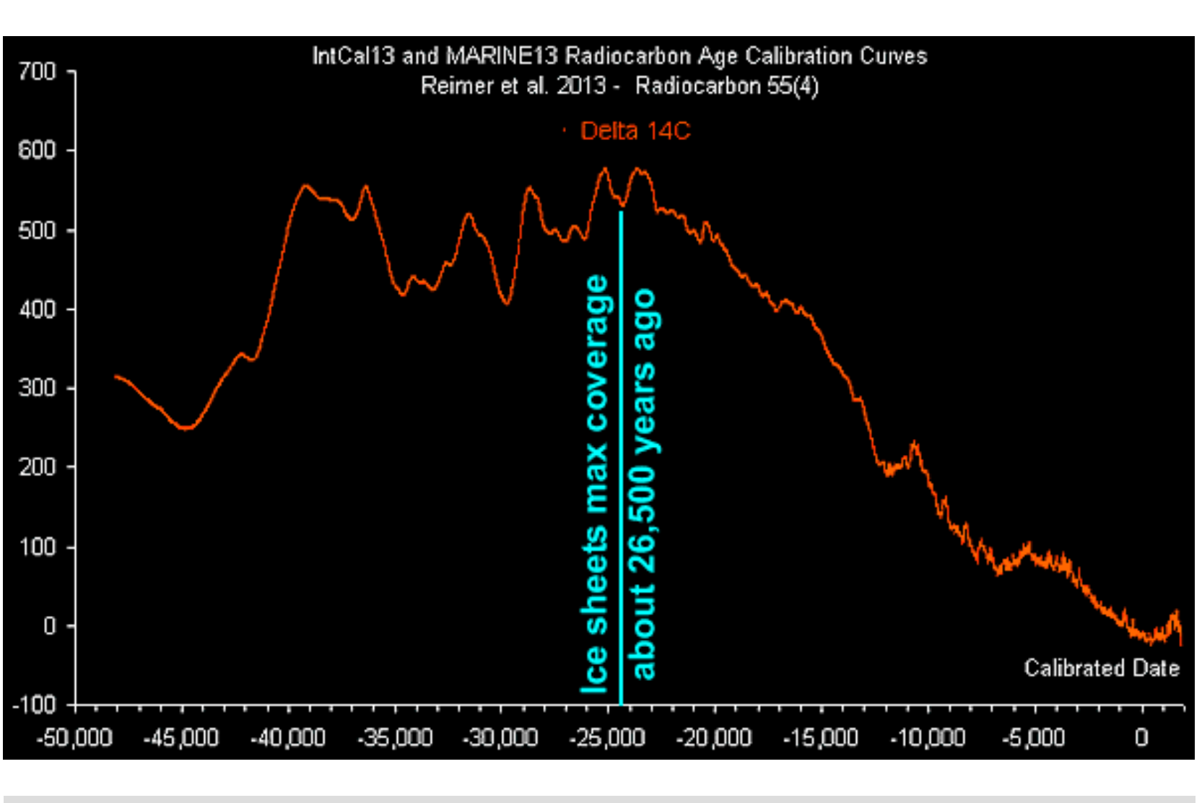


Wikimedia - William M. Connolley

There have been **at least five major ice ages** in Earth's history
(Huronian, Cryogenian, Andean-Saharan, late Paleozoic, and the latest Quaternary Ice Age).
…
The causes of ice ages are not fully understood for either the large-scale ice age periods or the smaller ebb and flow of glacial–interglacial periods within an ice age.

Wikipedia - Ice Age
https://en.wikipedia.org/wiki/Ice_ages

The invention of **radiocarbon dating** in **1949** inevitably led to the dating of the **Last Ice Age**.



Malaga Bay - Alaskan Muck: Dating Debacle
https://malagabay.wordpress.com/2019/07/08/alaskan-muck-dating-debacle/

… the **Last Ice Age** … occurred from the end of the Last Interglacial **to the end of the Younger Dryas**, encompassing the period **c. 115,000 – c. 11,700 years ago**.

Wikipedia - Last Glacial Period
https://en.wikipedia.org/wiki/Last_Glacial_Period

The **Younger Dryas**, which occurred **circa 12,900 to 11,700 years BP**, was a return to glacial conditions which temporarily reversed the gradual climatic warming after the **Last Glacial Maximum**, which lasted from **circa 27,000 to 20,000 years BP**.

Wikipedia - Younger Dryas
https://en.wikipedia.org/wiki/Younger_Dryas

Modern humans evolved in Africa around 300,000 years ago …
They **migrated out of Africa during the Last Glacial Period** (Ice Age) and had populated most of the Earth by the time the Ice Age ended 12,000 years ago.

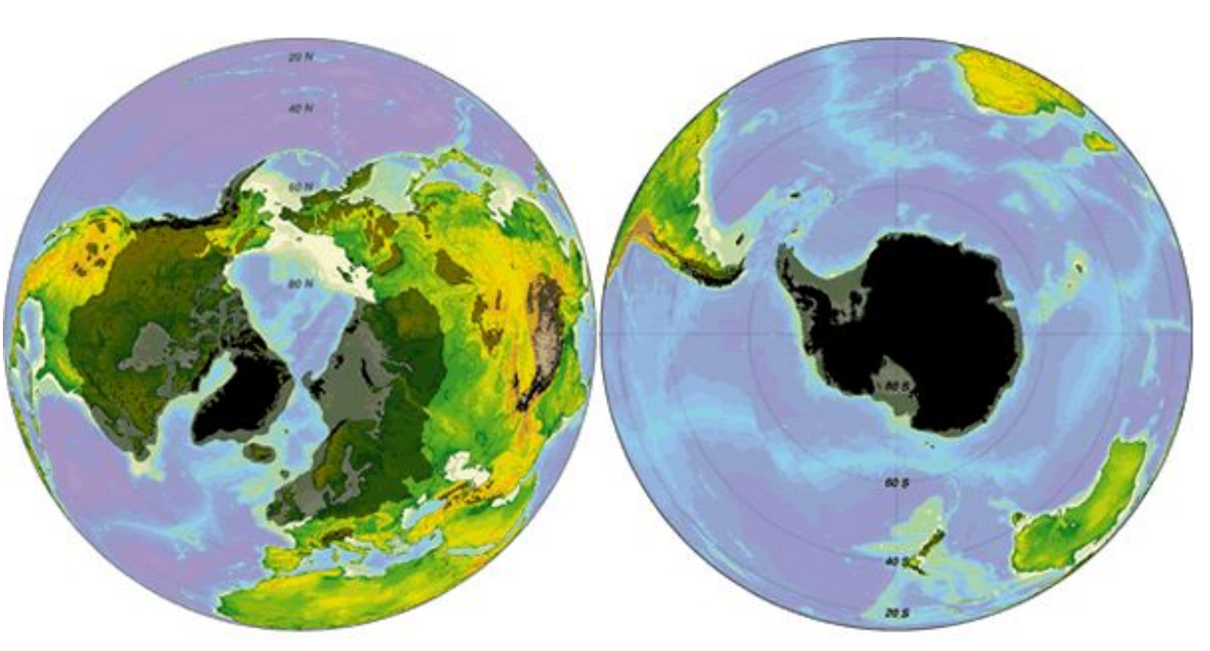
Wikipedia - Human History
https://en.wikipedia.org/wiki/Human_history

Woolly mammoths survived on Saint Paul Island **until around 3,750 BC** …

Wikipedia - St. Paul, Alaska
https://en.wikipedia.org/wiki/St._Paul_Island,_Alaska

And

The dating of the **Last Ice Age** inevitably led to the dating of the **Pleistocene** in **2009**.



Recent (black) and Maximum (grey) glaciation
Wikimedia: Hannes Grobe/AWI

The **Pleistocene** (often referred to colloquially as the **Ice Age**) is the geological epoch that lasted **from c. 2.58 million to 11,700 years ago**, spanning the Earth's **most recent period of repeated glaciations.**

Before a change was finally confirmed in 2009 by the International Union of Geological Sciences, the cutoff of the Pleistocene and the preceding Pliocene was regarded as being 1.806 million years Before Present (BP).

Wikipedia - Pleistocene
https://en.wikipedia.org/wiki/Pleistocene

However, there are problems associated with the mainstream ***Ice Core Chronologies***.

More specifically:

The problems for any ***Glaciologist*** hoping to date the **Greenland Ice Sheet** [or dreaming about establishing the past climate] begins with the summer accumulation of surface **Cryoconite**.

Cryoconite holes on the Greenland ice sheet

Microbes on ice: Climate amplifiers?
Climatica – Joseph Cook – 9 December 2013
https://web.archive.org/web/20150326134001/http://climatica.org.uk/microbes-ice-climate-amplifiers

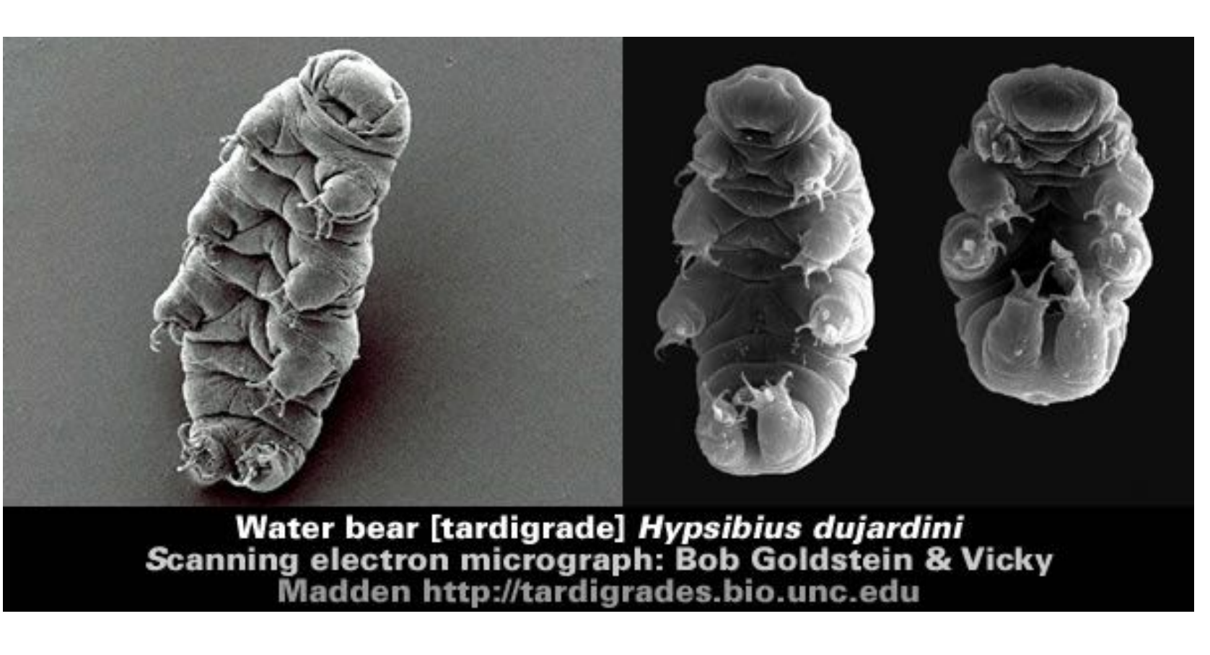
Cryoconite is powdery windblown **dust** made of a combination of small **rock particles**, **soot**, **volcanic ash**, and **microbes** which is deposited and builds up on snow, glaciers, or ice caps.

The darkening, especially from small amounts of soot, absorbs solar radiation melting the snow or ice beneath the deposit, and sometimes creating a cryoconite hole.

Cryoconite **may** contain **dust from far away continental deserts or farmland**,
particles from volcanic eruptions or
power plant emissions, and
soot.
…
During summer, **cryoconite holes** frequently **contain liquid water** and thus provide a niche for cold-adapted **microorganisms** like bacteria, algae **and animals** like rotifers and tardigrades to thrive.

Cryoconite typically settles and concentrates at the bottom of these holes creating a **noticeable dark mass.**

Wikipedia - Cryoconite
https://en.wikipedia.org/wiki/Cryoconite



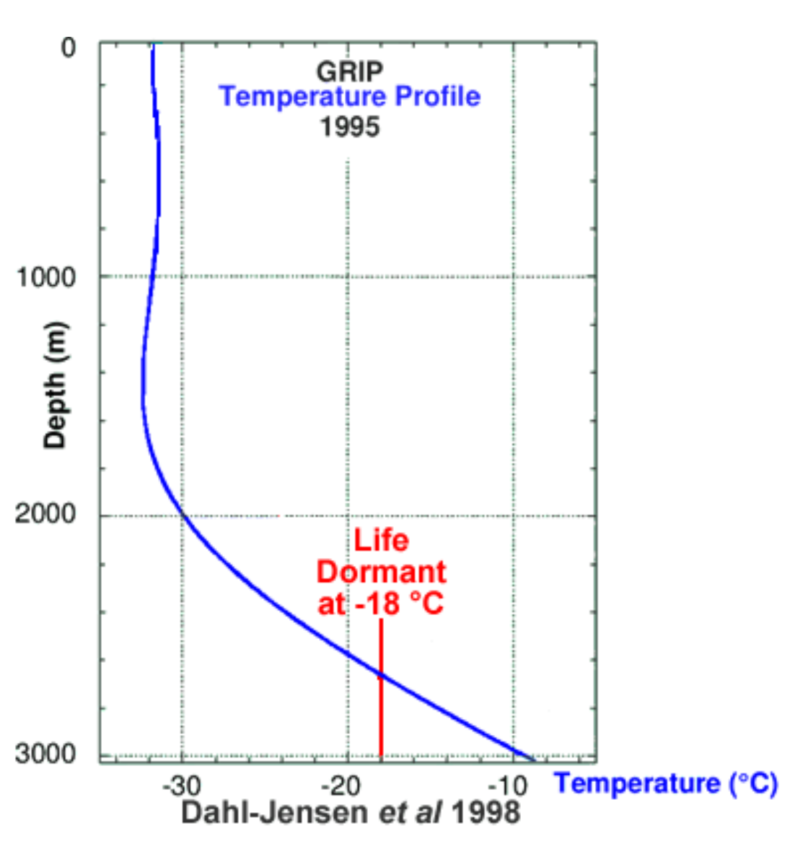
Water bear [tardigrade] ***Hypsibius dujardini***
Scanning electron micrograph: Bob Goldstein & Vicky Madden http://tardigrades.bio.unc.edu

One of the important concepts that *Earth Scientists* should be aware of is that ***Life on Earth*** is generally deemed to be **dormant at −18 °C** [or below].

Conversely, *Life on Earth* is generally deemed to be **active from around −17 °C** up to an uncertain upper limit that may be as high as 151 °C.

Therefore, *Earth Scientists* should **not** consider an **ice sheet** to be always devoid of life.

Malaga Bay - Frozen Fauna
https://malagabay.wordpress.com/2015/11/26/frozen-fauna/



Past Temperatures Directly from the Greenland Ice Sheet
D Dahl-Jensen, K Mosegaard, N Gundestrup, G D Clow,
S J Johnsen, A W Hansen, and N Balling
Science - Vol 282 - 9 October 1998
https://www.researchgate.net/publication/237131406

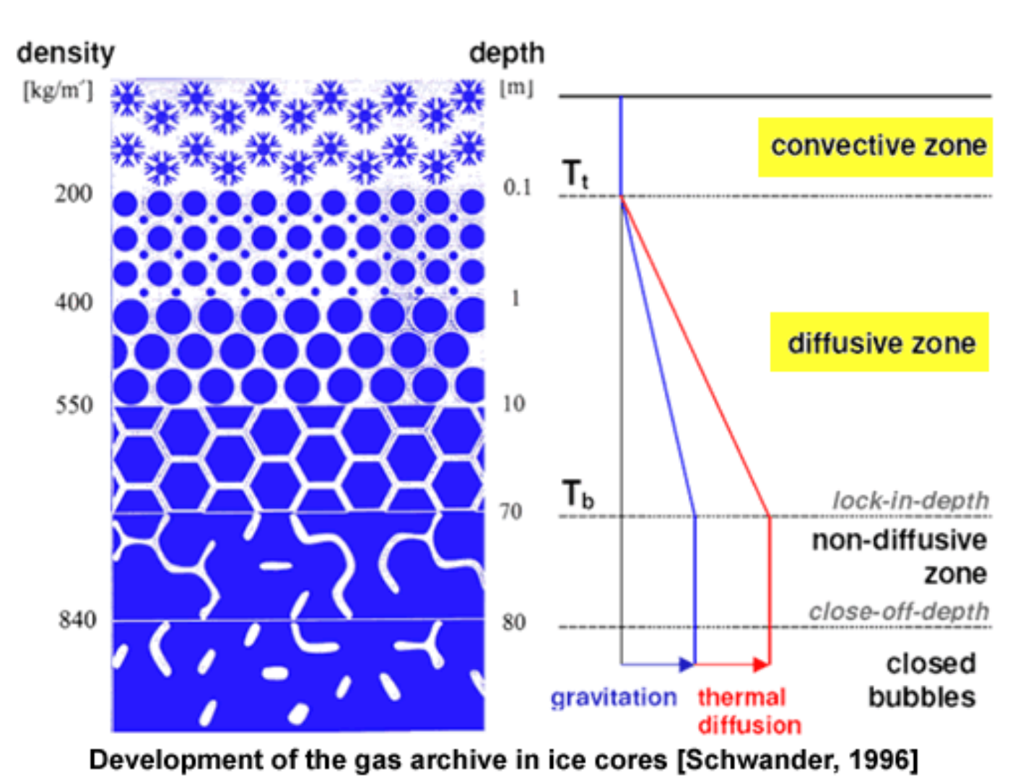
The surface **cryoconite** deposited during a summer season slowly gets buried and compressed under successive layers of winter **snow** and summer **cryoconite** that may [or may **not**] be associated with summer **melt layers** of refrozen surface water and a few inches of summer **snow**.

In **central Greenland** a typical year might produce **two or three feet of winter snow**, plus a **few inches of summer snow**.

When this turns to ice, **the two layers** will **make** up **no more than a foot of ice**.

Wikipedia - Ice Core
https://en.wikipedia.org/wiki/Ice_core#Visual_analysis

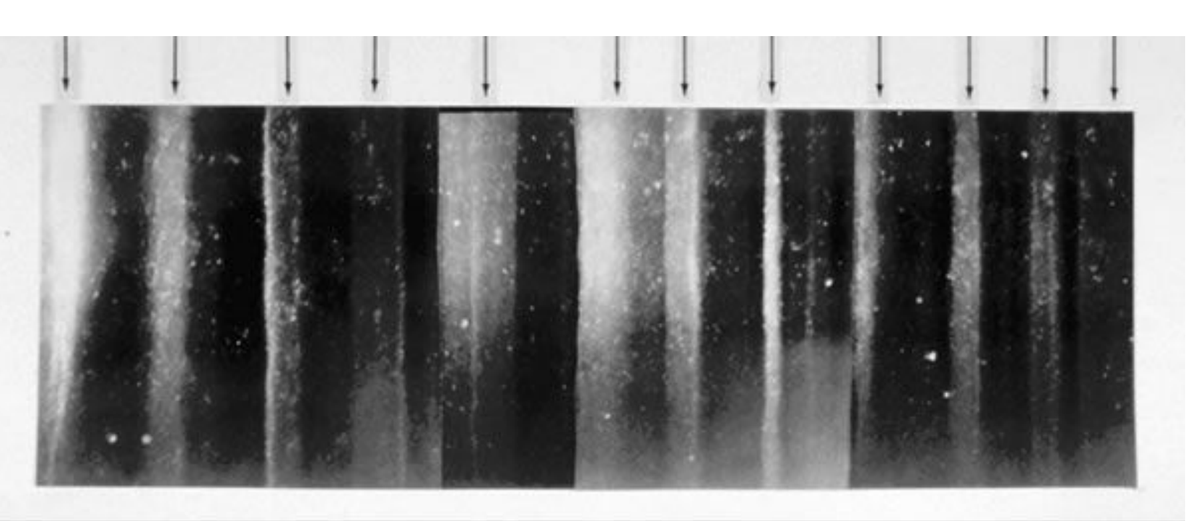
The weight of the overlying **snow** soon compresses the buried winter **snow** into crystalline **firn**.



Development of the gas archive in ice cores [Schwander, 1996]
A Short Primer on Ice Core Science – Hubertus Fischer

Malaga Bay - Monte Rosa Modelling
https://malagabay.wordpress.com/2018/11/30/monte-rosa-modelling/

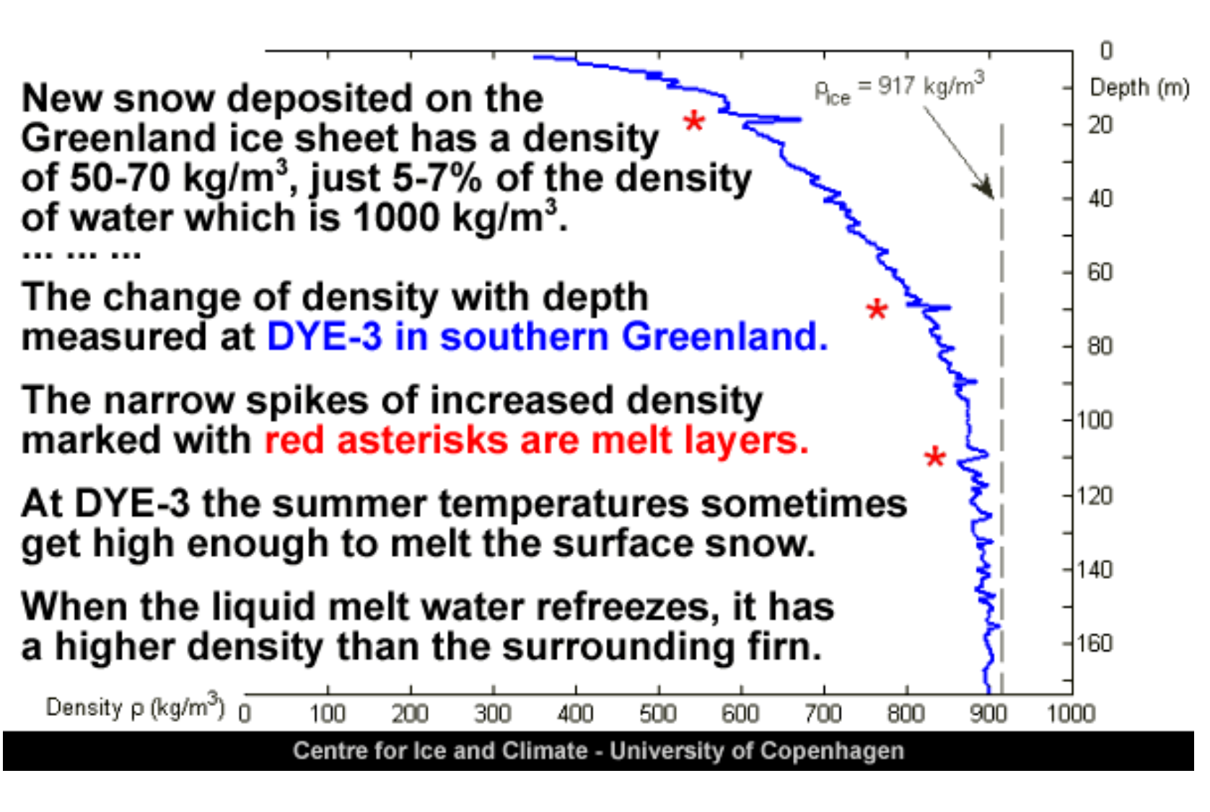
The compression process slowly proceeds [with depth] and the layers of crystalline **firn** is largely ***degassed*** to form layers of winter **ice** separated by layers of summer **cryoconite** [along with any associated summer **snow** and **melt layers**].



19 cm section of GISP 2 ice core from 1855 m showing annual layer structure illuminated from below by a fiber optic source
The section contains 11 annual layers with summer layers (arrowed) sandwiched between darker winter layers
Average: 17.27 mm per year at 1,855 metres

Malaga Bay - Chronology: 1 – Ice Cores
https://malagabay.wordpress.com/2013/06/18/chronology-ice-cores/

Overall, the compression of the **ice** and **cryoconite** layers stops at a depth of around 200 metres.

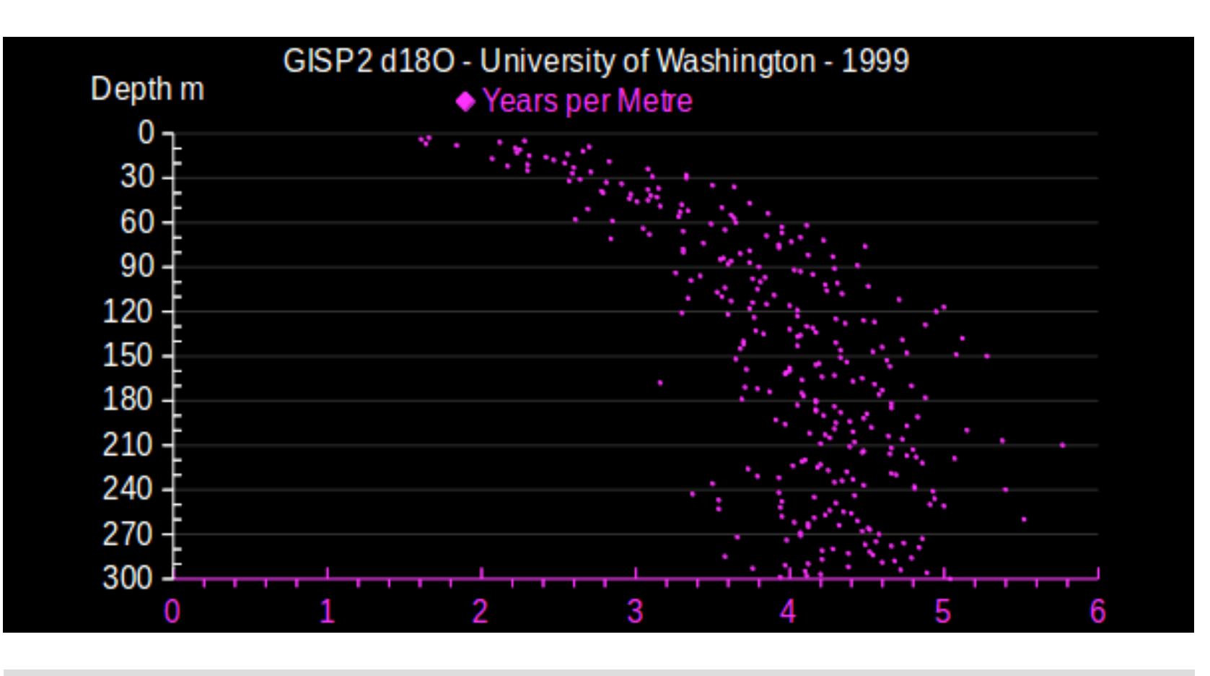


New snow deposited on the Greenland ice sheet has a density of 50-70 kg/m³, just 5-7% of the density of water which is 1000 kg/m³.
… … …
The change of density with depth measured at DYE-3 in southern Greenland.
The narrow spikes of increased density marked with red asterisks are melt layers.
At DYE-3 the summer temperatures sometimes get high enough to melt the surface snow.
When the liquid melt water refreezes, it has a higher density than the surrounding firn.

Centre for Ice and Climate - University of Copenhagen

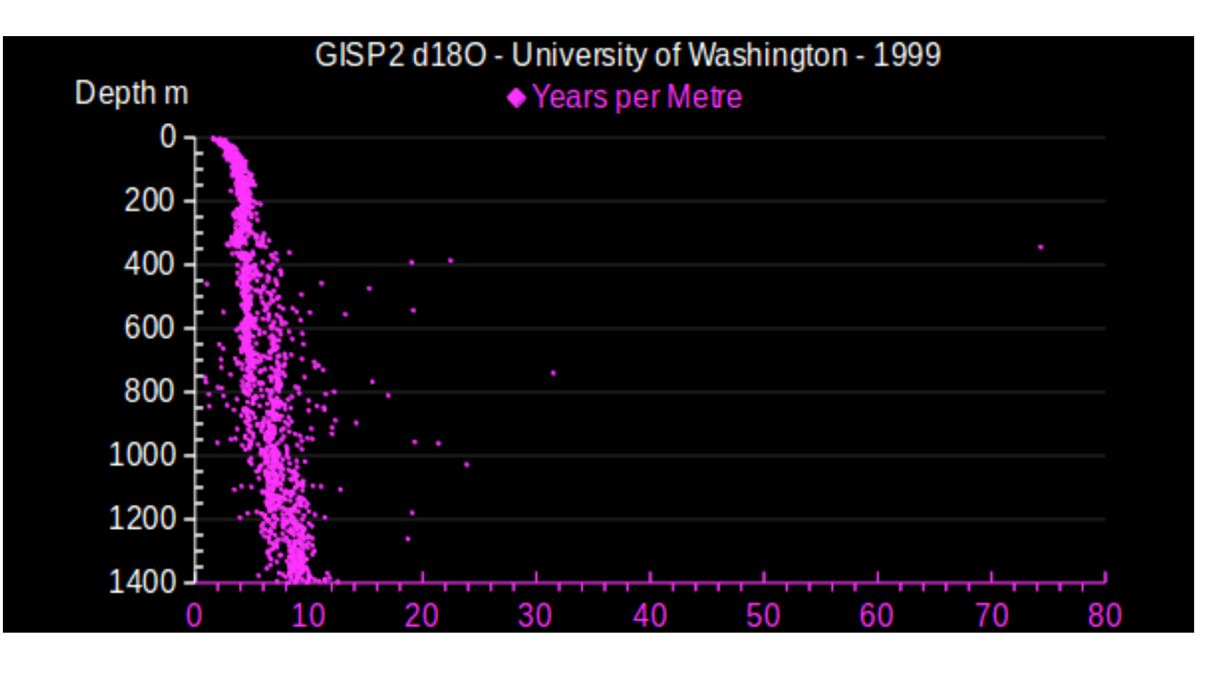
The **density of ice** approaches **a peak of 917 kg/m³** in **ice cores at** … **about 200 metres** …

Malaga Bay - Chronology: 2 – Greenland and Oxygen Isotopes
https://malagabay.wordpress.com/2013/06/27/chronology-2-greenland-and-oxygen-isotopes/

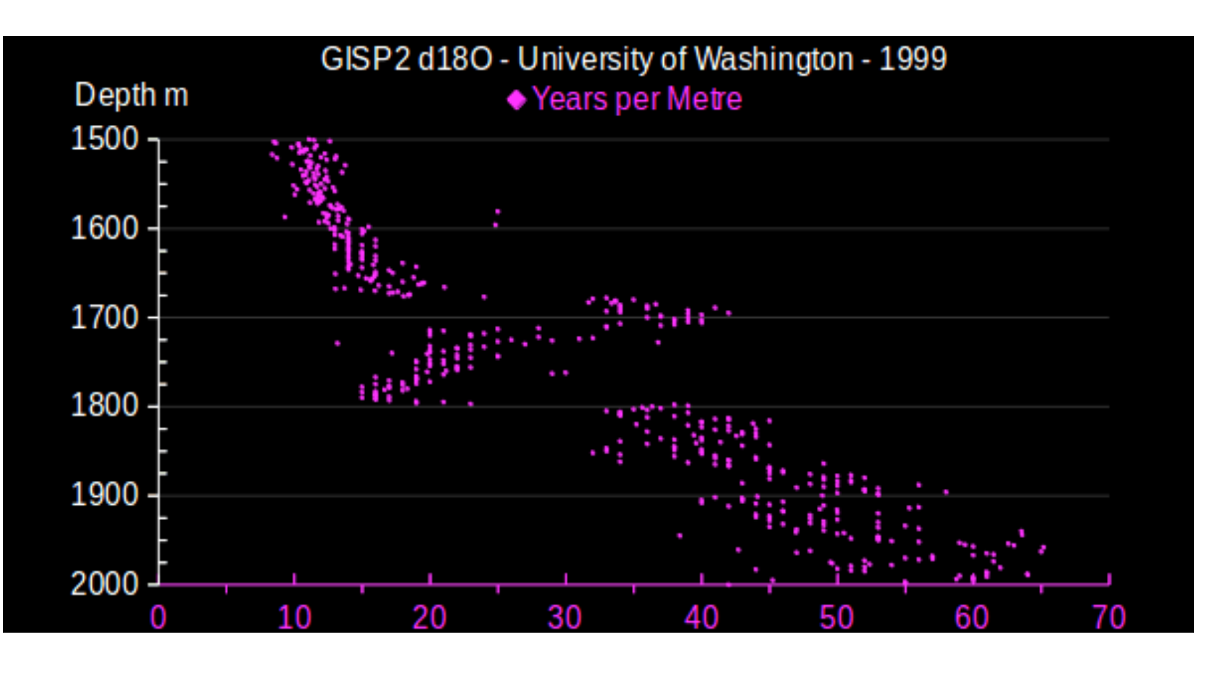


The entire continuous GISP2 delta 18O sample data set (excluding the silty ice samples)
University of Washington's Quaternary Isotope Laboratory - 5 March 1999
https://web.archive.org/web/20060517193048/http://depts.washington.edu/qil/datasets/gisp2_silty_ice.txt

Ice flows [plastically] like a **very** viscous liquid [unless it is constrained by a physical barrier] and any subsequent thinning of an annual layer [below around 200 metres] is attributed to **flowing ice**.



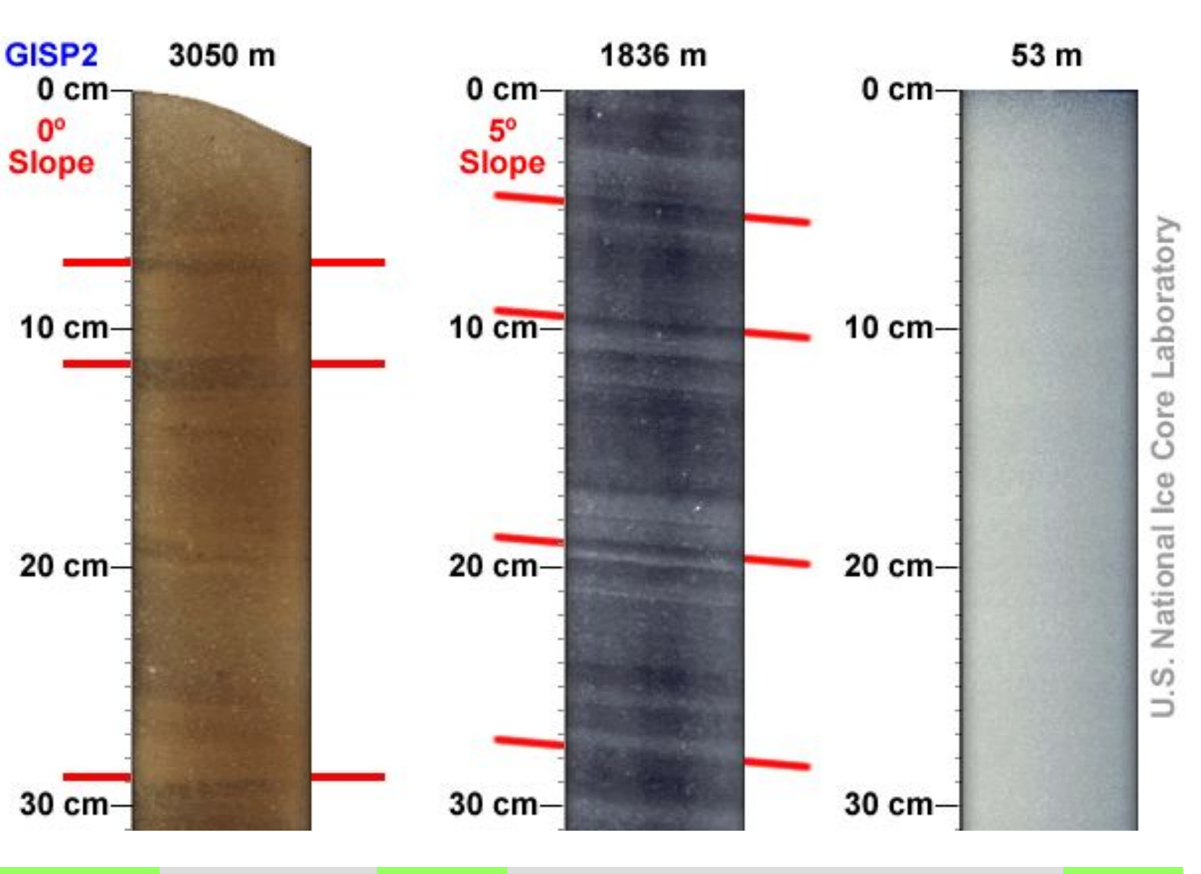
Unexpected variations in the measured thickness of the annual layers may arise because of changes in the climate **and/or** catastrophic events **and/or** human **errors**.



The down slope **flow** of the domed **Greenland Ice Sheet** is very clearly revealed by the **5º degree slope** of the annual layers in the **GISP2 ice core** seen [for example] at a depth of 1,836 metres.

In contrast:

The brown **silty ice** at the bottom of the **GISP2 ice core** [for example] at a depth of 3,050 metres has been **prevented** from **flowing** because the layers are very visibly **horizontal** e.g. 0º slope.



GISP2 Depth Metres	Sample Increment cm	Age BP	Calendar Date	Sample Increment Years	Sample Accumulation Rate mm/yr	Delta 18O
1,836.00	20.00	16,161	-14,211	7.40	27.03	-43.04
1,836.20	20.00	16,168	-14,218	7.40	27.03	-39.61
Average	20.00			7.40	27.03	-41.33
Equivalent	30.00			11.10		

The entire continuous GISP2 delta 18O sample data set (excluding the silty ice samples)
University of Washington's Quaternary Isotope Laboratory - 5 March 1999
https://web.archive.org/web/20060517193048/http://depts.washington.edu/qil/datasets/gisp2_silty_ice.txt

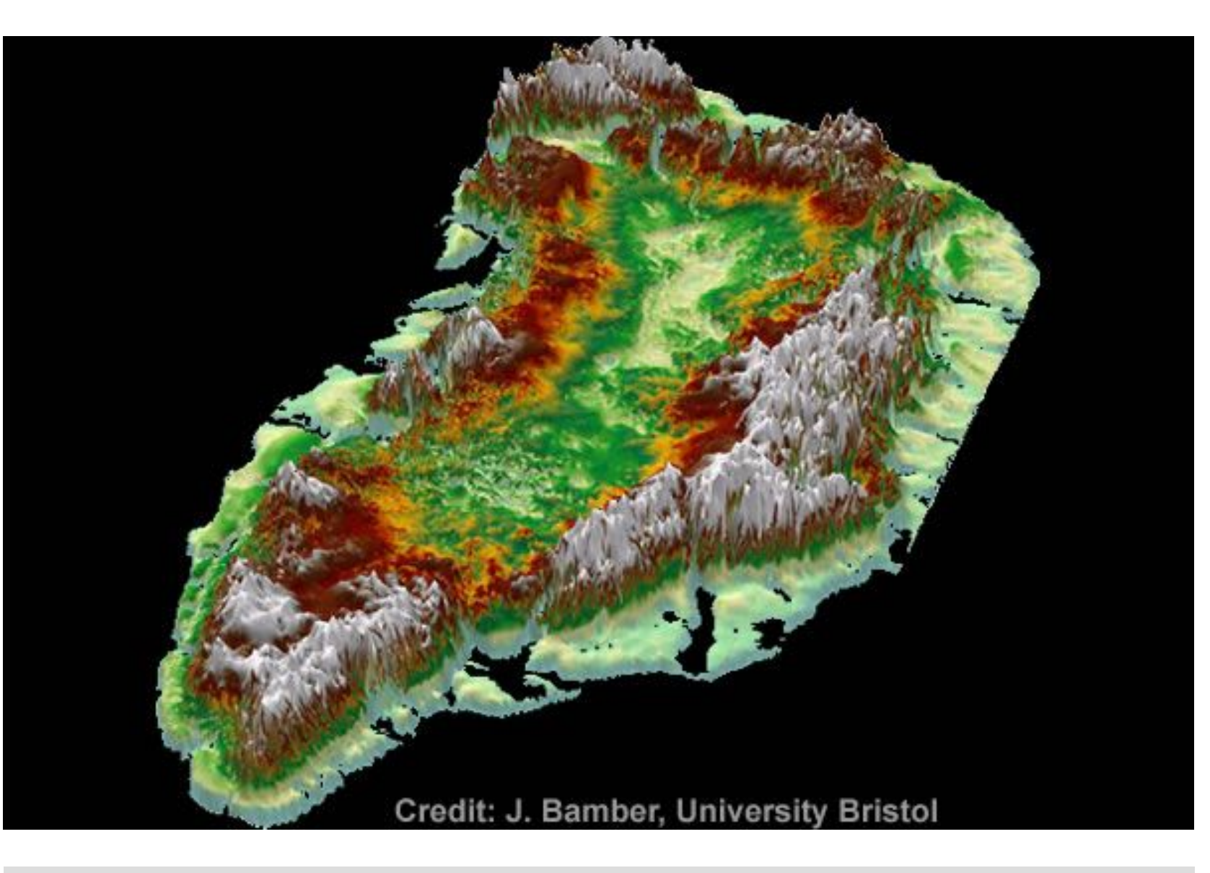
By the time Alley and the **GISP2** project finished in the early 1990s, they had pulled a nearly 2-mile-long *core* (**3,053.44 meters**) from the **Greenland** ice sheet, providing a record of **at least the past 110,000 years**.
…
The gradually increasing weight of overlying layers compresses deeply buried snow into ice, but annual bands remain. Relatively young and shallow snow becomes packed into coarse and granular crystals called **firn (top: 53 meters deep)**.

Older and deeper snow is compacted further (middle: 1,836 meters).

At the bottom of a core **(lower: 3,050 meters), rocks, sand, and silt discolor the ice**. (Photographs courtesy U.S. National Ice Core Laboratory)

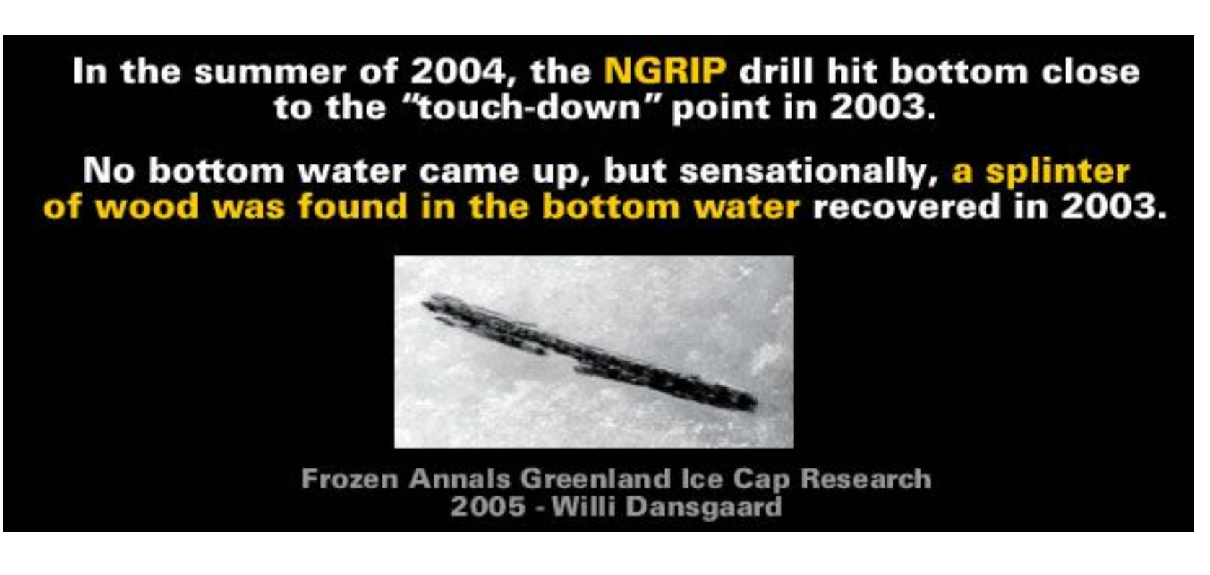
Frozen in Time: The Ice Core Record - Holli Riebeek - 15 December 2005
NASA Earth Observatory
https://web.archive.org/web/20140531051753/http://earthobservatory.nasa.gov/Features/Paleoclimatology_IceCores/

The **silty ice** of the **GISP2 ice core** is evidently trapped in the **Greenland Basin**.



Credit: J. Bamber, University Bristol

Under the Greenland Ice Sheet - LiveScience - 29 August 2013
https://web.archive.org/web/20140104201729/https://www.livescience.com/39298-under-the-greenland-ice-sheet.html



In the summer of 2004, the NGRIP drill hit bottom close to the "touch-down" point in 2003.

No bottom water came up, but sensationally, a splinter of wood was found in the bottom water recovered in 2003.

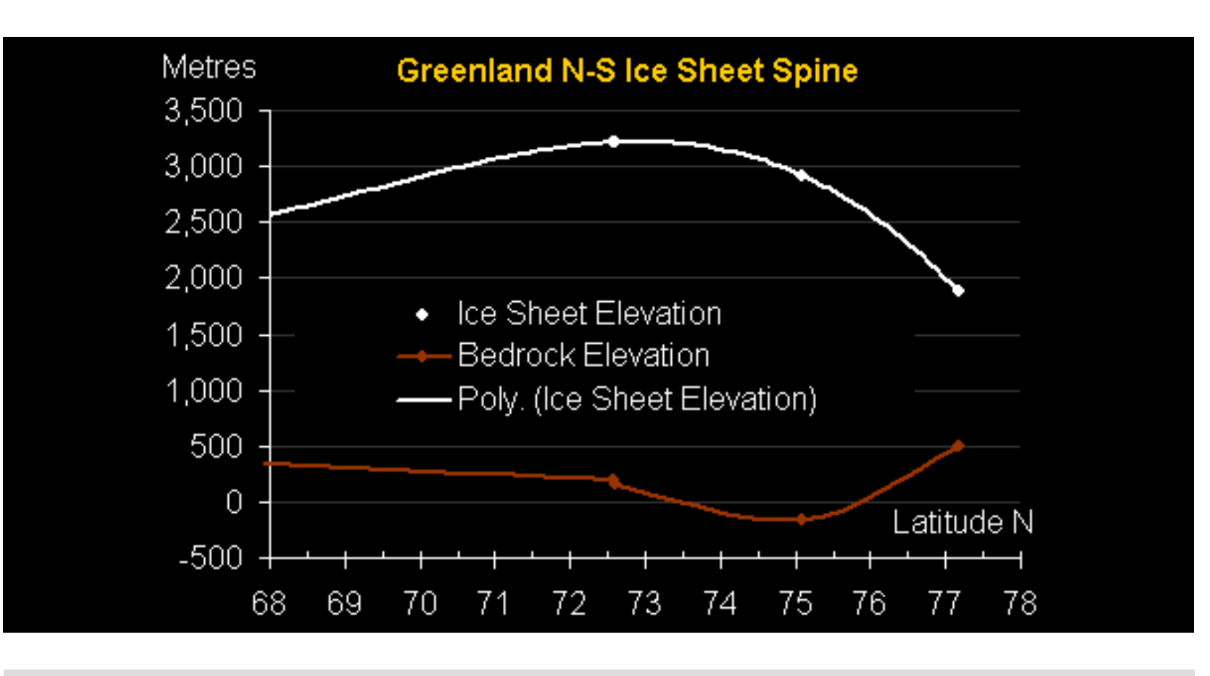
Frozen Annals Greenland Ice Cap Research
2005 - Willi Dansgaard

… **Greenland** forms a **natural basin** with the lowest level of this basin reaching **down to** about **963 metres below sea level** according to the National Snow and Ice Data Center.

Malaga Bay - The Great Greenland Snow Job - 06 - The $64,000 Question
https://malagabay.wordpress.com/2014/12/05/the-great-greenland-snow-job-06-the-64000-question/

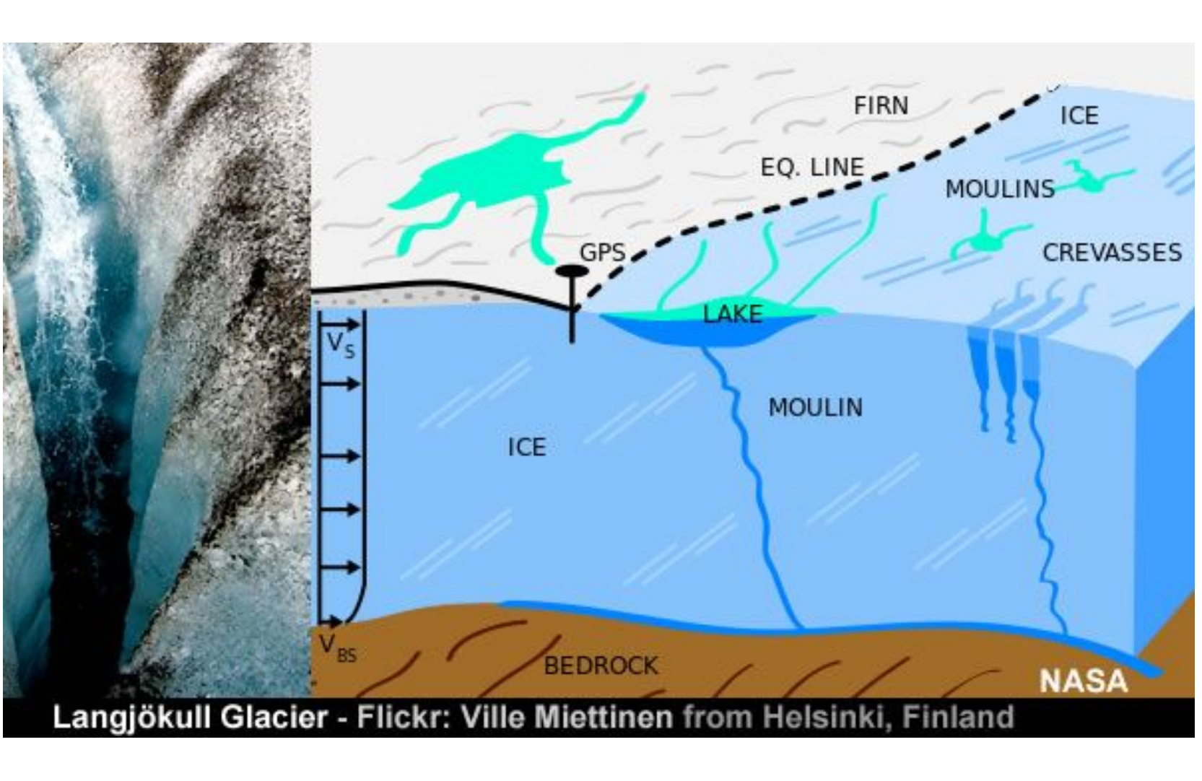
The unconstrained uppermost sections of the **Greenland Ice Sheet flow** in **all** directions whilst the more constrained lower sections **flow** by following the *path of least resistance* towards the outlet channels from the **Greenland Basin**.

Overall, the **Greenland Ice Sheet** profile suggests the bulk of its **flow** is currently South to North.



Malaga Bay - The Great Greenland Snow Job - 07 - Bending Time
https://malagabay.wordpress.com/2014/12/09/the-great-greenland-snow-job-07-bending-time/

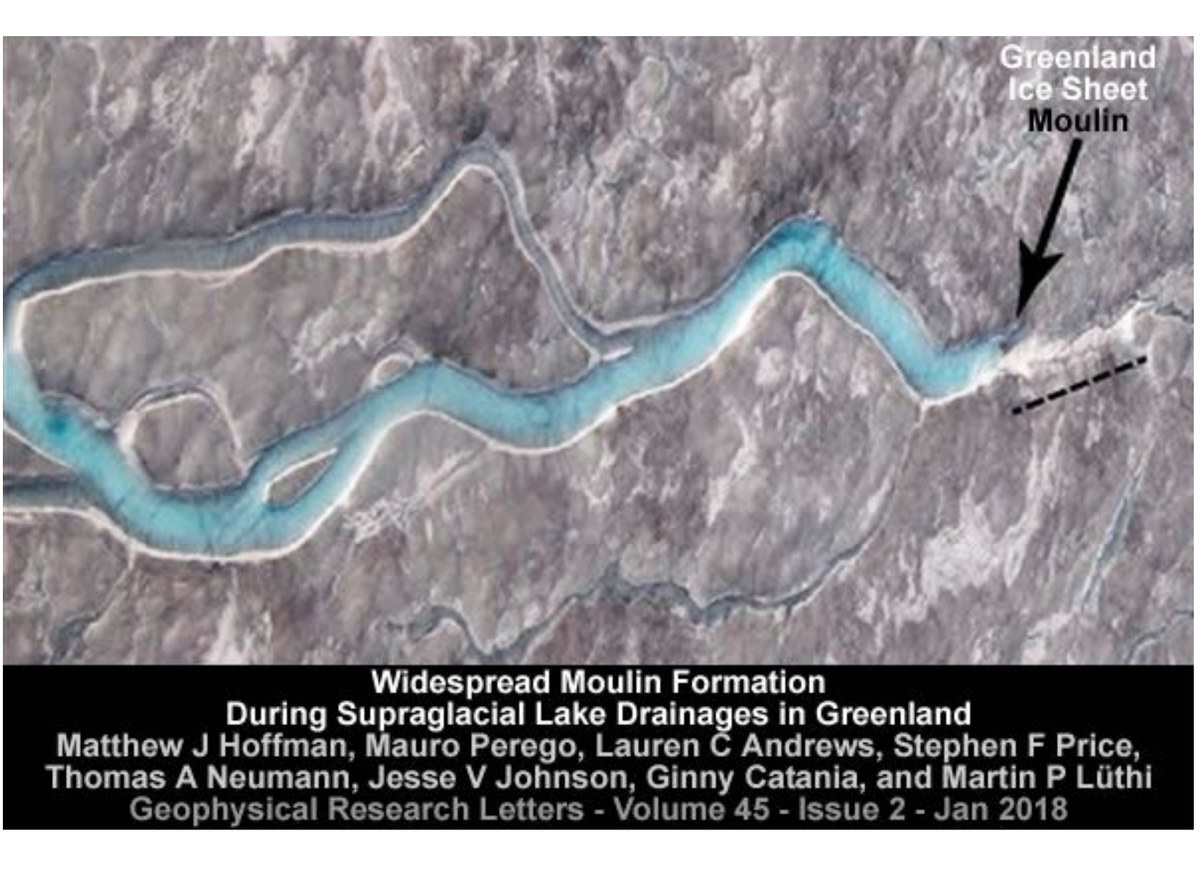
The origin of the **silty ice** of the **GISP2 ice core** is probably associated with an ancient **river/lake or** surface **melt water** channelled down to the base of the **Greenland Ice Sheet** via **moulins**.



Langjökull Glacier - Flickr: Ville Miettinen from Helsinki, Finland

A **moulin** is a roughly circular, vertical (or nearly vertical) **well-like shaft** formed where a **surface meltstream exploits a weakness in the ice**.

Wikipedia - Moulin (geomorphology)
https://en.wikipedia.org/wiki/Moulin_(geomorphology)



Widespread Moulin Formation
During Supraglacial Lake Drainages in Greenland
Matthew J Hoffman, Mauro Perego, Lauren C Andrews, Stephen F Price, Thomas A Neumann, Jesse V Johnson, Ginny Catania, and Martin P Lüthi
Geophysical Research Letters - Volume 45 - Issue 2 - Jan 2018

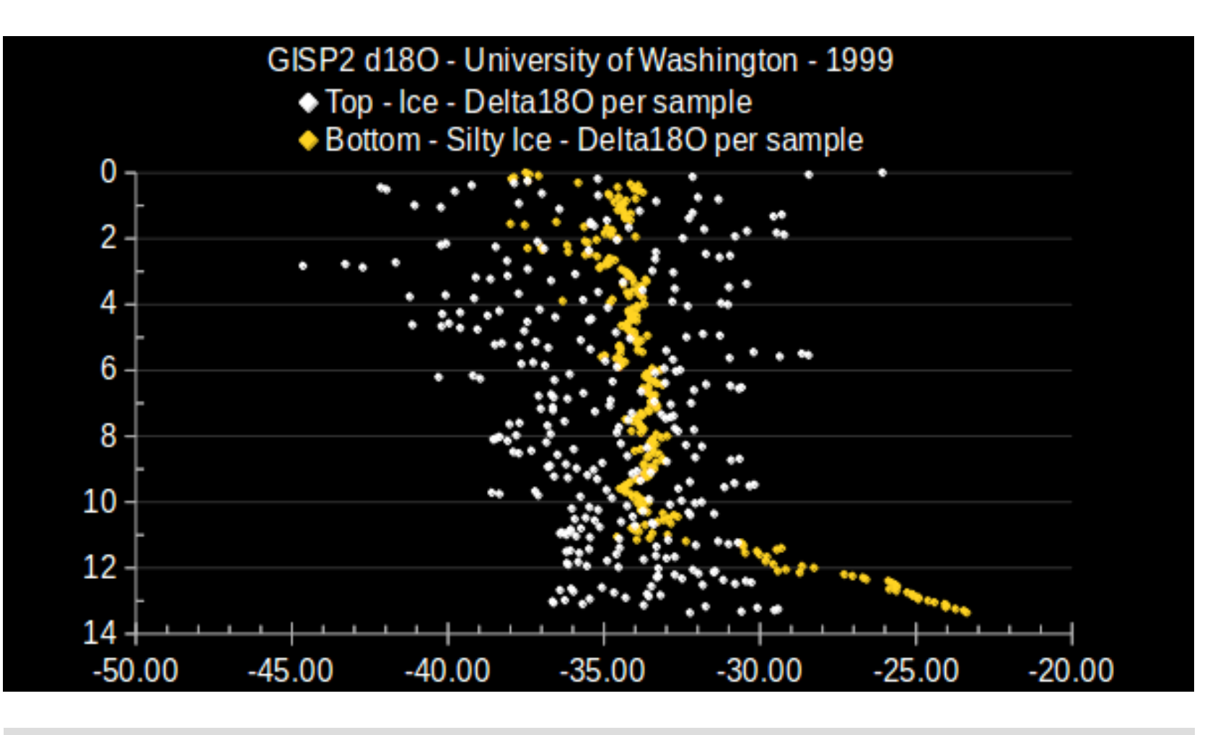
Nearly all proglacial **water discharge** from the **Greenland Ice Sheet is routed englacially** via **moulins**. Crevasse and moulin formation is dependent on persistent (crevasses) or transient (moulin initiation) stresses which result in surface-to-bed hydrofracture (e.g. Hoffman et al., 2018; Christoffersen et al., 2018).

Physically Based and Stochastic Models for
Greenland Moulin Formation, Longevity, and Spatial Distribution
Lauren C Andrews & Kristin Poinar - University of Buffalo - 2019
https://ntrs.nasa.gov/api/citations/20190000701/downloads/20190000701.pdf

The similarities in the ***Delta^{18}O*** profiles from the top and bottom of the **GISP2 Ice Core** suggest the bottom **silty ice** is **refrozen** summer **melt water**. The rapid and turbulent descent of summer **melt water** via a **moulin** may [or may **not**] help to explain the brown **silty** appearance of the bottom **ice**.

Either way:

The GISP2 **silty ice** displays a distinct **basal warming** trend in the final three metres.



The Oxygen Isotope Data for the Silty Ice Section of the GISP2 D core
University of Washington's Quaternary Isotope Laboratory
https://web.archive.org/web/20060517193048/http://depts.washington.edu/qil/datasets/gisp2_silty_ice.txt

Ice sheet dynamics describe the motion within **large bodies of ice** such as those currently on **Greenland** and Antarctica.
…
A number of factors can affect bed temperature, which is intimately associated with basal meltwater. The melting point of water decreases under pressure, meaning that water melts at a lower temperature under thicker glaciers. This acts as a "double whammy", because thicker glaciers have a lower heat conductance, meaning that the **basal temperature is also likely to be higher**.

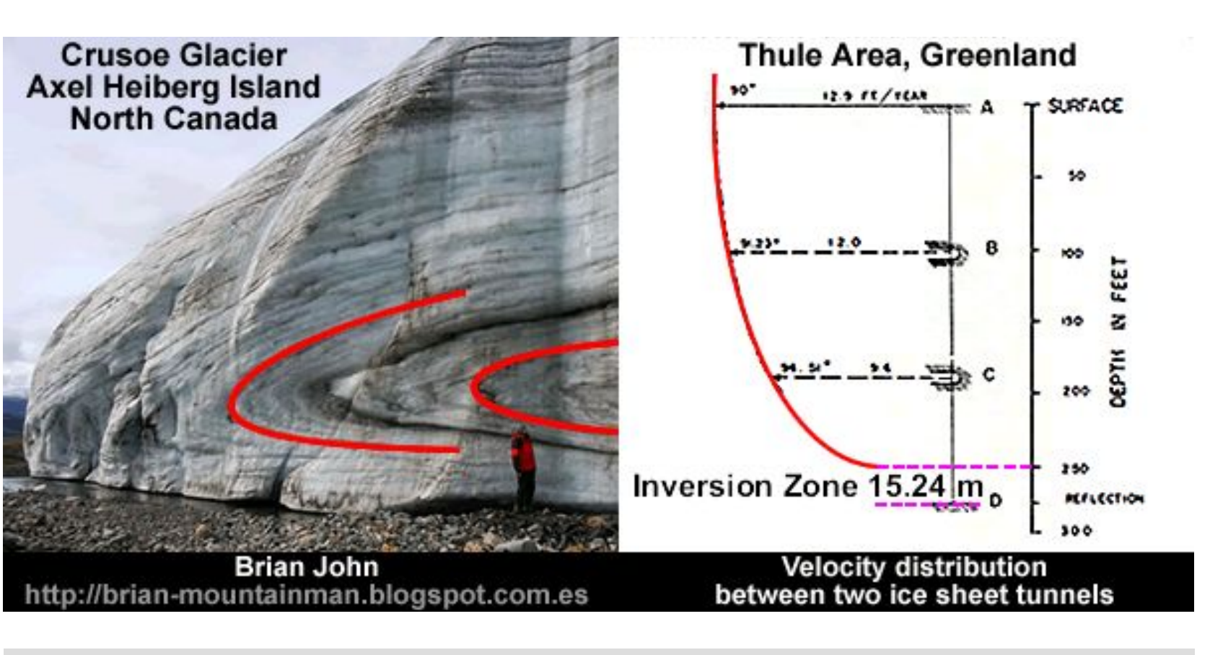
Wikipedia - Ice-sheet Dynamics - 13:12 1 April 2024
https://en.wikipedia.org/w/index.php?title=Ice-sheet_dynamics&oldid=1216691148

The problems with **ice cores don't** end there.

Glaciologists drilling down to bedrock may [or may **not**] encounter the *leading edge* of advancing **ice** [or even a series of *leading edges*] in their **ice core.**

The problem being:

The *leading edge* of an **ice sheet** contains a series of **duplicated annual layers** in **reverse order** caused by the advancing **ice sheet** *plastically* rolling forward [like the tracks on a military tank].



Brian John
http://brian-mountainman.blogspot.com.es
Velocity distribution between two ice sheet tunnels

Glaciation "impossible" on the Wiltshire Downs? - Brian John - 4 December 2009
https://brian-mountainman.blogspot.com/2009/12/glaciation-impossible-on-wiltshire.html

The leading edge of the Greenland Ice Sheet "plastically" flows like a continuous track [aka tank tread or caterpillar track] when the ice sheet is advancing.

Malaga Bay - The Great Greenland Snow Job – 02 – Camp Century Strata
https://malagabay.wordpress.com/2014/11/25/the-great-greenland-snow-job-02-camp-century-strata/

The ice at the bottom of a shaft 100 feet back of the cliff face **has not disturbed** the rocky ground beneath nor even lichen communities, but instead it has **flowed "plastically"** over it.

After Operations Report - 1st Engineer Arctic Task Force
https://archive.org/details/DTIC_AD0123338/page/141/mode/1up

The textbook concept of **a "bulldozing" edge of an ice sheet does not correspond to conditions found** in TUTO.

Glacial geologists present numerous examples of terminal moraine buried by glacial till of subsequent glaciations without being destroyed.

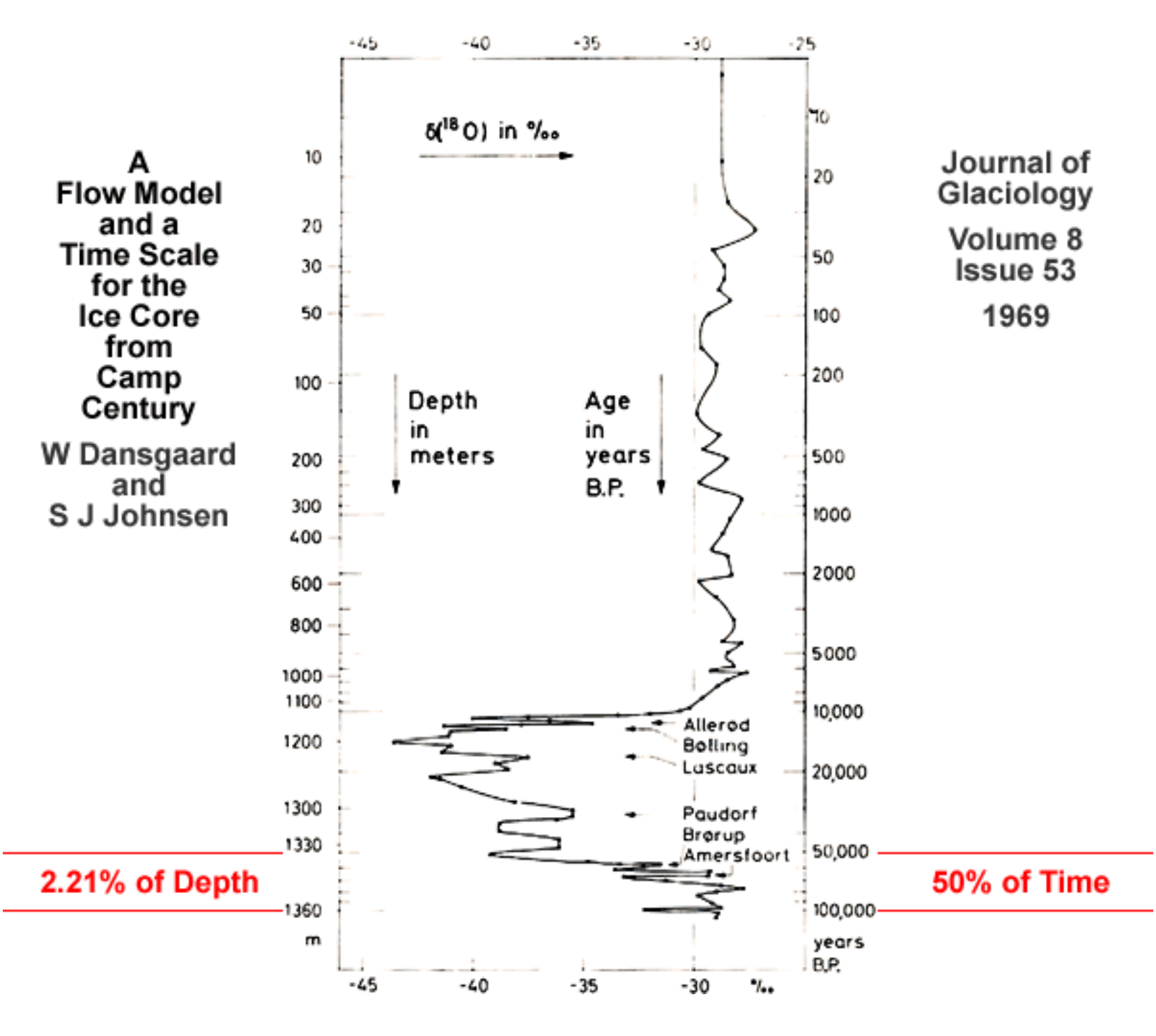
With the exception of some cases of outlet glaciers, **the propagation of large ice sheets occurs apparently without any bulldozing.**

Investigation of Shear Zones in the Ice Sheet Margin, Thule Area, Greenland - 1961
George K. Swinzow
U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, N.R.
Journal of Glaciology - Volume 4 - Issue 32 - 1962
https://www.cambridge.org/core/journals/journal-of-glaciology/article/investigation-of-shear-zones-in-the-ice-sheet-margin-thule-area-greenland/DA357812D91760A0A902FA1795663AB0

In 1969 the first **deep ice core** chronology was published covering 100,000 years in 1,360 meters.

Unsurprisingly:

50% [50,000 years] of the chronology is from the bottom **2.21% [30 metres]** of the **ice core**.



The agreement with other quite independent climatological estimates, covering nearly **100 000 years**, leads us to the conclusion that the time scale and therefore our flow model is basically correct **down to 30 or 35 m above the bottom**.

A Flow Model and a Time Scale for the Ice Core from Camp Century
W Dansgaard and S J Johnsen
Journal of Glaciology - Volume 8 Issue 53 - 1969
https://www.cambridge.org/core/journals/journal-of-glaciology/article/flow-model-and-a-time-scale-for-the-ice-core-from-camp-century-greenland/598BDE0C570955E3076C677CCC41B500

… holes were drilled at **Camp Century, Greenland** (77°10'N. 61°08'W.).
…
In June **1966**, drilling was resumed with the Electrodrill, which had been modified. On July 2, at a depth of **1,370.5 meters, ice** containing **silt bands** and **small pebbles** was encountered.

On July 4, after drilling through 16.9 meters of this material, the interface at the **bottom of the ice cap** was reached at a depth of **1,387.4 meters**.

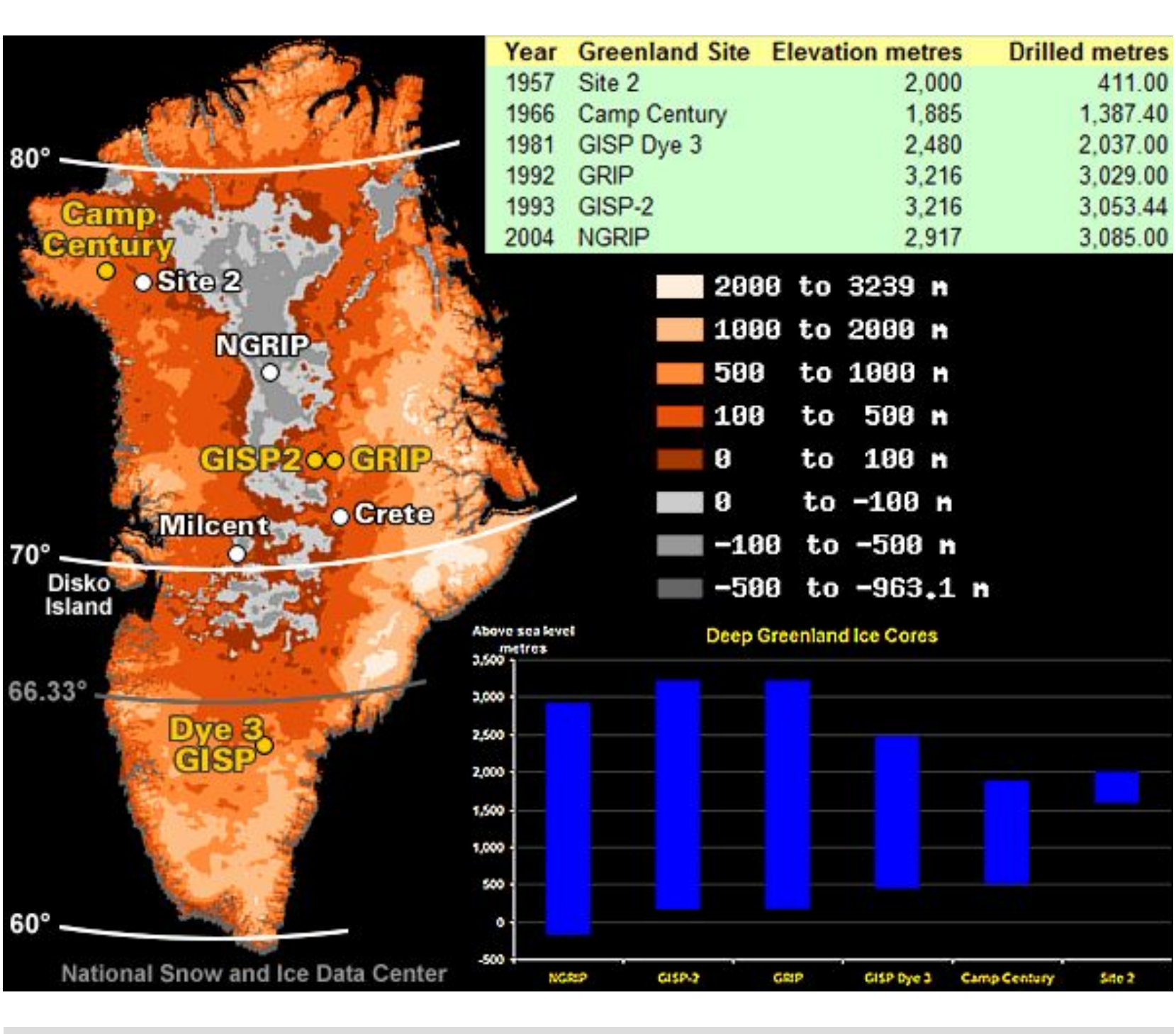
The **bottom material** is **frozen till**; 3.55 meters of this material was recovered.

The **total depth** of the hole is **1,391 meters**.

Deep Core Drilling in Ice and Core Analysis at Camp Century, Greenland, 1961-1966
B. Lyle Hansen and C. C. Langway Jr.
U. S. Army Cold Regions Research & Engineering Laboratory
Antarctic Journal - September-October 1966
https://malagabay.files.wordpress.com/2024/04/1966-deep-core-drilling-in-ice-and-core-analysis-at-camp-century-greenland.pdf

400 metres from the bottom the ***Holocene Hockey Stick blade*** bends away from the ***shaft***.

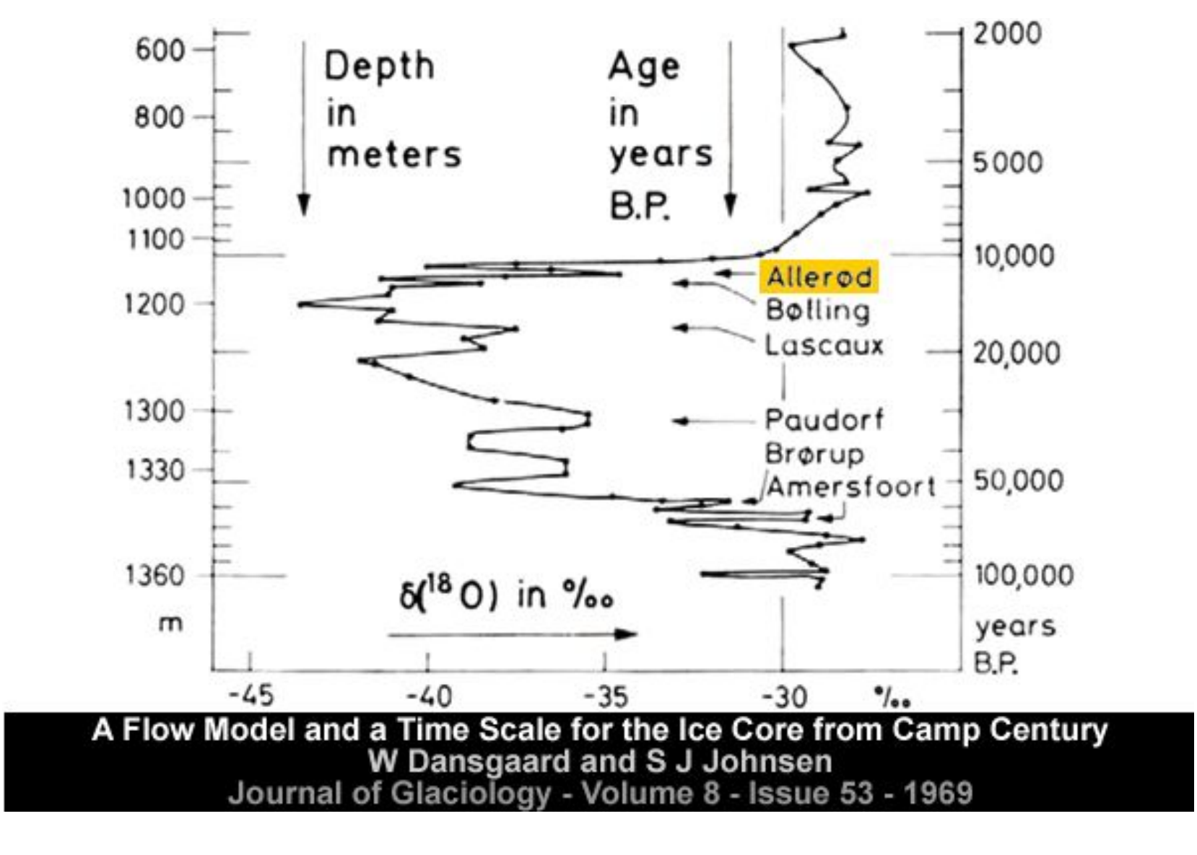
Malaga Bay - The Great Greenland Snow Job - 03 - Hewing the Holocene Hockey Stick
https://malagabay.wordpress.com/2014/11/27/the-great-greenland-snow-job-03-hewing-the-holocene-hockey-stick/



Year	Greenland Site	Elevation metres	Drilled metres
1957	Site 2	2,000	411.00
1966	Camp Century	1,885	1,387.40
1981	GISP Dye 3	2,480	2,037.00
1992	GRIP	3,216	3,029.00
1993	GISP-2	3,216	3,053.44
2004	NGRIP	2,917	3,085.00

Malaga Bay - Getting to Grips with Greenland
https://malagabay.wordpress.com/2018/12/10/getting-to-grips-with-greenland/

Willi Dansgaard believed he had discovered the **Last Glacial Period** lurking in the ***blade*** of his ***Holocene Hockey Stick*** along with a series of **warming** periods such as the **warm, moist Allerød.**



A Flow Model and a Time Scale for the Ice Core from Camp Century
W Dansgaard and S J Johnsen
Journal of Glaciology - Volume 8 - Issue 53 - 1969

The **Allerød** oscillation was a **warm** and **moist** global **interstadial** … c.13,900 to 12,900 BP.
…
It raised temperatures in the northern Atlantic region **to almost present-day levels** …
…
The **Greenland oxygen isotope** record **shows the warming** identified **with the Allerød** to be after about **14,100 BP** and before about **12,900 BP**.

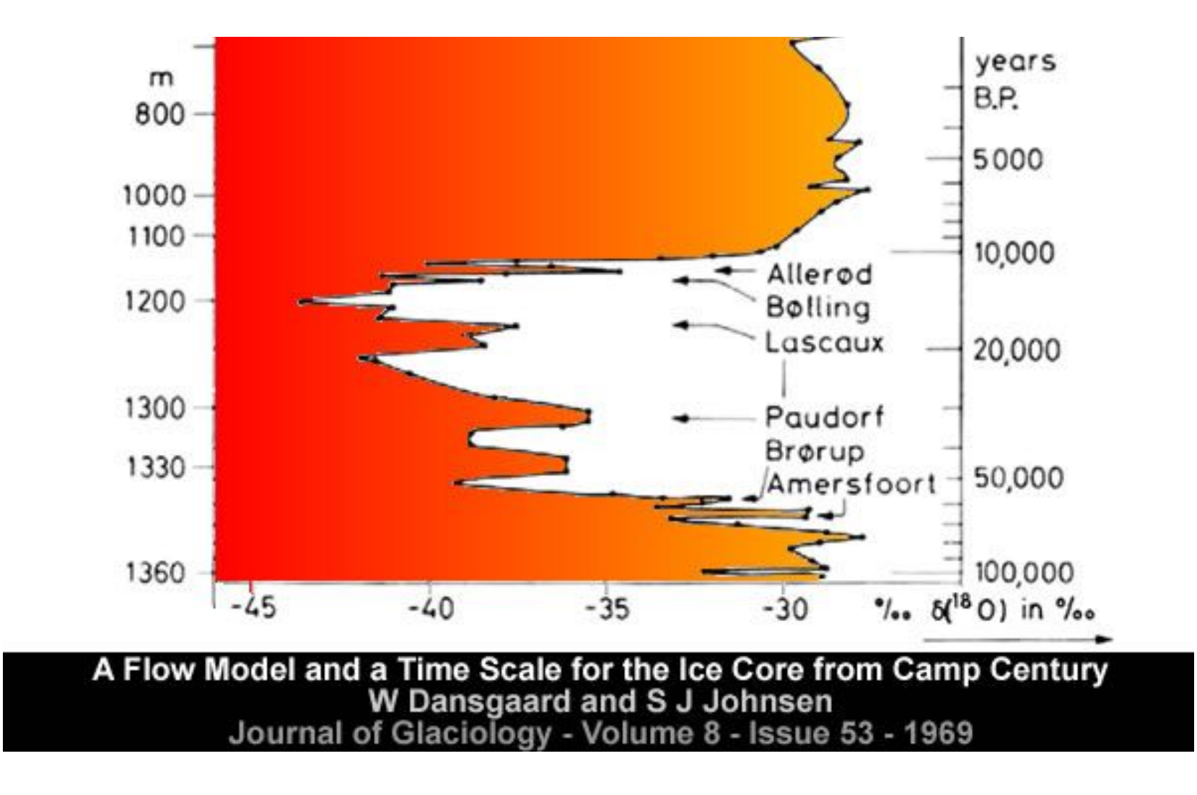
Wikipedia - Allerød Oscillation
https://en.wikipedia.org/wiki/Aller%C3%B8d_oscillation

Stadials are periods of colder climate, and interstadials are periods of warmer climate.

Wikipedia - Stadial
https://en.wikipedia.org/wiki/Interstadial

On the one hand:

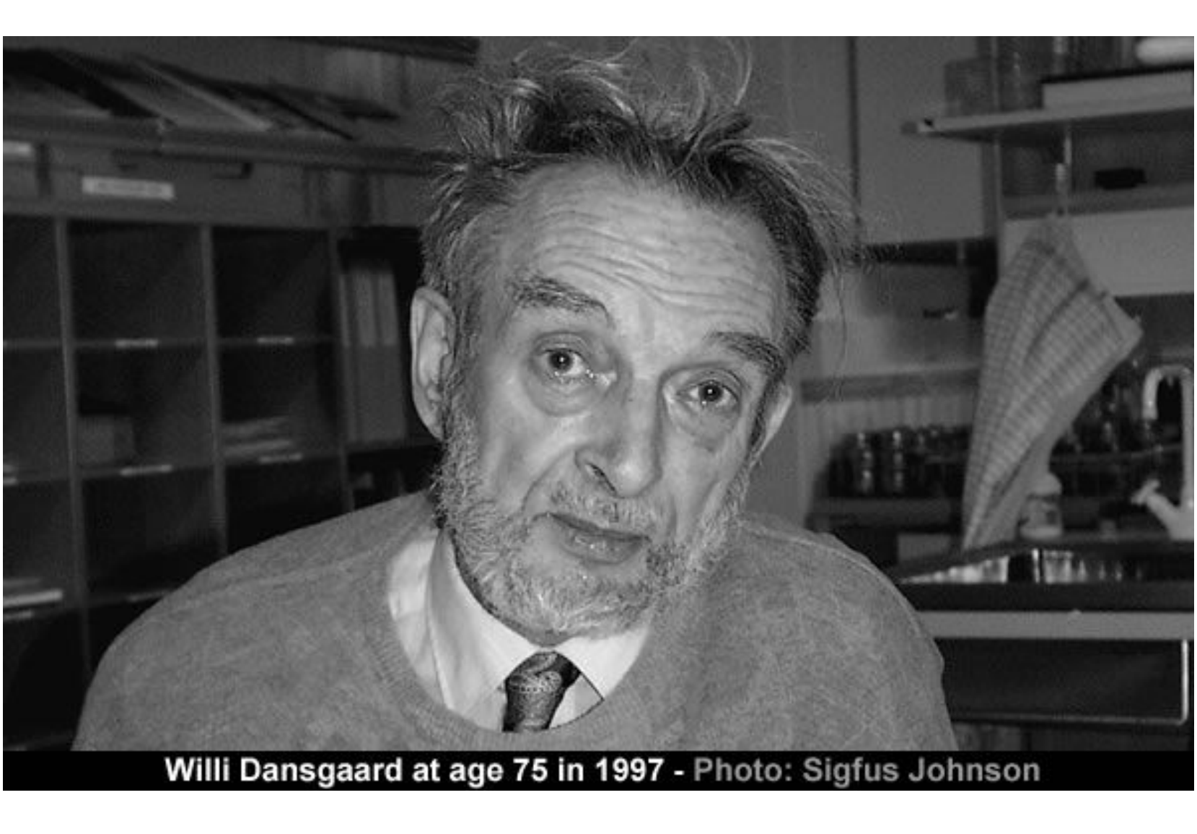
Willi Dansgaard's invention of **ice age warming** periods was very warmly received.



A Flow Model and a Time Scale for the Ice Core from Camp Century
W Dansgaard and S J Johnsen
Journal of Glaciology - Volume 8 - Issue 53 - 1969

Dansgaard–Oeschger events, named after … **Willi Dansgaard** and Hans Oeschger, are rapid climate fluctuations that occurred **25 times** during the **last glacial period**.

Wikipedia - Dansgaard–Oeschger Event
https://en.wikipedia.org/wiki/Dansgaard-Oeschger_events


Willi Dansgaard at age 75 in 1997 - Photo: Sigfus Johnson

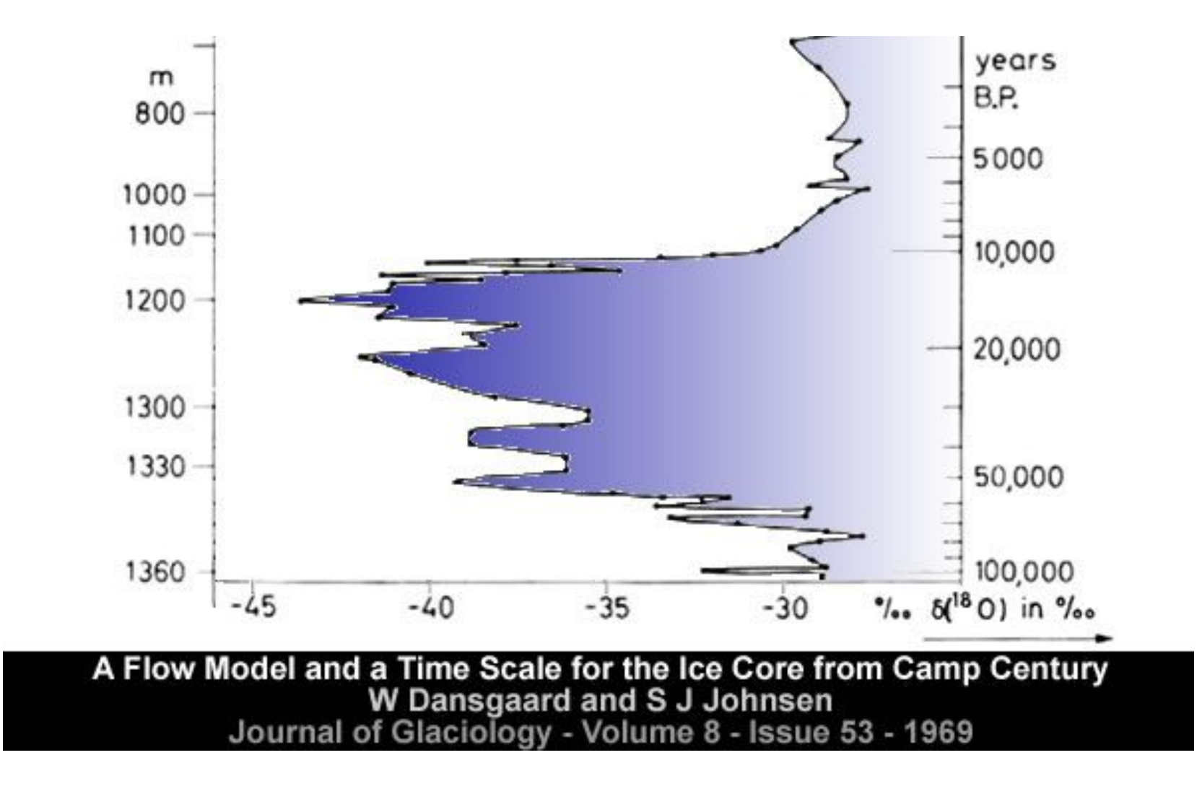
Willi Dansgaard, distinguished professor emeritus at the Niels Bohr Institute and head of the Geophysical Isotope Laboratory at the University of Copenhagen, Denmark, died in Copenhagen on January 8, 2011 at the age of 88. He is recognized as one of the world's foremost authorities on past climate change as revealed in polar ice cores.
…
His groundbreaking discovery of the seasonal variations and rapid changes in climate over short time intervals was established by measuring variations in the stable oxygen isotope ratio data (O^{18}/O^{16}) in the 1390 m deep core recovered at Camp Century, Greenland.
…
Until Dansgaard's groundbreaking climate study, the difficulty lay in finding individuals interested in seriously studying ice cores.

Obituaries - Willi Dansgaard (1922–2011) - Chester C Langway Jr
https://journalhosting.ucalgary.ca/index.php/arctic/article/view/67182/51092

Arctic - Volume 64 Number 3
https://journalhosting.ucalgary.ca/index.php/arctic/issue/view/4848

On the other hand:

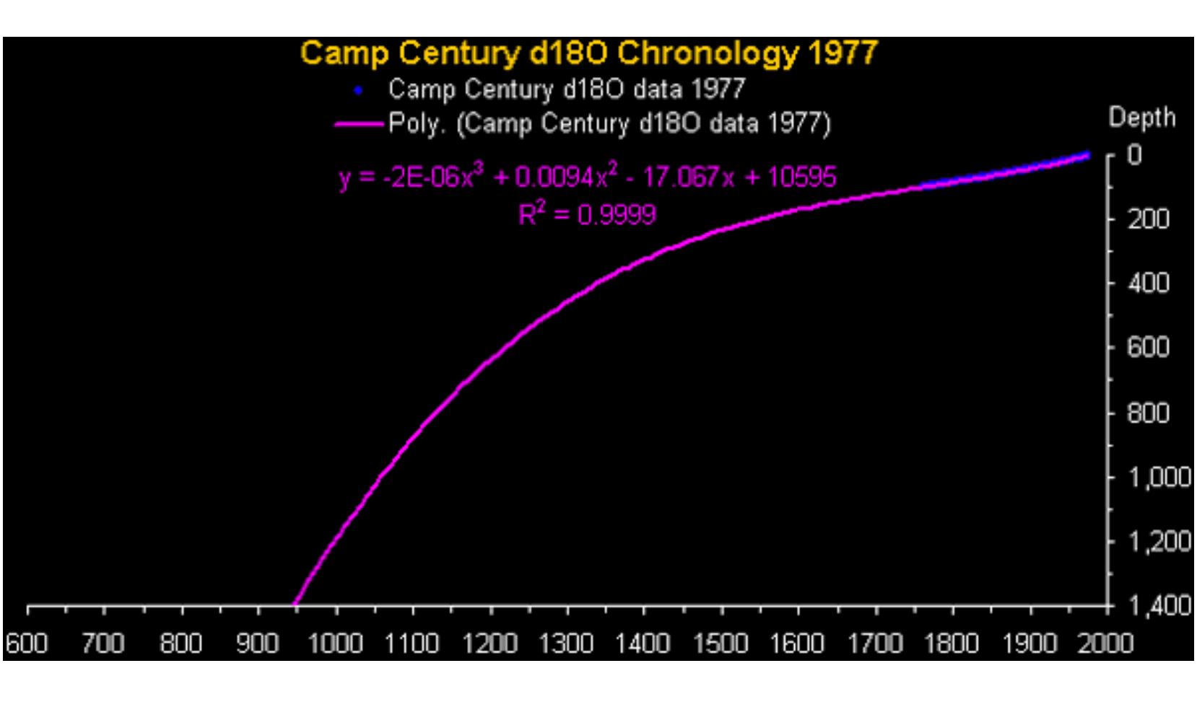
The adjectives **warm** and **moist don't** *spring to mind* when examining an **ice core** sample [from the **icy** Camp Century in North Greenland] containing a consolidated series of spiky **cooling** outliers.



A Flow Model and a Time Scale for the Ice Core from Camp Century
W Dansgaard and S J Johnsen
Journal of Glaciology - Volume 8 - Issue 53 - 1969

Moreover:

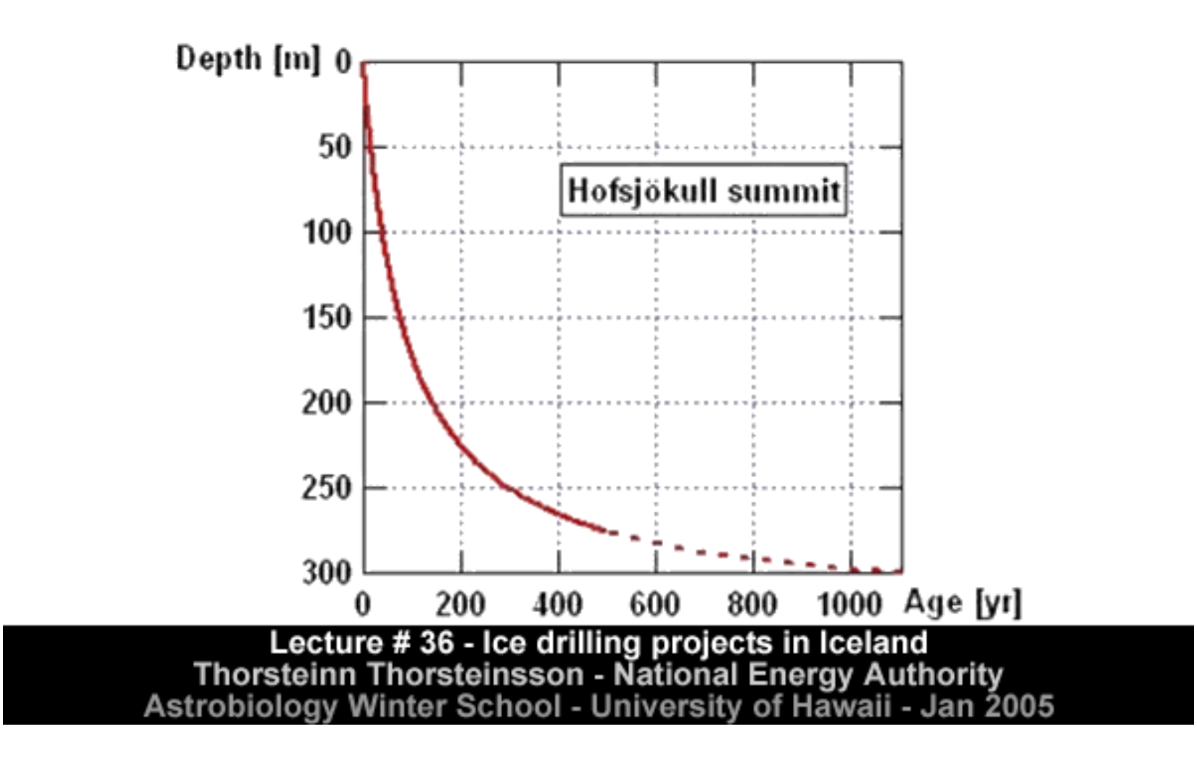
The *Camp Century* **δ^{18}O ice core** data suggests the **Greenland Ice Sheet** dates back to **945 CE**.



A **Camp Century** stratigraphy [based upon the uppermost 100 metres] detailed in a **δ^{18}O** study [from 1977] very strongly suggests the **Greenland Ice Sheet** formed in **945 AD**.

Malaga Bay - The Great Greenland Snow Job - 02 - Camp Century Strata
https://malagabay.wordpress.com/2014/11/25/the-great-greenland-snow-job-02-camp-century-strata/

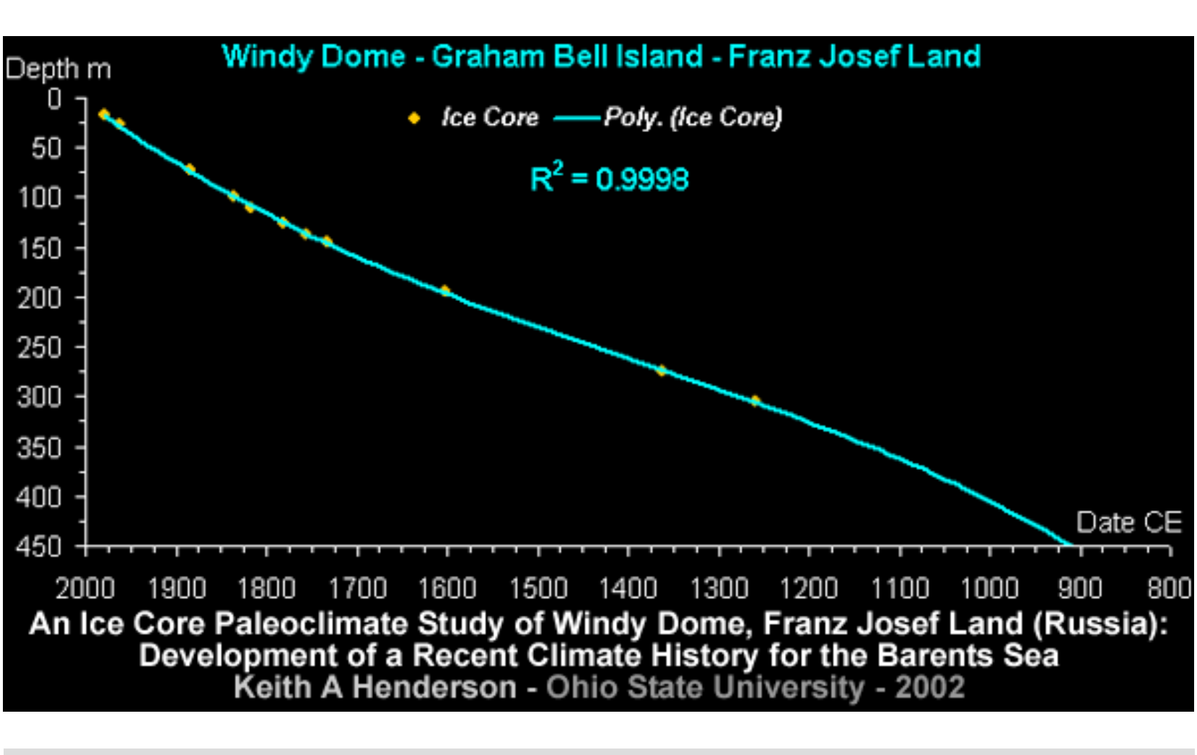
The **945 CE** origin of the **Greenland Ice Sheet** aligns with the appearance of **ice** in **Iceland** and the origin of the **Windy Dome Ice Cap** on Bell Island in the Russian **Franz Josef Land** archipelago.



Lecture # 36 - Ice drilling projects in Iceland
Thorsteinn Thorsteinsson - National Energy Authority
Astrobiology Winter School - University of Hawaii - Jan 2005

The **Vatnajökull Ice Cap** and the **Hofsjökull Glacier** are in the region of **1,100 years old**.

Malaga Bay - Iceland's Ice
https://malagabay.wordpress.com/2018/11/23/icelands-ice/



An Ice Core Paleoclimate Study of Windy Dome, Franz Josef Land (Russia):
Development of a Recent Climate History for the Barents Sea
Keith A Henderson - Ohio State University - 2002

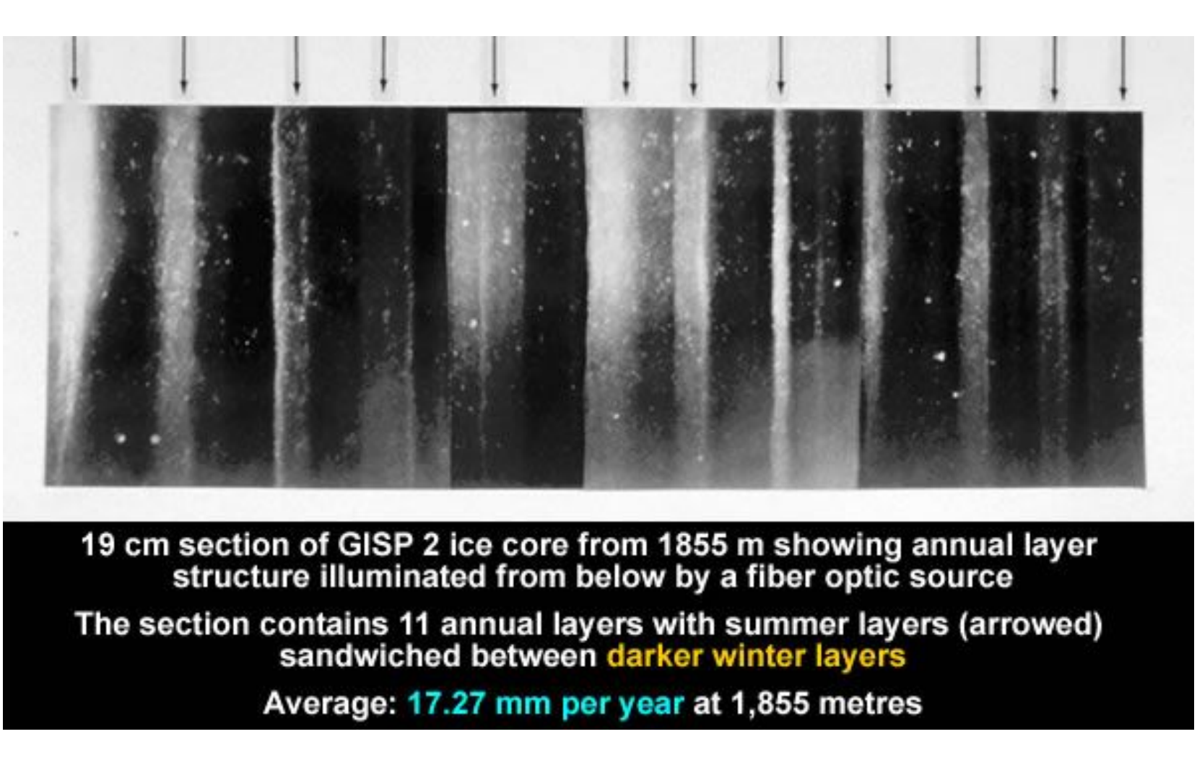
Malaga Bay - Alaskan Muck: Windy Dome Ice Core
https://malagabay.wordpress.com/2019/08/08/alaskan-muck-windy-dome-ice-core/

Franz Josef Land is a Russian archipelago in the Arctic Ocean.

Wikipedia - Franz Josef Land
https://en.wikipedia.org/wiki/Franz_Josef_Archipelago

Lastly:

One of the more spectacular **Ice Sheet** statements is that at an unspecified depth the "**individual years cannot be distinguished**".


19 cm section of GISP 2 ice core from 1855 m showing annual layer structure illuminated from below by a fiber optic source
The section contains 11 annual layers with summer layers (arrowed) sandwiched between darker winter layers
Average: 17.27 mm per year at 1,855 metres

At an **unspecified depth**, the "**individual years cannot be distinguished**" in the **ice core**.

Malaga Bay - Chronology: 1 – Ice Cores
https://malagabay.wordpress.com/2013/06/18/chronology-ice-cores/

Deeper into the core the layers thin out due to ice flow and high pressure and eventually **individual years cannot be distinguished**.

Wikipedia - Ice Core - 08:09, 21 May 2013
https://en.wikipedia.org/w/index.php?title=Ice_core&oldid=556071044

To his eternal credit Willi Dansgaard wrote about the disappearance of the annual **cryoconite** layers [containing **rock particles**, **soot**, and **volcanic ash**] at depth in an **ice core**.

When Willi Dansgaard states **Dye 3** drilled into "**ice from the last glaciation**" at **1,785 metres** it's possible he's describing the **cooling** outliers that form the **cold *blade*** of his ***Holocene Hockey Stick***.


"An ice core from great depth ... it is transparent"
Dye 3 1978-81 - Frozen Annals - Willi Dansgaard - 2005

Fig. 10.3 **An ice core from great depth** is released from the core barrel.

Note that it is transparent.

The **air bubbles** are dissolved in the crystal lattice at great pressures.

When the ice relaxes **at normal pressure** they **re-appear**, but now **around micro-particles that occur most frequently in summer layers**.

Thereby these layers become visible and may be used for dating by counting summer layers downward.
…
At a depth of **1785 metres** dust and conductivity measurements indicated that we were **entering the ice from the last glaciation**.

Frozen Annals - Willi Dansgaard - 2005
http://www.iceandclimate.nbi.ku.dk/publications/FrozenAnnals.pdf

Dye 3 began in the summer of **1979** using a new Danish electro-mechanical ice drill yielding a 10.2 cm diameter core. From July to August 1979 using ISTUK, 273 m of core was removed. At the end of the 1980 field season ISTUK had gnawed down to 901 m. In 1981 at a depth of 1785 m dust and conductivity measurements indicated the beginning of ice from the last glaciation.

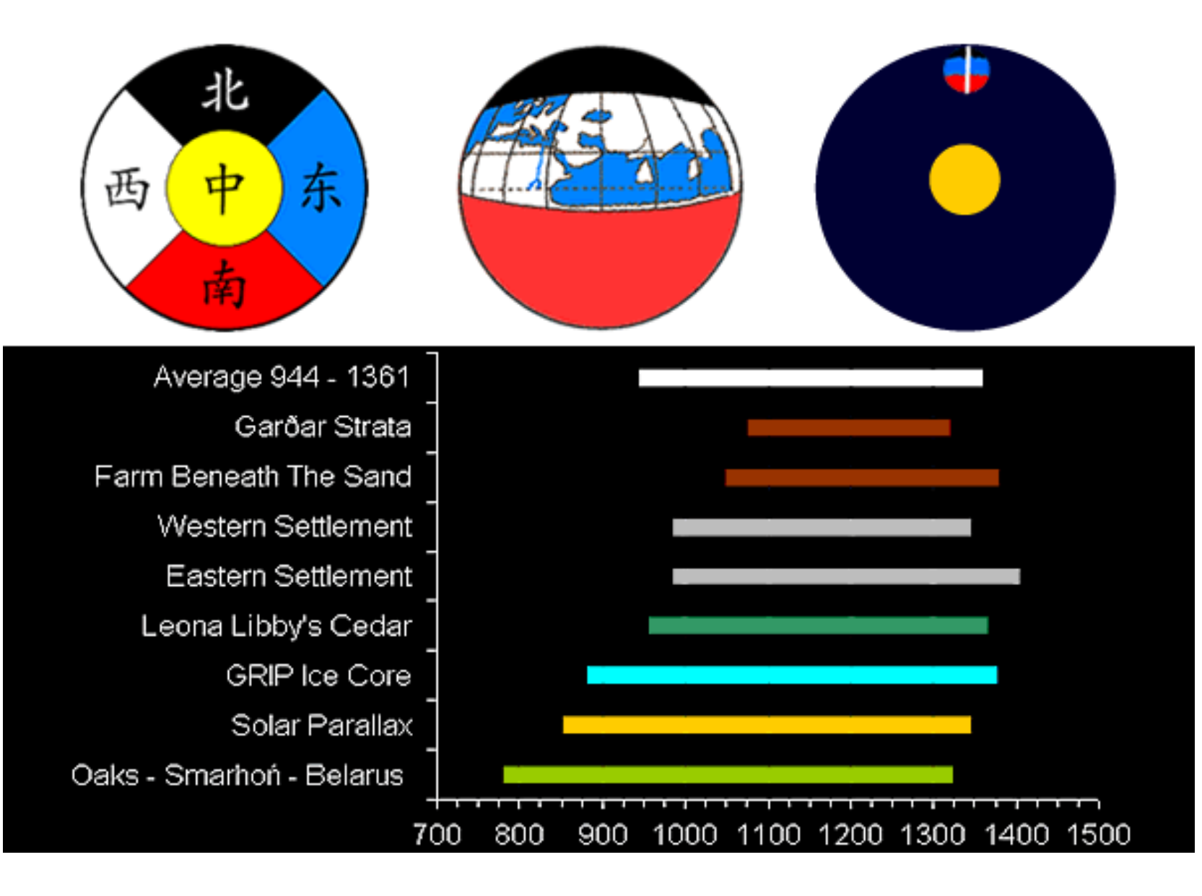
Coring continued and on August 10, **1981**, **bedrock was reached at a depth of 2038 m**. The depth range for the Danish drill was 80–2038 m.

Wikipedia - Dye 3
https://en.wikipedia.org/wiki/Dye_3

The sudden disappearance of the **Cryoconite** layers at depth in the **Greenland Ice Sheet** is totally consistent with a period of continuous **snowing** from about **850** to **1350** **CE** that was triggered by the Southern Hemisphere being continuously titled towards the Sun.

More specifically:

A period of continuous **snowing** would explain why the airborne constituents of **cryoconite** are distributed throughout the "transparent" section of the **ice core** as "micro-particles".



The Earth's ***Sol Invictus Orbit*** existed [in round numbers] between **850 CE and 1350 CE.**

Malaga Bay - Ptolemy's Paradigm: Sol Invictus Orbit
https://malagabay.wordpress.com/2021/03/14/ptolemys-paradigm-sol-invictus-orbit/

The details of this period of continuous **snowing** can be refined with the help of Willi Dansgaard.


Willi Dansgaard - *Dye 3* 1973 - Frozen Annals - Willi Dansgaard - 2005

> **Dye 3** **1973**
> …
> The drill was installed 25 m below surface at the bottom of one of the columns supporting the station.
> …
> The **density** increases downward **from 350 kg/m³** at surface **to 920 kg/m³ at** a depth of c. **100 m**, where the snow has been compressed into solid ice.
> …
> **We counted** 740 **seasonal δ cycles**, so the core reached back to A.D. 1231.
>
> The counting was difficult in places, because surface melting often occurs in the summer time. The melt water seeps through the porous snow and refreezes somewhere in the cold firn, which disturbs the layer sequence, of course.
> …
> The **annual layer thickness** averaged 53 cm of ice equivalent, but it **was particularly high around A.D. 1400**.

Frozen Annals - Willi Dansgaard - 2005
http://www.iceandclimate.nbi.ku.dk/publications/FrozenAnnals.pdf

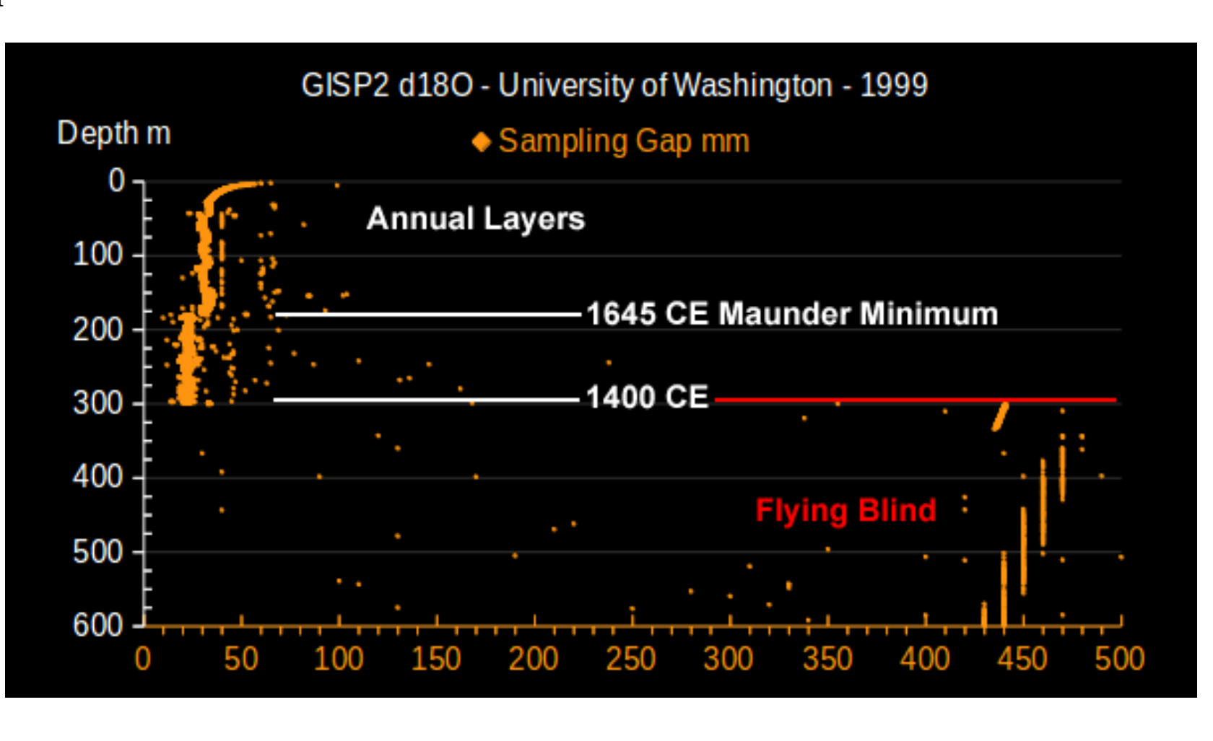
> **Edwin Johnson** (1842–1901) was an English historian, best known for his … radical claim that the whole of the so-called Dark Ages between **700** and **1400 A. D.** had never occurred, but had been **invented** by Christian writers who created **imaginary** characters and events.

Wikipedia - Edwin Johnson (historian)
https://en.wikipedia.org/wiki/Edwin_Johnson_(historian)

> **Dye 3** is an **ice core** **site** and previously part of the DYE section of the Distant Early Warning (DEW) line, located at (65°11′N 43°49′W, 2480 masl) in Greenland.
> …
> **Dye 3** in **1973**, an intermediate drilling **to c. 390 m**

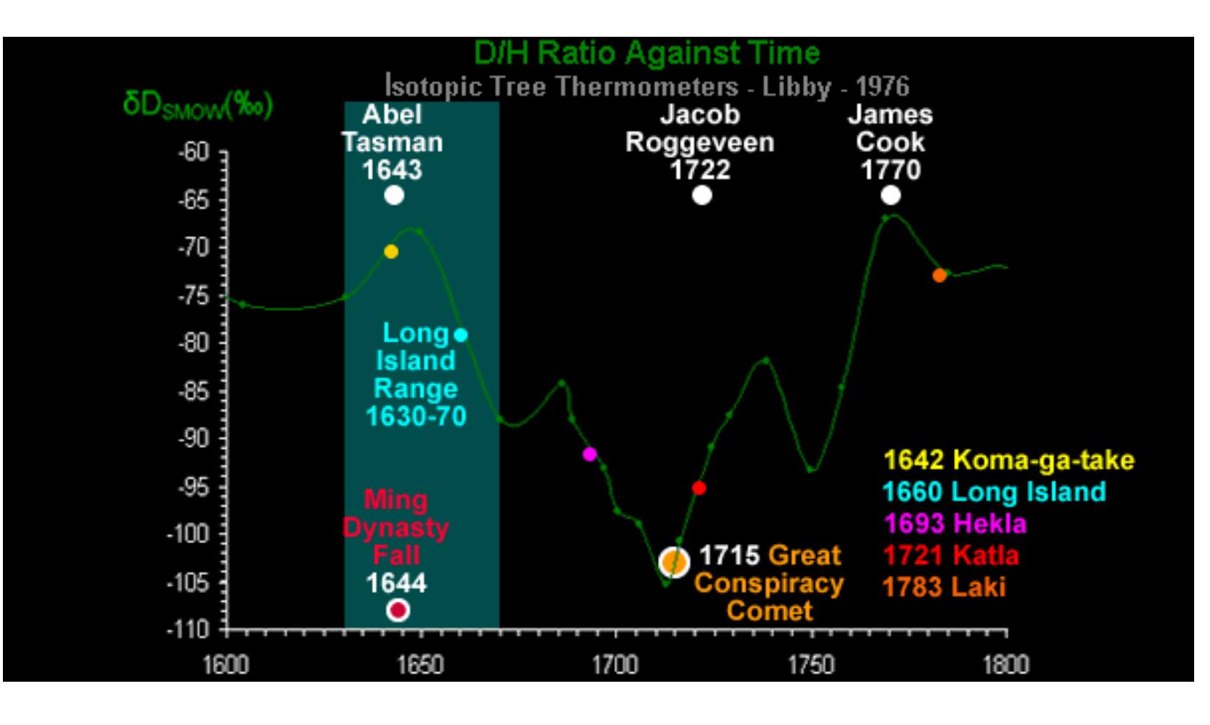
Wikipedia - Dye 3
https://en.wikipedia.org/wiki/Dye_3

The *sampling regime* adopted for the **GISP2** **ice core** suggests they encountered Willi Dansgaard's "**particularly high**" annual layers "**around A.D. 1400**" at a depth of about 300 metres and realised they were ***flying blind*** below this depth because the *regular* series of annual layers **terminated** at this depth in the **GISP2** **ice core**.



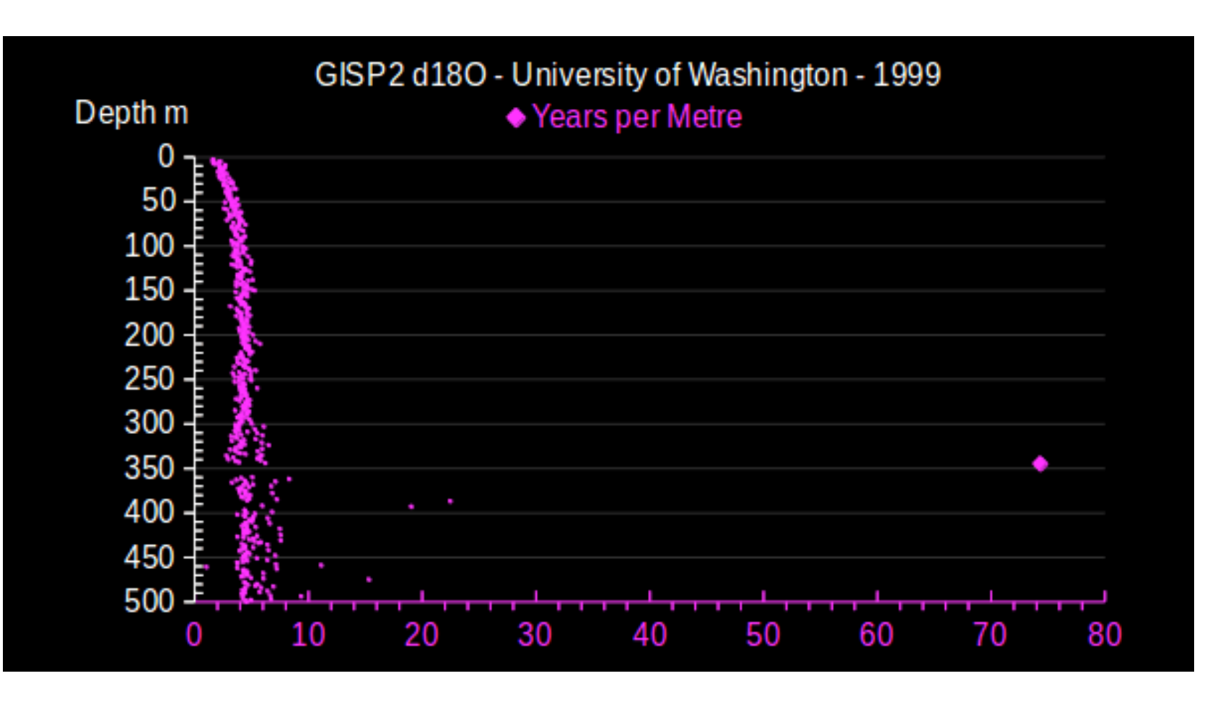
> The **Maunder Minimum**, also known as the "prolonged sunspot minimum", was a period around **1645** to 1715 during which sunspots became exceedingly rare.

Wikipedia - Maunder Minimum
https://en.wikipedia.org/wiki/Maunder_minimum

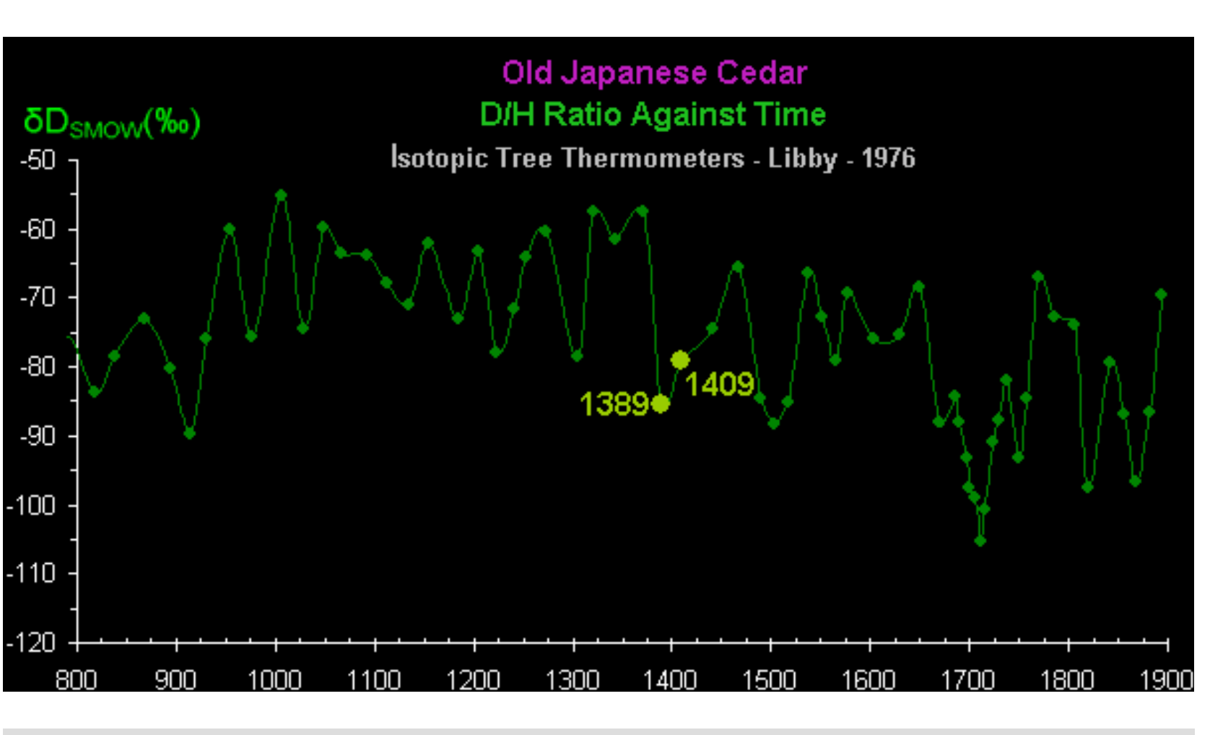


Working backwards in time the **Great Conspiracy Comet** appeared in the depths of the **Maunder Minimum** which appears to have been an **enormous** **fragmentation event**.

Malaga Bay - Great Conspiracy Comet
https://malagabay.wordpress.com/2024/02/23/great-conspiracy-comet/

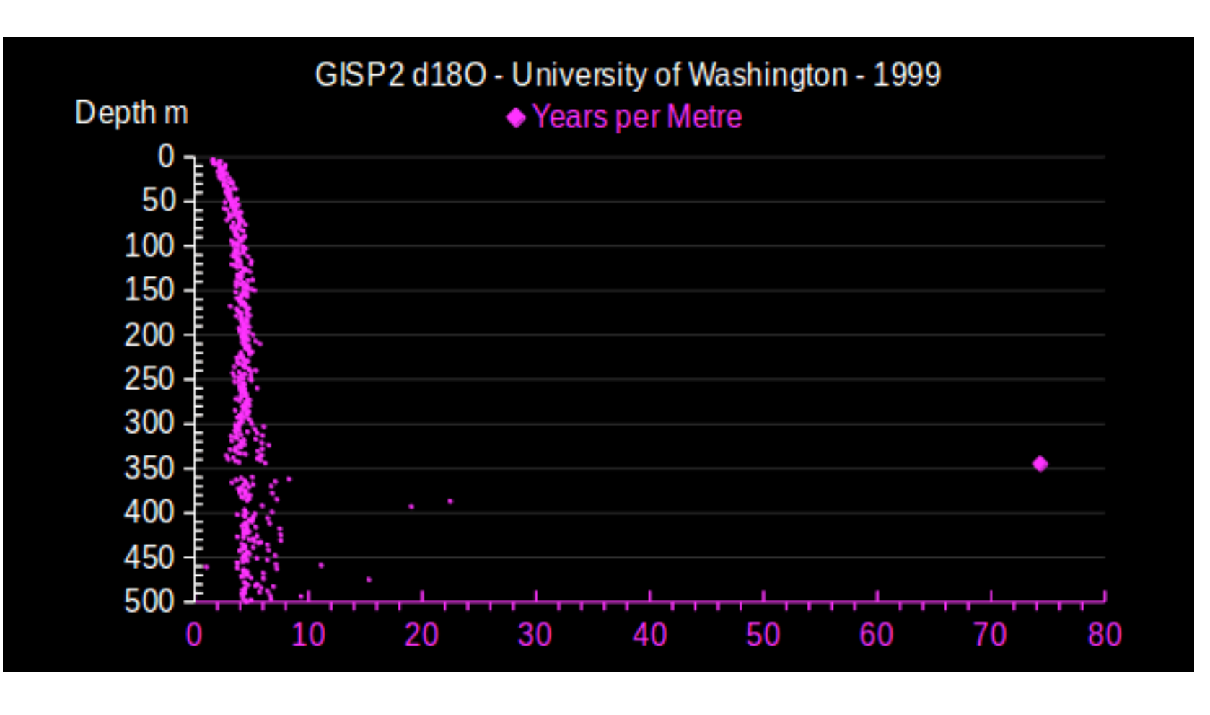


IF the **GISP2** *dating regime* events at 300 and 345 metres [above] align with **Leona Libby's** *Old Japanese Cedar* chronology at 1409 and 1389 CE i.e. "around A.D. 1400".
THEN the **ice core** accumulation rate for this period averages out to **2.25 metres** **per year**.



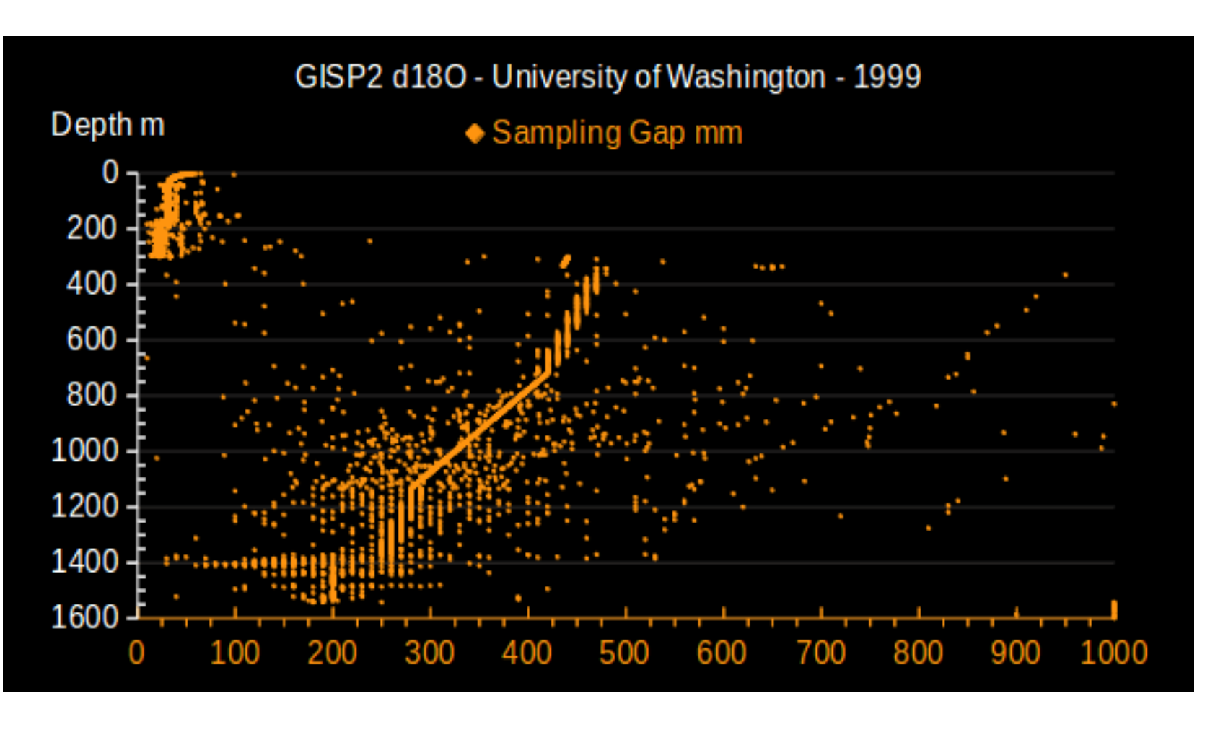
Malaga Bay - Great Conspiracy Comet
https://malagabay.wordpress.com/2024/02/23/great-conspiracy-comet/

The probability that the *regular* series of annual layers **terminated** at 300 metres in the **GISP2** **ice core** is reflected in the curious branching of the *dating regime* at 300 meters.



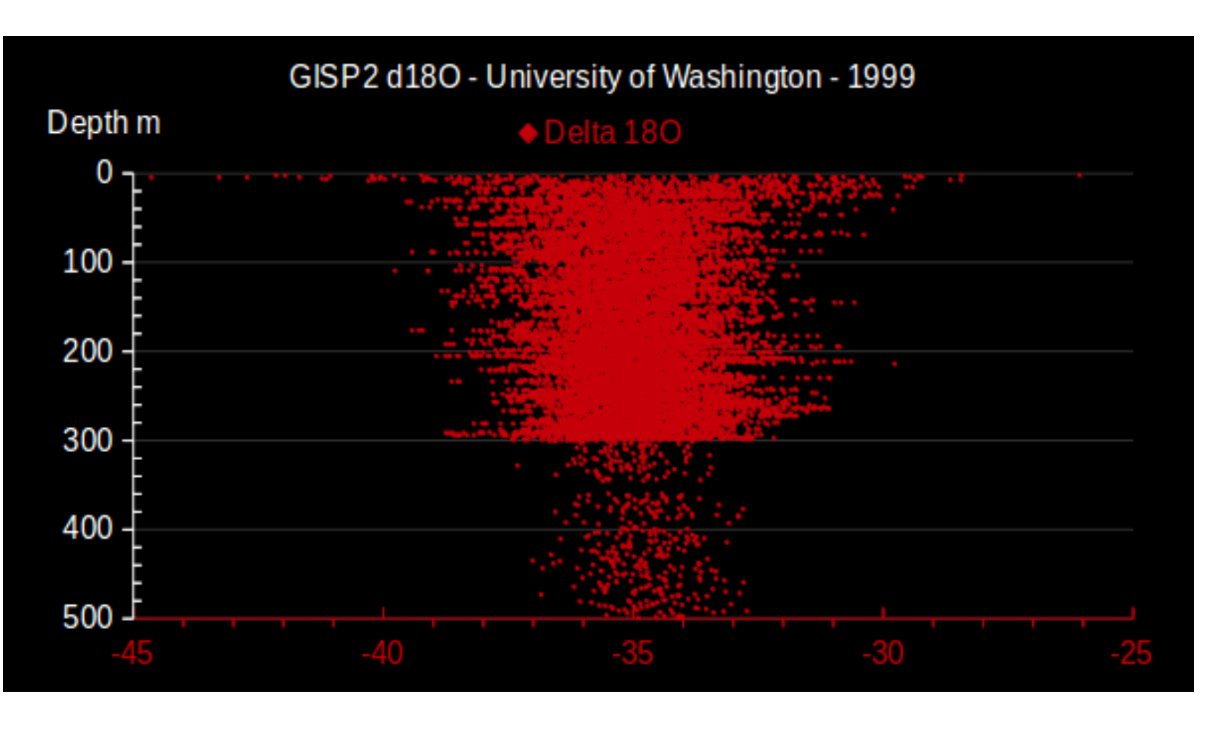
Either way:

Below about 300 metres the **GISP2** **ice core** *sampling regime* becomes more that a little curious and this explains why Willi Dansgaard was counting "**seasonal δ cycles**" instead of annual **ice** layers.

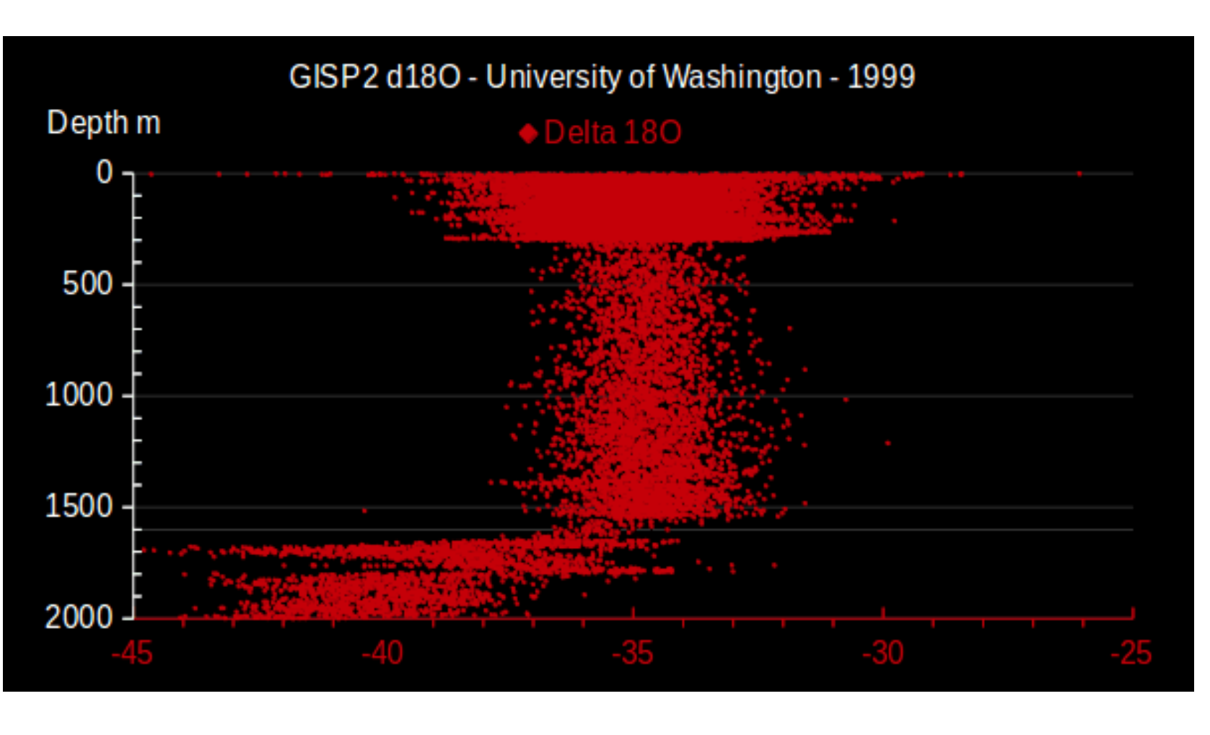


And

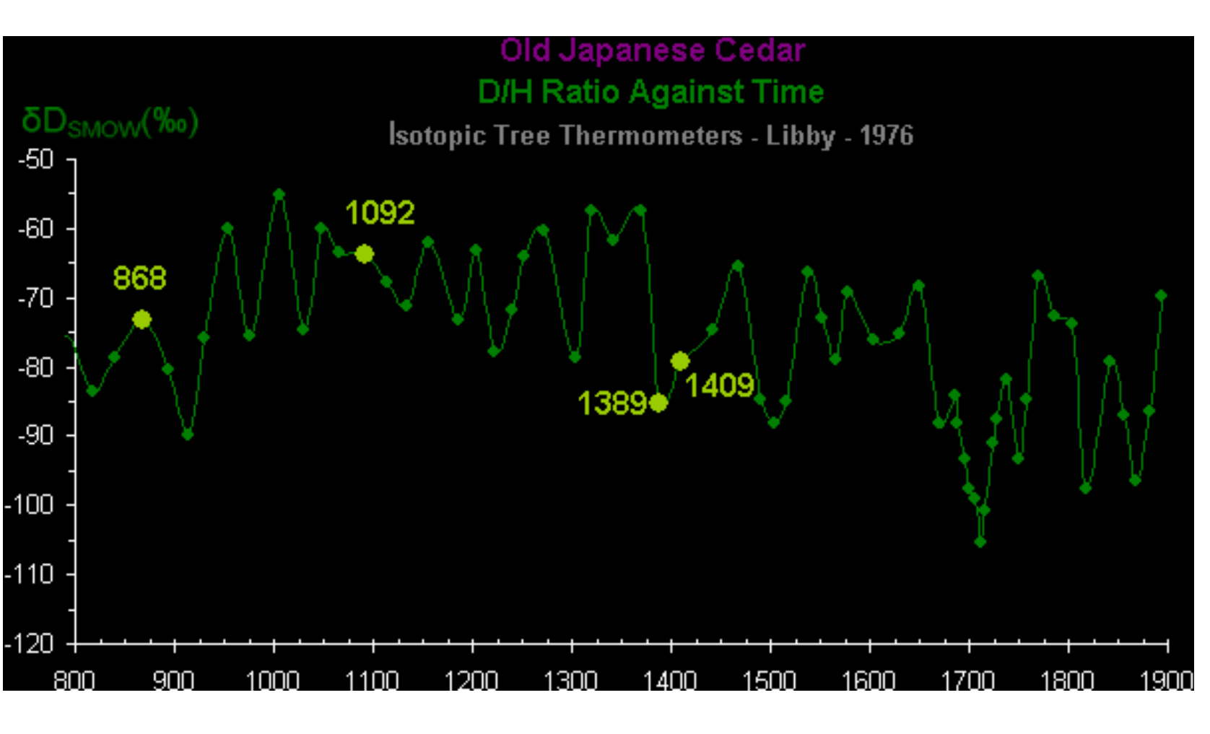
Below about 300 metres the **GISP2** **ice core** **δ^{18}O** values experience a remarkable *regime change*.



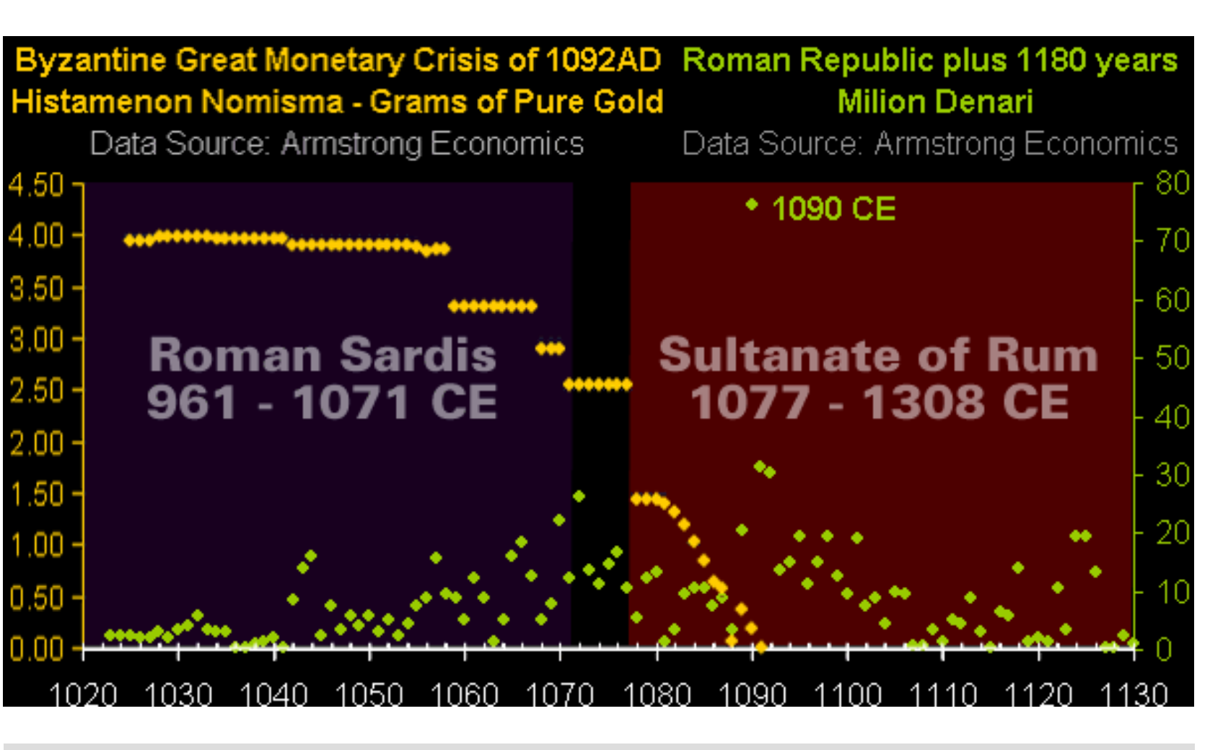
The *new regime* in the **GISP2** **ice core** **δ^{18}O** values extends from [roughly] 300 to 1,550 metres.



IF the *new regime* below 300 meters represents the **1400 CE** **termination** of a period of continuous **snowing** with an average annual **ice** accumulation rate of **4 meters** per annum



THEN the *new regime* **begins** at 1,550 metres in **1087 CE** at the start of the ***Great Monetary Crisis***.



Malaga Bay - Synchronicity
https://malagabay.wordpress.com/2023/06/23/synchronicity/

Either way:

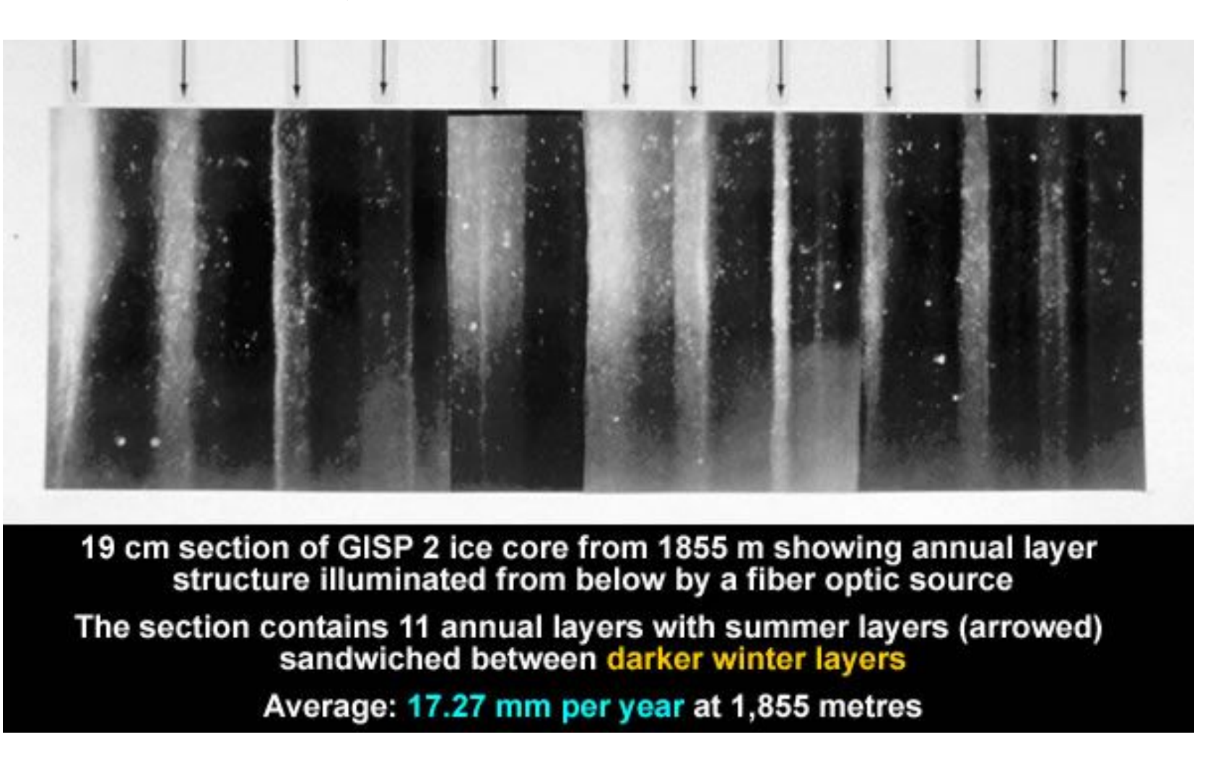
The narrower range and more regular pattern of the *new regime* is very suggestive of a **snow lake** that accumulates in a natural basin above the **snow line**. As the depth on **snow** in a **snow lake** increases the lower levels are compacted into **ice**. Usually, the **ice** finds a natural outlet from the basin [as a **glacier**] and the level of the **snow lake** remains fairly steady.

However, if there's no natural outlet [or only a very restricted outlet] then the **snow lake** may continue to grow to form an **ice cap** or **ice sheet**.

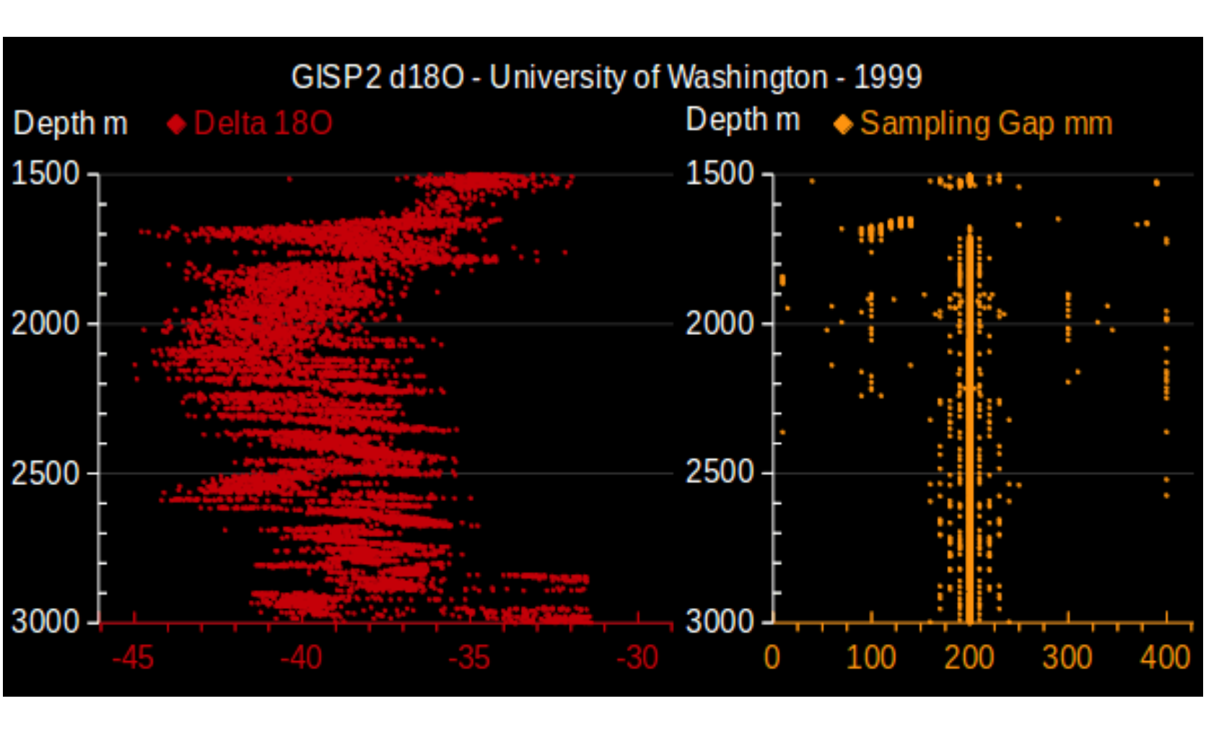

Snow Lake at the head of Biafo and Hispar Glaciers, Northern Areas, Pakistan
Credit: Dave Hancock/Field Touring - www.fieldtouring.com

Wikipedia - Snow Lake
https://en.wikipedia.org/wiki/Snow_Lake

IF the *new regime* in the **GISP2** **ice core** [between 300 and 1,550 metres] represents a **snow lake**
THEN it's base is resting upon an **ice sheet** or **glacier ice** because regular **cryoconite** layers are present in the **GISP2** **ice core** at 1,855 metres.

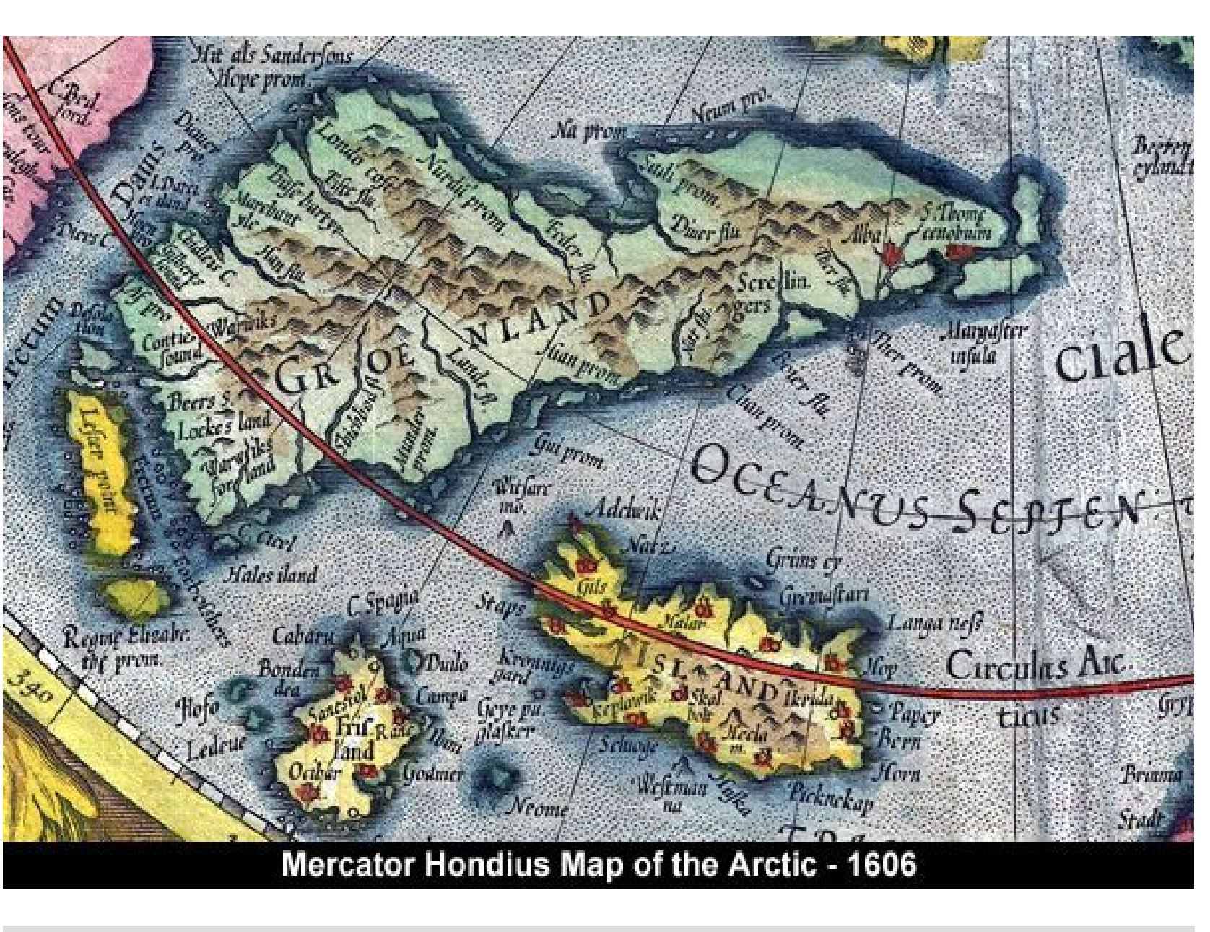

19 cm section of GISP 2 ice core from 1855 m showing annual layer structure illuminated from below by a fiber optic source
The section contains 11 annual layers with summer layers (arrowed) sandwiched between darker winter layers
Average: 17.27 mm per year at 1,855 metres

The appearance of a stable 200 mm *sampling regime* around 1,650 metres in the **GISP2** **ice core** suggests they were **no** longer ***flying blind*** because the regular **cryoconite** layers had reappeared **and** the tilted and jagged sequencing of the **δ^{18}O values** between about 1,650 and 2,950 metres is very suggestive of **flowing** **ice** with some spiky *pivot points* above **reversed** layer sequences.



The arrival of the *new regime* at the **GISP2** site was triggered by the clockwise rotation of the Greenland landmass caused by the expansion of the Polar and Atlantic basins.

The clockwise rotation of the Greenland landmass is vividly illustrated by the current position of the Eastern Settlement [S. Tomç cenobum] being to the **South** of the Western Settlement [Alba].

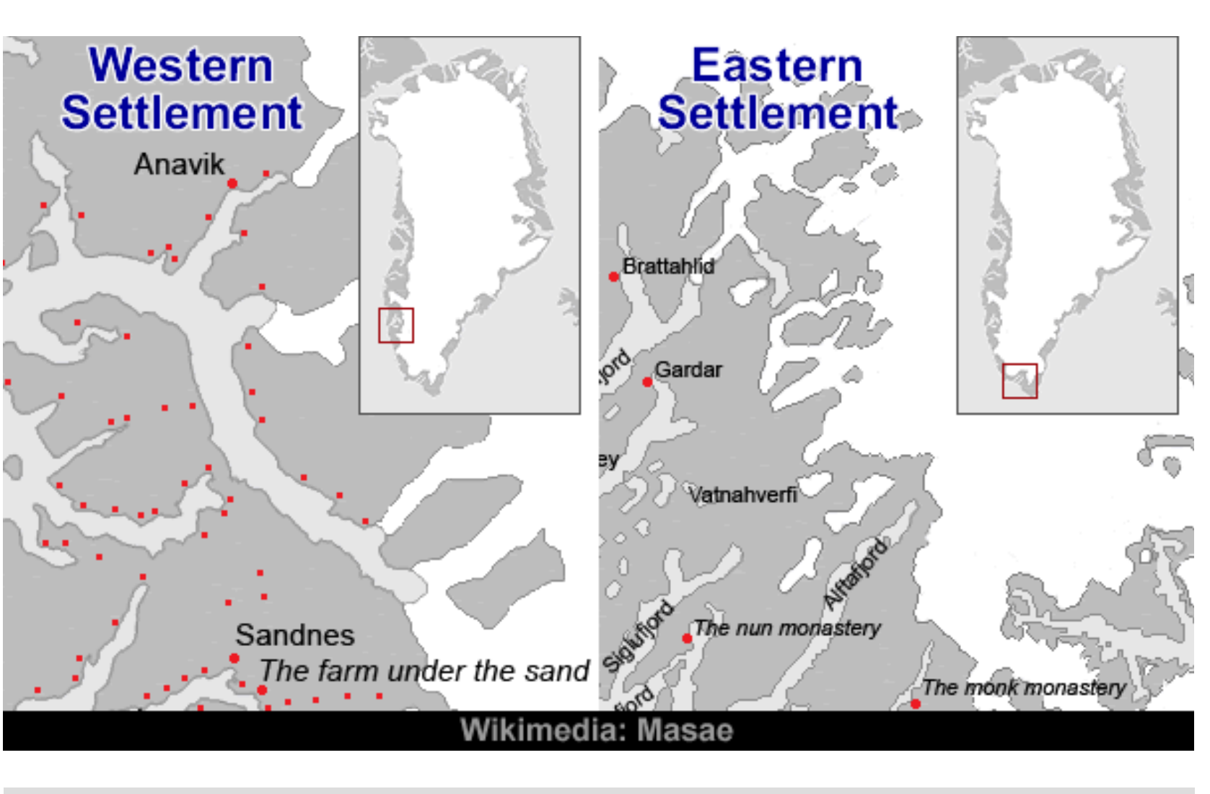

Mercator Hondius Map of the Arctic - 1606

Wikimedia - 1606 Mercator Hondius Map of the Arctic
https://commons.wikimedia.org/wiki/File:1606_Mercator_Hondius_Map_of_the_Arctic_(First_Map_of_the_North_Pole)_-_Geographicus_-_NorthPole-mercator-1606.jpg


Mercator Hondius Map of the Arctic - 1606

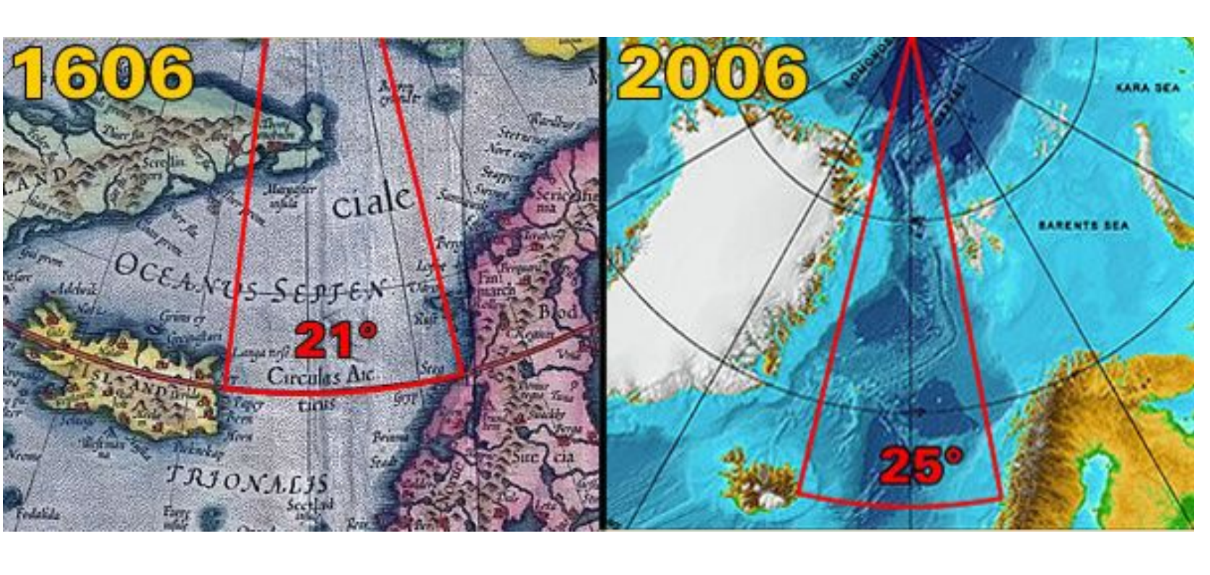
Alba is the Scottish Gaelic name for **Scotland**.

Wikipedia - Alba
https://en.wikipedia.org/wiki/Alba



Wikimedia: Masae

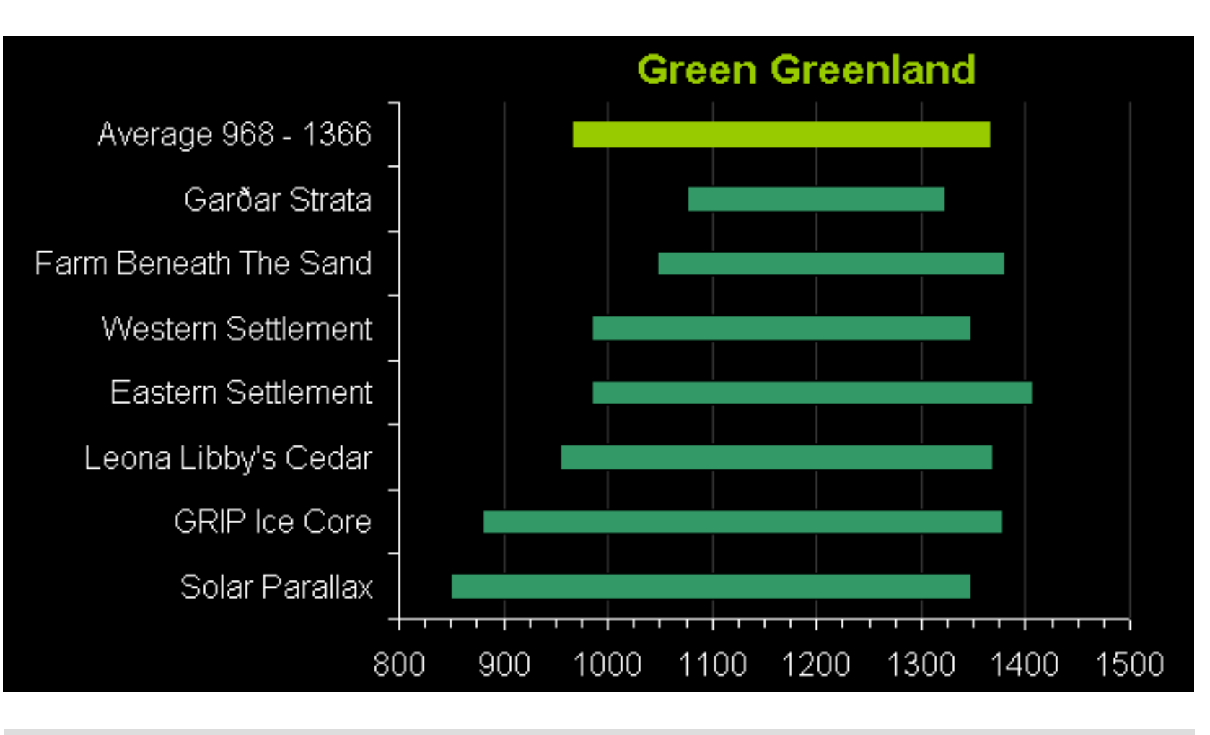
Malaga Bay - Ptolemy's Paradigm: Green Greenland
https://malagabay.wordpress.com/2021/04/19/ptolemys-paradigm-green-greenland/



The cartographic evidence shows Iceland went South by about 1½º between **1606** and **1906** and the distance between Iceland and Norway increase by about 4º of longitude.

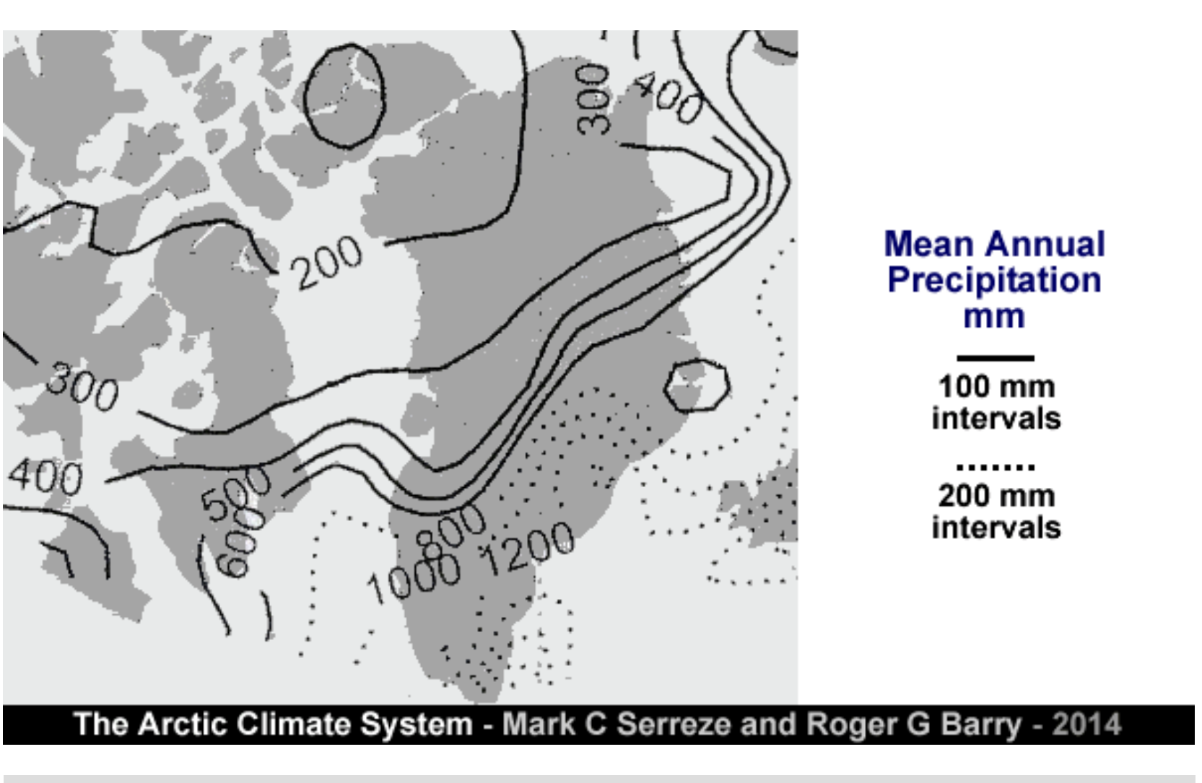
Malaga Bay - Iceland Goes South
https://malagabay.wordpress.com/2017/02/04/iceland-goes-south/

During the period of continuous high level **snowing** from about **850** to **1350** **CE** these Greenland coastal settlements are said to have been inhabited by Europeans from **985** until about **1408 CE**.



Malaga Bay - Ptolemy's Paradigm: Green Greenland
https://malagabay.wordpress.com/2021/04/19/ptolemys-paradigm-green-greenland/

The current pattern of **precipitation** in Greenland is very unevenly distributed with much of the North receiving only 200 mm per year while parts of the South receive up to 1,200 mm per years.

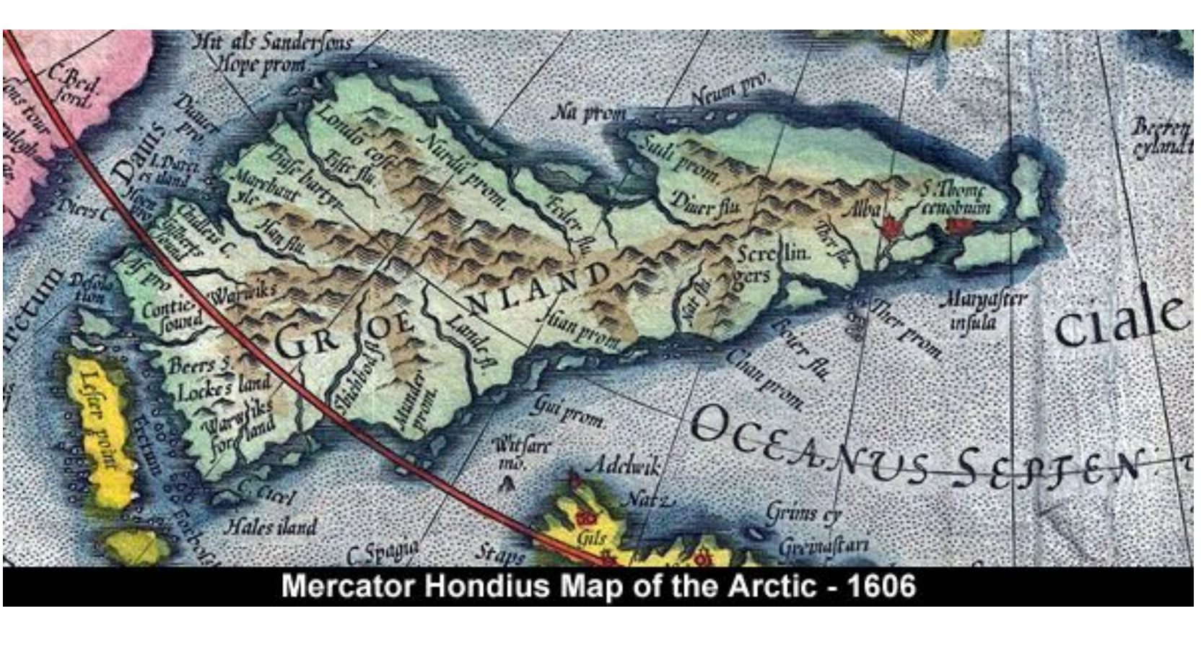


The Arctic Climate System - Mark C Serreze and Roger G Barry - 2014

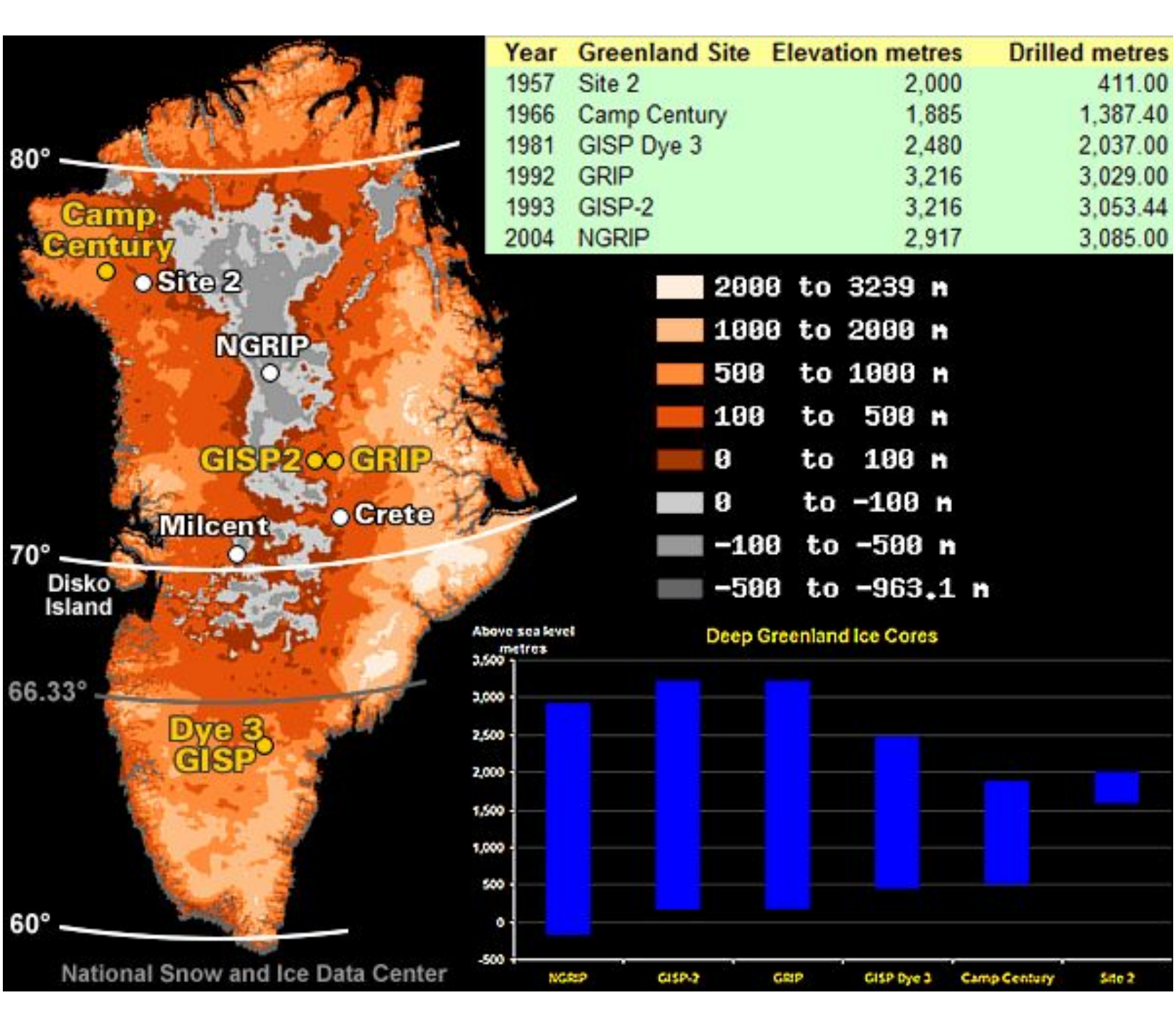
The Arctic Climate System - Mark C Serreze and Roger G Barry - 2014
Amazon US: https://www.amazon.com/dp/B00J8LQPY2
Amazon UK: https://www.amazon.co.uk/dp/B00J8LQPY2

However:

The historical orientation of the Greenland landmass suggests the **Ice Sheet** initially accumulated in the mountainous regions of what is now Northern Greenland.

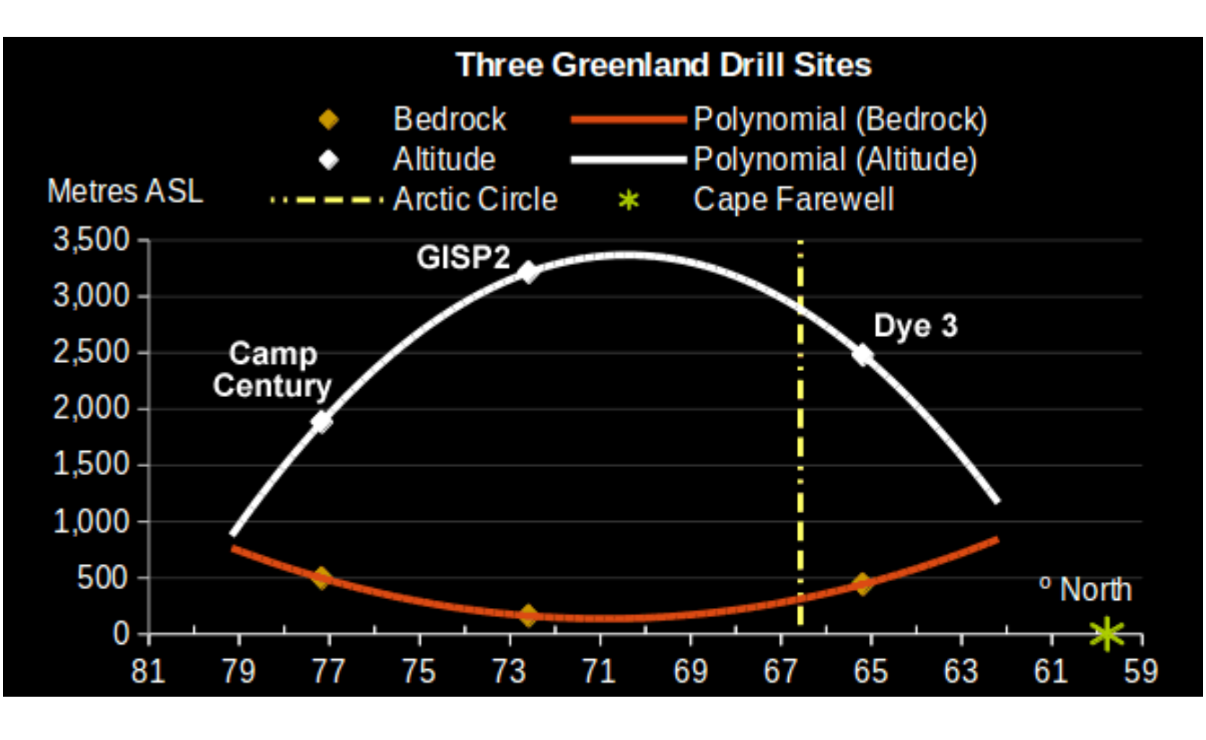

Mercator Hondius Map of the Arctic - 1606

The subsequent clockwise rotation of the landmass **reversed** the precipitation pattern so that the centre of **Ice Sheet** accumulation is now wedged between high mountains in central Greenland.



Year	Greenland Site	Elevation metres	Drilled metres
1957	Site 2	2,000	411.00
1966	Camp Century	1,885	1,387.40
1981	GISP Dye 3	2,480	2,037.00
1992	GRIP	3,216	3,029.00
1993	GISP-2	3,216	3,053.44
2004	NGRIP	2,917	3,085.00

If the **Ice Sheet** initially accumulated in what is now Northern Greenland
Then the **Ice Sheet** would naturally **flow** down-slope towards the **GISP2** drill site.



Therefore:

The **cold** ***blade*** and **cooling** spikes of Willi Dansgaard's ***Holocene Hockey Stick*** are

more likely to have originated in **high altitude snowfall** in Northern Greenland during the period when the Southern Hemisphere was permanently tilted toward the Sun
and
less likely to have originated in a theoretical ***Ice Age*** that's **not** fully understood.

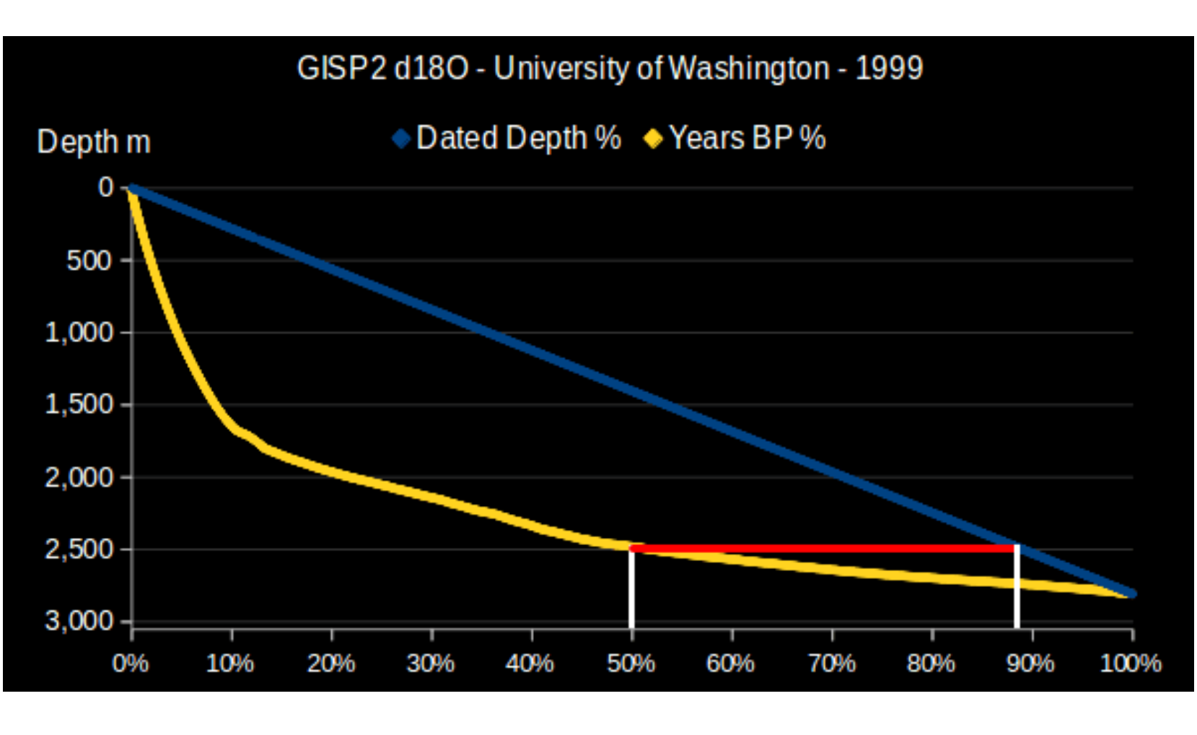
Malaga Bay - The Arabian Horizon: The Ptolemy Inheritance
https://malagabay.wordpress.com/2016/10/17/the-arabian-horizon-the-ptolemy-inheritance/

Overall:

It appears the mainstream dating of **ice cores** is an arcane art form.

1969 *Camp Century* had **50%** of it's 100,000 years BP in the bottom **2.21%** of dated ice.

1999 *GISP2* had **50%** of it's 110,000 years BP in the bottom **11.64%** of dated ice.



Dating **stops** at 2,808 metres in the 3,053 metre **GISP2 ice core**.
The **silty ice** begins at a depth of 3.040 metres.

An arcane art form that's avidly adopted **Dadaism**.

… **Dadaism** was an art movement … the Dada movement … **rejected** … **logic**, **reason**, …

Wikipedia - Dada
https://en.wikipedia.org/wiki/Dada

Dating Varves

In theory it's simple *abacus maths* counting annual varve layers from the ***Cariaco Basin***.

Wikimedia: Sémhur, NordNordWest, and Milenioscuro

The **Cariaco Basin** lies off the north central coast of Venezuela and forms the Gulf of Cariaco. It is **bounded on** the east by Margarita Island, Cubagua Island, and the Araya Peninsula; on **the north by Tortuga Island** and the Tortuga Banks; on the west by Cape Codera and the rocks known as Farallón Centinela; and on the south by the coast of Venezuela.
…
The Cariaco Basin is an east-west trending **pull-apart basin** located on the continental shelf off the eastern coast of Venezuela. It is a deep depression composed of **two sub-basins**, the eastern basin and the western basin, each of **about 1,400 metres (4,600 ft) depth**, separated by a saddle of approximately 900 metres (3,000 ft) water-depth. To the south, the basin confines with the wide (~50 km) Unare Platform.
…
Water circulation inside the basin is restricted, which, combined with the high annual primaryproductivity of the region, causes the basin to be permanently **anoxic below ~250 m**.

This naturally occurring anoxic basin allows for sediments to be deposited without bioturbation, **forming varves of alternating light and dark color**, which **correspond to the dry or rainy season**.

Wikipedia - Cariaco Basin
https://en.wikipedia.org/wiki/Cariaco_Basin

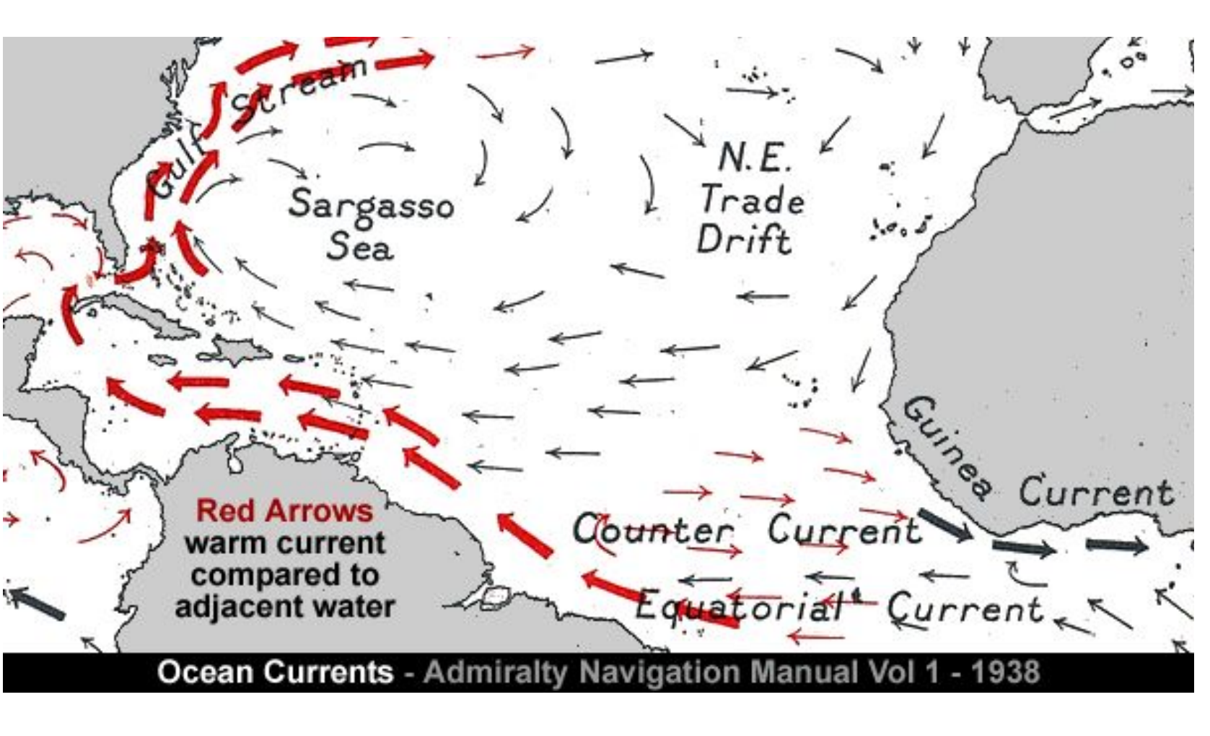
Varves - Fukui Prefectural Varve Museum - Wikimedia: Yasunorihayashi

A **varve** is an **annual layer of sediment** or sedimentary rock.

Wikipedia - Varve
https://en.wikipedia.org/wiki/Varve

Anoxic waters … are **depleted of dissolved oxygen.**

Wikipedia - Anoxic Waters
https://en.wikipedia.org/wiki/Anoxic_basins

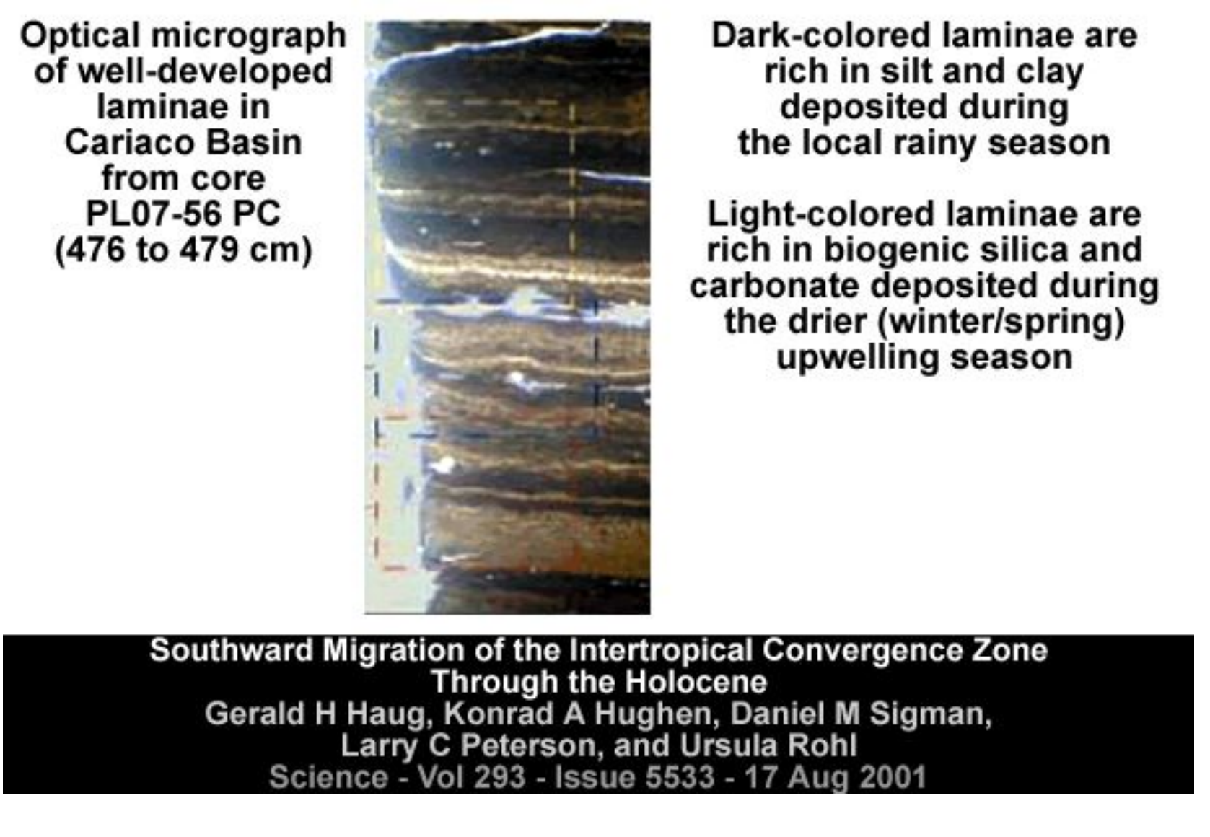


Ocean Currents - Admiralty Navigation Manual Vol 1 - 1938

The **North Equatorial Current** (NEC) is a **westward** … **current** … driven by the north-hemisphere easterly trade wind.

Wikipedia - North Equatorial Current
https://en.wikipedia.org/wiki/North_Equatorial_Current

If you're counting from the topmost layer the *abacus maths* and dating should be straightforward.



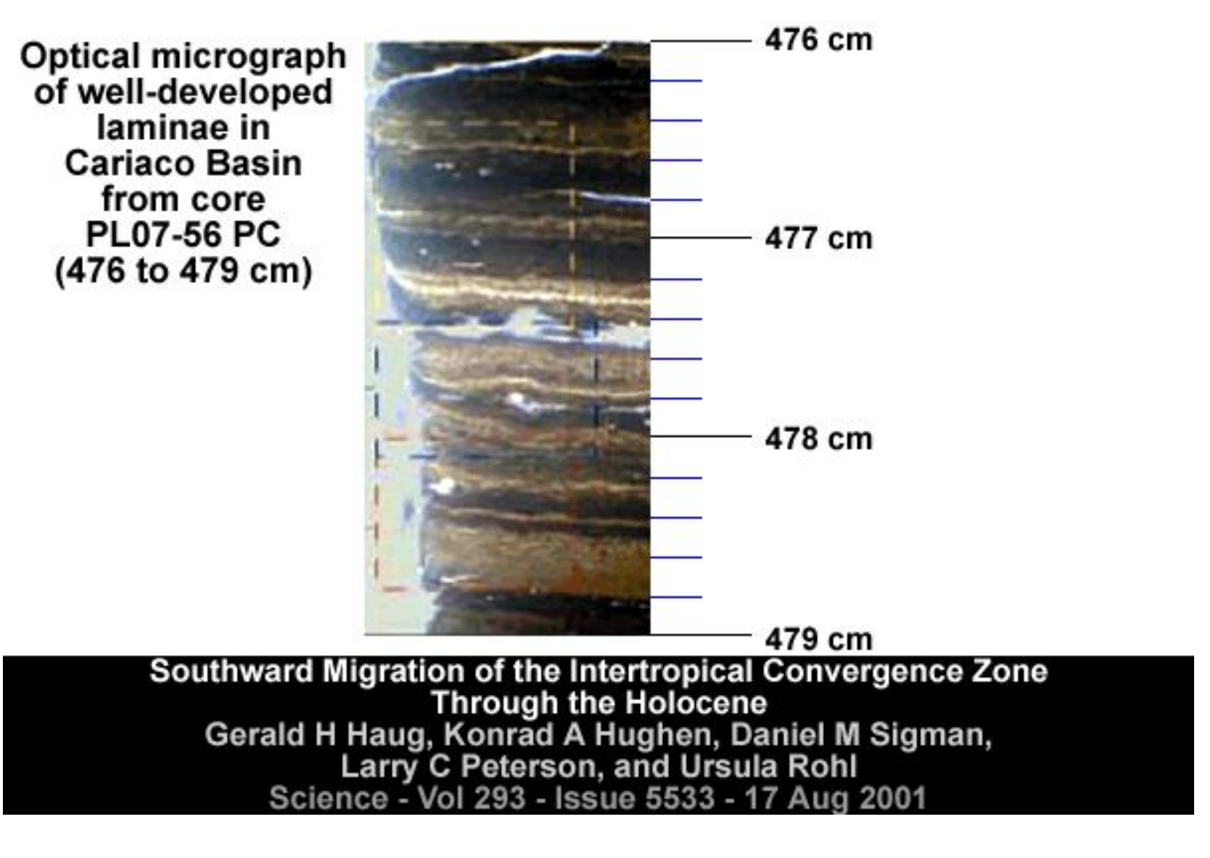
Southward Migration of the Intertropical Convergence Zone Through the Holocene
Gerald H Haug, Konrad A Hughen, Daniel M Sigman, Larry C Peterson, and Ursula Rohl
Science - Vol 293 - Issue 5533 - 17 Aug 2001

Ocean Drilling Program (ODP) Site 1002 (10°42.73'N, 65°10.18'W) was drilled at a **water depth of 893 m**, well below the depth (~300 m) at which oxygen-free conditions in the **Cariaco** water column currently begin. We report on the **uppermost 5.5 m of** the 170-m **sediment** sequence recovered at Hole 1002C …

Southward Migration of the Intertropical Convergence Zone Through the Holocene
Gerald H Haug, Konrad A Hughen, Daniel M Sigman, Larry C Peterson, and Ursula Röhl
Science - Vol 293 - Issue 5533 - 17 Aug 2001
https://www.researchgate.net/publication/11835122

In practice that's way too easy.

1st Employ a strict **2 mm sampling** regime instead of relying upon the *whims of nature.*

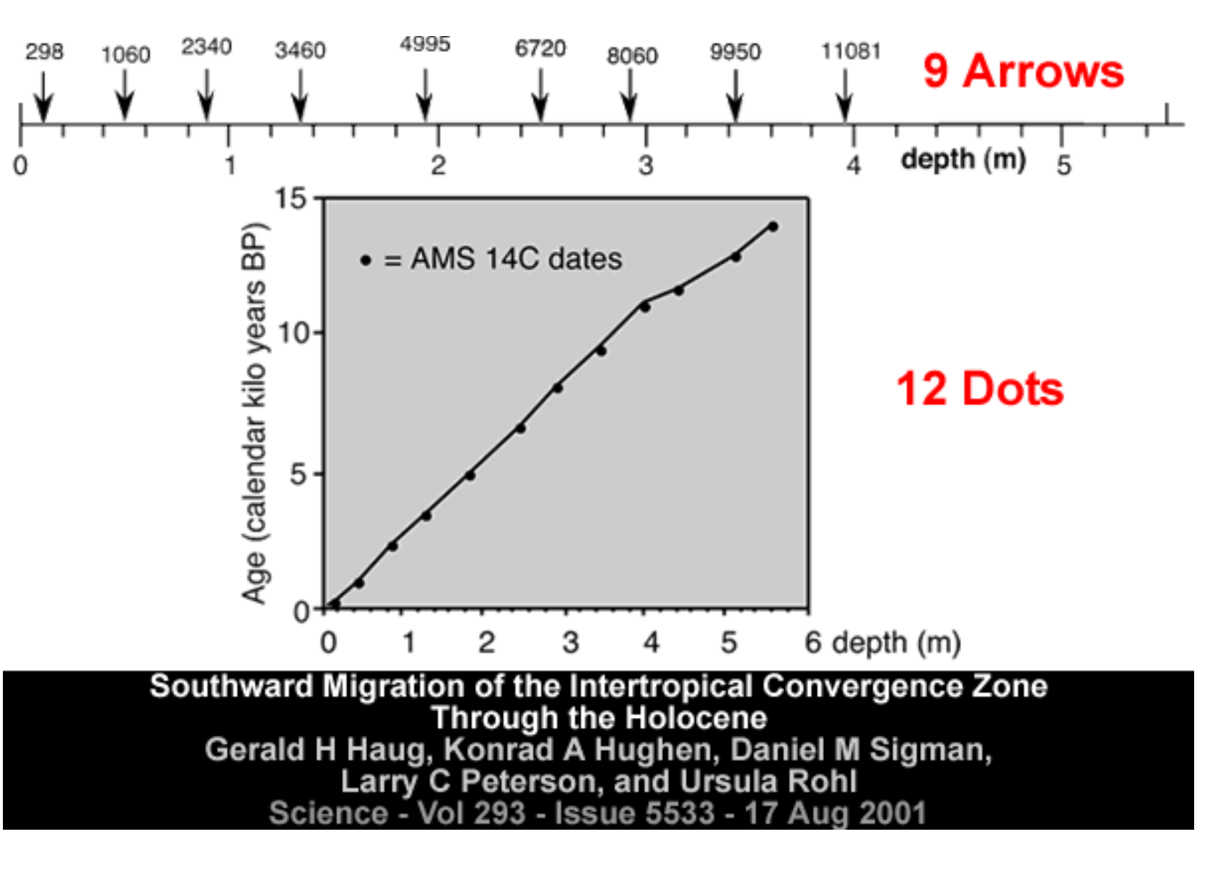


Southward Migration of the Intertropical Convergence Zone Through the Holocene
Gerald H Haug, Konrad A Hughen, Daniel M Sigman, Larry C Peterson, and Ursula Rohl
Science - Vol 293 - Issue 5533 - 17 Aug 2001

Bulk sedimentary **iron** (Fe) and **titanium** (Ti) were **measured over this interval at 2 mm spacing**, corresponding to a sampling interval of ~4 to 5 years, with a profiling x-ray fluorescence scanner at the University of Bremen.

Southward Migration of the Intertropical Convergence Zone Through the Holocene
Gerald H Haug, Konrad A Hughen, Daniel M Sigman, Larry C Peterson, and Ursula Röhl
Science - Vol 293 - Issue 5533 - 17 Aug 2001
https://www.researchgate.net/publication/11835122

2nd Deploy ***detailed age control*** using **"10" calibrated radiocarbon dates** instead of using the old fashioned *abacus maths* method to count the annual layers.

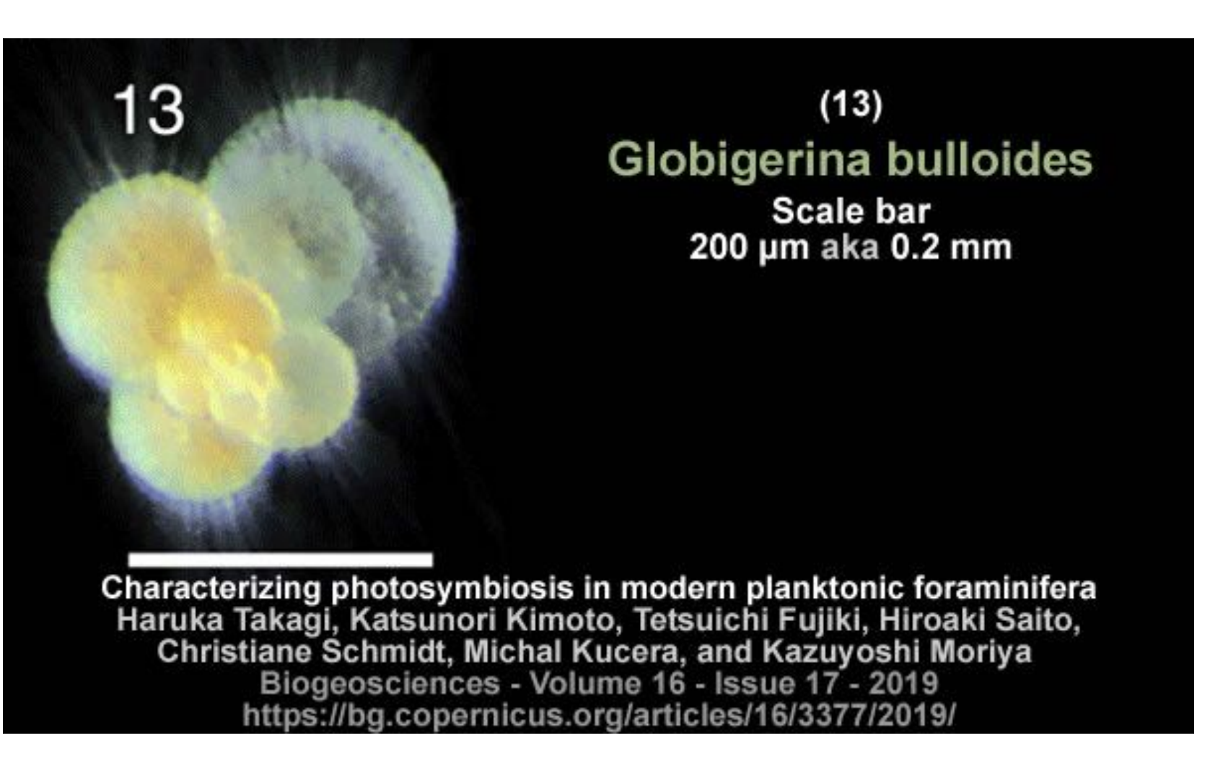


Southward Migration of the Intertropical Convergence Zone Through the Holocene
Gerald H Haug, Konrad A Hughen, Daniel M Sigman, Larry C Peterson, and Ursula Rohl
Science - Vol 293 - Issue 5533 - 17 Aug 2001

Detailed age control is based on a series of **10** accelerator mass spectrometry (AMS) **^{14}C dates** of the planktic foraminifer Globigerina bulloides, all transferred to calendar years **using** the **calibration** of (7).
...
7. M. Stuiver et al., Radiocarbon 40, 1041 (1998).

Southward Migration of the Intertropical Convergence Zone Through the Holocene
Gerald H Haug, Konrad A Hughen, Daniel M Sigman, Larry C Peterson, and Ursula Röhl
Science - Vol 293 - Issue 5533 - 17 Aug 2001
https://www.researchgate.net/publication/11835122

3rd Add some *spice* to your **radiocarbon** results by dating deposits from the **upwelling** season.



Characterizing photosymbiosis in modern planktonic foraminifera
Haruka Takagi, Katsunori Kimoto, Tetsuichi Fujiki, Hiroaki Saito, Christiane Schmidt, Michal Kucera, and Kazuyoshi Moriya
Biogeosciences - Volume 16 - Issue 17 - 2019
https://bg.copernicus.org/articles/16/3377/2019/

Globigerina bulloides is a species of heterotrophic **planktonic foraminifer** with a wide distribution in the photic zone … It is **able to tolerate** … **low-latitude upwelling** regions.

Wikipedia - Globigerina Bulloides
https://en.wikipedia.org/wiki/Globigerina_bulloides

Detailed age control … **^{14}C dates** of the planktic foraminifer **Globigerina bulloides** …
Light-colored laminae are rich in biogenic silica and carbonate **deposited during** the drier **(winter/spring) upwelling** season.

Southward Migration of the Intertropical Convergence Zone Through the Holocene
Gerald H Haug, Konrad A Hughen, Daniel M Sigman, Larry C Peterson, and Ursula Röhl
Science - Vol 293 - Issue 5533 - 17 Aug 2001
https://www.researchgate.net/publication/11835122

Upwelling mixes this "old" water with the surface water, giving the **surface water an apparent age of about several hundred years** (after correcting for fractionation).

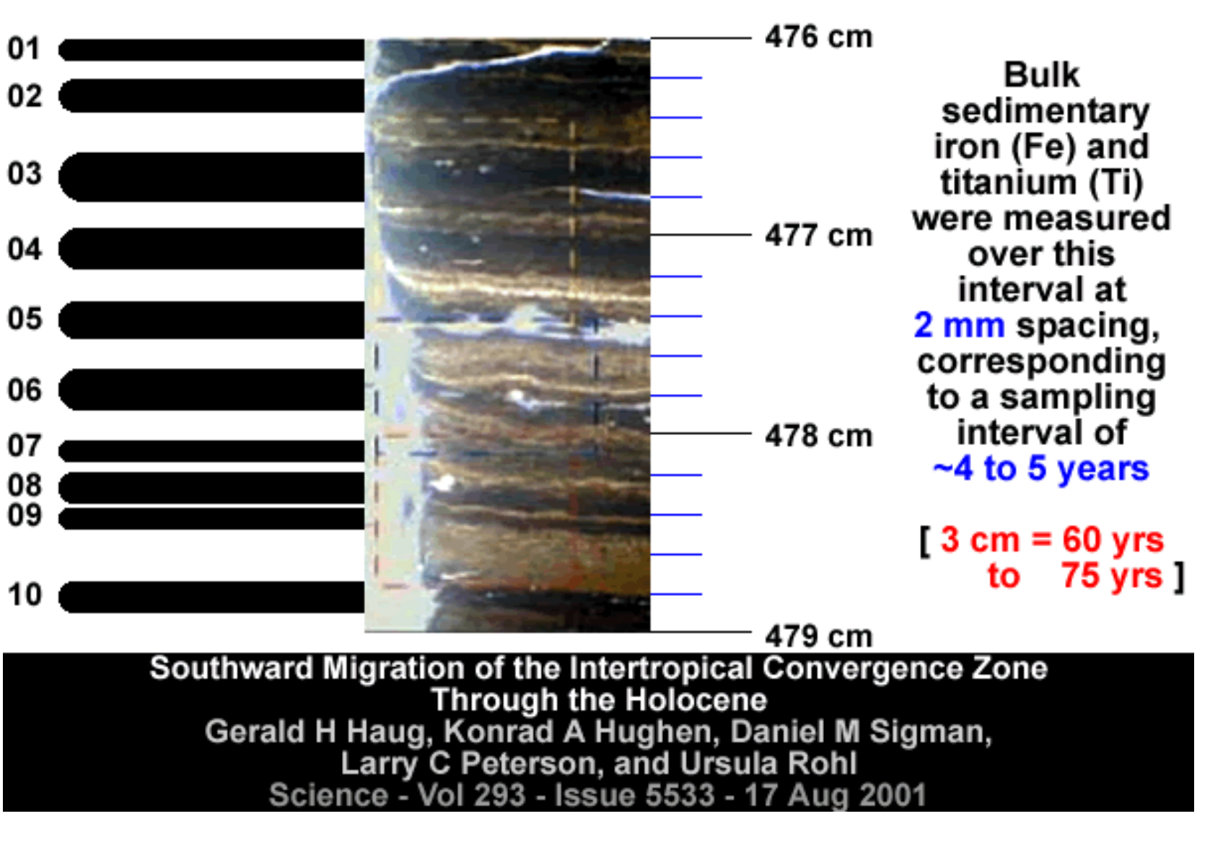
This effect is **not** uniform – the **average effect** is about **400 years**, but there are **local deviations of several hundred years** for areas that are geographically close to each other.

Wikipedia - Radiocarbon Dating
https://en.wikipedia.org/wiki/Radiocarbon_dating

Voilà!

550 centimetres represents between **11,000 years** at a rate of **4 years** per 2 millimetres
and **13,750 years** at a rate of **5 years** per 2 millimetres

3 centimetres represents between **60 years** at a rate of **4 years** per 2 millimetres
and **75 years** at a rate of **5 years** per 2 millimetres.



Southward Migration of the Intertropical Convergence Zone Through the Holocene
Gerald H Haug, Konrad A Hughen, Daniel M Sigman, Larry C Peterson, and Ursula Rohl
Science - Vol 293 - Issue 5533 - 17 Aug 2001

Titanium and iron concentration data from the anoxic Cariaco Basin, off the Venezuelan coast, can be used to infer **variations in the hydrological cycle over** northern South America **during the past 14,000 years** with subdecadal resolution.
…
Bulk sedimentary **iron** (Fe) and **titanium** (Ti) were **measured over this interval at 2 mm spacing**, corresponding to a **sampling interval of ~4 to 5 years** …

Southward Migration of the Intertropical Convergence Zone Through the Holocene
Gerald H Haug, Konrad A Hughen, Daniel M Sigman, Larry C Peterson, and Ursula Röhl
Science - Vol 293 - Issue 5533 - 17 Aug 2001
https://www.researchgate.net/publication/11835122

The above visual analysis of the **calibrated radiocarbon dates** suggest the overall dating process has **exaggerated** the results from the **Cariaco Basin** by somewhere between **6** and **7.5 times.**

This **Exaggeration Factor** can help unravel the very curious results extracted from the far more modest depths of ***Laguna Blanca*** in the Venezuelan Andes.

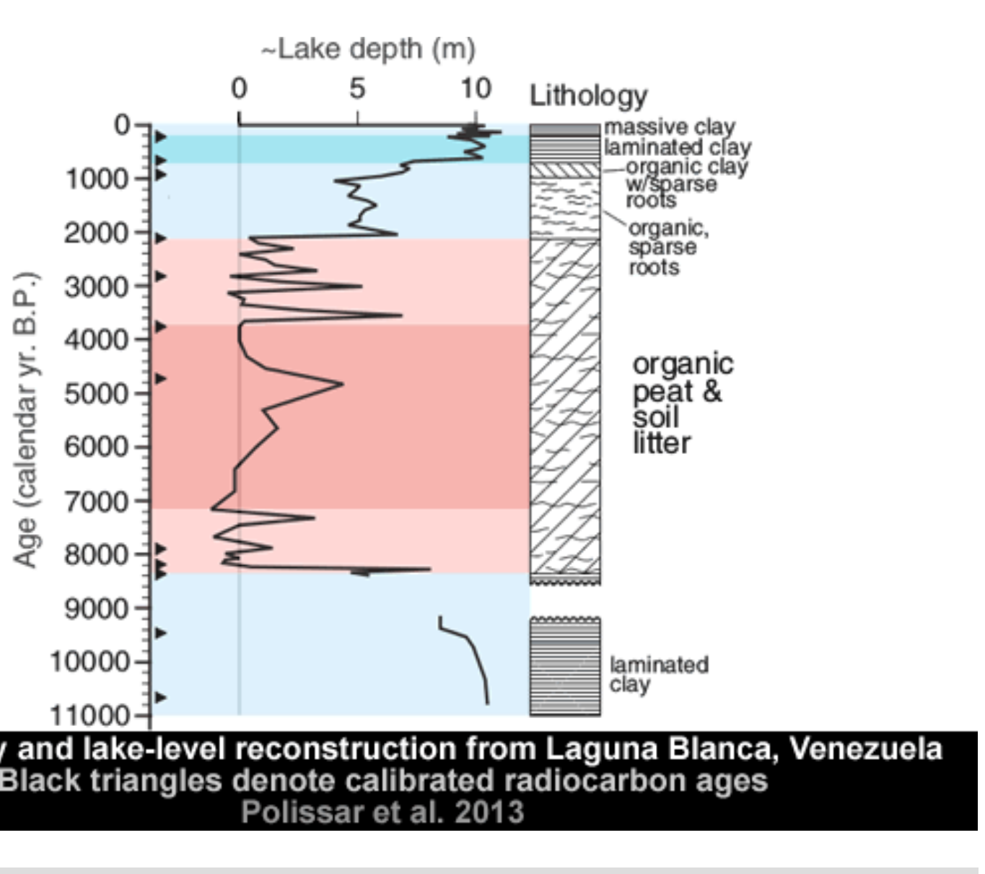
Wikimedia: Sémhur, NordNordWest, and Milenioscuro

Laguna Blanca (8° 20′ N, 71° 47′ W, 1,620 m a.s.l.) is a **small shallow lake** in an unglaciated watershed where sediment lithology and geochemistry offer first-order proxies for changes in lake level and hence regional moisture balance.

Synchronous Interhemispheric Holocene Climate Trends in the Tropical Andes
Pratigya J Polissar, Mark B Abbott, Alexander P Wolfe,
Mathias Vuille, and Maximiliano Bezada
Proceedings of the National Academy of Sciences 110(36) - August 2013
https://www.researchgate.net/publication/255986814

More specifically:

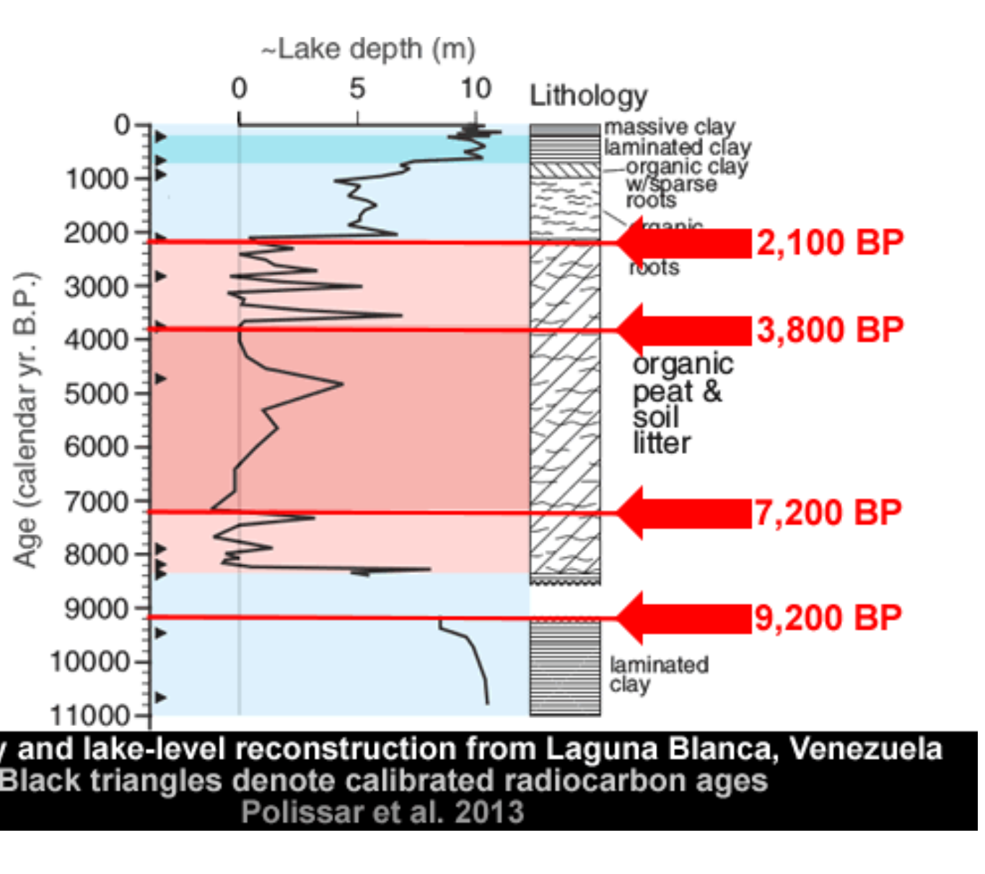
► What caused the **recurring droughts** that lasted until 2100 BP?
► What caused the **dating discontinuity** beginning around 9200 BP?



Stratigraphy and lake-level reconstruction from Laguna Blanca, Venezuela
Black triangles denote calibrated radiocarbon ages
Polissar et al. 2013

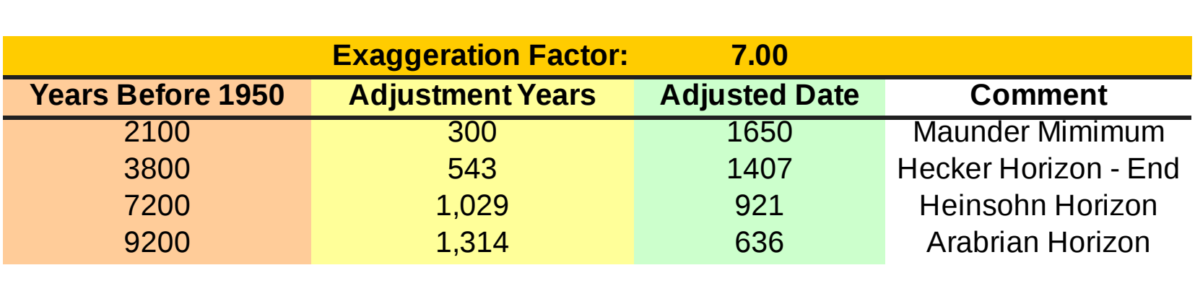
Synchronous Interhemispheric Holocene Climate Trends in the Tropical Andes
Pratigya J Polissar, Mark B Abbott, Alexander P Wolfe,
Mathias Vuille, and Maximiliano Bezada
Proceedings of the National Academy of Sciences 110(36) - August 2013
https://www.researchgate.net/publication/255986814

The colour coded horizons in the ***Laguna Blanca*** lithology can easily be identified and dated.



Stratigraphy and lake-level reconstruction from Laguna Blanca, Venezuela
Black triangles denote calibrated radiocarbon ages
Polissar et al. 2013

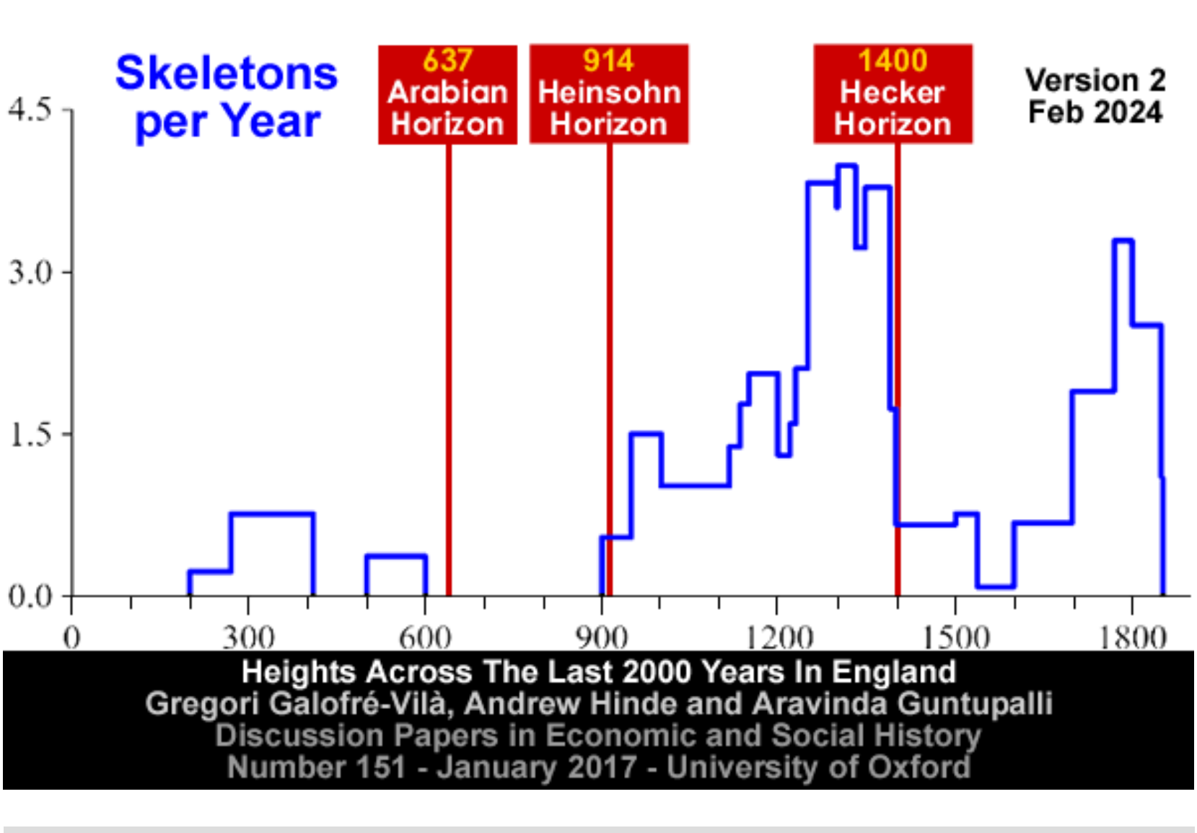
Using an **Exaggeration Factor** of **7** the mainstream dates are reduced to produce **Adjusted Dates**.



	Exaggeration Factor:	7.00	
Years Before 1950	**Adjustment Years**	**Adjusted Date**	**Comment**
2100	300	1650	Maunder Mimimum
3800	543	1407	Hecker Horizon - End
7200	1,029	921	Heinsohn Horizon
9200	1,314	636	Arabrian Horizon

Note: After the *Arabian Horizon* the **calibration curve** has inserted **~1,200** phantom years.

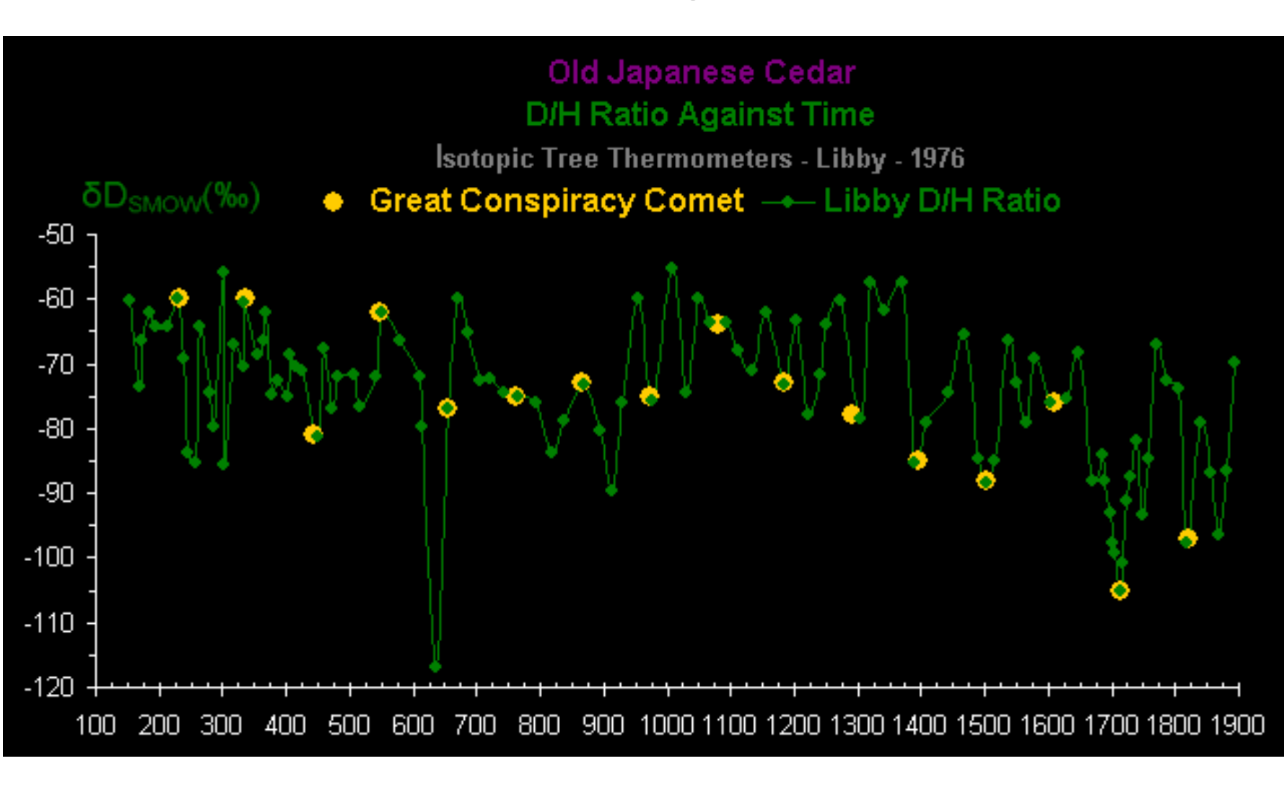
The **Adjusted Dates** align very well with previously identified ***event horizons*** and



Heights Across The Last 2000 Years In England
Gregori Galofré-Vilà, Andrew Hinde and Aravinda Guntupalli
Discussion Papers in Economic and Social History
Number 151 - January 2017 - University of Oxford

Malaga Bay - History of British History
https://malagabay.files.wordpress.com/2024/02/04-history-of-british-history.pdf

the **Adjusted Dates** align very well with **Leona Libby's** *Old Japanese Cedar* chronology.



As always:

Review the evidence and draw your own conclusions.