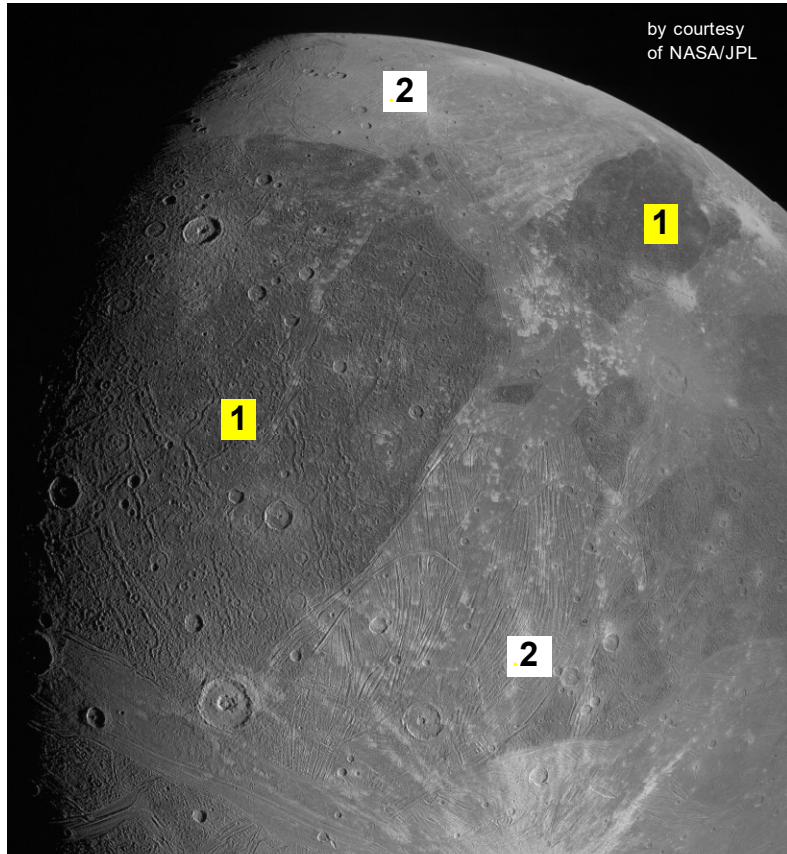


Ganymede will help us to understand the Expansion Tectonics Process on Earth caused by the PT -Impact Event

Similar to Earth Jupiter's moon **Ganymede** shows **Expansion Tectonics** over it's whole surface area. Looking on Ganymede's geological map then it is very obvious that the brown colored areas represent fragments of a sphere which are slowly drifting away from each other. It is undeniable that the moon's mantle has expanded !

A new sharp image of Jupiter's moon **Ganymede** was made by NASA's **Juno** spacecraft during its **June 7, 2021, flyby**, from a distance of only 1038 km. **The image shows clearly distinct dark and bright terrain, and long structural features possibly linked to tectonic faults. Ganymede's surface is composed of two types of terrain :**

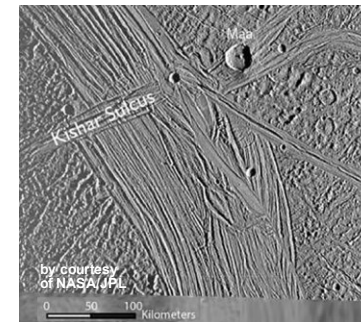
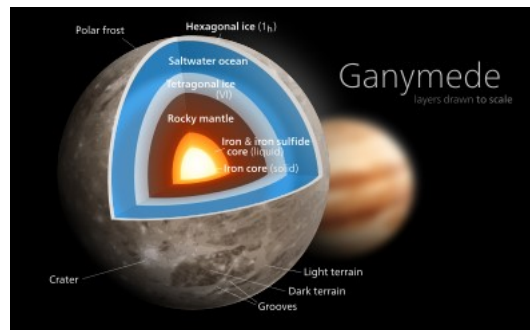
1.) Dark old regions, saturated with **impact craters** and currently dated to four billion years ago, cover about one third of it. These dark regions contain clays and organic materials that could indicate the composition of the impactors from which Jupiters moons accreted. (→ on the geological map the old regions are indicated in brown color).



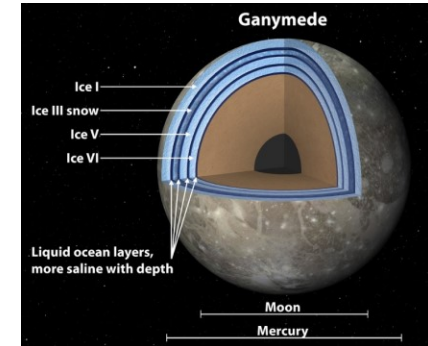
2.) Brighter and younger regions, crosscut by extensive grooves and ridges, cover the other two thirds of the moon's surface. The cause of the light terrain's disrupted geology was likely the result of **tectonic** activity.

Water ice seems to be present everywhere on Ganymede's surface, with a mass fraction of 50–90% :

The bright grooved regions (areas) have a more icy composition than the dark regions. The modern view is that these bright grooved regions are mainly **tectonic** in nature. **Cryovolcanism** is thought to have played only a minor role. Scientists believe that in the past Ganymede may have passed through one or more Laplace-like resonances (episodes of eccentricity excitations of its orbit), and that this probably caused significant tidal heating of the interior of Ganymede. The formation of the grooved terrain may be a result of one or more such tidal heating episodes. The scientists think that this tidal heating episodes may have caused an expansion of Ganymede's mantle caused by thermal expansion and phase transitions in the high-pressure ice which forms Ganymede's mantle. But there is also the possibility that the **Gilgamesh Impact** and other Impacts have caused the mantle expansion (Harry K. Hahn)



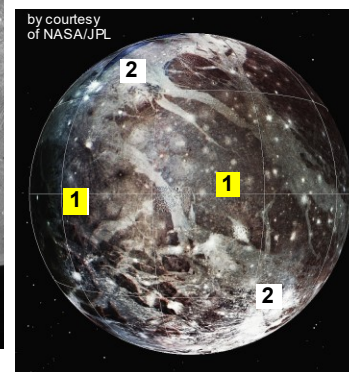
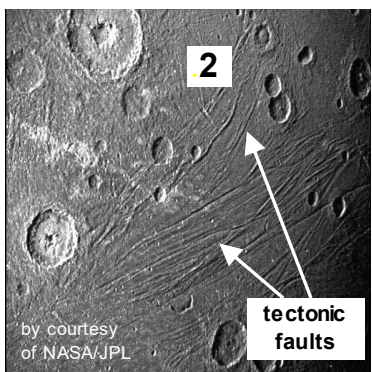
Tiamat Sulcus region of Ganymede showing Strike-slip tectonics



Internal Structure

Jupiter's largest moon Ganymede (Ø 5150 km) is composed of approximately equal amounts of **silicate rock** and **water**. It appears to be fully **differentiated**, with an internal structure consisting of an **iron-sulfide-iron core**, a **silicate mantle** and outer layers of water ice and liquid water, which may contain more water than all of Earth's oceans combined. The precise thicknesses of the different layers in the interior of Ganymede depend on the assumed composition of silicates (fraction of **olivine** and **pyroxene**) and the amount of **sulfur** in the core.

The average density of Ganymede, 1.936 g/cm³, suggests a composition of about equal parts rocky material and mostly water **ices** (→ see info to : **Water-Ice-types**). Beside water ice there are various non-water materials on Ganymede's surface present : **carbon dioxide**, **sulfur dioxide** and, possibly, **cyanogen**, **hydrogen sulfate** and various **organic compounds**. The **Galileo** space probe has also found **magnesium sulfate** (MgSO₄) and, possibly, **sodium sulfate** (Na₂SO₄) on Ganymede's surface. These salts may originate from the subsurface ocean. Ganymede has a thin **oxygen** atmosphere that includes O, O₂, and possibly O₃ (**ozone**). **Atomic hydrogen** is a minor atmospheric constituent. The oxygen is thought to be produced when water ice on Ganymede's surface is split into **hydrogen** and **oxygen** by radiation, with hydrogen then being more rapidly lost due to its low atomic mass. **Thermolysis** of water (→ **water molecules split** into hydrogen & oxgen at T > 2200° C), where the required heat is provided by impacts, could be another possibility ! (comment by Harry K. Hahn). Ganymede is the only moon known to have a **magnetic field**. This causes auroras to glow around the moon's north and south poles.

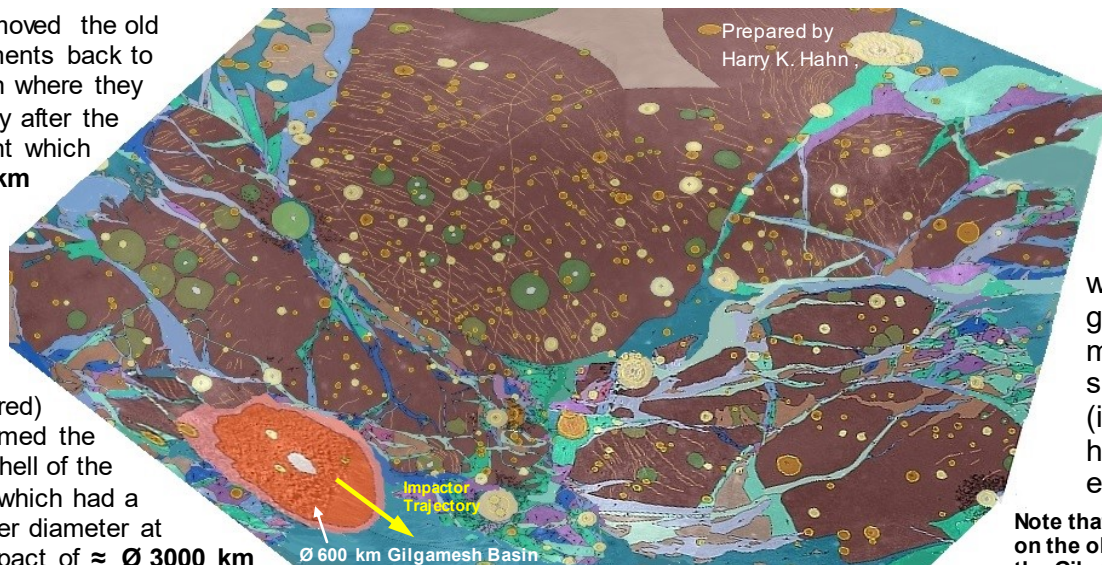


The surface of Jupiter's moon Ganymede seems to be the result of Expansion Tectonics caused by a Global Impact Event

Jupiter moon [Ganymede](#) (Ø 5150 km) shows indication for a global [Expansion Tectonics](#) process. Looking at Ganymede's geological map then it seems to be obvious that the brown colored (old crust-) areas represent fragments of a sphere which are slowly drifting away from each other. It's obvious that an expansion process was started at a certain point of time and the fragments of the old smaller spherical shell (brown) got slowly pulled apart by an expanding mantle underneath ! Having a close look at the pattern of the "expanding cracks" between the old brown-colored crust fragments, than it seems that one global impact event was the initial trigger for the break-up of Ganymede's old spherical shell (→ the brown-colored surface area) ! This global impact event not only provided the impact energy and the required shock-waves to shatter Ganymede's crust in one single event. It also provided the energy & conditions which started the massive mantle-expansion of Ganymede. My new

Image 1 : I have moved the old (brown) crust-fragments back to the original position where they were located shortly after the Global Impact Event which caused the Ø 600 km "Gilgamesh" Impact Basin

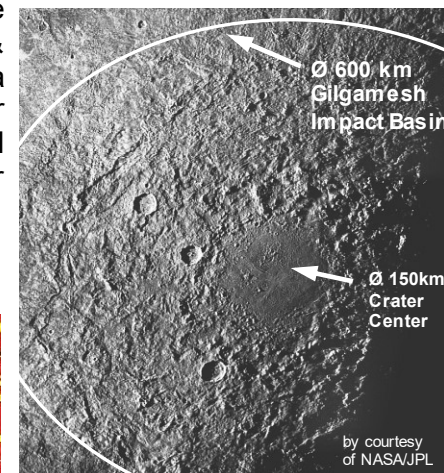
This manipulated Geological Map of **Ganymede** clearly shows that the old (brown-colored) crust fragments formed the original spherical shell of the moon Ganymede, which had a considerable smaller diameter at the time of the impact of ≈ Ø 3000 km



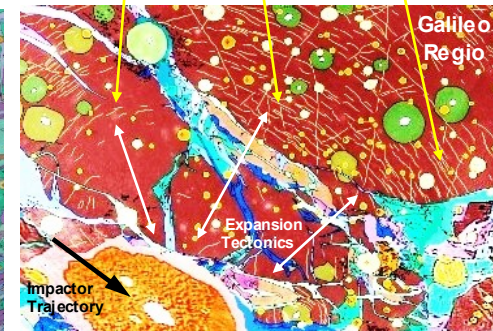
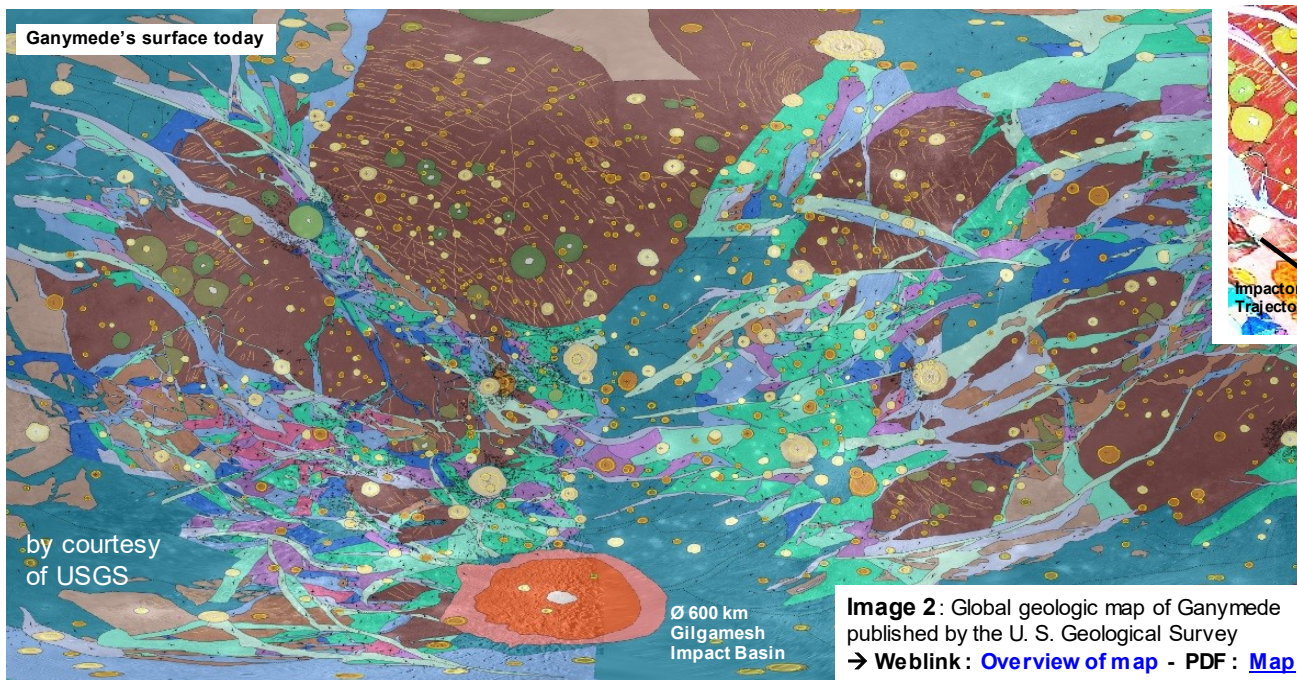
analysis indicates that the Ø 600km [Gilgamesh Impact Basin](#) (pages 23-26, 78, 163, 214 in this PDF) and the impact energy and fracture pattern caused by this global impact event in all probability triggered the obvious expansion tectonics process on Jupiter's moon Ganymede ! Because there are strong similarities to the PT-Impact Event on Earth : → e.g. crater (impact basin) size ≈ 1/10 to 1/5 of the planet's (moon's) Ø, the impact angle was ≤ 15°, a massive expansion tectonics

was triggered (started) by the giant impact, and a surface & mantle which seems to have a similar structure (→ high water (ice) content) Ganymede will help to understand the similar expansion tectonics on Earth !

Note that these **concentric sets of fractures** on the old crust-fragments were caused by the Gilgamesh-Impact ! (→ my analysis !)



Different structural features indicate the impactor's trajectory (→ see next page !)



According to the Geological Map these curved furrows (fractures) were caused by large impact(s) into a relatively thin brittle lithosphere during the Nicholsonian period

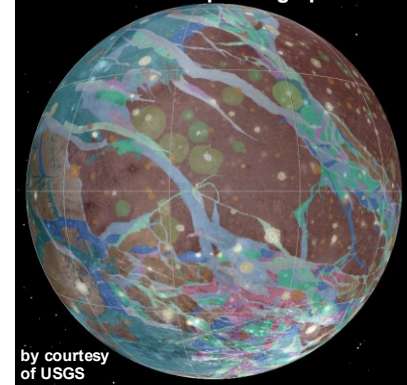
Near-infrared & UV-spectral analysis

Water ice exists everywhere on the surface of Ganymede with a mass fraction of 50–90%. Strong water-ice absorption bands are present.

Interesting Weblinks : [Ganymede Geology](#)
Rotating Geological Map : [GEO Animation](#)
Link2 : [Rotation Animation 2](#)

Image 2 : Global geologic map of Ganymede published by the U. S. Geological Survey
→ Weblink : [Overview of map](#) - PDF : [Map](#)

"A shattered & expanding Sphere"

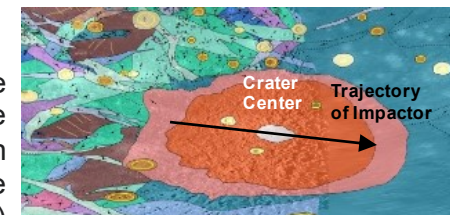


Global Geological Map of Ganymede

The Gilgamesh Impact, a large shallow Impact, fractured Ganymed's crust and caused Expansion Tectonics in the mantle

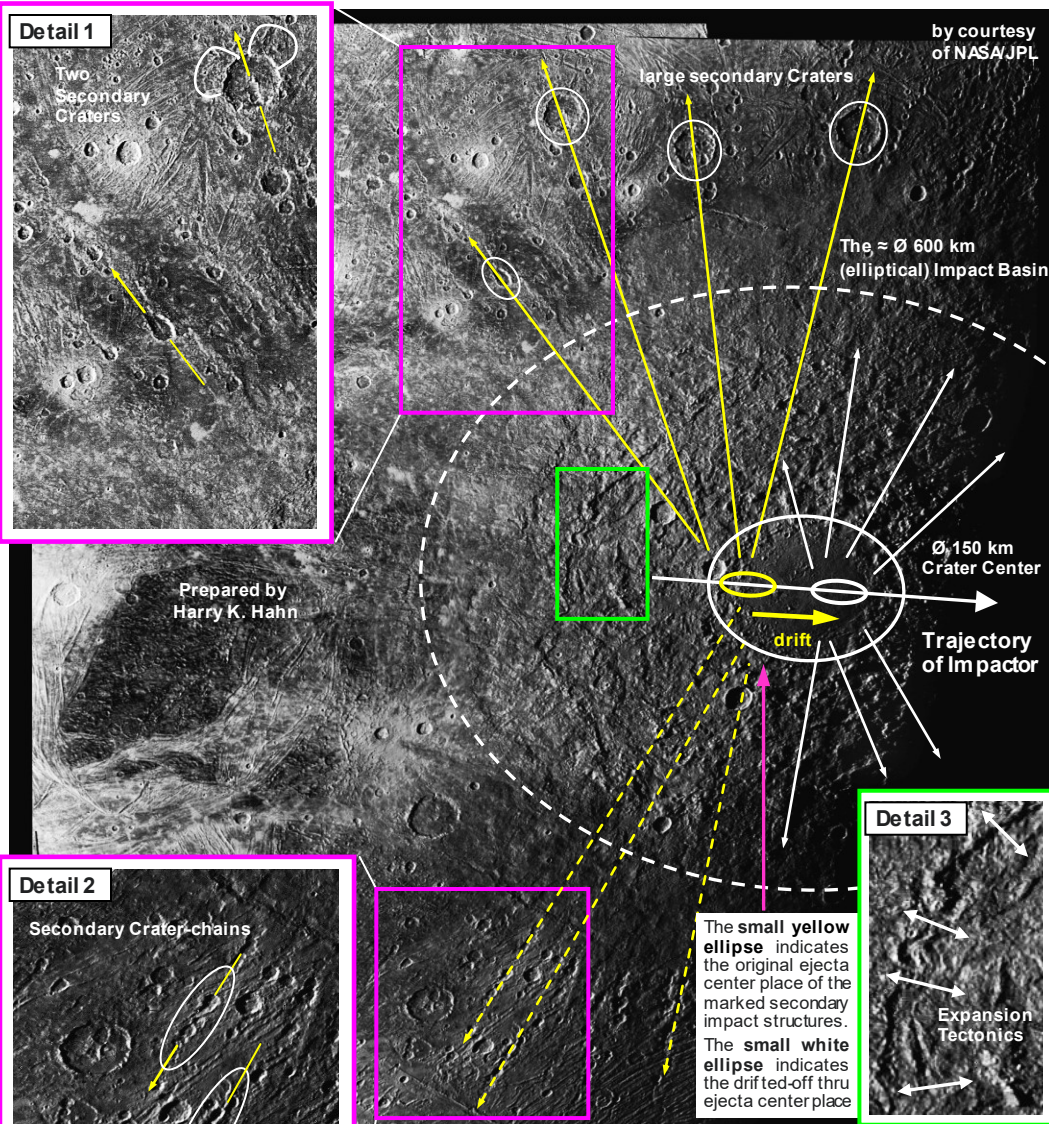
There is strong indication that the $\varnothing 600\text{km}$ elliptical **Gilgamesh Impact Basin** is responsible for the global fracture pattern that shattered the old and smaller spherical shell (dark regions) of Jupiter's moon Ganymede, and that this giant Impact started an Expansion Tectonics process in Ganymed's mantle, which slowly pulled apart the old crust fragments by an expanding mantle underneath. Similar as on Earth (\rightarrow the PT-Impact Crater) this giant oblique (shallow) Impact obviously caused the "tectonic plates" (the fragments of the old crust) and the Expansion Tectonics process on Ganymede. Beside the extreme seismic shock waves and the secondary impact structures (crater chains & big secondary craters) caused during the impact, also the powerful tangential impulse induced into Ganymed's crust and mantle by the giant shallow impact, together with the induced impact heat, must have been the decisive factors for the global fracture pattern.

Secondary Crater-chains and large Secondary Craters caused by the Gilgamesh Impact clearly indicate that the **Gilgamesh Crater**



Geological map of the Gilgamesh Impact Basin
The $\varnothing 600\text{ km}$ impact basin is marked in orange

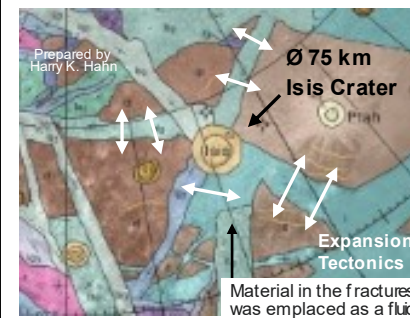
slowly drifted away from the original impact site into the direction of the original impact impulse (= trajectory of the impactor). Further indication comes from expansion tectonics structures on the rear-end of the impact basin. (\rightarrow see left image !)
The real drift of the crater may exceed $> 1000\text{ km}$!



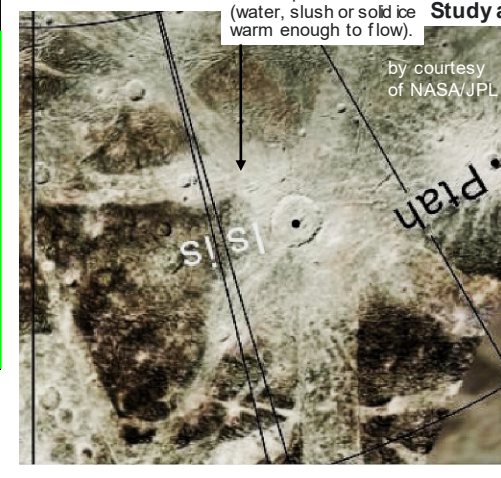
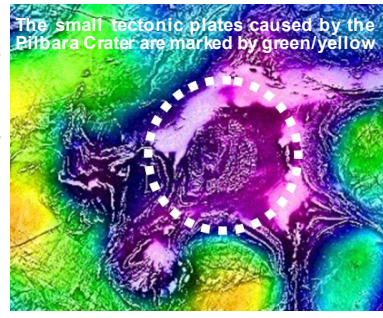
Gilgamesh Impact Basin on Ganymede : The $\varnothing 600\text{ km}$ (elliptical) impact Basin (w hite dashed line) and the inner $\varnothing 150\text{ km}$ elliptical crater center indicate an $\approx 10^\circ$ shallow (oblique) Impact. Secondary crater chains & secondary impacts and expansion tectonics indicate that the crater drifted away from the original impact site (w hite arrow)

Ganymede's Isis Crater and an old Crater on Earth caused tectonic plates

Another interesting crater on Ganymede, the $\varnothing 75\text{ km}$ **Isis Crater**, also seems to have caused "plate tectonics" in a smaller scale on Ganymede. The image and the geological map of Ganymed's Isis Crater and its surrounding area indicate that a small tectonic plate on Ganymede (\rightarrow brown-colored on the geological map) obviously was fractured by the Isis Impact (Crater) and the fragments of this old plate then drifted apart after the impact. A very similar impact crater which fractured Earth's crust $\approx 3\text{ Ga}$ ago also exists on Earth !



On the Pilbara Craton in NW-Australia there is a similar, yet unknown !, impact scenario visible where an impact crater obviously has fractured Earth's young crust and caused tectonic plates !
Weblinks to my study
 \rightarrow : [Link 1](#) ; [Link 2](#)



Study also available on: www.permantriassic.de / www.permantriassic.at