THE EARTH-MOON COLLISIONS

Presenting three collisions in detail

ABSTRACT

To verify the likelihood of a new solar system formation hypothesis, research was conducted into a possible low speed, shallow angled Earth-Moon collision at 4.1 billion years ago.

Via a tailored set of indicators, not just one but three collisions were identified beyond a reasonable doubt. All are presented in great photographic and topographic detail in this paper. On the Moon, the three impact areas are: Aitkin basin (4.1Ga), a double string of major maria (3.5-3.9Ga) and wider Oceanus Procellarum (450Ma?). On Earth, the respective corresponding impact areas are identifed as: The Arctic, the Canadian shield and equatorial Gondwana (centred at current Antarctica). As a result, many issues in geology can now be explained, from the 'faint young Sun paradox' to Hadean geology and continental drift.

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Chapter 1. Planet – Moon collisions in general

There is little research into possible collisions between terrestrial planets and their moons. When related to Earth and our Moon this is even a somewhat sensitive 'no go' area. The general accepted paradigm for solar system formation, the 'Solar Nebular Disk Model' (SNDM), offers no specific logic as to whether or not this might have happened in the past. In contrast, the recently developed 'Purging Hypothesis' suggests that during the Hadean epoch all inner planets would be subject to substantial orbital disturbances which *could* have lead to low-speed, shallow angled planet-moon collisions. Since the purging hypothesis is far more explanatory than SNDM, it is interesting to examine if indeed such collisions did happen.

1.1 Planet-moon collisions, ice layers and the 'faint young Sun paradox'

Although not a 'sine qua non' condition for the remainder of this paper, it is fitting to describe the conditions and consequences of potential collisions according to the earlier mentioned purging hypothesis. Rather distinct from SNDM, it suggests sizeable terrestrial spheres at origin by default were equipped with outer ice layers of up to 20% of total radius, akin to the still intact 'archetype' ice moons of Enceladus, Europe and Ganymede. As such, any early terrestrial planet-moon collision would have generic consequences: The smaller sphere – our Moon- would risk losing its entire ice envelope at its first major collision, whereas the larger sphere – Earth- will have its ice layer locally damaged, causing *rotational imbalance* leading to heat convection between land and ice. This in turn would provide the energy for first melts in Earth's water / methane / ammonia ices just above land creating warm, dark, UV-free caveats ideal for amino acids to form. With intensified melting, rivers and sediments would dominate the ever more exposed Hadean surface until finally Earth's lower ice layer would become unstable, grinding and pulverising the surface. Ultimately it would become the highly pressurised bottom of an all-encompassing Archean ocean in which first oxygenic photosynthesis based algae formed around 3.5-3.8 Ga. The ocean levels gradually declined over billions of years as water enters the rebounding mantle. This process would be enhanced by the resulting expansionary silicon oxidation at Earth's core. Summarised this would solve 1) the formation of amino acids 2) the 'faint young Sun paradox' 3) Earth's limited damage during the Late Heavy Bombardment 4) the 'missing Hadean rocks' and 5) continental drift as a function of upper mantle rebound. We will elaborate later and continue with the actual collisions.

1.2 The framework of collisions indicators

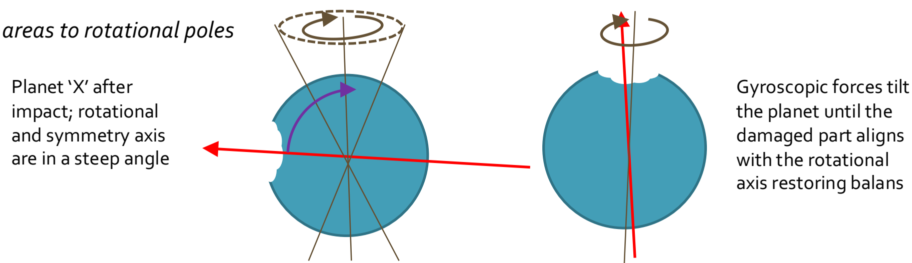
When looking for evidence of collisions we refrained from constructing complicated theoretic models or impressive computer simulations which nowadays seems to be sufficient to 'proof' anything. In stead the focus was on comparing 'one-on-one' actual footage of Moon and Earth. Regarding our Moon, identifying suspect areas was relatively easy; Aitkin Basin, the wider Oceanus Procellarum area and two strings of individual maria clearly stood out on topographic, chemical and gravitational anomaly maps. On Earth the situation was more difficult because of general erosion and recent plate tectonics. Highly sceptical of finding anything, a framework of 7 collision indicators was constructed using logic and studying nearby terrestrial spheres. All 7 indicators are explained in the next paragraphs.

1. Polar features, static (e.g. a wider circular impact rim with a long straight line as 'first touch' base)
2. Polar features, dynamic (tectonic plates moving towards poles)
3. Topographic features, static (surface depressions or elevations, circular imprints)
4. Topographic features, dynamic (annual vertical crustal motion)
5. Gravitational anomalies
6. Chemical / radio active imprints; (dome) volcanism; lack of spin
7. High concentration of small secondary craters;

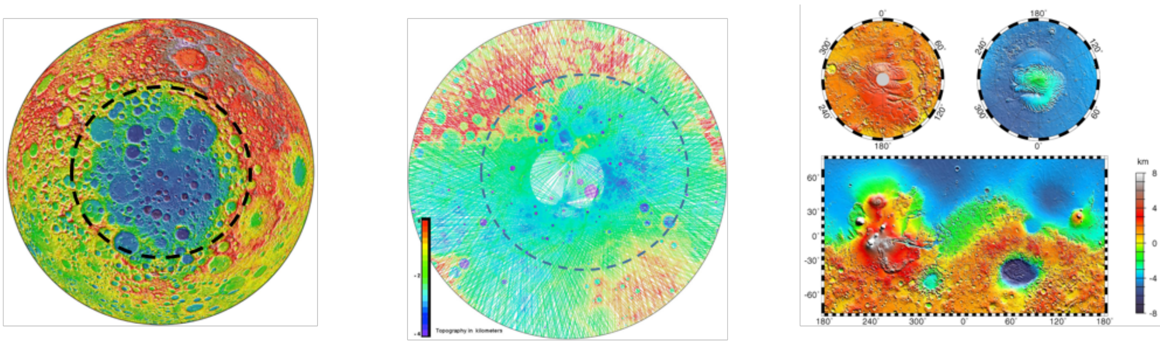
1.3 Polar scars

Polar scars proved to be the dominant indicators. The idea is that if an impact significantly damages part of a rotating (ice)sphere, it will generate rotational imbalance. Gyroscopic forces will next restore balance by moving the damaged area towards one of its rotational poles. In case plate tectonics is enabled, only the plate of the damaged part may migrate to a pole. Either way, poles are the ultimate places to look for scars of large impacts.

Figure 1.1 Spheres in general move damaged areas to rotational poles



This ‘polar mechanism’ can be easily verified: on Earth we will show that the two major impacts locations are indeed found at our exact(!) north pole and our exact(!) south pole, the latter a clear example of a plate tectonics correction. Next, when looking at our closest neighbours below, our Moon, Mercury and Mars all have their major impact area’s at their rotational poles. The colour blue represents depressed, lower situated area’s in all three cases.



Moon south pole impact basin (Aitken) | Mercury north pole impact basin | Mars north pole impact basin (in blue)

Figure 1.2 Examples of spheres moving impact sites to poles.

Note that in general, any solid sphere without tectonics will have great difficulty if it is hit <u>twice</u>. It can handle one damaged area at one pole but a second hit would be impossible to correct as trying to do so would move the first damaged area out of its polar position. The result will be ‘eternal’ gyroscopic swings, heating up the interior perhaps even stirring volcanic activity all over the sphere, until all of its spin is eventually lost. Since the ‘polar mechanism’ appears to have occurred at other inner planets, there might be a (highly speculative!) common history with respect to planet-moon impacts:

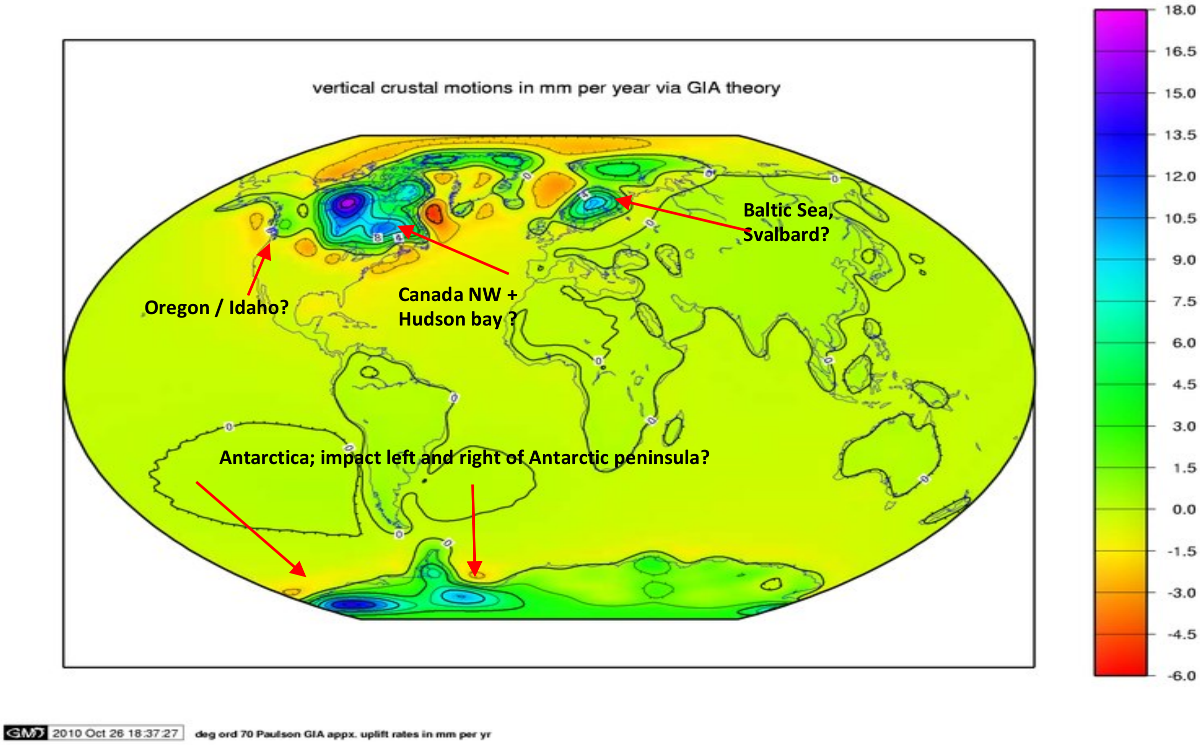
- ***Earth – Moon***
  The scars of the 2 largest collisions are found at exactly (!) Earth’s poles. The Moon’s dominant impact area is at its south pole.
- ***Mercury - Venus***
  At Mercury we see a major impact area at – again- its north pole, and a secondary impact spot at Caloris Basin. Lacking tectonics, a second impact could not be corrected, arguably causing the loss of spin. Obviously Venus would be its suspected impactor with corresponding impact areas at Aphrodite Terra and Ishtar Terra. The gravitational event causing the suggested collision may also be related to the start of Venus’ retrograde rotation.
- ***Mars – Martian Moon (now asteroid belt)***
  The Martian surface shows an impact at Hellas Planitia basin and a second devastating impact at –again - its north polar basin. The larger Martian moon responsible for this impact (400-500km in diameter at least) would later have disintegrated forming the asteroid belt due to resulting rotational imbalance.

The ‘polar mechanism’ has an additional effect in case a sphere is hit twice, while tectonics *are* enabled. Gyroscopic forces would then ultimately move the newly impacted plate – if located at the opposite hemisphere- to the other rotational pole. A prime example is Gondwana / Antarctica as shown later. With the impacted plate arriving at the opposite pole, the planet’s rotational axis will once more become stable.

1.4 Earth: Topographics

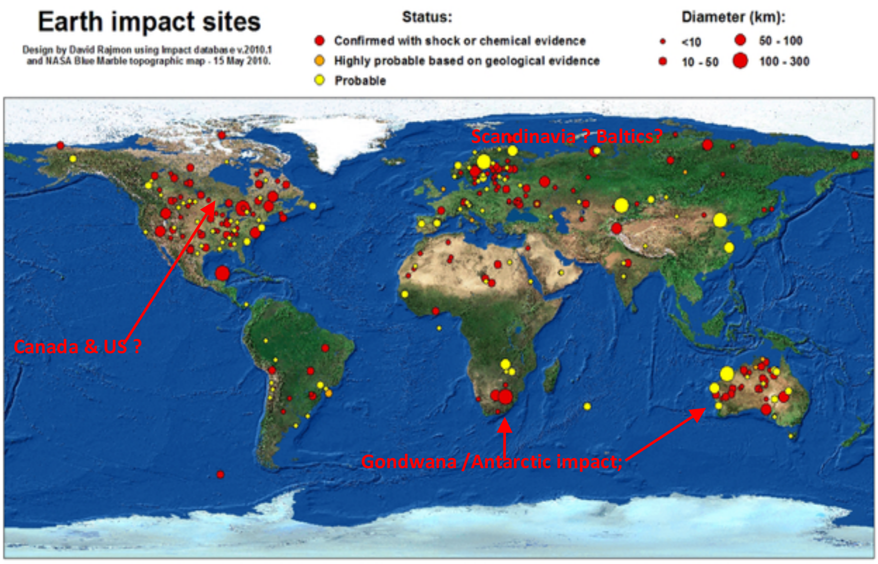
With respect to typical static topographic features of interest, these would include:

1. A large circular impact rim feature and a depressed *OR elevated* central feature.
2. A long *straight line* at the base of such a circular feature, indicative of a shallow wide body impact.
3. In case at least one of the spheres had a substantial ice layer at the time of impact, linear breaking ice shelves could pierce the crust, resulting in a long straight crustal fracture line exactly at the centre of impact.



The annual vertical crustal motion map above, was another important Earth impact indicator. The usual geologic explanation of this chart is that during ice ages, ice masses would invade from the poles, their weight depressing the region while blocking any rebound. As the ice recedes, the surface next rebounds at an increased rate. This explanation is only *partly* plausible. Ice masses for sure *do* temporarily block crustal rebound, however physically it is unlikely they could have <u>caused</u> the extreme local and circular surface depressions. More likely, the depressed area's already existed prior to recent ice ages. If so, ancient impact areas would be an alternative explanation. As such, the vertical crust motion map gave the suspect impact area's of:

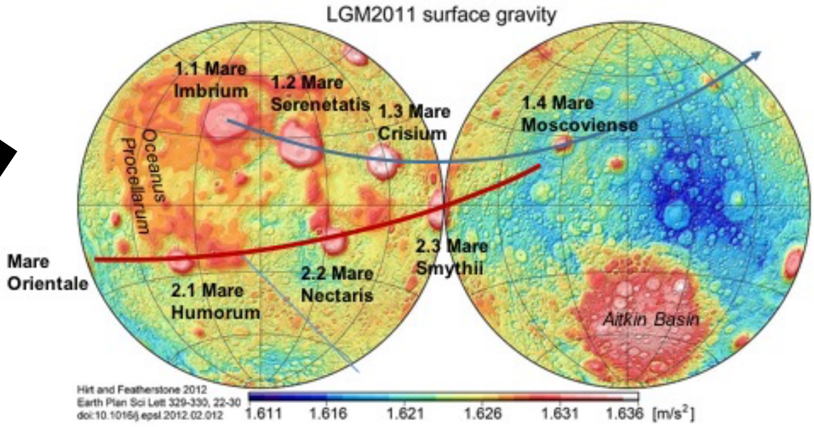
1. A chain of impacts at; Canada NW territories / Nunavut, Hudson Bay / Nastapoka Arc, Gulf of St Lawrence
2. A related (?) impact at the northern Baltic sea
3. Antarctica, left and right of the Antarctic peninsula



To confirm whether vertical crust motion may be related to collisions we decided to have a look at meteorite impacts, reasoning any recent major impact *might* show up as smaller debris re-impacting. Indeed, there appears to be a correlation, not just in the north but also in the south, since Australia, Africa and South America were all part of greater Gondwana until 200Ma

However -and quite surprisingly- crater research learned only some of the concentrated craters are related in age. Many do vary in age, which would suggest that continents with suspected lunar impacts, would (much) later become elevated being the first areas to emerge out of the ocean and thus be subject to more - and older- meteorite impacts than the rest of the still submerged continental crust. We will elaborate on the responsible geophysical process later.

1.5 Moon: Gravity anomalies

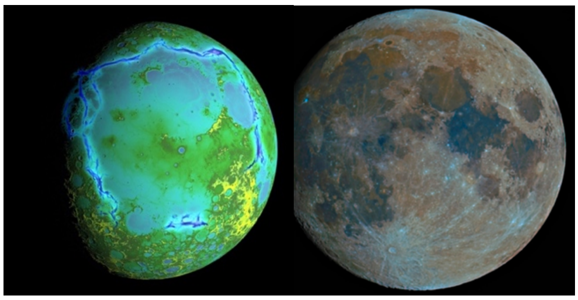


On the moon, the famous dark maria stand out. General consensus is that they are caused by ancient volcanic eruptions preceded by impacts of large asteroids. Though impacts seem a valid option, it is not likely asteroids or meteors were the impactors, given the one-sided concentration of the maria, their non-circular shape and relative wide gravity anomalies. The visual spectrum does not really reveal much more about their origin. This changes when looking at the detailed gravity maps of the 2011 GRAIL mission indicating three separate impact candidates:

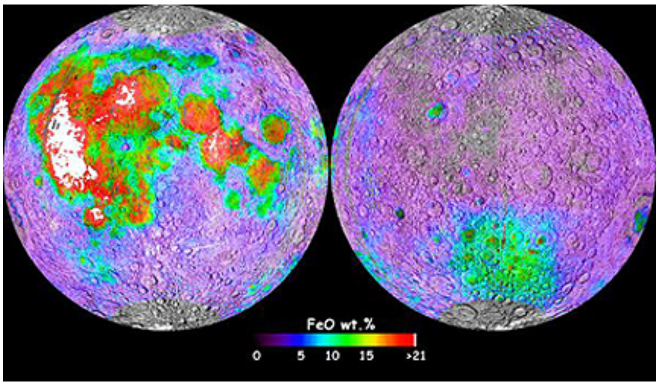
1. **Aitkin Basin**. First and foremost, Aitkin basin, which is hardly visible in the visual spectrum, revealed itself as the remnant of a wide body impact occurring at ca. 4.1 Ga and is now generally considered to be just that. Earth is its likely impactor yet this option is hardly ever mentioned. Arguably the idea is that such a violent collision would have left more structural damage to both spheres. However, such reasoning is based upon the implicit and *unproven* assumption that both Earth and Moon at 4.1Ga should be more or less similar to their current appearances. Quite in contrast –and in line with the purging hypothesis- both spheres at 4.1 Ga would however have had a substantial ice layer, quite capable of absorbing the brunt of the impact energy, explaining the quite limited 'visual' damage on the Moon. If indeed the Moon once had an outer ice layer, this would be the moment it lost it. This is highly consistent with the fact that -unlike Aitkin basin-, all other major impact basins *did* cause clear visual damage to the Lunar surface and are all younger then 4.1 Ga.

2. **The major maria**. When looking at the surface gravity map of the major maria above, one can see they appear to be all connected by two imaginary trajectories, crossing at Mare Moscoviense. This offers the distinct possibility of a shallow, low speed, multi-zone (delta) impact with a large body. Again, Earth would be the prime suspect, since a multi-zone impact is consistent with buoyancy effects one may expect from Earth's formidable water layer once its ice layer melted. In the previous paragraph we saw the Canadian shield showing a string of suspect impact zones. As such it did not take long to confirm that the suspect areas of Canada NW, Hudson Bay, Nastapoka Arc and gulf of St Lawrence are the <u>*exact*</u> in-line mirrored imprints of Mare Imbrium, Serenetatis, Crisium and Moscoviense. In chapter 3 all stunning details are provided.

3. **The wider Oceanus Procellarum area.** Since both strings of maria stretch well beyond Oceanus Procellarum, the Oceanus Procellarum area itself should logically be treated as a separate and more framed impact suspect. To further illustrate: To the right we see the 'unexplained' NASA PIA 18822 study of the Gravity Gradient Frame of Procellarum indicating a gravitational anomaly in the crust. Adjacent we see the Moon in false colours, showing the same frame as a rusty surface feature, best visible at Mare Frigoris to the North. As shown later in chapter 4, this NASA study –for which NASA itself has no explanation- has a *perfect* inversed correlation with the widening circular scars or 'mid ocean ridges' on the ocean floor around Antarctica. The 'dusty' overlap at mare Serenetatis suggests this impact is the youngest impact candidate. With Mare Imbrium and Serenetatis situated within the rusty area, we also get the prediction these two prominent maria would have left their imprints on Earth at two different locations! The crustal motion map on the previous page suggests this <u>could be</u> left and right of the Antarctic peninsula.



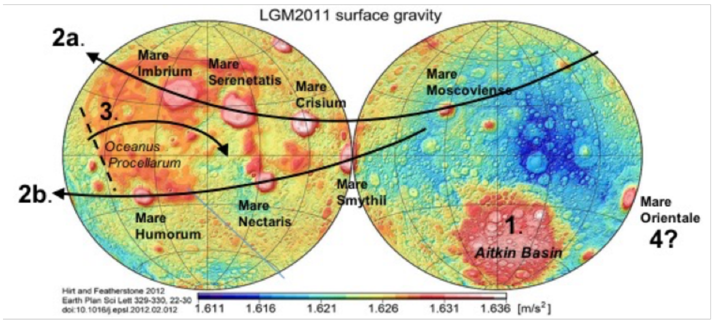
1.6 Moon: Chemical imprints

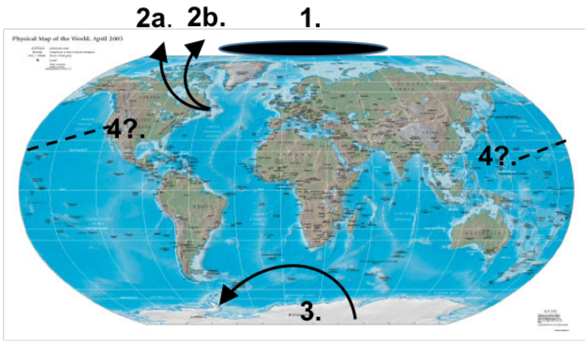


Finally, we studied some chemical composition maps for details. The idea is that any impact between Moon and Earth would superheat the water trapped in between both spheres. At those pressures and temperatures, water becomes supercritical; a physical state in which it can dissolve even rock but not the heaviest elements in it (Iron, Titanium, Thorium, Uranium). As such, it would erode and dissolve the entire rocky surface at the impact zone of both spheres and logically leave behind exceptionally high concentrations of KREEP materials whereas the rocks were spread over the entire Lunar surface as regolith. On the map to the right, the iron oxide distribution seems to indicate the wider Oceanus Procellarum area is indeed related to a wide-body impact. *(Clementine map of Lunar iron oxide concentrations)*. Also it indicates a clear linear impact base at its left *and* a slightly 'rolling' skew to the right upon unfolding.

1.7 The three Earth-Moon collisions

Below the numbers of all collisions are inserted, with their counterparts on Earth and Moon.





Referring to the impact numbers above: We propose to coin the three impacts us follows

1. **The Arctic or 'Hadean' impact, ca. 4,1 Ga**. The 'mother of all impacts' between Earth's *current* North Pole (Gakkel Ridge to Canada basin) and the Lunar Aitken basin near the *current* Lunar South Pole.
2. **a. The Canadian Shield ('Archean') impact 3.9 Ga String 1**. This involves a. Mare Imbrium = Canada North West, b. Mare Serenetatis = Hudson Bay West bank, c. Mare Crisium= Hudson Bay East (Nastapoka arc) and d. Mare Moscoviense = Gulf of St Lawrence.
2. **b. The Canadian Shield ('Archean') impact 3.9 Ga String 2**. This involves a. Mare Smythii = Gulf of Bothnia, b. Mare Nectaris = Aegir Ridge c. Mare Humorum=Greenland. Both strings belong together, forming a 7-zone delta pivot impact. Due to tectonics, part of the string 2 impacts later migrated to the east on Earth.
3. **The Gondwana/Antarctica ('Ordovician'?) impact ca. 450 Ma?** This impact has a bent trajectory and occurred between the Moon's Oceanus Procellarum / Imbrium/ Serenitatis region (NASA study PIA 18822) and Earth's <u>equatorial</u> Gondwana, centred at current Antarctica. On Earth, the borders of this nearly squared impact area are the *spreading* mid oceanic ridges around Antarctica. During this collision, Mare Imbrium and Mare Serenetatis impacted right and left of the Antarctic peninsula, forming it as such.
4. **Mare Orientale** shares comparable features with Mariana Trench *and* a large impact area at the border of Idaho / Utah, U.S.A. We will address what could be behind this trinity in relation to the growth of the Pacific. The Mare Orientale impact likely belongs to the Gondwana impact, as it is located centred in front of Oceanus Procellarum. It might also be part of the 2b string impact series.

   The next Chapters will describe in detail each of the above 3 collisions:

Chapter 2. The Hadean Collision (4.1 Ga)

The Lunar Aitken basin is highly visible on the topographic and surface gravity map. This huge area is generally recognised as the oldest impact basin on the Moon with age estimates varying from 4.0 to 4.3 Ga. It is thought to be forged by a very low impact speed (10 km/s) with a huge body. *Reference: "..constraining the size of the South Pole-Aitken impact, Potter, Collins et.al.".*
Aitken basin is located near the Lunar south pole so that is a major indicator. It is a large depressed circular area, with a *linear* 1700- km base at the lower right side of Aitken basin, all again consistent with a wide-body impact. In addition, there are elevated iron levels. These are enough factors to look for a matching feature on Earth. Theory predicts the best place to look for is at Earth's poles. And indeed, a matching impact zone on Earth is found at exactly our North pole; The 1700 km (!) straight impact line of Amundsen Basin / Gakkel ridge. Though slightly eroded by tectonics and the later rotation of Greenland, the detailed mapping is still recognisable as analysed below. Lunar images are presented in their mirrored (inversed) image to allow for easier comparisons with Earth features.

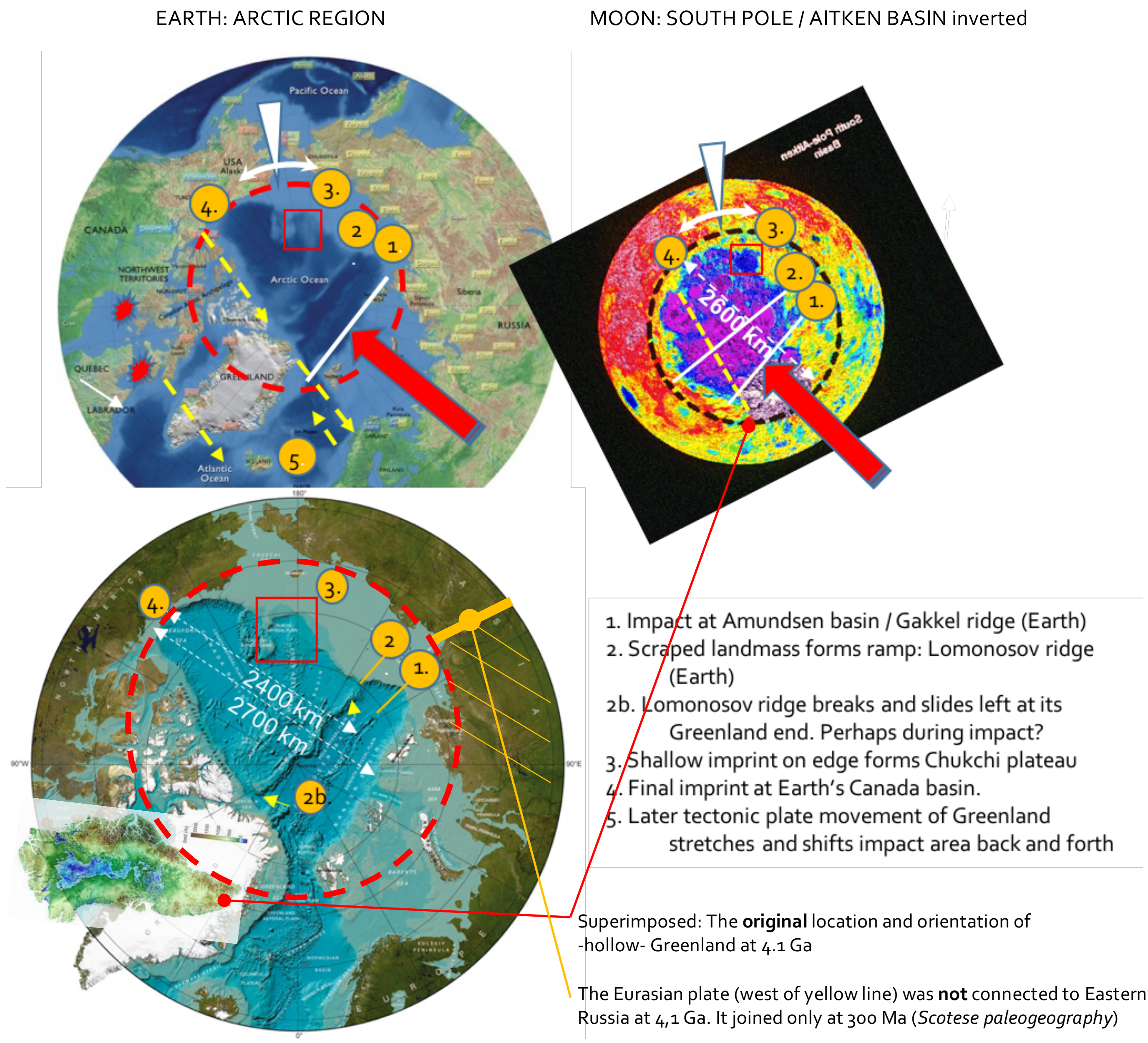


Figure 2.1; Earth polar region and Moon topographic south pole region; Source Clementine Topographic map, Lunar Planetary Institute

2.1 Primary observations

1. In general: notice the similar forces inflicted on the edges of both circles; On the moon we see huge compressing forces (in red) form mountains around the impact zone, just like on Earth.
2. The entry points for both spheres are at the straight white lines indicated by the red arrows. On Earth, the primary entry is the Eurasian continent at the Barentz-Kara sea margin, reaching the ocean floor at current Gakkel ridge. Its near perfect straight line might indicate a huge ice shell piercing the crust at Gakkel ridge.
3. An identical secondary line -most likely scraped landmass from the Gakkel ridge area- forms Lomonosov ridge. At the Greenland-end of Lomonosov ridge we can see this ridge appears snapped during impact and pushed away towards Canada so that Lomonosov and Gakkel Ridge now slightly angle at about 10 degrees. This double impact feature seems to be reflected on the Lunar picture as well.
4. Next we see a less deep imprint creating the Chukchi Plateau and Mendeleyev Ridge. At the corresponding Lunar impact area, we see this reflected by a square which is blue in stead of purple, indicating a less deep imprint.
5. Next we see the impact ending at Canada Basin. The original impact forces on both surfaces must have been tremendous as even to this date, both areas are still way below their surrounding surface, on the Moon even 6 km.
6. On the Moon, on top we see a surface pressure divide between the two red area's indicated by a white triangle. On Earth there is an *exact* copy of this divide in pressure, forming the Bering sea and Bering straight between current Russia and Alaska. Alaska itself would appear to have some additional landmass compared to the original situation. Notice also the angle of this divide on Earth grows disproportionally larger towards the south, compared to the Lunar situation. A stark indication the seafloor on Earth has dilated substantially at the Pacific ever since.
7. Looking at the bottom-left part of the Lunar Aitkin Picture, we see a stretched red feature, horizontally aligned with a *hollow* centre, attached to the lunar area that would correspond with Quebec on Earth. We see no such feature on current day Earth. However, studying tectonics, this is the location where Greenland would be, while still connected *horizontally*, to the North American continent. Notice how Greenland's rotated arc-shaped south East coast perfectly aligns with the impact circle. Also, Greenland land-wise is actually *hollow* at its centre as the superimposed picture shows, just as the Lunar situation predicts.
8. Related to this; Within Earth's red dotted wider impact circle we see a stark dissonant with the Lunar situation: parts of Northern Canada and Greenland appear crushed, fragmented and are located inside the original impact circle. The lunar situation suggests this would not be the original situation upon forming the arctic region. This suggests some major event would ***afterwards*** have caused the scattering of North West Canada and the later detachment and rotation of Greenland. This is consistent with another suspect Earth impact area we already identified in the first chapter; The Canadian Shield. It will be addressed in the next chapter.
9. Zooming out, the Lunar picture suggests that a half circle, from Greenland to Bering Street and the Lena river in Russia is original and related arctic landmass, forged at 4,1 Ga. This suggests:
    a. Unlike many 'scientific' tectonic animations, almost no tectonic movement occurred ever since in this half-circle region. In addition; the Arctic seafloor is to be seen as depressed continental crust, not seafloor.
    b. All of Earth's landmass west from the Lena river would originally *not* be located this high up north on Earth. *Again* this is correct. This is a separate landmass, the Eurasian plate, only joining at the Lena at 300 Ma.

2.2 Secondary considerations; ice layer and terraforming

The above described geographic similarities combined with the compliance of all major collision indicators forms a very compelling case for an actual Earth - Moon collision. This leads us to an important next question; Does it in anyway indicate Earth indeed had a 1200+ km outer ice layer at time of impact, quite similar to the well preserved ice moons of our solar system? (see Annex 1).

If indeed Earth had an outer ice layer, then most of this water would have gradually entered the upper mantle over the past 4,1 billion years, suggesting fluid water -unlike ice- is not a stable outer layer: The highly compressed upper mantle would absorb any water coming in via cracks or subduction. This reduces surface water pressure overhead, which in turn allows it to rebound further, sucking in more water, etc. As a side effect, the top continental crust upon which the ice layer once rested would stretch, break and next spread as separate continents along the expanding upper mantle. Such a mantle-rebounding/ ocean-depleting process is in line with the two water consuming processes generally acknowledged in geology:

1. Water saturated ocean floor *does* enter the mantle via subduction and arguably hardly any of this surface water returns to the surface. In stead it is 1) stored as water inside pockets under the convex continental crust or 2) stored as hydroxide or otherwise inside rocks (Serpentinite, Ringwoodite) or 3) takes part in other chemical reactions. Regardless its ultimate form, the water influx facilitates pushing up the convex continental crusts 'from below', as the upper mantle gradually rebounds.
2. At the volcanic mid ocean ridges, water is currently used to 'franticly' quench magma, producing new low-density pillow lava, effectively expanding the ocean floor 'from above' even if some is later sub-ducted at a slow rate.
3. There is a *potential* third water related process: Earth's core of liquid iron and liquid nickel is hot enough to also have a next layer of liquid **silicon**. Any water (or oxygen) coming in contact with this layer immediately engages into (wet or dry) silicon oxidation $Si+2H_2O \rightarrow SiO_2 + 2H_2$, a highly expansionary process with the oxide growing to +54% its original size. It would cause Earth to physically expand inside-out with the mid oceanic ridges frantically producing new seafloor to keep up. Subduction would provide the needed influx of new oxygen atoms, ironically sustaining Earth's expansion, whereas it has always been used to 'prove' the theory of plate tectonics as the main driver for continental drift. Remarkably, in January 2017 a study was published indicating indeed residual pure silicon is part of Earths core. https://phys.org/news/2017-01-silicon-element-earth-core.html

These surface water consuming processes combined, deliver the theoretic engine needed to gradually transform Earth from a 1200km+ ocean world, towards a planet with a rebounding, swollen and less dense upper mantle leaving only shallow oceans on top of it. This 'terraforming' process is quite in line with physics as well:

1. It would be a mass and volume neutral process since only the location of surface water changes.
2. The upper mantle's density would drop considerably compared to the lower mantle density. This is consistent with todays upper mantle density dropping to nearly 60% the density of the lower mantle.
3. Earth's mass distribution would change; As its outer layer is no longer 1200 km of light ice, Earth's inertia would increase *significantly*, leading to slower rotation. Again this is consistent with our current day of nearly 24 hours, as opposed to an estimated shorter than 5 hours at inception.
4. Interestingly, all current continental crust combined ***would*** fit together on a approx. 30% smaller sphere. Current ocean floor would not have existed back than, but formed later via 'mid oceanic ridges' to compensate expansion.

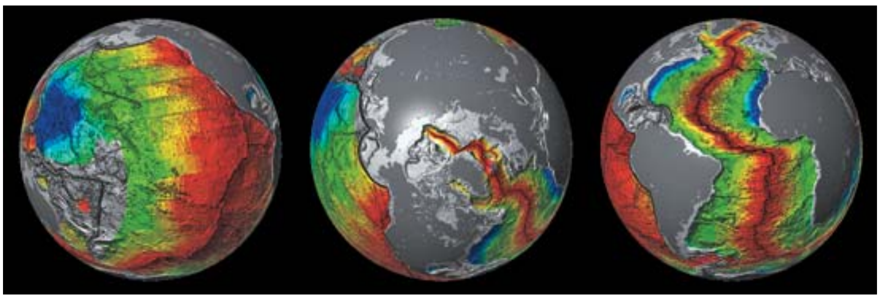
Testing the 30% mantle expansion thesis

The expansion hypothesis is not new. It was long considered an alternative to tectonics, but the suggested mass increase could never be substantiated in practice or in theory. However, the new element of a deep Archean ocean solves this. Moreover, for the first time, the Arctic impact gives us a chance to put it to the test: **If** the Hadean sphere was indeed 30% smaller, it should show up at Earth's current Arctic impact circle since it encompasses all meridians:

1. Referring to the Hadean impact comparison on the previous page, the diameter of the dotted wider impact circle on the Moon at the South Pole / Aitken ('SPA') region is 2600 km, whereas
2. On Earth this circle is now about 3350km, the distance between north Alaska and Longyearbyen on Spitsbergen.

Thus, on Earth it is now 1-3350 / 2600 or 29% wider. This would suggest an upper mantle radius of 4970 km at 4.1 Ga, with an extra ice layer of some 1430 km (combined 6400 km). Also, since we earlier concluded the Arctic half circle is one of the most stable regions, its widening would have logically occurred at the *Atlantic* side of the circle. Again, this seems consistent with the Arctic picture in the middle, below. In addition, even considering some slow rate subduction, it appears the bulk of this expansion happened over the last 250 million years! Notice also the huge blue (old) spot on the seafloor east of Mariana Trench. We will get back to this area in the final chapter.

Figure 2.2. Patterns of seafloor spreading in the Pacific (left), Arctic (centre), and Atlantic oceans (right); U.S. Dept. of Commerce/NOAA



Data on mantle expansion
All of this would mean current sophisticated technology should be able to detect substantial mantle rise. Remarkably the first data ever gathered scientifically on a grand scale regarding mantle expansion, was immediately subject of a huge controversy. From 1976 to 1993 data was collected form a network of over 600 VLBI stations on Earth and arguably the outcome was an average growth of Earth's outer mantle of no less than 18 mm per year.
This is consistent with the excessive seafloor spreading which started some 250-200 million years ago as the previous picture showed. It was however not consistent with the upcoming theory of plate tectonics which suggested a static Earth. Consequently, the findings where reportedly next corrected:

Space Geodetic Network:

'….Calculations based on the established global observational network to 1993 gave a mean "value of up-down (radial) motions of over 18 mm/year", this was considered extremely high when compared to expected de-glacial rates. It was "expected that most VLBI stations will have up-down motions of only a few mm/year" and it was then ***recommended*** *that the vertical motion be "restricted to zero, because this is closer to the* ***true*** *situation than the average of 18 mm/year….".*

-Robaudo & Harrison (1993)-

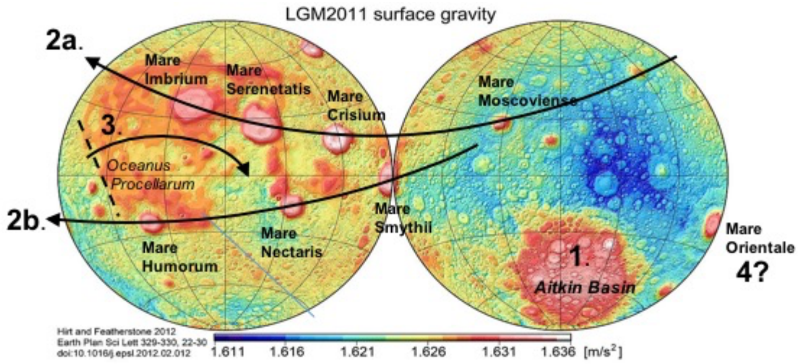
Proponents of the –not always very credible- expansionary school, claim that ever since 1993, a 17 mm/year correction factor is applied when processing any data on Earth's up-down mantle motions. Though not a subject of this paper per se, if true, it is for sure morally questionable. Remarkable as the 18mm/year values may be, they are in line with what we will present later.

Chapter 3. The Archean Collision (3.5 - 3.9 Ga)

After describing the Hadean collision, the next features of interest are the major Lunar maria, which are all positioned at Earth's facing side. In great detail the seven major maria of impact 2a and 2b can be mapped onto the Canadian shield. The Oceanus Procellarum area is not part of this collision and will be addressed in the next chapter.

3.1 The forming of the maria

General consensus is that Lunar maria are related to impacting asteroids or meteors, their basins later flooded by lava from the Lunar interior. The radiometric ages of maria rim material range from 3,16 to 4,2 Ga, but most are dated around 3.9 Ga. The ages of the lava basalts range from 3 to 3,5 Ga *(source Wikipedia).* As such, it is generally believed the major maria to the right (2a and 2b) would have formed somewhere between 3.5-3.9 Ga.

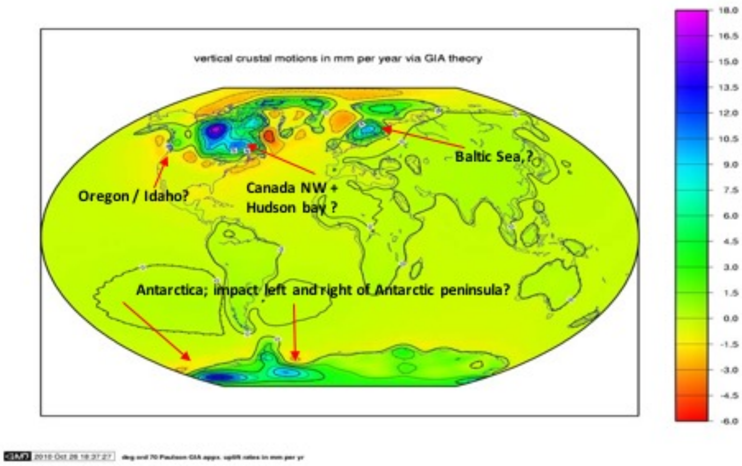


There are however problems with the consensus view of individual meteor impacts; Since all maria are concentrated on one side of the Moon, the meteors would preferably have impacted simultaneously which is unlikely. In addition, all maria are irregularly shaped and their surface gravity distribution is relative wide, both *__not__* consistent with meteor impacts. An even more troublesome aspect is revealed when looking at the surface gravity map of the Moon above; The major maria are actually aligned along two virtual trajectories. A serial meteorite like Shoemaker-Levy 9 could be involved but we just suggested the maria are not related to meteor impacts at all. In contrast, the more plausible solution would be a multi-zone impact with a wide-body object. Taking this option a step further, we notice both trajectories 2a and 2b actually converge at Mare Moscoviense. If taken at face-value, this *could* mean they form a combined seven-zone delta impact where the Moon would have banked left and right during an impact converging or diverging at Mare Moscoviense.
Earth at 3.9 Ga, would have had an outer water layer in access of 1200 km (see Annex 1) being quite able to exert substantial surface tension and buoyancy effects consistent with the 'bumpy' impact trajectories as depicted above. To proof all of this, we will demand nothing less then finding the exact inversed copy of this 7-fold maria delta impact on Earth where **__each__** of the inversed imprints must have the correct 1) size 2) shape 3) relative position and 4) relative orientation. We will start with the dominant 2a string.

3.2 String 2a: The imbrium impacts

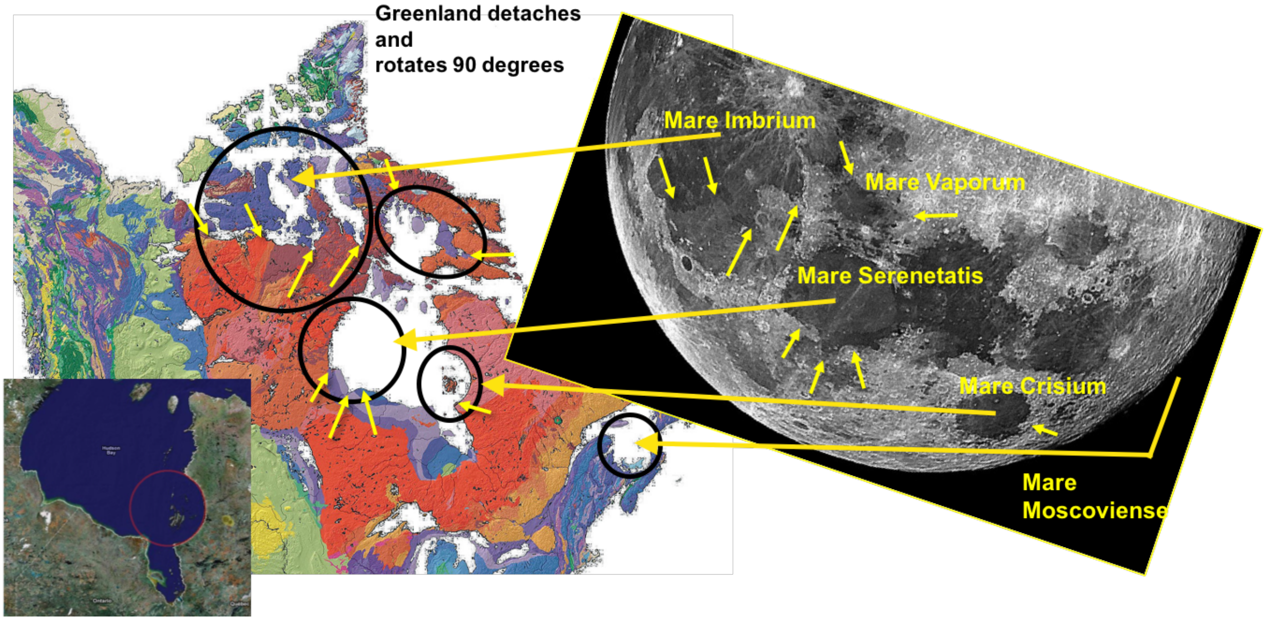
First of all, at the respective impact zones on Earth we expect the surface to be just 'gone' like on the Moon, without leaving the typical impact material one would normally expect. The reason is that upon impact any water trapped between both surfaces would be subject to extreme pressure and temperature reaching supercritical levels. In this physical state water can fragment and dissolve surface rock, but not the heavier metals in it (Fe, Ti, Th, U) explaining their high oxide concentrations near impact zones.

Earlier we explained why we *can* use the Earth vertical crustal motion map and the EDEIS crater impact map to identify any suspect corresponding Earth impact zones, something which is not intuitive given the consensus interpretation of these maps.



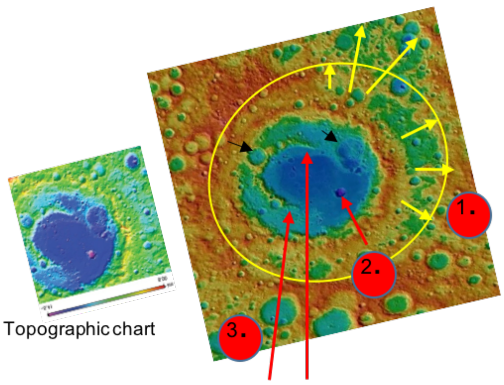
Focussing on the dominant 2a string maria, the vertical crustal motion map suggests Canada NW and Nastapoka arc at Hudson Bay are the prime suspects for finding counterparts. On the next page this is confirmed by projecting the 2a string onto the Canadian shield.

Diameter Mare Imbrium: 1100 km → Correct sized virtual circle, correct display of southern shore line
Diameter Mare Serenetatis: 675 km → Correct sized half imprint at Hudson Bay West
Diameter Mare Crisium: 550 km, circular element 450 km → Diameter Nastapoka arc Hudson Bay East: 450 km
Diameter Mare Moscoviense : 277 km → Diameter Gulf of St. Lawrence: 280 km



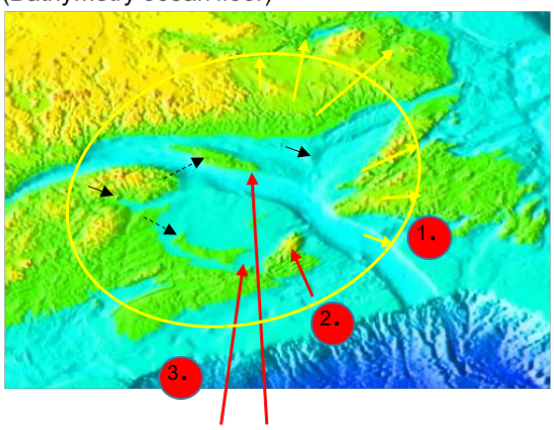
The distance between Mare Crisium and Serenetatis on the Moon is larger compared to the distance between Hudson bay East and Hudson bay West. This is consistent with the later tectonic movement on Earth of Hudson Bay East towards Hudson Bay West. In general, distances can also vary due to the Moon veering off between two impacts.

Moon, Mare Moscoviense 277 km
(inversed and rotated)
Gravity anomaly chart, source: Grail mission



Topographic chart

Earth, Gulf of St Lawrence 280 km
(Bathymetry ocean floor)



1. *Yellow ellipse and arrows:*
On the Moon, right outside the primary impact ring, there is a green area indicating unusual low surface compression to the right and top.
On Earth, at the same spot, we see a major landslide to the right and top, explaining where the missing impact energy went into

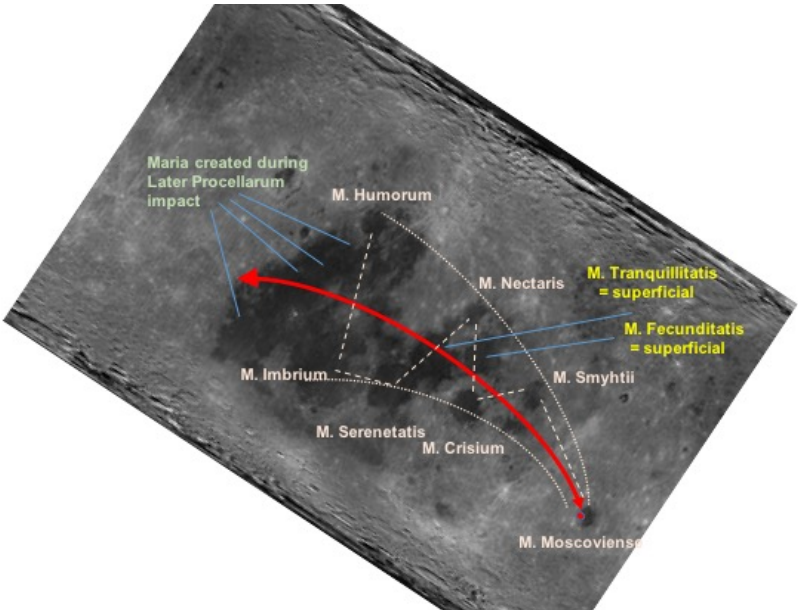
2. On the Moon we see a small but clear crater at the base of the central impact basin
On Earth on exactly the same spot we see a clear bulge (White Hill, Nova Scotia), providing the fingerprint-like inverse of the lunar crater

3. *Red arrows:*
On the moon we see a 'horse shoe' shaped impact feature. Notice the reversed convex curvature on the outer tip of the lower half.
On Earth we see the same horse shoe like impact feature, albeit detached from the center due to the impact.
Notice the same reversed convex curvature at the outer tip of the lower half (Prince Edward Island, right above the left red arrow)

In all, these **four** (five) Earth imprints match in 1) shape 2) size 3) position *and* 4) orientation. As such, it is statistically ***impossible*** that these are not the combined imprints of the corresponding four Lunar maria.

3.2 String 2b: The Smythii impacts

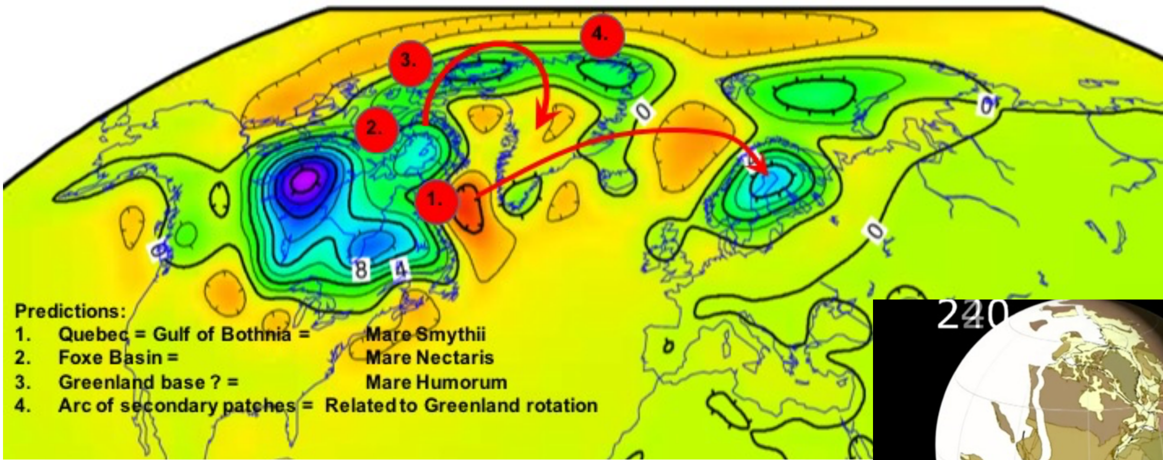
To upgrade the confirmed 4-fold impact to the suggested 7-fold delta impact structure, we must next find the inversed imprints of string 2b (Smythii, Nectaris and Humorum) at their projected Earth locations, just north of the 2a series. This is not easy, since the 2b series fractured Earth's surface and are likely now found on migrated tectonic plates, due to these impacts. This suggested disposing of impact energy, is highly consistent with the fact that all 2b mare have less gravitational anomalies imprinted on the moon (see Lunar surface gravity map) then the 2a series.



To start off, the inversed Lunar situation to the right does provide the original location and orientation of expected impacts. In white letters we see the seven pivot maria with gravity anomalies. At the Procellarum side, the view gets distorted by material of this more recent 3rd impact, arguably also involving M. Tranquillitatis and M. Fecunditatis.

a) Mare Smythii

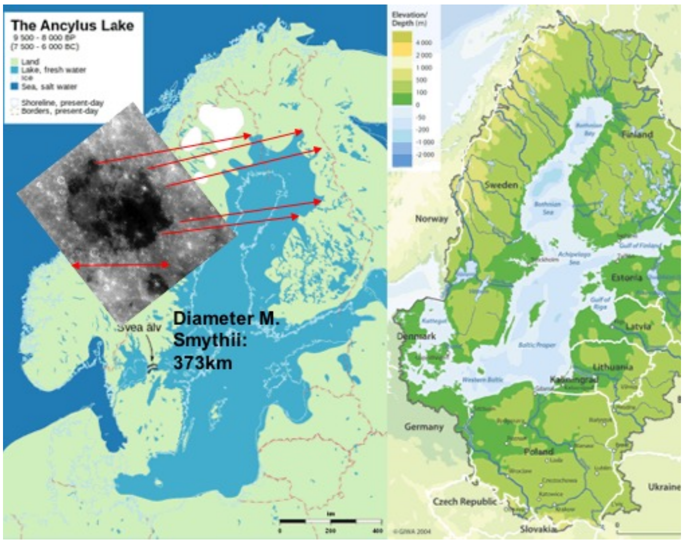
On Earth, starting from the Gulf of St Lawrence (Mare Moscoviense), we should see from east to west the inversed imprints of Mare Smythii, Nectaris and Humorum. Earth's vertical crustal motion map below immediately presents an issue: The Baltic sea (gulf of Bothnia), is the eastern most candidate and should be inversed mare Smythii. Looking at the Lunar position of Smythii relative to Moscoviense and Crisium, this means Scandinavia would have been positioned over Quebec at 3,5 Ga (near the red dot nr.1 below), rotated 90 degrees counter clockwise. Notice there is indeed a red area near red dot nr 1. which has a rotated 'ghost shape' similar to the gulf of Bothnia. From this we get a first tentative idea that the *entire* Scandinavian plate would originally be adjacent and partially on top of Canada rotated 90 degrees. Losing its crust may have exposed or formed the old cratons at Canada.



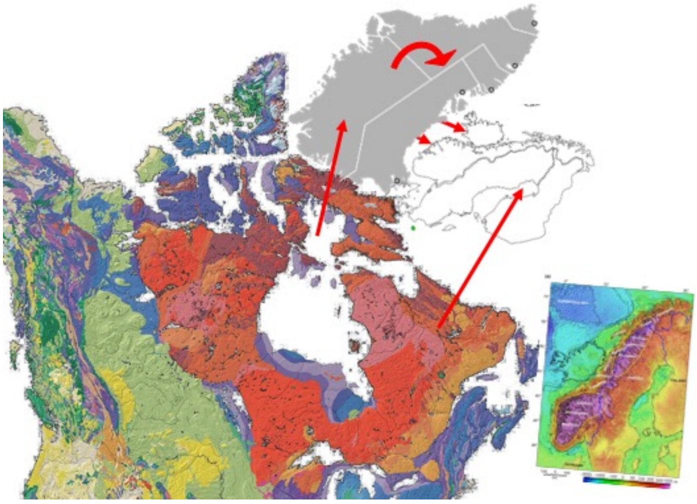
Studying plate tectonic studies by Prof. C. Scotese *(right)* suggests the idea that Scandinavia positioned much closer to Cananda is rather likely. Notice however this Scotese projection is only from 250 Ma. (*Scotese youtube presentation; https://youtu.be/TDHxQimnRGc)*

What would be distinctively different at 3.5Ga compared to 250 Ma is the orientation of Greenland. The picture of the Arctic collision at page 8 shows Greenland rotated 90 degrees as its current South East coast was at the artic impact circle. This would mean the shoreline of Norway would have been attached to the current ***west*** coast of Greenland at 3.5 Ga. To 'prove' all this we first must establish the predicted detailed match between Smythii and gulf of Bothnia:

As demonstrated to the right, the shape of inverted mare Smythii, is indeed a near perfect copy of the Gulf of Bothnia. The match was not easy to establish as one has to go back some 10.000 years to find a higher water mark (400 km in diameter) confirming the land around the Gulf is actually shaped as this mare. Again one should realise this is <u>not</u> just a random place on Earth, matching a random Lunar Mare. It is a pinpointed location, predicted by the map where <u>one and only one</u> inversed mare had to fit in order to verify the 7-fold impact!



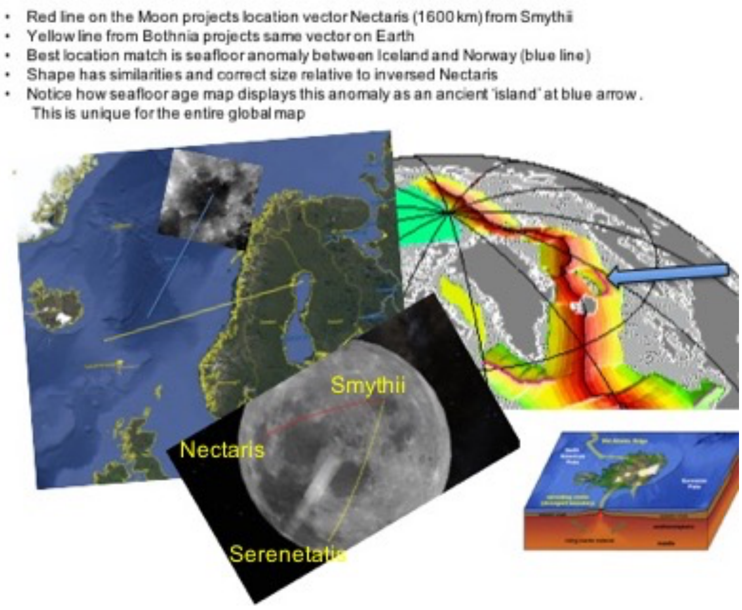
Next, looking at the orientation of Smythii on the Lunar map of the previous page, we must rotate the current Scandinavian plate at least 45 degrees clockwise to get its correct angle 3,5 Ga years ago. This gives us the map to the right showing Greenland and Scandinavia in their offset positions. Notice how the bathymetry of Norway sub-Lofoten allows for the inclusion of Iceland. This detail is of course rather speculative ...



B, Mare Nectaris

Although the original idea was that Mare Nectaris could be the inverse of Foxe basin, this later appeared to be an incorrect assessment. Mare Nectaris is located too far east of Foxe basin to be its counterpart. As became evident soon enough Foxe basin *is* however related to the inversed mare Vaporum as can be seen on the earlier picture of the Imbrium impact series.

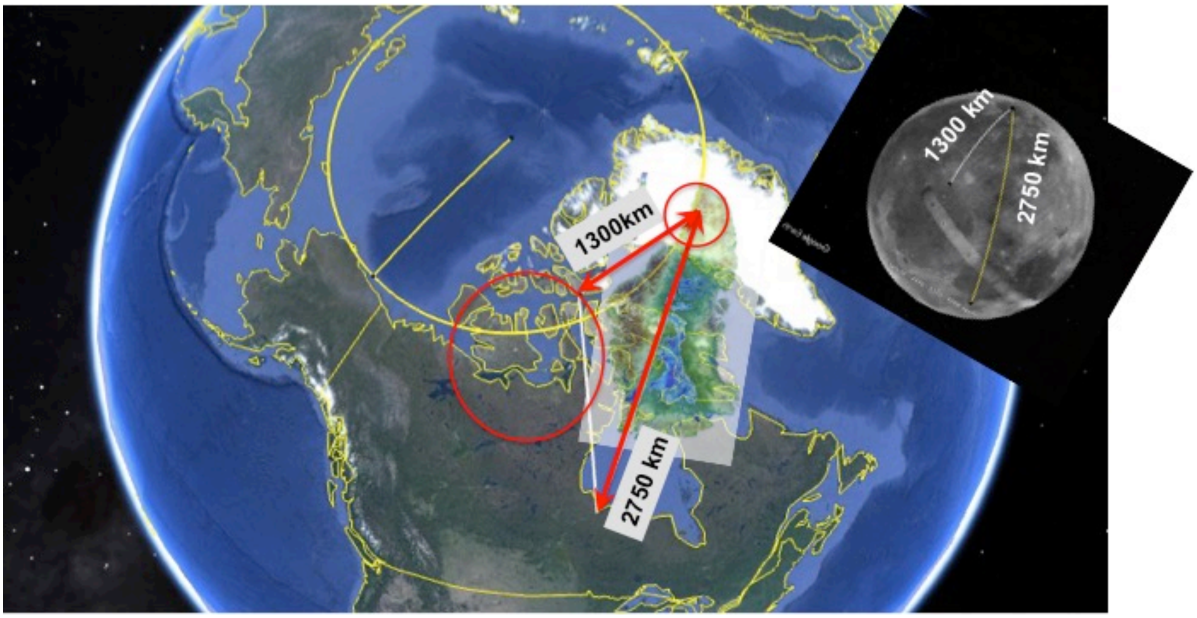
The Mare Nectaris imprint on Earth can be found by first defining the location vector relative to mare Smythii on the Moon and next projecting this vector onto the gulf of Bothnia. As displayed to the right this points to an area east of Iceland. Best matching in location and shape is **Aegir Ridge/Norway basin**. Inversed mare Nectaris is shown to the right and indeed the projection on Earth looks acceptable, displaying the south-west 'winglet' of inversed Nectaris. The location is all the more plausible since it represents a continental crustal fragment in an otherwise expanding sea floor area (*picture far right*)



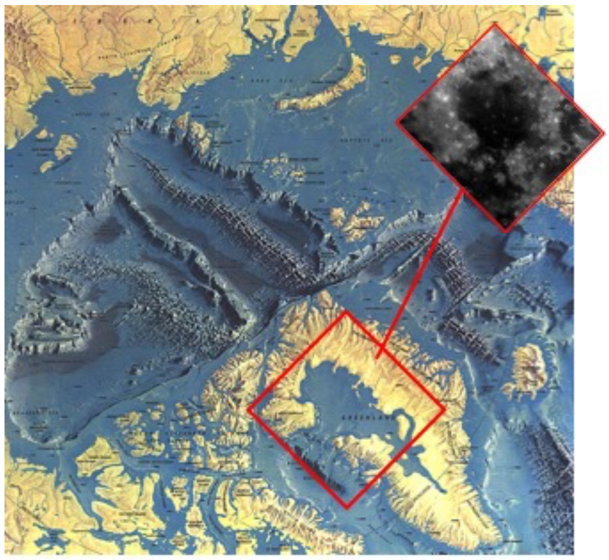
Iceland, it would appear, would first have moved east as part of Norway, and next pulled back by the mid ocean ridge like a rubber band to become a separate island on top of it

C. Mare Humorum

Mare Smythii and Nectaris were located using the Scandinavian plate, later moving to the east. Since mare Nectaris was at the border (Aegis ridge) we logically need to map the last mare -mare Humorum- onto the North American plate. In the top right of the picture below we see the Lunar distances of Humorum relative to Imbrium (1300km) and the southern most tip of Serenetatis (2750 km). Projected onto the Canadian Shield this results in a predicted impact spot on Greenland where both vectors combine.



To the right we see the actual imprint of inversed Mare Humorum ***exactly*** at the predicted Greenland location. Notice that again we have a match in 1.size 2.shape 3.location 4. orientation.



Greenland 90 degrees rotation fractured the mid-Atlantic ocean ridge. Mare Humorum is at correct projected spot.

As an extra; What makes this impact series remarkable is the suggested upright position of Greenland (semi transparent above) after the Hadean impact and thus prior to the Archean impact. There are two options:

1. *Either the rotation of Greenland happened gradually in the millions of years between the two impacts **OR***
2. *This happened **during** the Archean impact itself. If one assumes that Imbrium was indeed key to detaching Greenland, then the entire Greenland rotation must have happened between the Imbrium and Humorum impact, suggesting a full rotation within 3 minutes (1800 km). With an impact speed of 10km/s it would have travelled in parallel to the Moon, suggesting the Moon could even have 'surfed' the final distance on southern Greenland itself before fixating it onto its current location and veering off.*

***If** this is correct, it would mean an immense plate acceleration, which combined with its inertia would lead to land being folded like a harmonica or crumple zone, which is basically what fjords are. It would explain why specifically Greenland and Norway have them. In the next chapter it will be shown Chili and New Zealand's southern island were faced with the same ordeal. And precisely here we also see fjords. Although this 3 minute movement sounds outlandish, one would prefer this scenario precisely because of the fjords. It would for sure be a good way to dispose of the enormous impact energy.*

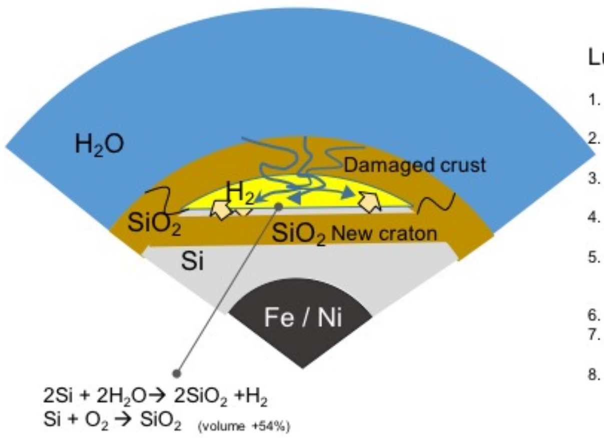
Together with Smythii and Nectaris, this Humorum impact makes three additional matches in the Canadian region. The impacts are somewhat less in quality as they are positioned on moving and scattered tectonic plates. Nevertheless, with all of them retrieved, it seems defendable to conclude the confirmed 4(5)-fold impact is in fact part of an 8-fold delta shaped impact at the Canadian Shield.

3.3 Consequences for Earth and Lunar geology

With the two extensively documented Moon-Earth collisions it becomes clear geology should embrace Lunar impacts and their profound influence. With it, comes the accpetance that Earth did have a substantial ice and ocean layer once and that losing this water layer to sub-surface locations is its key geological process. We have no problem suggesting this process for Mars or Venus, yet when it comes to Earth we emotionally do not like to consider we could be in the midst or even 'end' of the same process. There are some related issues which now need to be re-considered:

1. *Revision of plate tectonics as leading paradigm for continental drift*

General consensus is that all landmass on Earth consists of floating tectonic plates that over billions of years bump, rotate, merge and morph seemingly erratically all over the place. The Aitkin-Arctic impact comparison suggests however this is <u>not true</u> for the northern hemisphere. The Arctic area has not changed much since the impact of 4.1 Ga. The changes involve a recent 30% expansion of seafloor at the mid-Atlantic ocean ridge and the anomaly of the fractured parts of Canada NW and the clockwise rotation of Greenland. Next, the Canadian Shield impact showed that also mainland Canada has not changed much in either location or form since 3,9-3.5 Ga. From this we must conclude that continents, by default, are more or less fixed to the mantle and that only along the widening mid ocean ridges major breakups occur. The notable exceptions are the plates of Greenland and Scandinavia, both of which are directly impacted by the Moon. It would appear only impacted plates are prone to later 'come lose' from the mantle and migrate and rotate more freely. <u>We are however talking in the context of a more fluid Archean ocean floor</u> when suggesting plates 'come lose', 'float' and 'rotate'. Below a suggested *potential* explanation is given as to why impacted plates could ultimately <u>literally</u> float on top of the ocean after an impact!



Lunar impacts and silicon oxidation of Earth

1. Pressurized water slowly penetrates damaged crust and enters the –partly- unbound silicon layer below, starting wet silicon oxidation
2. Wet silicon oxidation creates new crust (craton) under the damaged crust. The process is highly expansionary as the oxide always grows to +54% of original silicon volume
3. The waste product of hydrogen accumulates under original convex crust providing floating potential. Water film keeps hydrogen inside.
4. As the diameter of the craton grows, the relative crustal upward lift of hydrogen increases to the 3rd power whereas the mass of the crust above it increases only to the 2nd power.
5. Ultimately the sides of the patch crack and a large chunk of crust above craton detaches forming a rotating floating crustal plate (Scandinavia) which may even surface before falling back to the ocean floor elsewhere.
6. Craton seals off further water intrusion.
7. Ultimately as Earth slowly expands, global crust rips at several places at mid oceanic ridges, creating new ocean floor which is partly subducted.
8. The subduction of <u>water saturated</u> ocean floor provides a continuous influx of new oxygen atoms ensuring <u>unstoppable</u> wet or dry silicon oxidation until either all silicon at the core is reduced (oxidized) or all surface water is consumed. Venus and Mars are arguably beyond this point.
9. Earth's mantle thus expands via opening of mid Atlantic ridges causing continental drift. Plate tectonics as such is more cosmetic; it is not the driver of continental drift.

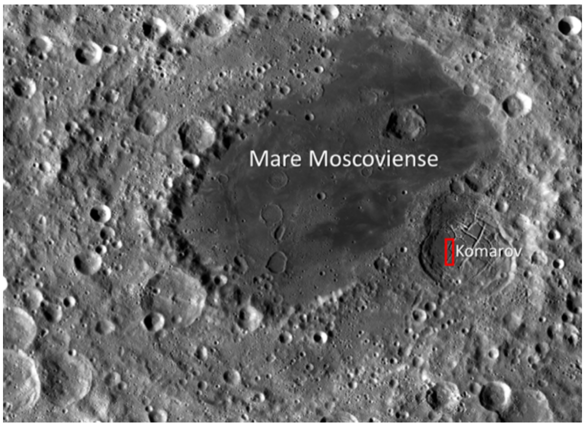
2. *Reconsideration of Lunar basin age and formation*

Although the age assessments of Lunar basalts and analyses of Apollo mission rock material may be technically correct, it is questionable as to exactly what they represent in terms of Lunar 'geology' and what, if anything, this says about a potential impact date. Assuming the impacts are Earth related, 'syntax errors' in reasoning are easily made:

1) Any Earth-Moon impact will deposit some amount of Earth material onto the Lunar surface which could very well cause 'tainted' rock samples or wrong age determinations.
2) If Earth related, supercritical water may at times (e.g. Procellarum) only have excavated the basins, exposing and partly meta-morphing 3,5-3.9 billion years old basalts typically existing at these Lunar depths.
3) With the later mare Procellarum impact, there may be additional 'contamination' of age determination.
4) Basalt age determination on the basis of crater counts would also be unusable. An Earth impact would leave behind substantial debris at Earth's orbit, causing extreme annual meteor shower impacts (like the Perseid and Leonid meteor showers) in the years afterwards. This would bias any age measurement upwards.

With respect to Mare basin formation, the community for long was convinced the mare basins are mainly the result of volcanic activity, following impacts. Recently, articles emerged suggesting they impact melts may yet dominate. The perennial problem is of course that this suggests extreme large individual asteroids which is not possible because of the one-side concentration. Looking objectively at all footage, all points to impact melts as explained next:

To illustrate the weak case for 'volcanism' one may look at Mare Moscoviense to the right. Being furthest away from Procellarum, it presents a reliable post-impact situation. Notice it does not show a caldera or concentric rings of lava inflows that one might expect when comparing to lava basins on Earth. In stead, the basin looks quite patchy and eroded to its right, suggesting not much 'fill' of any type after the impact. It looks more like a viscous silicate swamp that dried up eventually afterwards. One may also notice all maria are positioned lower than their surroundings and that (like normal craters) they often show a cascaded rim feature. An additional **a-typical** element for volcanic origin is the production of 'hollow' seismic data:

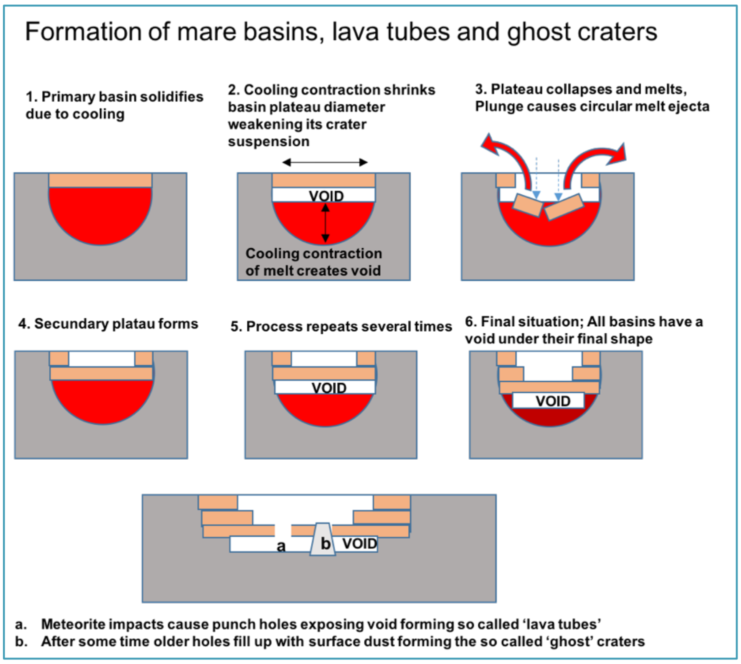


From Wikipedia:

Between 1972 and 1977, seismometers installed on the Moon by the Apollo missions recorded moonquakes. The Moon was described as "ringing like a bell" during some of those quakes, specifically the shallow ones.[16] This phrase was brought to popular attention in March 1970,[1] in an article in Popular Science.[17] When Apollo 12 deliberately crashed the Ascent Stage of its Lunar Module onto the Moon's surface, it was claimed that the Moon rang like a bell for an hour, leading to arguments that it must be hollow like a bell.[1] Lunar seismology experiments since then have shown that the lunar body has shallow moonquakes that act differently from quakes on Earth, due to differences in texture, type and density of the planetary strata, but there is no evidence of any large empty space inside the body.[16]

Nevertheless, a mare impact melt formation to the right **would** explain all of the discussed issues such as

- Lower position
- Lack of caldera
- Cascaded rim structure
- Hollow seismic data
- Circular post-impact ejecta around the maria (e.g. Maunder Formation around Mare Orientale)
- Lava tubes, ghost craters



To illustrate just how easy mistakes can be made in logic deductions, one may take for example the Maunder Formation: a ring of ejecta around Mare Orientale. The formation process to the right explains how such circular ejecta are caused by the postponed collapse of a primary basin. This leads to the odd situation that parts of the outer basin are OLDER than the circular ejecta around it. The community however concluded from this that since the ejecta are not the oldest parts, they would not be the result of an impact but rather of volcanism, downplaying the size and importance of the impactor as such. Notice also the ease with which the 'unexplained' issues of 'lava tubes' and ghost craters can now be explained.

3. Reconsideration of our orbital relation with our Moon

Accepting the impacts, there is also the strong likelihood of profound changes in the orbital relation between Earth and Moon throughout their combined history. Prior to the latest collision our Moon may have had a highly elliptical orbit with a perigee much closer than today. Prior to that, e.g. after the first collision, our moon might even have been a sister planet orbiting at a similar speed and distance from the Sun yet at a different inclination, not unlike the current Mercury-Venus situation. These may be relevant considerations when analysing our shared history.

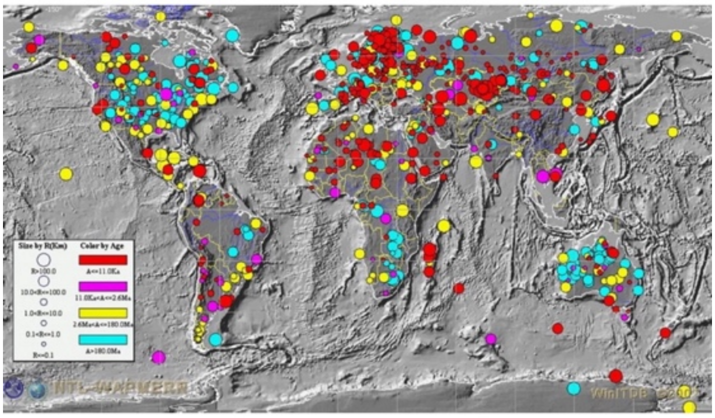
4. *General and special mantle expansion*

With a nod to the great Albert Einstein we may want to officially coin two new concepts in standard geology:

General mantle expansion would be the global mantle expansion of our Earth due to shared factors like:

- Rebound of the compressed mantle (pressure due to former Archean ocean)
- Transport of oceanic surface water to sub-surface locations (mainly via subduction)
- Consequent sub surface oxidation, mainly expansionary silicon oxidation
- Thermal expansion

Special mantle expansion would be the additional local influence due to Lunar impacts. If the mantle contains water at the time of impact, this could lead to macroscopic fracturing of the rock via supercritical water conditions. *Source: Supercritical Water/Rock Interactions and Generation of Artificial Geothermal Reservoirs in Deep-Seated High Temperature Rock Masses Toshiyuki Hashida, Toru Takahashi*
Through capillary effects water would be attracted from the surroundings and the area would expand in all directions, making the depressed impact area eventually rise above it surroundings. This in turn makes it the first to be –permanently- lifted above the oceanic surface and as a result be prone to the most and oldest meteor impacts (*EDEIS map right*)



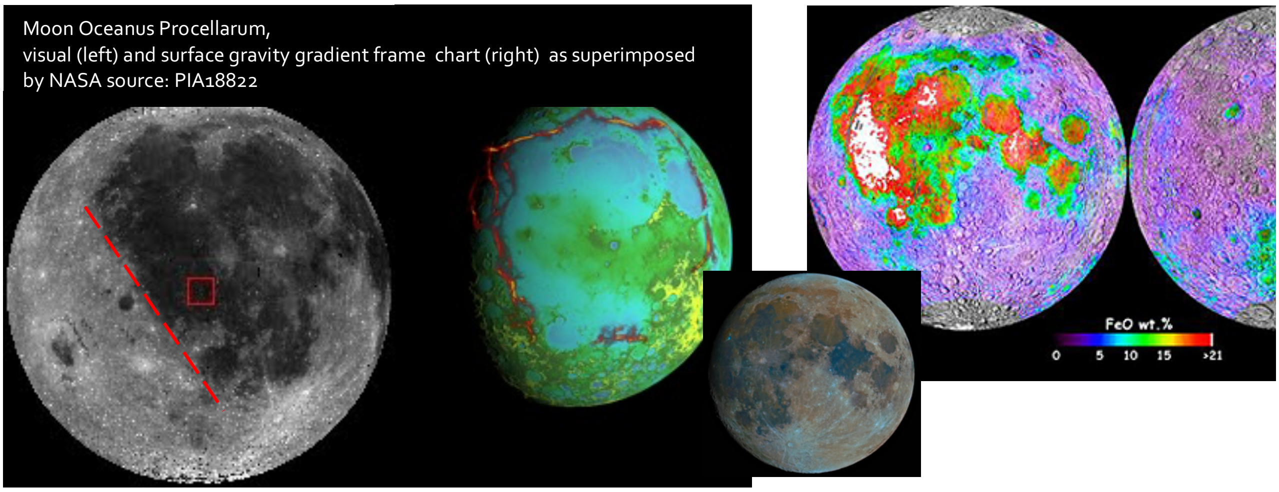
Next, with global ocean levels receding, the now exposed lifted continents would 'sag in' due to gravity and become more levelled with their surroundings. In the contraction process the lifted continents would 'give back' most of their artificially attracted water. This water may end up in the oceans or in (elevated) inner seas.

Chapter 4. The Antarctica collision (450 Ma?)

The large Oceanus Procellarum area on the Moon is the final candidate for yet another impact. On Earth, the indicators point at Antarctica as suspect. Since we already have the Arctic impact at our rotational pole, Antarctica could only be another impact if it's continental plate ('Gondwana') would move towards the south pole after its impact, allowing the Arctic area to stay at the north pole, precisely as described in the first chapter.

4.1 Oceanus Procellarum

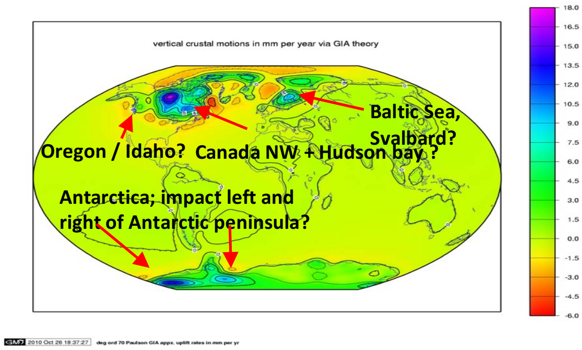
After the first collision, the Moon moved impacted Aitken basin to its South pole. The second collision could not be corrected, resulting in uncontrollable rotational imbalance until all spin was lost. Any third impact would therefor likely overlap the second, which appears to indeed have happened. Oceanus Procellarum most obvious impact indicator is its ca. 1500 km straight impact line at its left base (*the red dotted line in the inversed figure below*)



Moon Oceanus Procellarum,
visual (left) and surface gravity gradient frame chart (right) as superimposed by NASA source: PIA18822

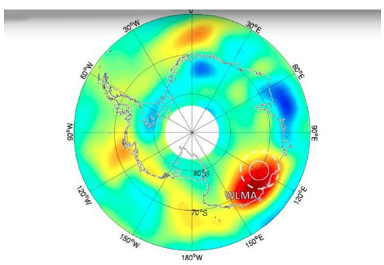
Additional indicators are the presence of iron (*figure far right*), KREEP material and dome volcanism. In addition, the NASA superimposed surface gravity gradient frame (*in the middle*), indicates a 'rolling' impact involving each of the four red sides of the NASA gravity gradient square. The false colour picture in the middle confirms the NASA study, as a rust-like dust marks the same frame, best visible at Mare Frigoris to the North. The dust overlaps at Mare Imbrium and Mare Serenetatis, hinting this is indeed the youngest impact. The volcanic basalts of Frigoris are dated at 3,77 Ga, serving as the upper time limit of impact. *Source: Ages and stratigraphy of mare basalts in Oceanus Procellarum, Mare Nubium, Mare Cognitum, and Mare Insularum, H. Hiesinger and J. W. Head III*. It would however appear this impact happened at far lower ocean levels allowing in theory a lower time limit of ca. 450-250 Ma.

4.2 Gondwana / Antarctica.



The indicators are clear:

1. Earth's vertical crust motion map, clearly shows an imprint left and right of the Antarctic peninsula.
2. A movement of equatorial supercontinent Gondwana to the south pole, from 450 Ma to 80 Ma (https://youtu.be/gjCcJtnbg_A and figure 4.3a next page) consistent with the earlier described polar mechanism
3. Antarctica is currently situated at exactly the South pole and has been there for a very long time.
4. Circular impact scars: The widening oceanic ridges around Antarctica, displaying a linear base at S-E Indian Ridge.
5. There is a gravity anomly suggesting a primary impact spot: the infamous Wilkes Land gravity anomaly (to the right) . This near 500 km wide sub-ice crater is thought to be the result of an impact less than 500 Ma (Wikipedia).



There are secondary arguments why this impact might be dated at 450-250 Ma: The first great extinction on Earth, the Ordovician-Silurian extinction is dated at 445 Ma. Also, the impacted Antarctica area would gradually lift due to special mantle expansion, which would push it up to sea level somewhere between 450 Ma and now. At that moment Antarctica would no longer generate rotational imbalance and could leave the south pole. Indeed from 280 Ma to 80 Ma Antarctica did leave the south pole (Scotese-paleogeography) before once more becoming the steady anchor at the south pole at 80 Ma, this time in its lifted position. Finally, a 445 Ma impact would cause a substantial part of Earth's remaining 400 km of ocean water to instantly vaporise and vent into space. The water pressure on the ocean floor would drop and the pressure equilibrium that contained the slowly rebounding Archean ocean floor would falter. Magma tensions would rise leading to first crustal bursts and mass production of new ocean floor at mid ocean ridges from ca. 250 Ma onwards. Before describing the impact in detail we will shortly address these bursts.

Figure 4.3a; Stage 1 445 Ma
Gondwana starts moving south

Figure 4.3b; Stage 2 250-140 Ma
scars slowly burst into seafloor producing ridges.

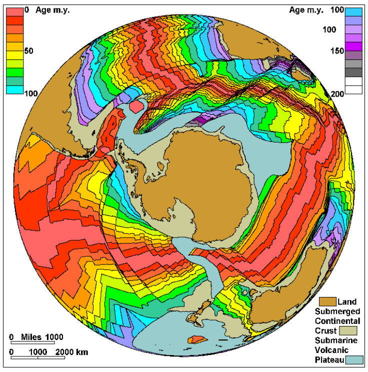


Figure 4.3c; Stage 3 140 Ma. – current
Ridges accelerate production of new ocean floor

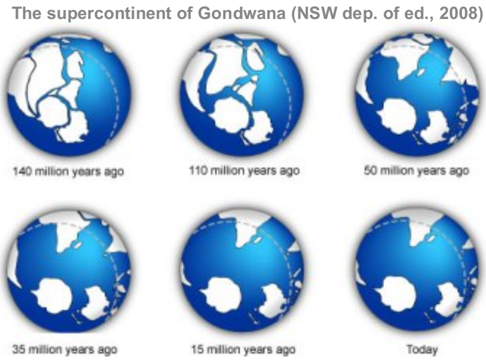


Figure 4.4 d; Stage 4; 250 million y.a. -current; Earth opens vertical ridges to compensate for Antarctic circular expansion and vv.

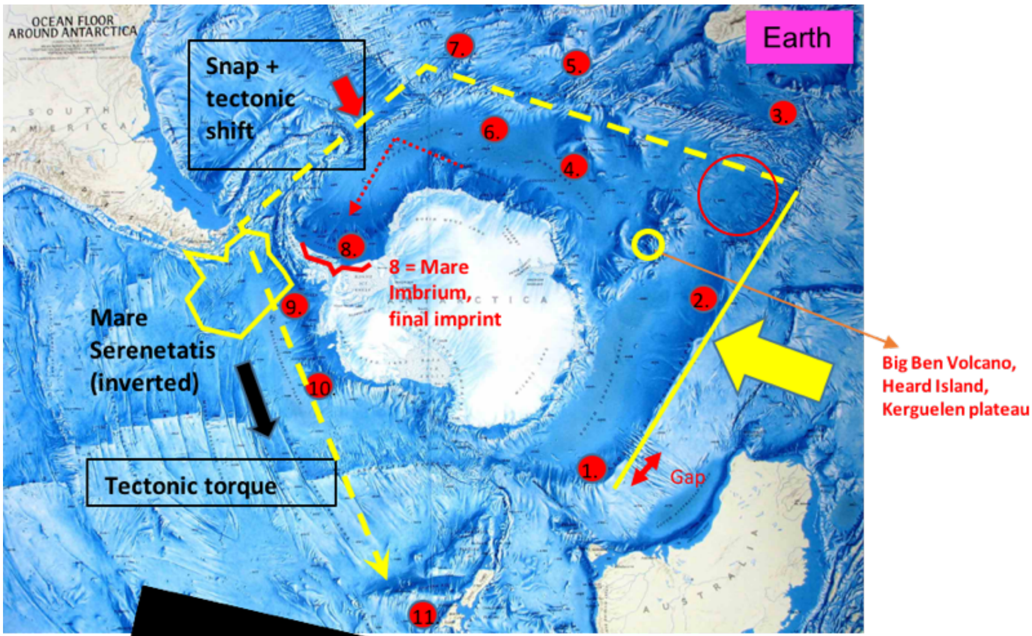
4.3 The circular ridges around Antarctica

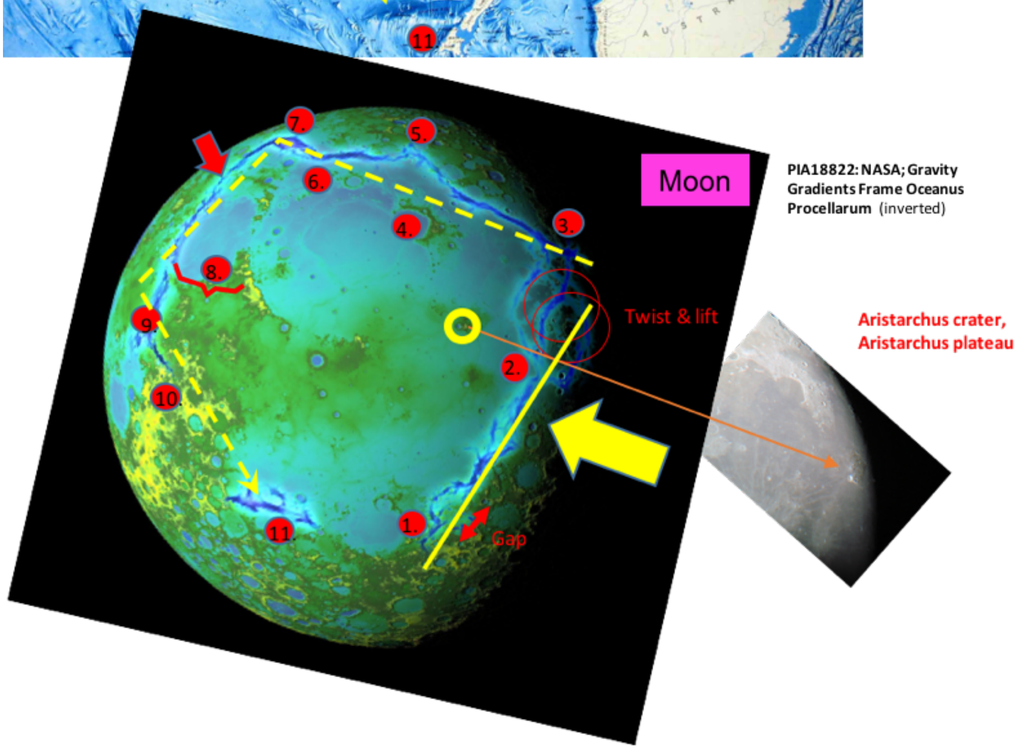
The ridges around Antarctica, just like any other ocean ridges, produce new seafloor to their north and south. The problem however is that they are not linear but *circular*: **As there is no subduction** at the Antarctic continent, all new seafloor to the south will lift the centre –Antarctica itself- and next the ridges will start pushing themselves away from Antarctica. As a result, the continents to the north of the ridges are pushed away at double speed from Antarctica as can be seen above. However, this means south of these ridges, we are now faced with a local circular expansion of Earth's seafloor and Earth must therefore compensate to retain its sphere-shape. It did so by opening the Pacific, Atlantic and Indian ocean ridges vertically above the horizontal Antarctic circular expansion. These vertical oceanic ridges logically get smaller towards the north pole since there is no circular expansion there. The seafloor expansion of these vertical ridges appears random, yet it can be demonstrated they are carefully opened in such a way that everywhere on the globe the same 'great circle' (circumference) is maintained. Summarized: If all this is correct, we should

1. **see the ocean ridges around Antarctica inversely imprinted on the Moon (reflecting NASA PIA 18822 study).**
2. **see them on a much smaller Lunar scale because we just argued that the ridges have pushed themselves away circularly on Earth since the time of impact.**

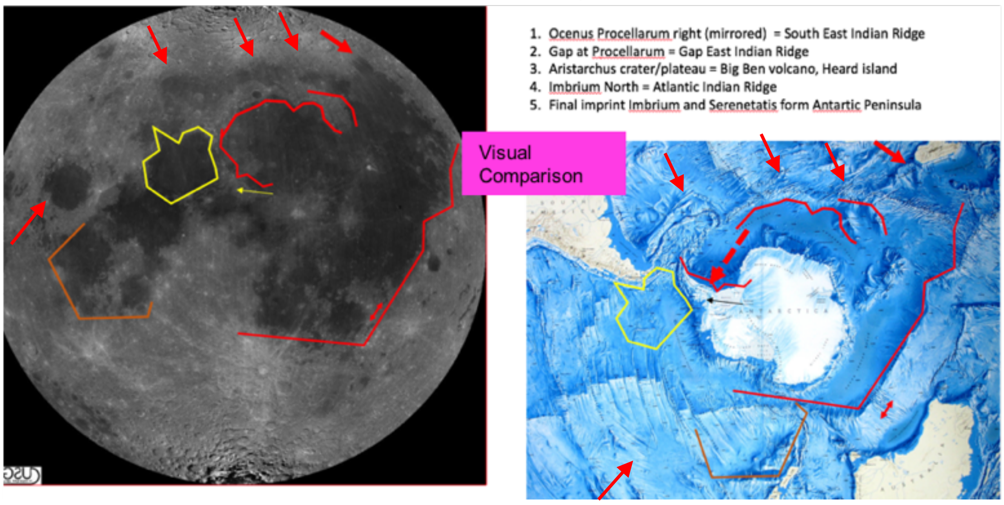
4.4 The impact in detail

At the next page we present this impact in great detail. The Antarctic ridges *perfectly* match the Moon's mirrored visual and gravity gradient map *and* do so on the suggested smaller scale! At the inverted Lunar picture, the impact starts with the straight impact line (yellow arrow) of Oceanus Procellarum. On Earth the impact starts with the corresponding straight line of the South East Indian Ridge just below current Australia. Next the Moon appears to move its weight to the right via stages 2 and 3, where it appears to lift, rotate and move left again at stage 3. Notice how this rotation circle at stage 3 is also visible on Earth's seafloor. The Moon continues along stages 3 to 7, forming the Atlantic Indian ridge and then leans left again, where the impact continues with the combined climax imprint of the Moon's Mare Imbrium and Mare Serenetatis on Earth. Squeezed between the two rims of these giant maria, the landmass of Antarctica's peninsula is formed, consistent with the earlier presented vertical crust movement map, defining the future split between South America and Africa. Next we see the moon delivering a tremendous torque on the saturated ocean floor and end its trajectory as it shortly touches under New Zealand (stage 11) on its exit.





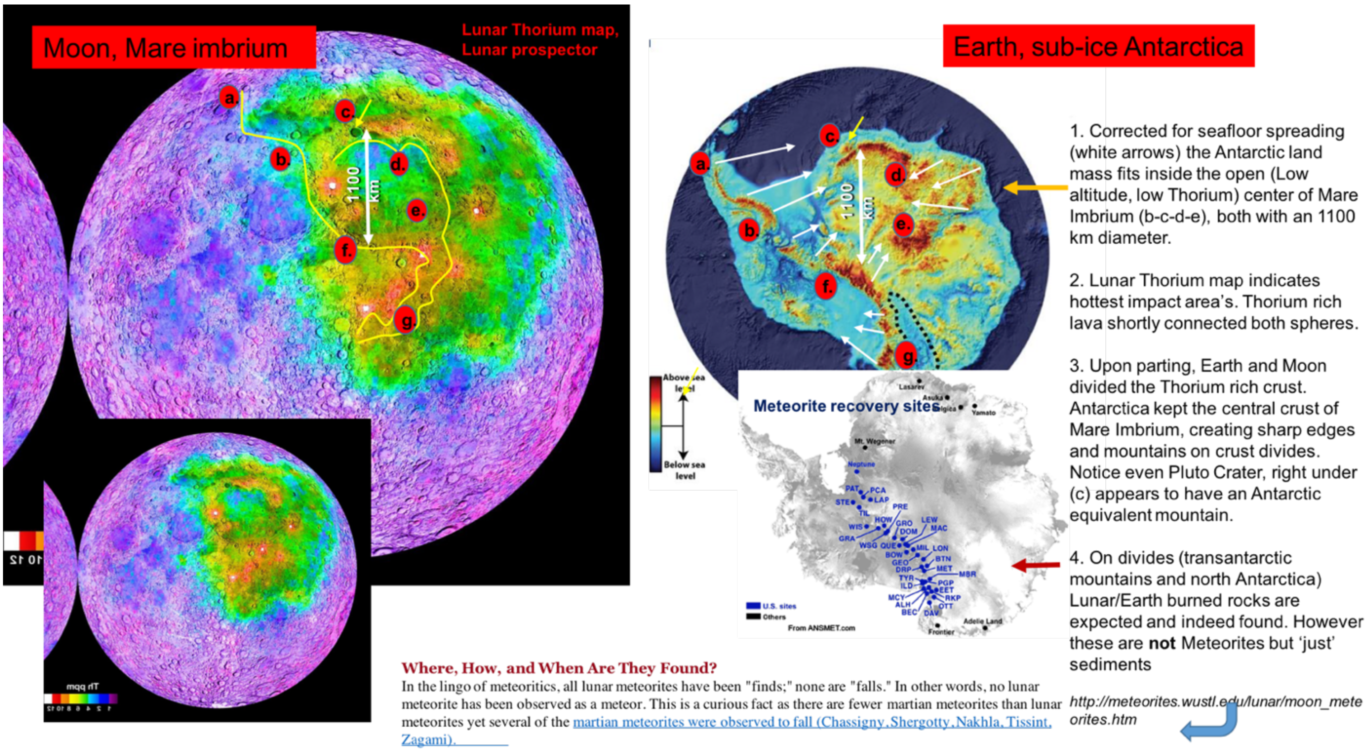
PIA18822: NASA; Gravity Gradients Frame Oceanus Procellarum (inverted)



Using Google Earth, the ocean floor around Antarctica, currently has a distance between stage 1 and stage 7 of about 8800 km. The lunar equivalent measures a distance of 3400 km between stage 1 and stage 7. This means that since the day of impact, Earth's Antarctic seafloor has grown about 8800-3400=5400 km relative to the time of impact. In order to maintain its sphere form, Earth must enlarge all great circles accordingly by opening the lateral ridges of the Pacific, Atlantic and Indian ocean. This effect alone is well within the earlier measured 29% total global mantle expansion. Notice the 5400km precisely equals the second Pacific displacement as presented in the next Chapter, indicating this is not somehow corrected by subduction but instead indicative of a synchronised global mantle expansion phenomenon.

4.5 Centre of impact: Mare Imbrium and West Antarctica

Now let's focus on the match between the original landmass of Antarctica and the Moon. At the very centre of the impact, underneath Antarctica's ice cap, we can see how this landmass corresponds to the impactor, being Mare Imbrium. The landmass on Earth is scattered but is reconstructed at the picture to the right.



Looking closely at the maps above we see the nice echo of Plato crater on Earth (little yellow arrow under c.). Next, the highly lit Thorium spot of Aristillus crater (between c. and f.) seems to correspond with Vinson Massif, the highest point of Antarctica, from where the Antarctica Peninsula appears to have split off. Earlier we looked at the resemblance between Aristarchus crater and Big Ben Volcano, Heard Island (see annex 2). Since Aristarchus age is estimated at 450 Ma (!), this impact *might* have happened around that time as well.

4.6 Consequences of the impact

Though the precise time of this impact may be uncertain, it is safe to say 450 Ma is the time where the consequences of the impact started to manifest themselves as Gondwana abruptly started to move south. In addition:

The O-S, P-Tr and Tr-J mass extinctions

450 Ma is the time of the first great mass extinction: The Ordovician-Silurian extinction. Massive amounts of CO_2 and N_2 are released into the atmosphere. The related later phased opening of the Pacific, Atlantic, Indian ridges may very well explain the other great extinctions (P-Tr at 251 Ma and Tr-J at 200 Ma). The actual trigger for the P-Tr extinction could be three large plates colliding near current South-East Turkey (mount Ararat) at around 250 Ma.

The Cambrian explosion

The worldwide explosion of first land-life at 540 Ma can be explained in case of a 450 Ma Lunar impact: A slowly approaching Moon at 550 Ma would start to cause tremendous tidal effects on Earth's oceans causing the highest (tilted) submerged continental crusts to emerge twice a day. Gradually sea-based life would become exposed to land twice a day. First for a few seconds, then minutes and then hours as the moon gets ever closer over a period of 100 million years. As such this would elegantly explain the gradual Darwinian 'involuntary' adoption of sea life to amphibious land-life. The exuberance of first land-based would end at 450 Ma with the moon impacting.

The riddle of the big dinosaurs

Until now it was not clear how the largest dinosaurs could have evolved to become so big -inconsistent with their bone structure- and why after the Jurassic era this was no longer possible. A closer moon would add to the explanation. The factors leading to a substantial lesser <u>net</u> gravitational pull are:

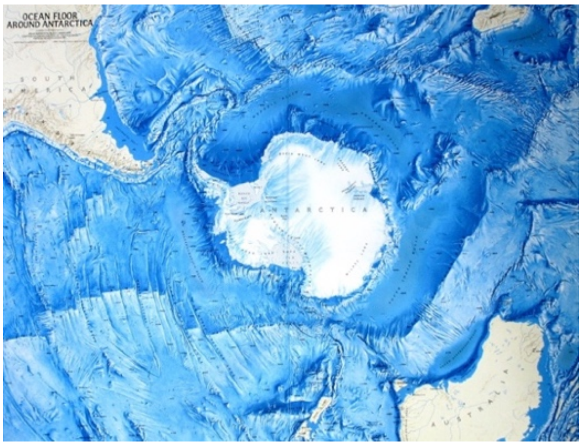
1. The closer proximity of the moon, causing a small but noticeable counter pull;
2. The faster Earth rotation back than counteracted Earth's gravitational pull, especially near the equator.
3. Part of the emerging crustal plates would be situated substantially higher above the mantle, creating more distance to the centre of Earth's mass leading to a squared lower gravitational pull. The levitation would be either due to impact induced local mantle expansion and/or to the highly convex shape of early crustal plates –having arguably formed the 30% smaller and thus more curved Hadean surface-. Once above sea level the curvatures -most likely with water and hydrogen under its surface- would become fully subject to gravity and cave in, forming mountain ranges at fold lines, thus eventually adjusting to current day curvature of the mantle.

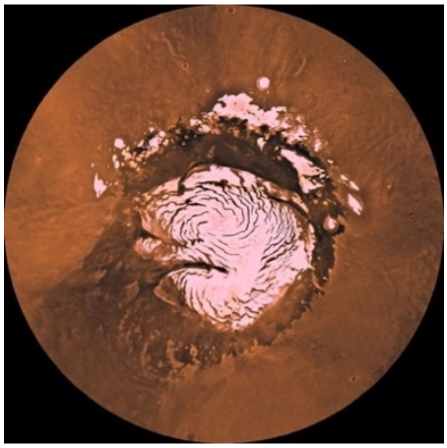
Combined these factors would explain why the late Jurassic eventually no longer supported big life forms: The Moon got further away, Earth's rotation slowed down, their habitat was no longer at the equator and the continents levelled.

As an add-on, we can generalise a typical ***<u>water saturated mantle</u>*** impact by:

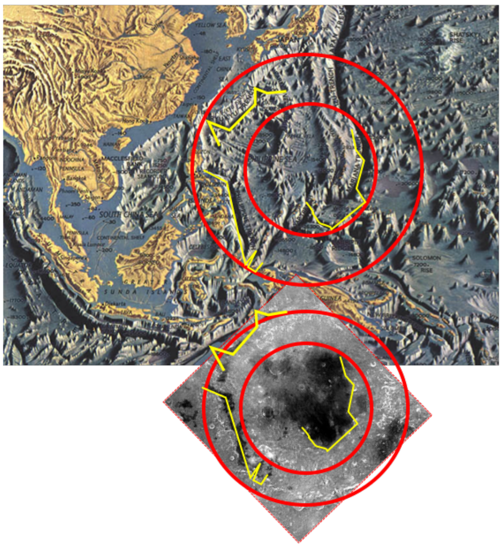
1. Clear signs of massive torque stress on the circular surface of impact around a rotational pole
2. A circular scar on the impacted plate, 'leaking' magma thus producing new surface at both sides of the circular scars (or 'oceanic ridges')
3. An elevated icy centre inside the circular area; since al this new surface cannot be subducted at the centre, it pushes up the impacted centre.
4. A final 'break' of the crust at the circular scar due to the high levitation of its centre, causing the other sub continents to circularly glide 'north' pushing them selves away as they produce more ocean floor…

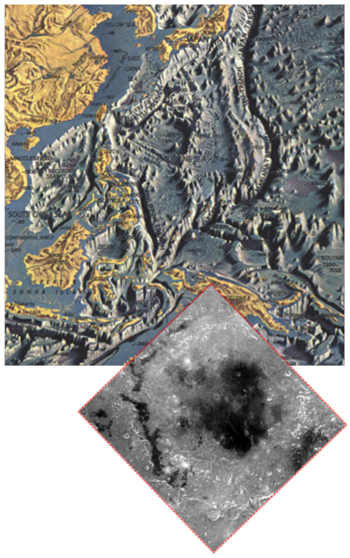
Following this general description, the picture to the right would suggest Antarctica was not the first continent in our solar system to have experienced this (Mars, Planum Boreum, North Pole):





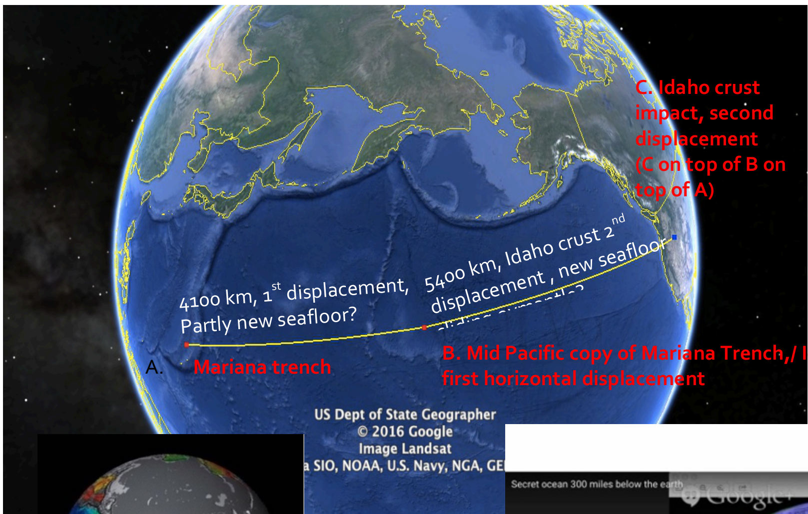
Chapter 5: A fourth impact? Mare Orientale and Mariana Trench

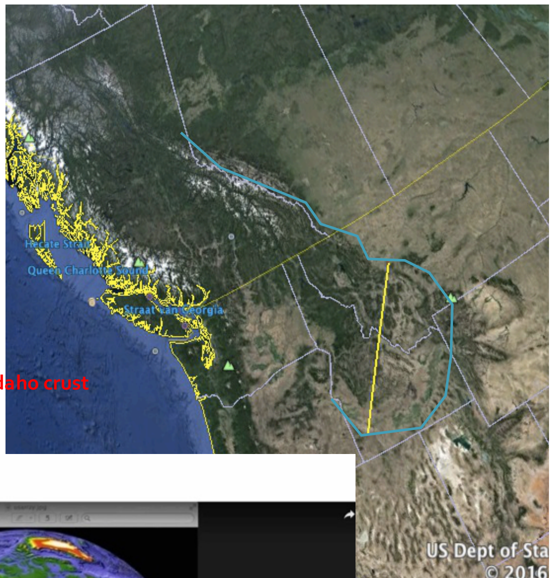


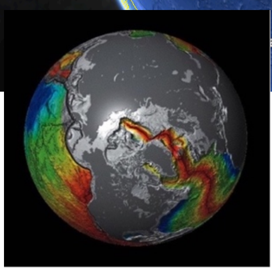


The global seafloor, in the 'ring of fire' area, has a very weird circular seafloor patch just west of current Philippines. This region boosts the Mariana Trench, the deepest sea floor spot on Earth. This spot has striking similarities with the Moon's last big unaccounted mare: Mare Orientale depicted on the bottom of the images to the right. The wider impact area on Earth is 3500 km compared to Mare Orientale measuring only 900 km widest. If this is indeed Lunar related, then we can only compare this impact with the previous Antarctica impact, showing a similar frantic local circular seafloor expansion on Earth. Since Mare Orientale is located exactly in front and centre of Oceanus Procellarum, this increases the likelihood of it indeed being part of the Antarctic impact as a 'first touch impact'.

To keep it short, there is a 'copy' of this impact at the middle of the Pacific (B, below) and another copy at the border of the state of Idaho / Utah (below right) in the U.S. What <u>**might**</u> have happened is that impacted crust itself was at Idaho, which at the time would be located above current Mariana Trench, indicating a much smaller Pacific. Just like the Antarctica situation, the centre of the impact was first lifted due to circular expansion by ridges no longer active today. However, unlike Antarctica, it <u>**was**</u> to some extend subducted to its east side (Mariana Trench) causing a huge tilt. Logically, due to lateral gravitational forces, the elevated centre detached diagonally, sliding off the Mariana location to the East. First to the middle of the Pacific (B), and next –from 250 Ma onward- towards the current location of the US (C) adding **5400km** of new ocean floor. This two-step move would explain the fast opening of the Pacific (below left). It also explains the light crust of Mariana and many rock layer unconformities in the US. In closing, the Pacific spread may have actually preceded the Antarctic seafloor expansion, but together they form the driver behind the world wide ocean floor expansion. As a point of interest: Notice the 'Lunar impact glide path' at the US Array picture below right. This footage displays the local rock expansion at 300 miles below surface! Notice also Greenland.







ANNEX 1; Calculating the initial ocean levels

Approach 1: Atomic mass of oxygen

The purging hypothesis suggests a distinct (and observed) process for the formation of all terrestrial spheres out of supercritical gaseous/liquid knots. As such, water was formed on a condensating Earth in great quantities right at the beginning as Earth's outer oxygen layer reacted with the hot diatomic hydrogen to form water vapour. On a smaller scale nitrogen and carbon would form ammonia and methane. On the inner boundry, the oxygen layer would have reacted with sulphur, magnesium and mostly silicon. Current indications (*Source: Wikipedia*) are that oxygen atoms account for 30.1 % of Earth's total mass.
Assuming most of the oxygen was unbound at origin, then half the oxygen layer would react with the elements of the lower layer and the other half to the elements of the upper layer (actually it would be more like 60-40% since the outer layer surface is larger). Then the oxygen in the upper layer would still have to first deal with the upper (thin) layers of carbon and nitrogen before being exposed to hydrogen. In all we could thus assume half of half or 25% of all oxygen could have formed water so the water mass would account for 25% * 30% = 7,5% of Earth's mass. We then get:

- Volume water* density water = 7,5% Volume Earth*density Earth
- As the density of water is 1gr/cm^3 and the density of Earth is 5,5gr/ cm^3 (Source: Wikipedia), the water volume would be: 7,5%*5.5=41% of Earth's total volume, forming the outer layer. Next, putting the radius of Earth at 1 and the radius of the inner non-water core at 'a', then the height of the outer water layer is (1-a). As the inner core of non-water sphere contains 59% of all Earth volume we get:

Volume non-water core sphere / Volume Earth = 59% or: (a^3) /1 = 59% or a=0.59^1/3 = 0.84, leaving (1-a) or 0,16 of the radius of Earth for the outer water layer. If we take the radius of Earth at 6500 km which is quite conservative as later collisions will have brushed away considerable volume, we get 0.16 x 6500 = 1040 km of water for the outer layer. Compensating for the 60-40 % upper-lower layer relation it would be ca. 1248 km

Approach 2: Diamond forming pressure

Quoting Wikipedia;

- '....In contrast, *eclogitic* diamonds contain organic carbon from organic detritus that has been pushed down from the surface of the Earth's crust through subduction (see plate tectonics) before transforming into diamond
- Diamonds that have come to the Earth's surface are generally quite old, ranging from under 1 billion to 3.3 billion years old.
- The conditions for diamond formation to happen in the lithospheric mantle occur at considerable depth corresponding to the requirements of temperature and pressure. These depths are estimated between 140 and 190 kilometres (87 and 118 mi) though occasionally diamonds have crystallized at depths about 300 km (190 mi)...'

Source: Wikipedia: Earth density

Depth[111] km	Component Layer	Density g/cm^3
0–60	Lithosphere[n 15]	—
0–35	Crust[n 16]	2.2–2.9
35–60	Upper mantle	3.4–4.4
35–2890	Mantle	3.4–5.6
100–700	Asthenosphere	—
2890–5100	Outer core	9.9–12.2
5100–6378	Inner core	12.8–13.1

Wikipedia here implicitly assumes that the enormous pressures needed for diamond forming could only be found inside the Earth's mantle at depths up to 300km. We are assuming however that

1. It is not likely eclogitic (=organic) diamonds would form inside the mantle. Also it is questionable subduction was active during that time
2. Earth was covered by a very high ocean, which in itself would be quite capable of producing comparable pressures.

Thus, it is more likely eclogitic (bio-based carbon) diamond was formed from floating living sea surface material (algae) which after dying sank to the bottom of the ocean floor, where it would be pressurised into diamond. The needed pressure on the seafloor should then correspond with lithosphere depths from 140 to 300 km. Since mantle material (rock) on average has about 4 x the density of water (see table above), our corresponding sea level depth would then be: 4 x 140 to 300 meters = 560 to 1200 km. Since we are assuming slowly depleting ocean levels this would mean ocean levels of 1200 km at 3.3 billion y.a. and 560 km at 1 billion y.a., This would imply an average depletion rate of 2,78 mm/year, likely corresponding to a similar mantle expansion rate.

Approach 3: Impact ratio of Lunar Aitkin basin and Earth's arctic circle

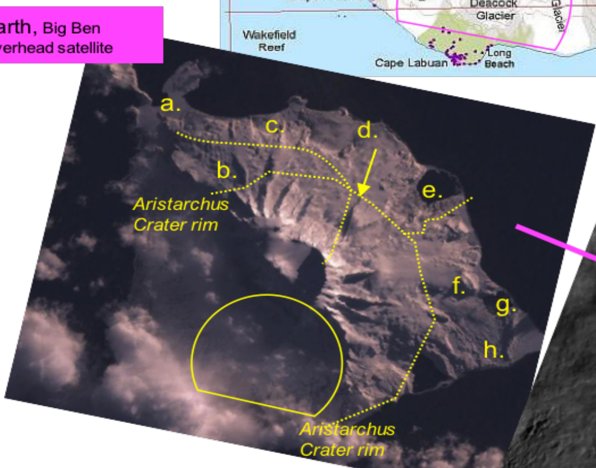
Referring to page 8, the diameter of the dotted wider impact circle on the Moon at Aitken is 2600 km whereas on Earth it is about 3350km, the distance between north Alaska and Longyearbyen on Svalbard / Spitsbergen. On Earth it is 1-3350 / 2600 or 29% wider, suggesting a general mantle expansion of up to 29% or 1430 km on Earth over the past 4 billion years and a lowering of the oceans of the same size. Interestingly, 1430 km at 4.1 Ga means a 230km higher level than at 3.3 Ga (approach 2). With 2,78 mm/y this altitude difference corresponds to 827,3 Million year age difference. This would have the Arctic impact occurring at 3.3Ga+ 0,827= 4.1 Ga, which is remarkably consistent.

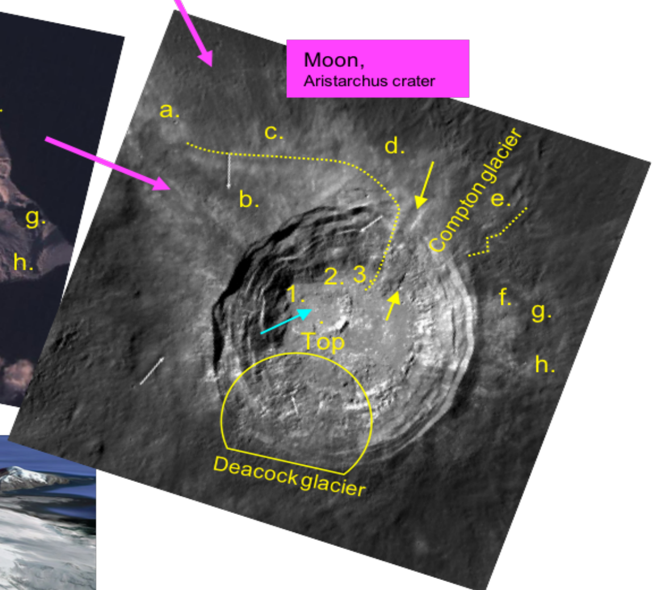
Of course such calculations come with tremendous uncertainties and assumptions, yet it is hopeful three completely independent methods came up with comparable numbers.

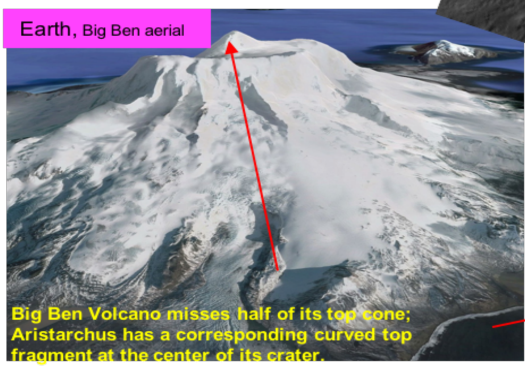
ANNEX 2: Aristarchus Crater vs. Big Ben Volcano

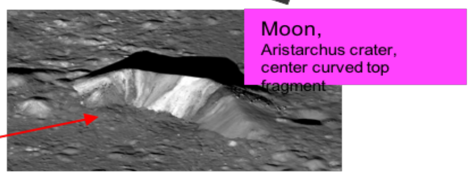
Aristarchus (Moon, inverted) = Big Ben Volcano, Heard Island (Earth)

Below: Big Ben volcano, Heard Island. To the right: Aristarchus crater (mirrored) on the Moon. Based upon impact coordinates these two features might be each others counter part and they are! The vertical ribbons on Heard island indicated 1,2,3 are exactly mirrored at Aristarchus steepest side. Next Compton Glacier is visible as a distortion at Aristarchus. Most strikingly Deadock glacier, a messy depressed part of the Big Ben is also the depressed part of Aristarchus crater rim. Next at the aerial picture we see the missing half of Big Ben's top cone, facing the steepest part of the mountain. At Aristarchus we see the missing half circle of Big Ben's top cone, buried up side down at the centre of Aristarchus crater also facing the steepest part of its crater. Next, notice the perfectly matching features a and b as well as the western 'Lagoons of Heard island' at f,g,h. The Big Ben Volcano rim indication is about 2x smaller than Aristarchus crater. This is likely due to the 6 times heavier gravity on Earth, causing the initial viscous magma-made mountain of Big Ben to cave in at the top and sag at the bottom, keeping its form but loosing its size (see explanation of Lunar dome volcanism below). A comparison can be made at several high Thorium mirrored spots, most notably The Moon's Aristillus crater vs. Vinson massif, Antarctica.



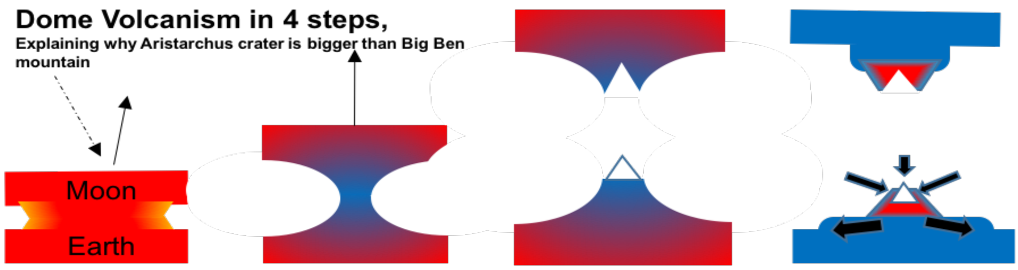






Dome Volcanism in 4 steps,

Explaining why Aristarchus crater is bigger than Big Ben mountain



Impact heats both surfaces
Magma sticks during exit

Magma becomes smaller and cooler in the middle due to quick expansion

Magma clods and breaks
Mountain and crater form

Heavy gravity on Earth causes sagging at the base and caving in at top. Moon crater remains wide and elevated