

El Sistema Solar

Curso de Actualización en
Ciencias Naturales
Setiembre 2017

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Departamento de Astronomía

Instituto de Física

Facultad de Ciencias



Nuestra galaxia

300.000 millones de estrellas

Our Planet Hunting Neighborhood

Sun →



Most of the planets
found to date lie
within about 300
light-years from
our Sun.

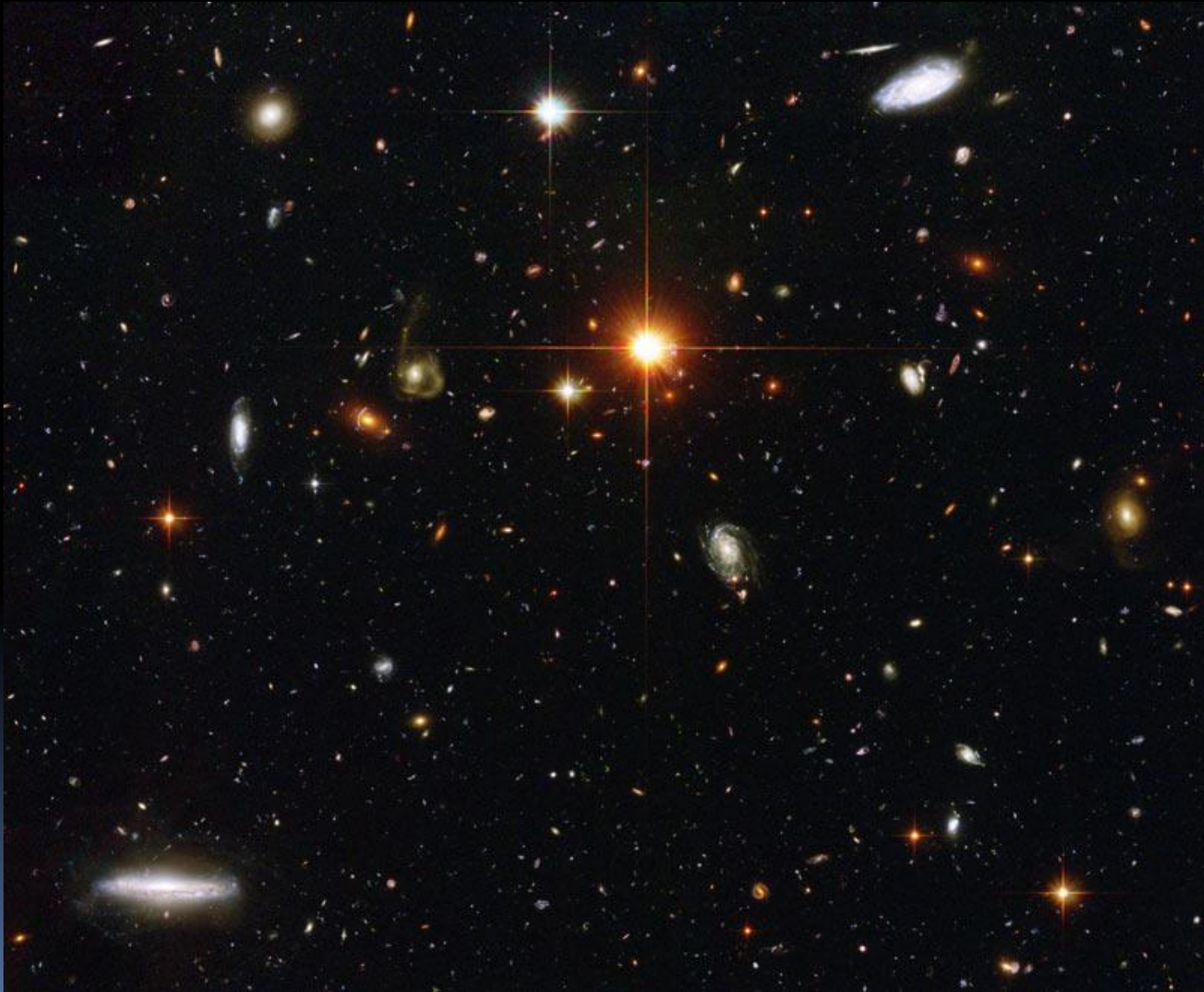
La Vía Láctea



Galaxia



Galaxias



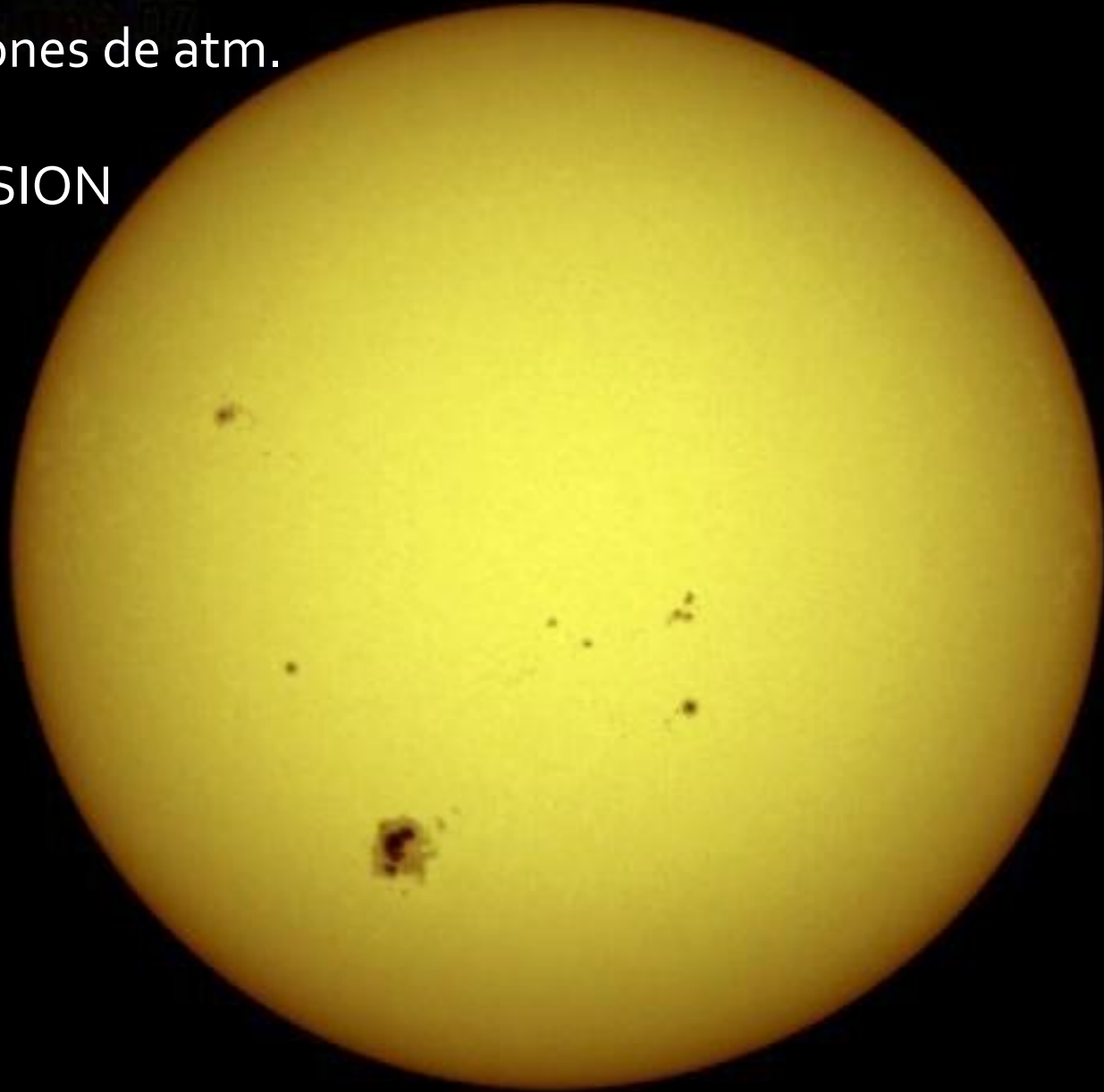
Temperatura sup = 5500 C

Temperatura int = 14.000.000

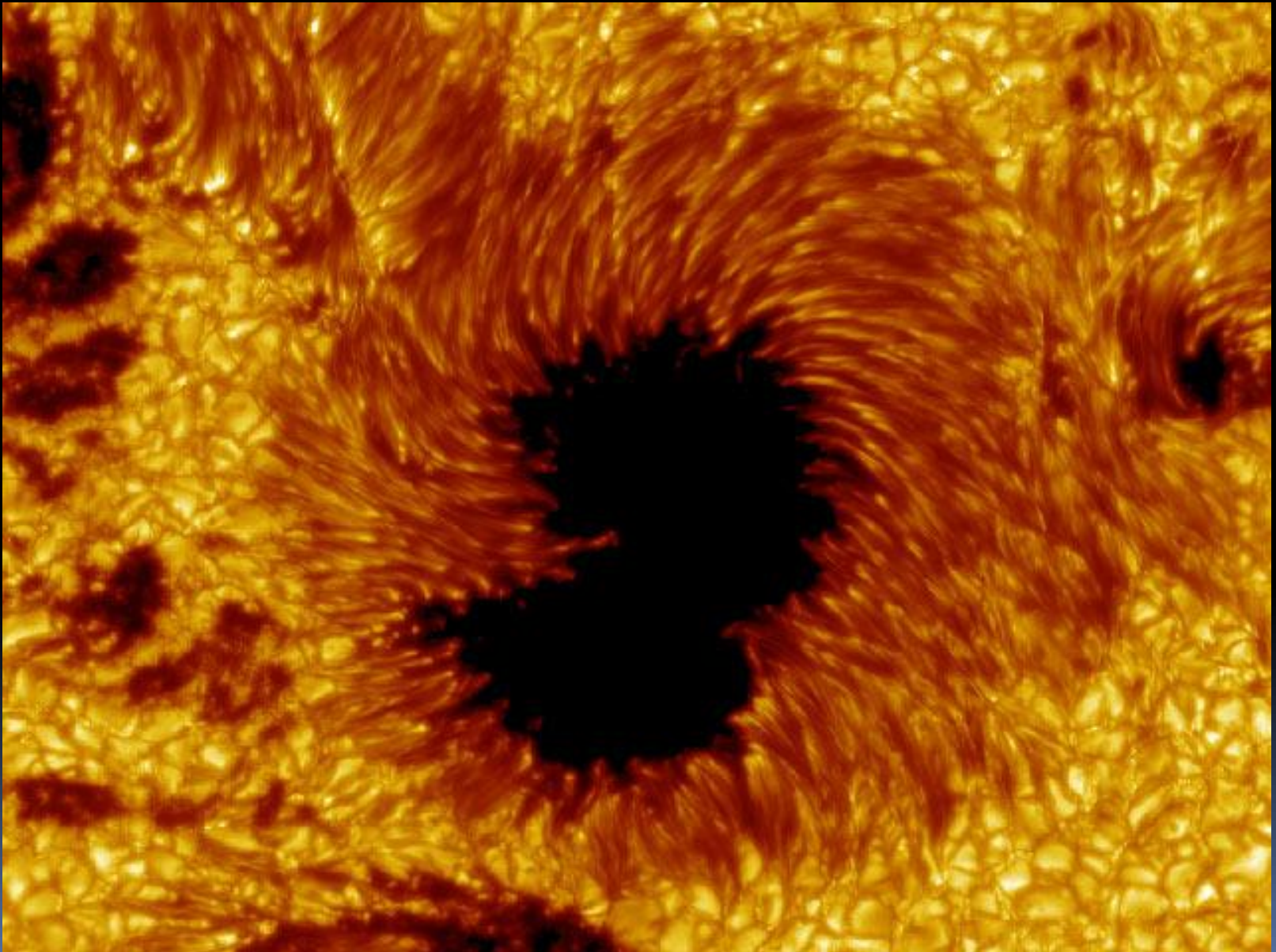
Presión = 250.000 millones de atm.

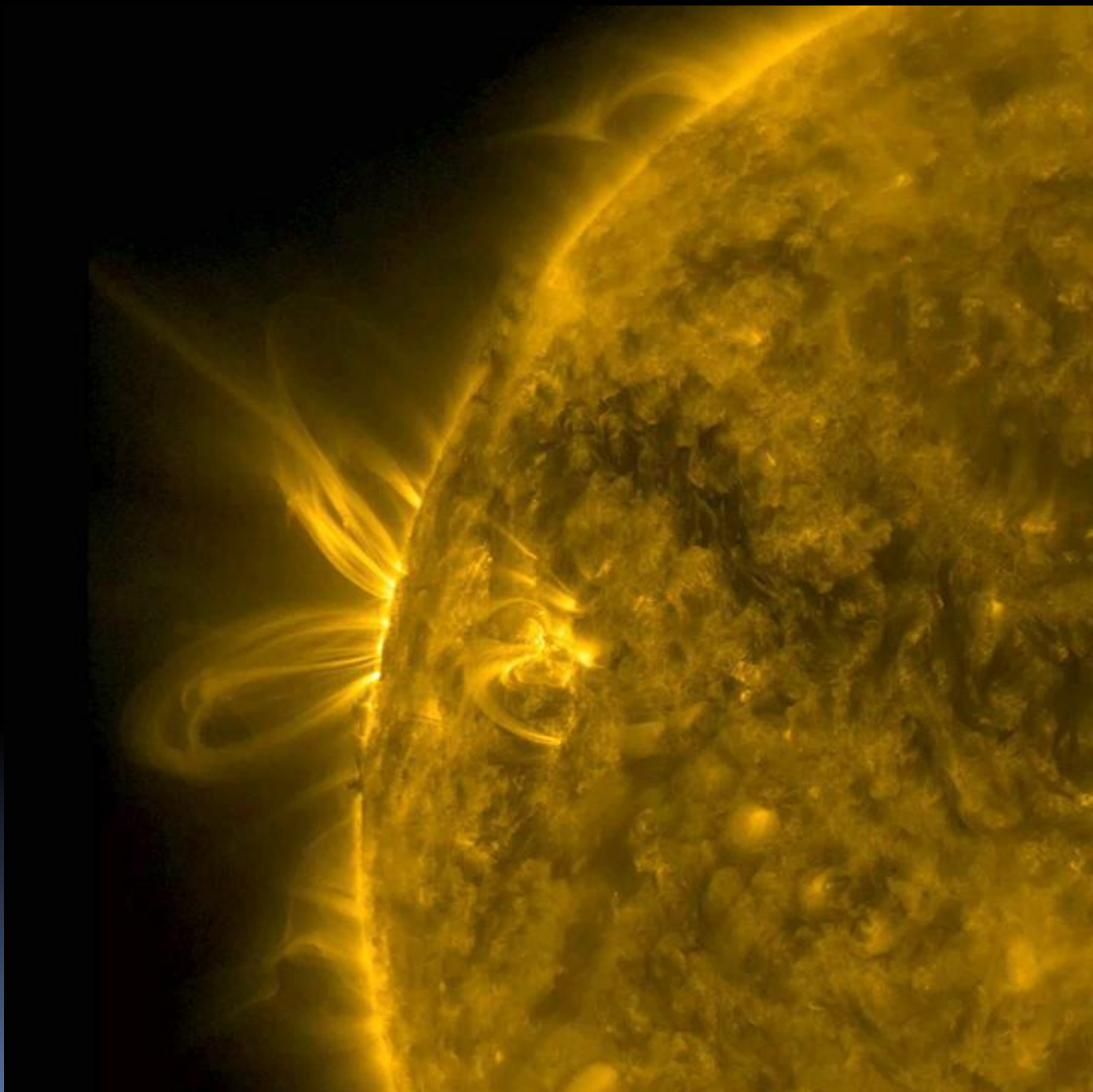
Equilibrio PESO – PRESION

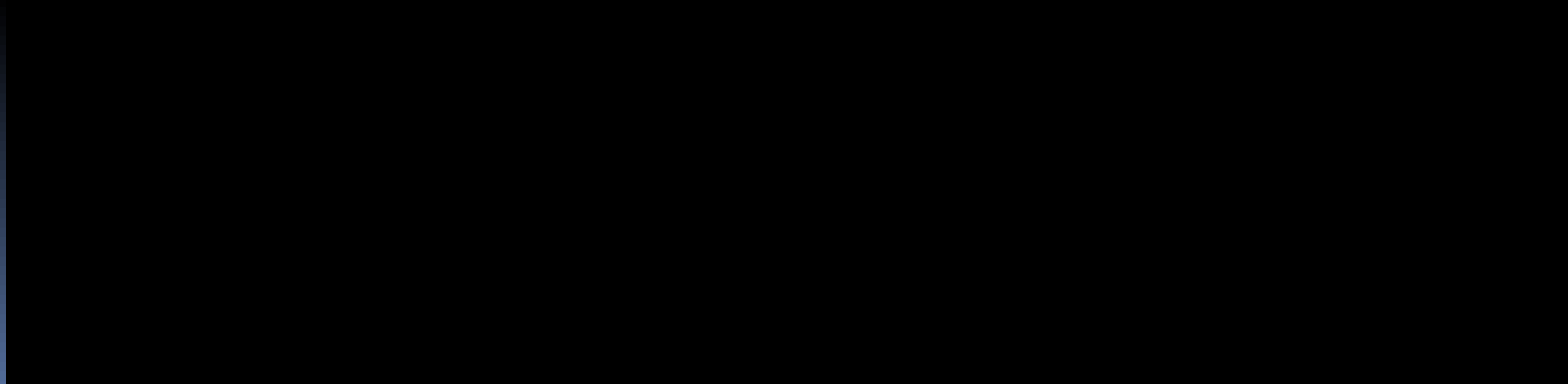
Sol



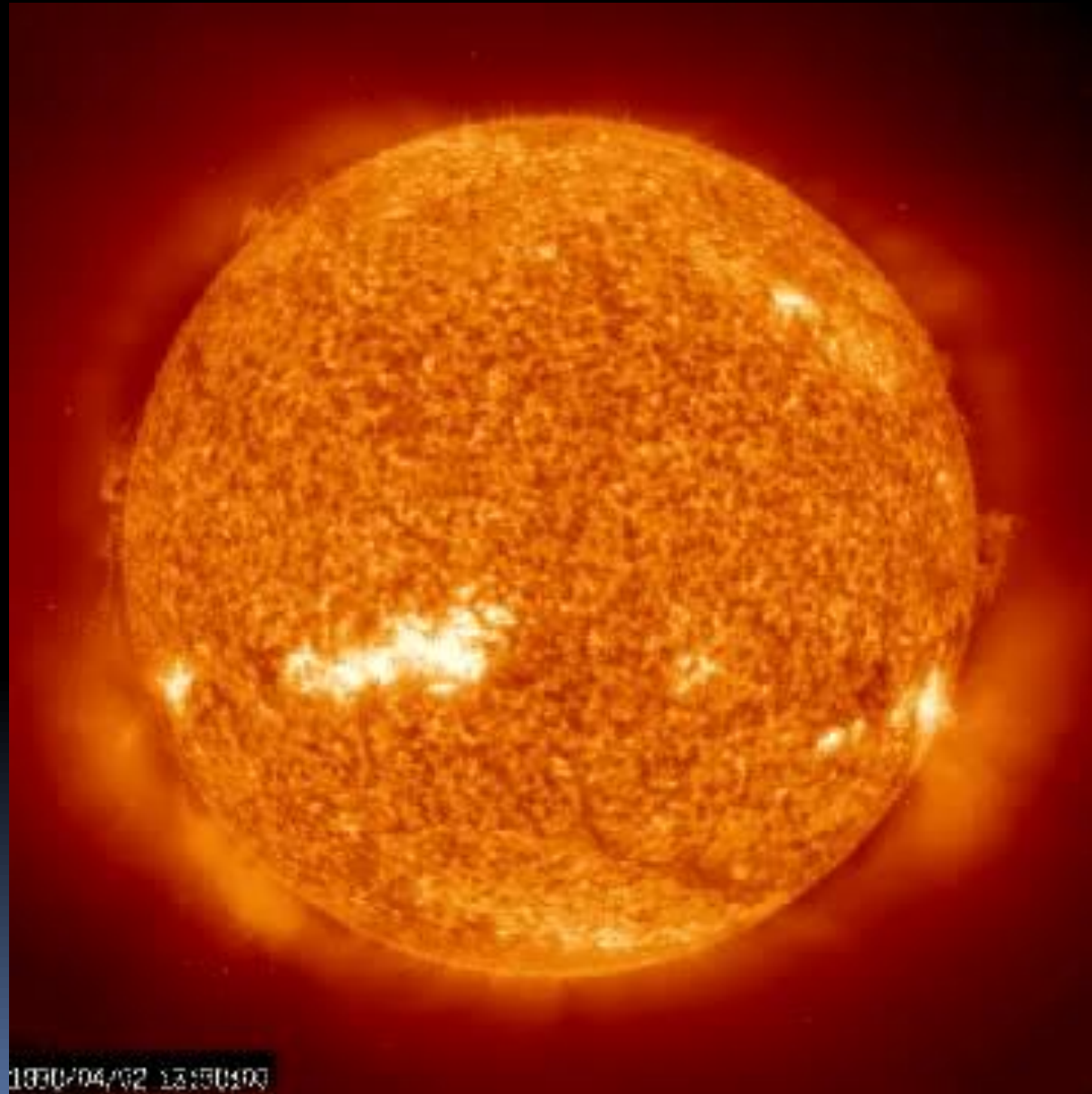
MANCHAS SOLARES: Campos magnéticos intensos

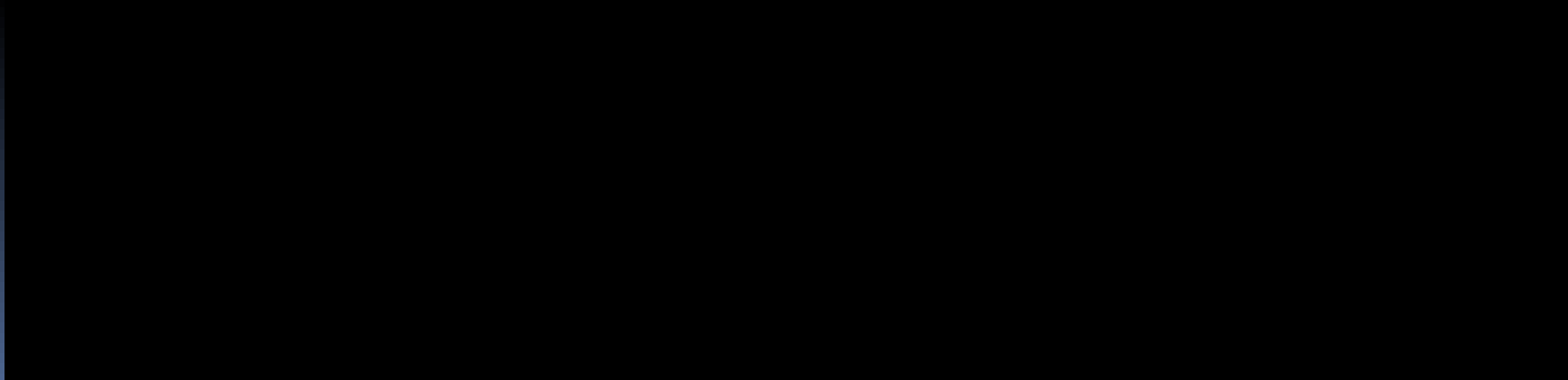






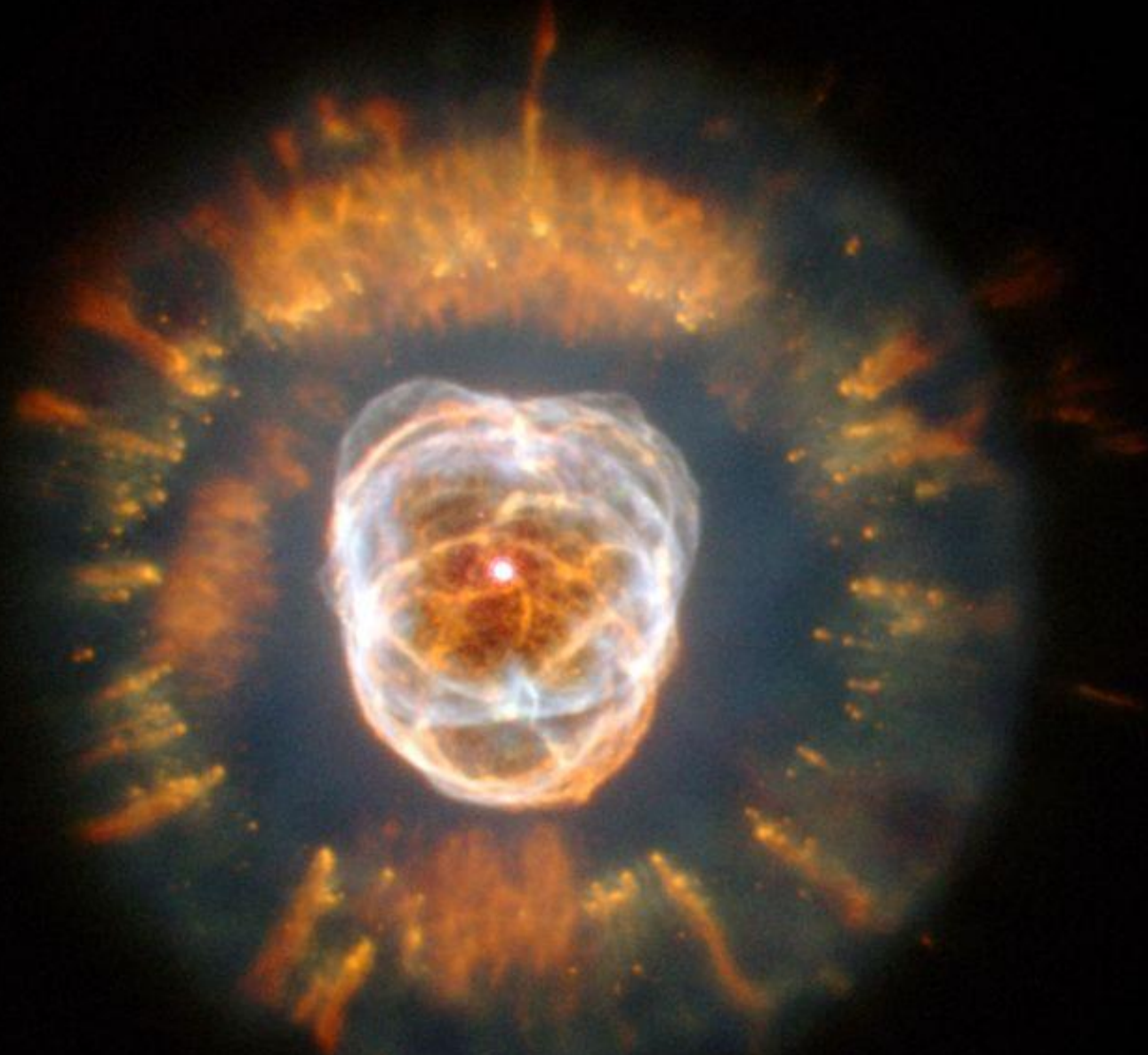
Sol: reactor de fusión



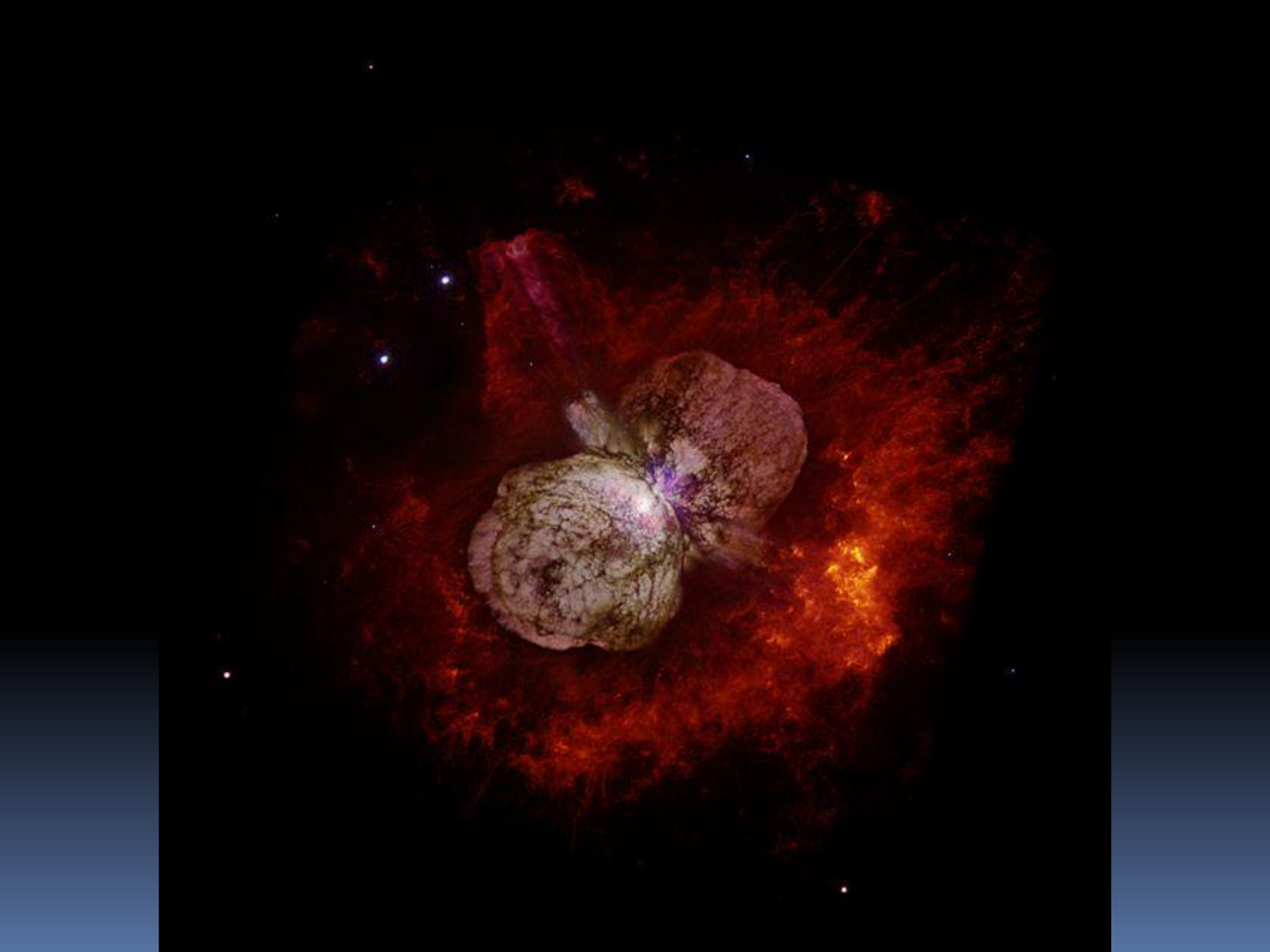


Muerte estelar





www.hubblesite.org



Medio interestelar enriquecido con “polvo” de estrellas.



Principales elementos en el polvo: CHON



Formación estelar

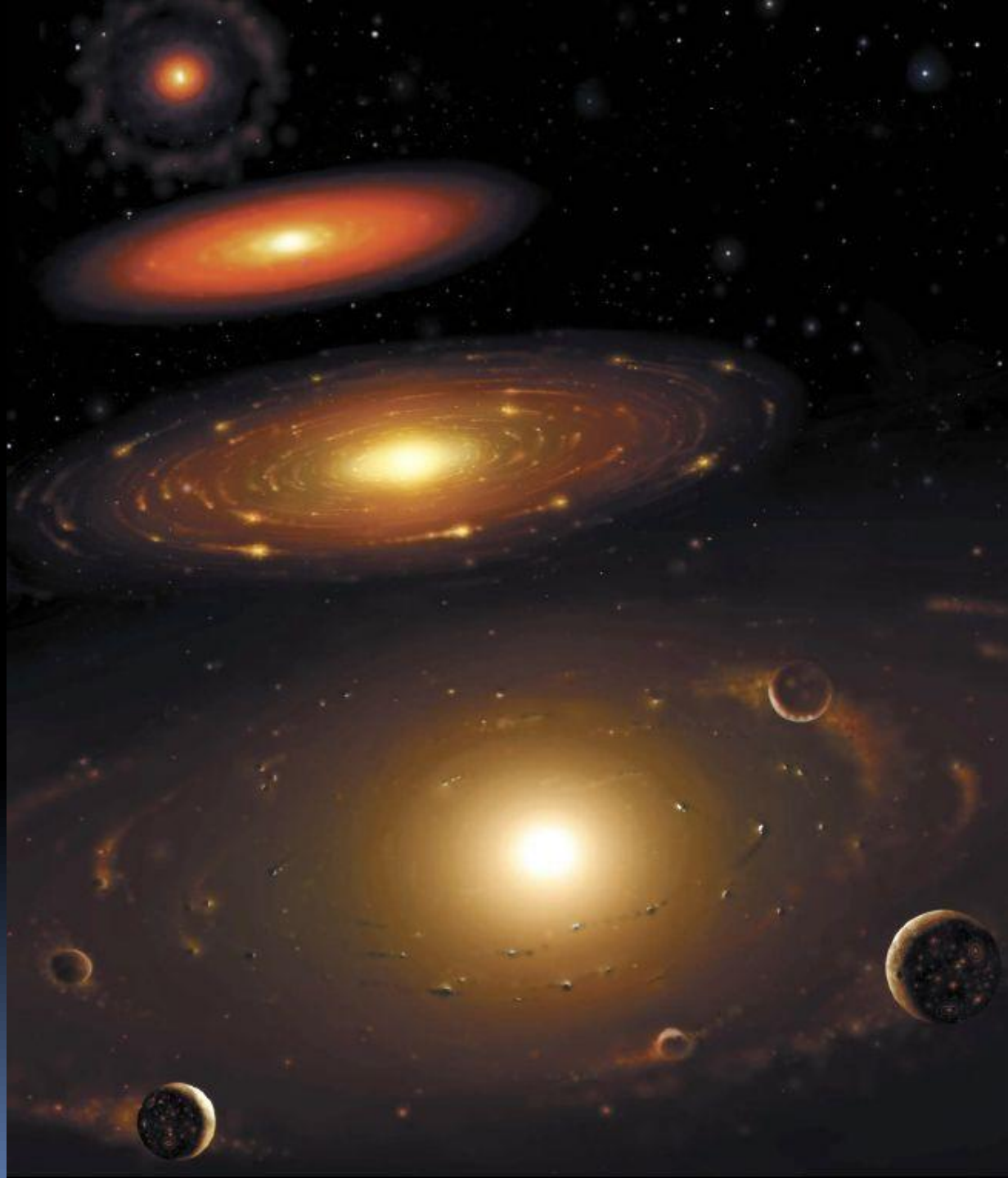




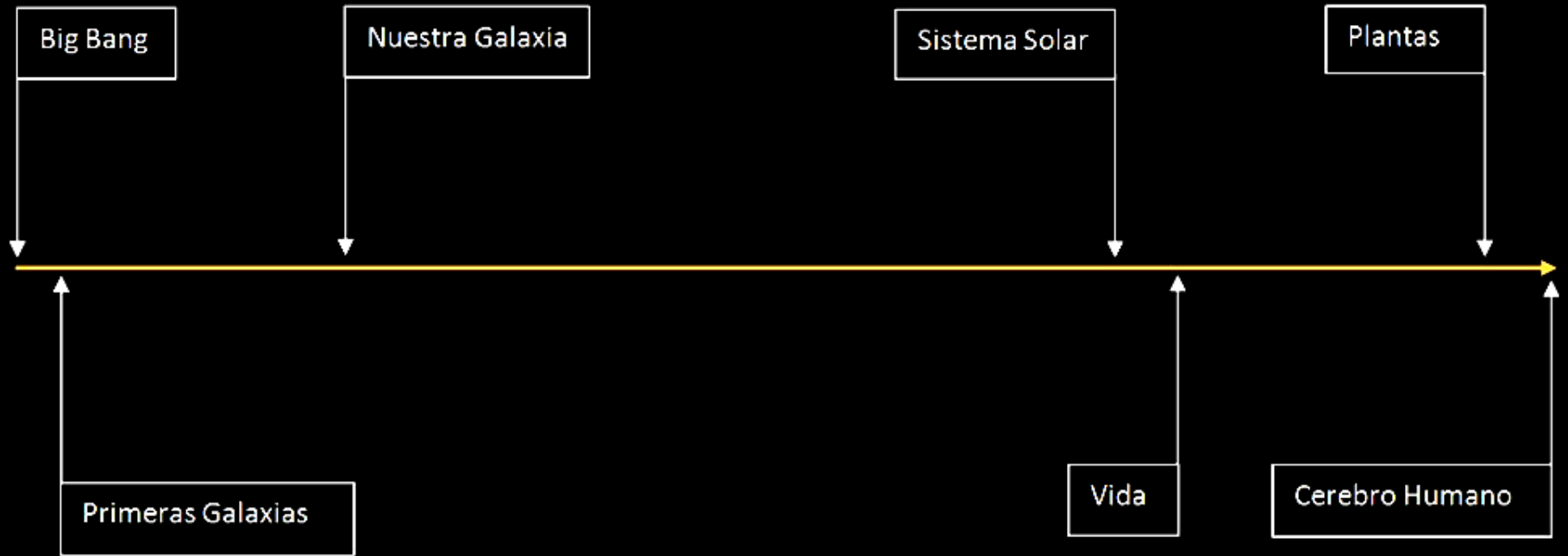
Protoplanetary Disks in the Orion Nebula HST • WFPC2

NASA, J. Bally (University of Colorado), H. Throop (SWRI),
and C.R. O'Dell (Vanderbilt University) • STScI-PRC01-13

Formación del Sistema Solar

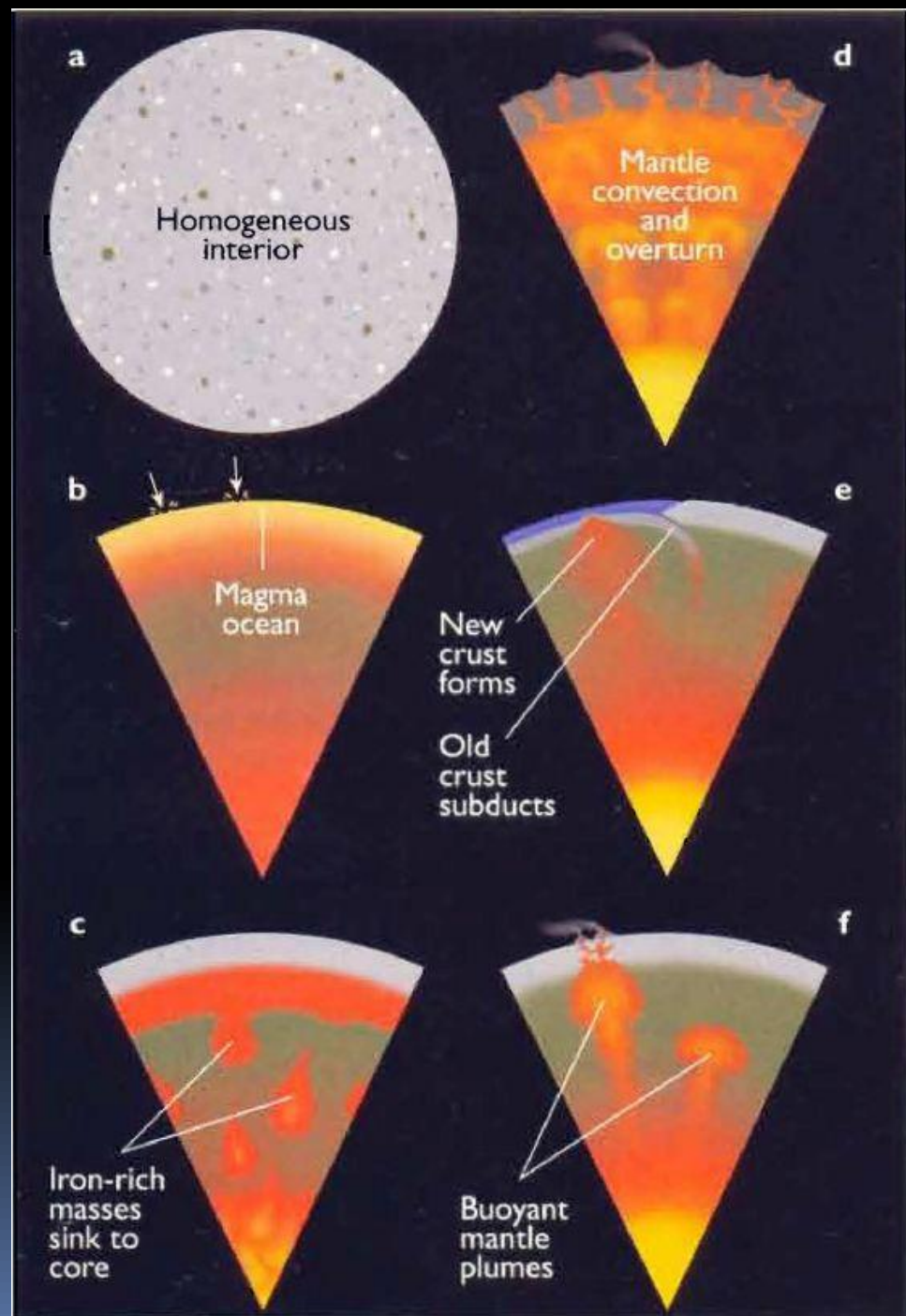


Cronología

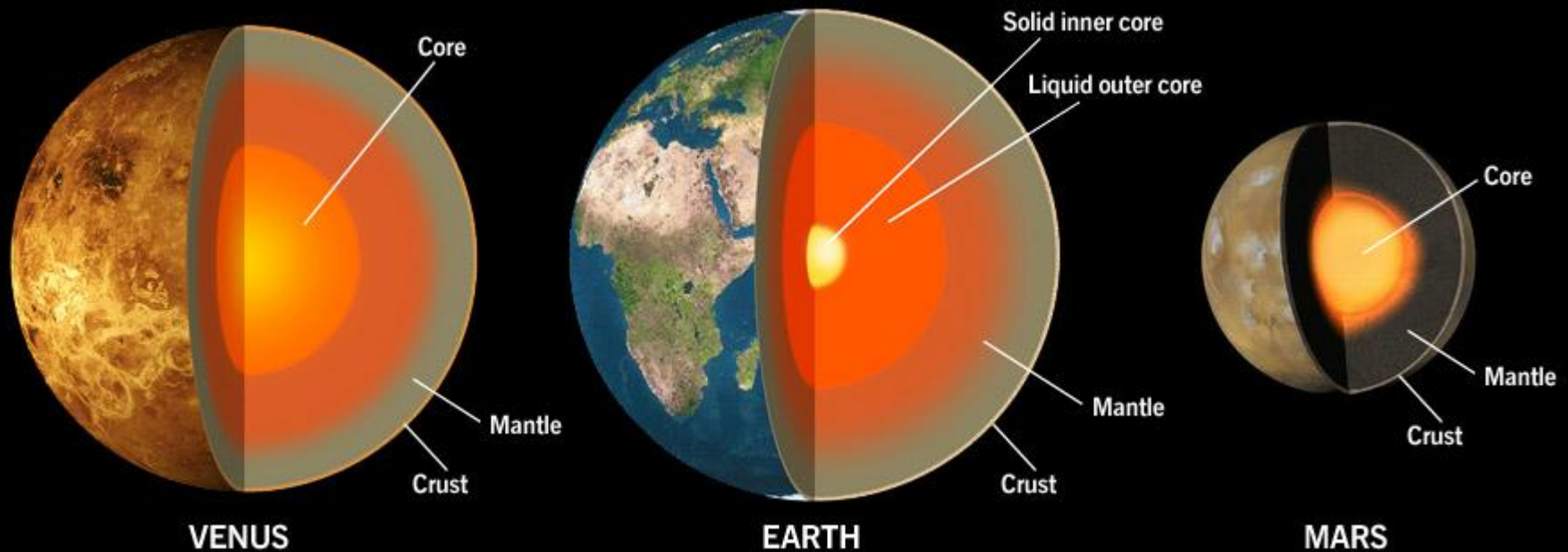


Big Bang: hace 13.700 millones de años

Evolución planetaria

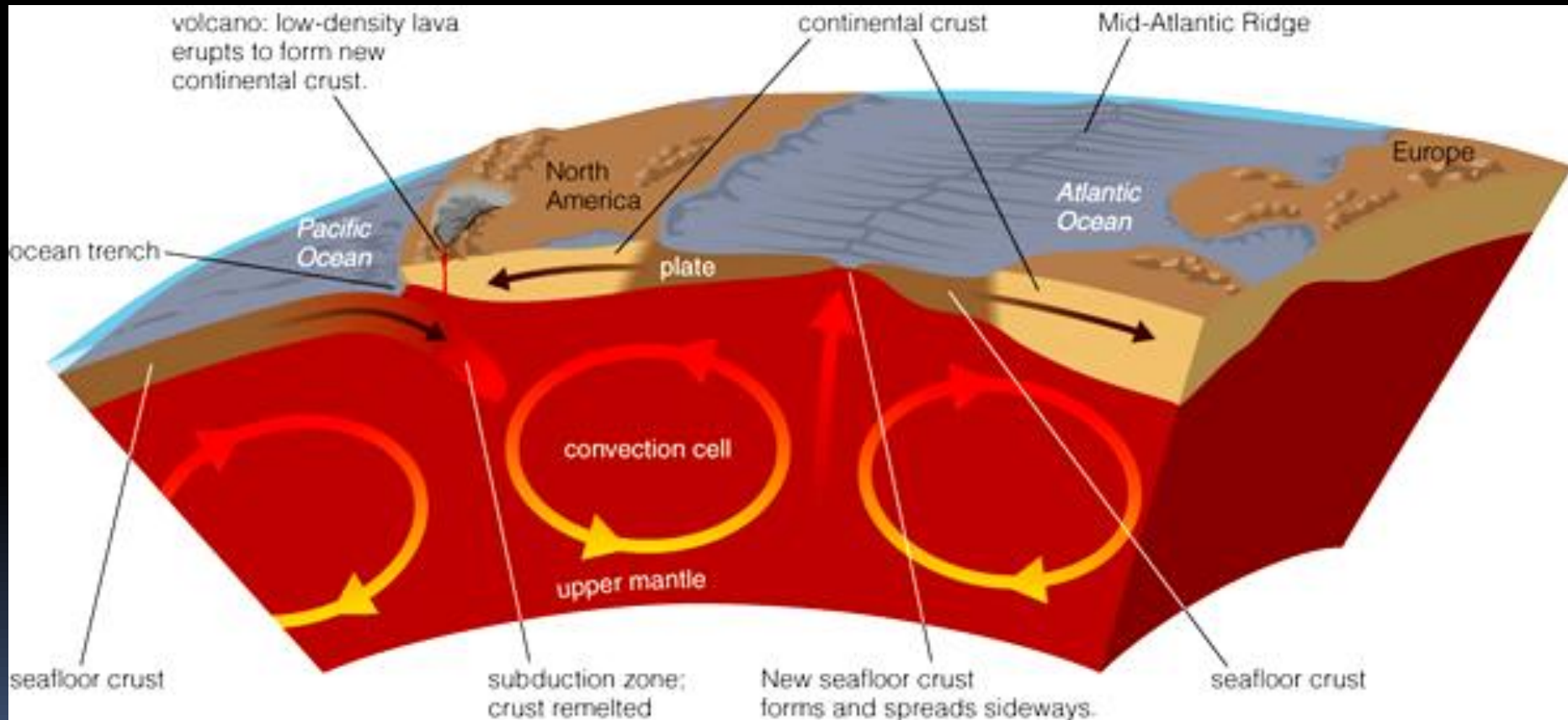


Evolución planetaria: administración del calor interno

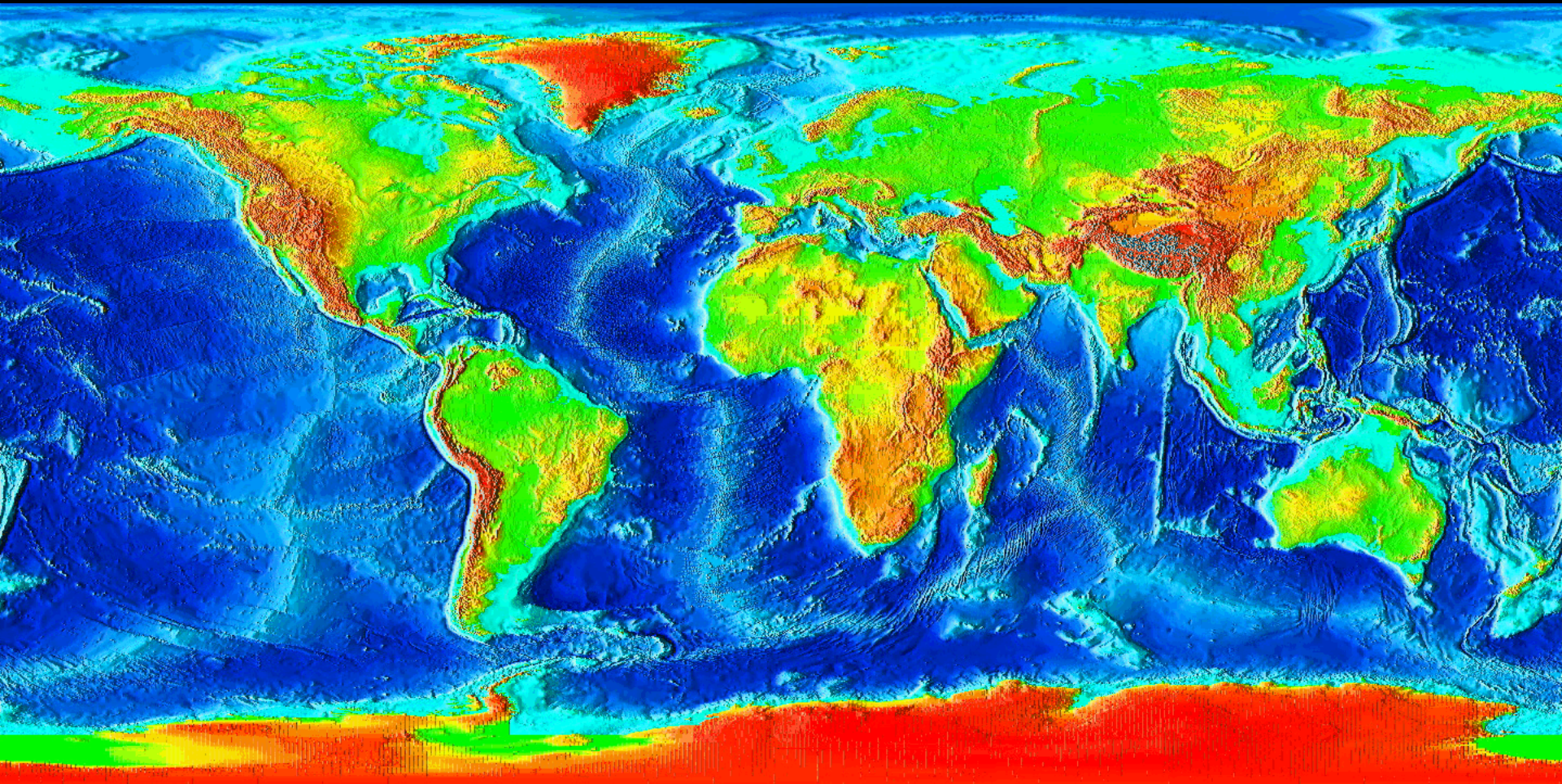


Tierra:

renovación superficie y atmósfera

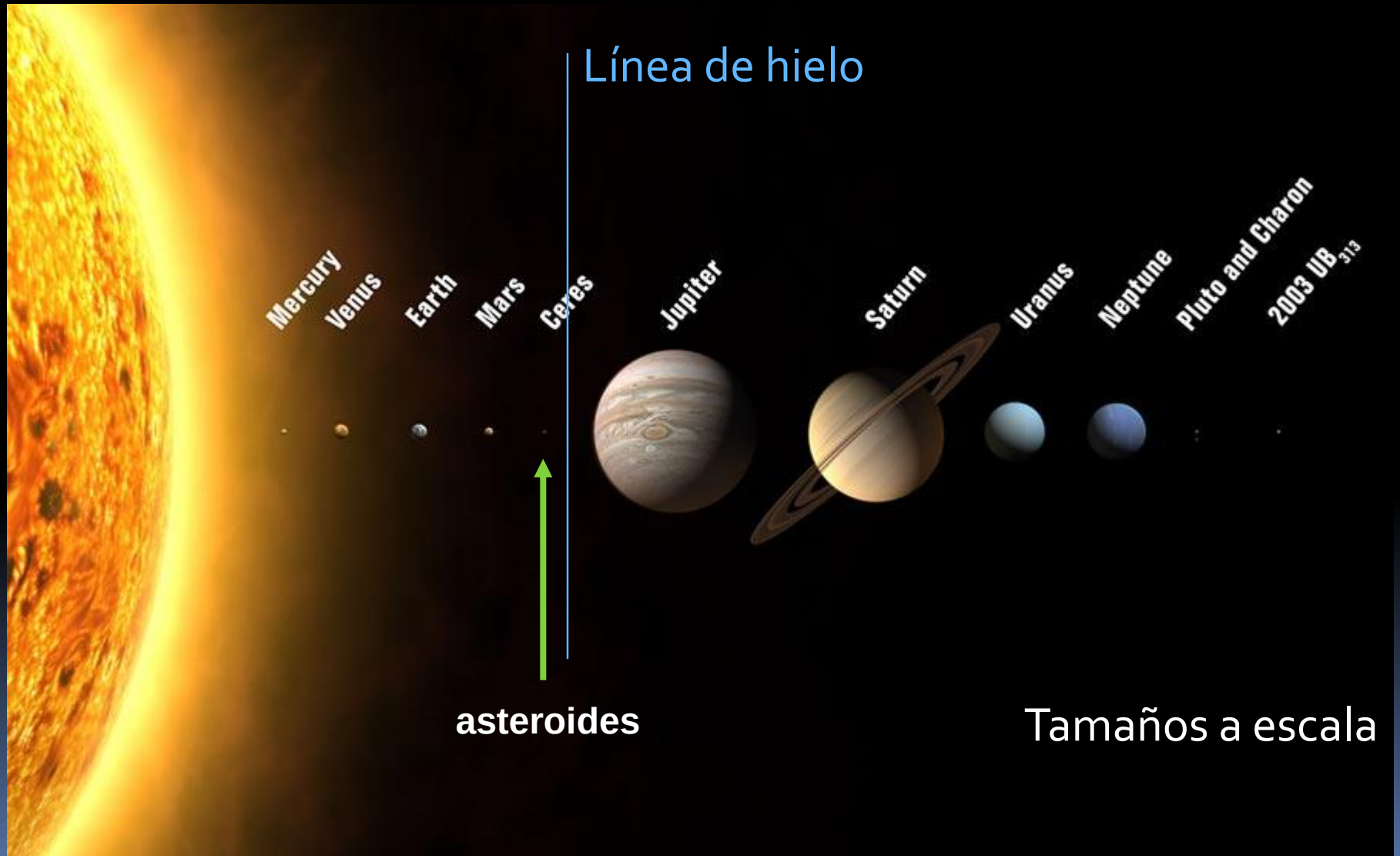


Tectónica



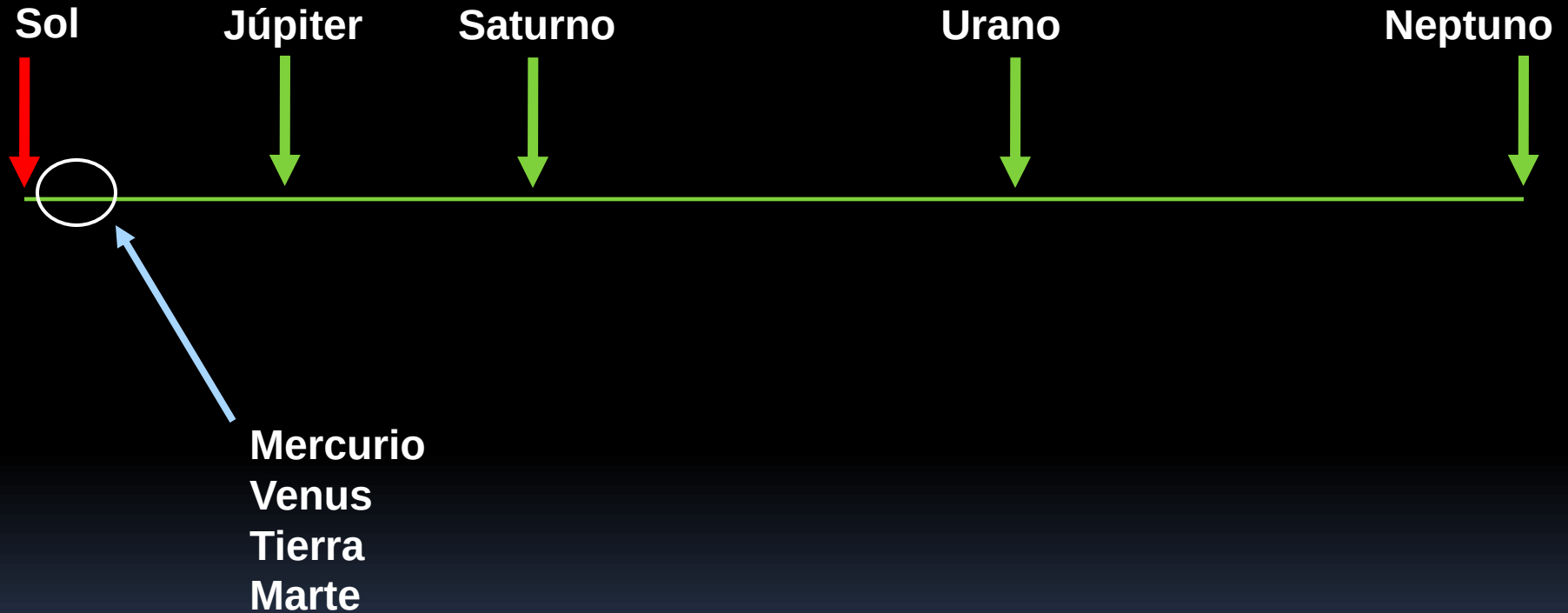
Sistema Solar

Mundos rocosos, gaseosos y helados



Sistema Solar

Distancias a escala



MUNDOS ROCOSOS

Mercurio

Día = 2 años mercurianos !
-170 C < Temperatura < 400 C

DIA

NOCHE

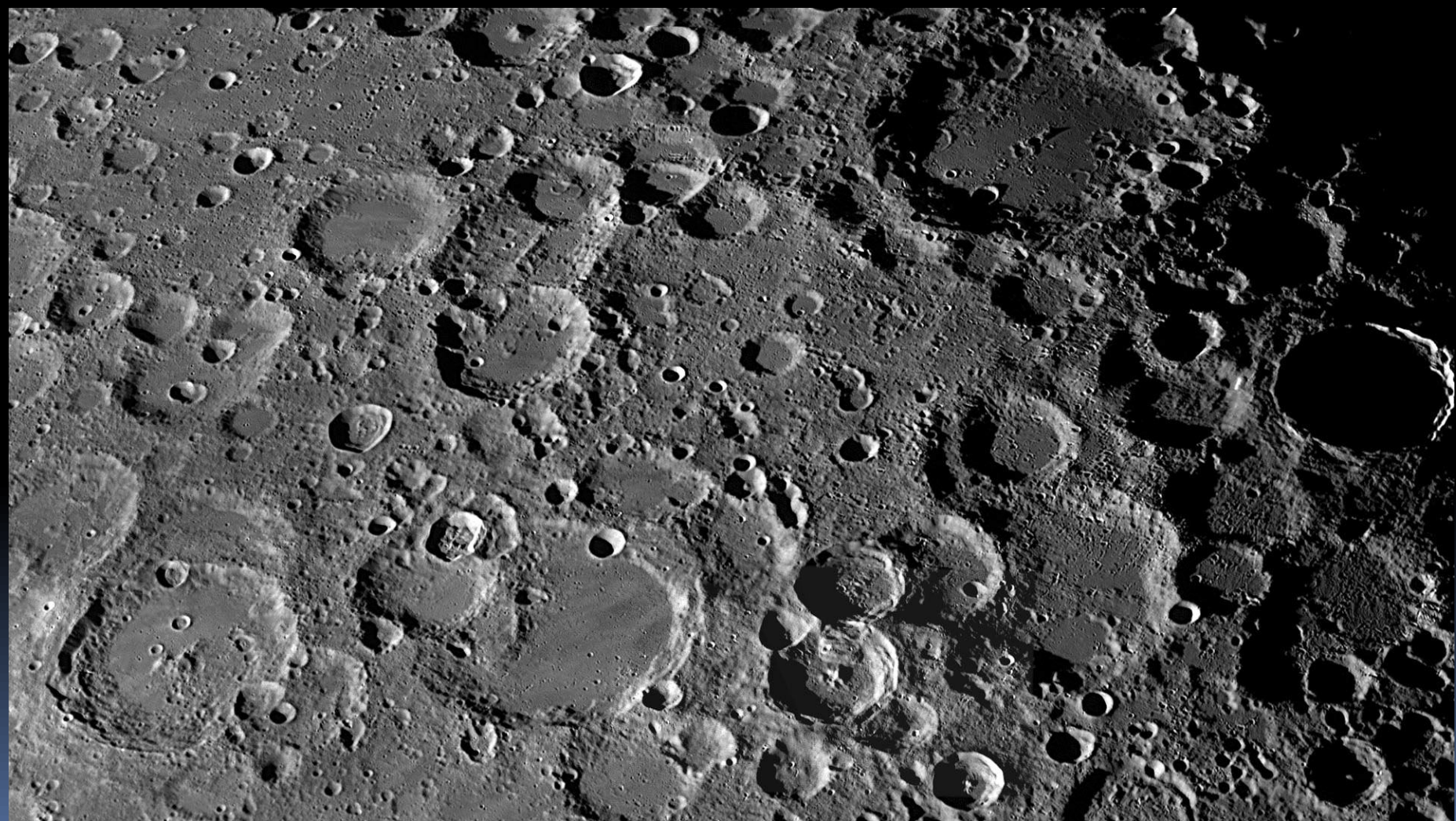


Mercurio

Cráteres de impacto



Cráteres lunares



Fractura en Mercurio



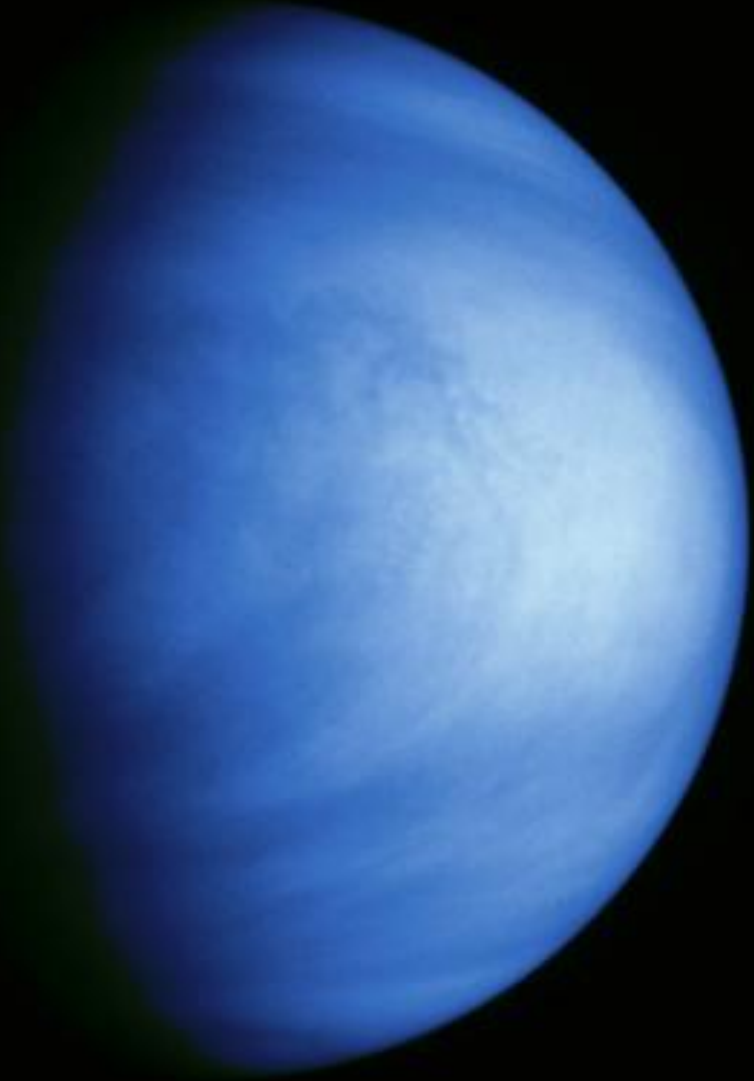
Venus

Temperatura media = 500 C

Presión = 90 atm.

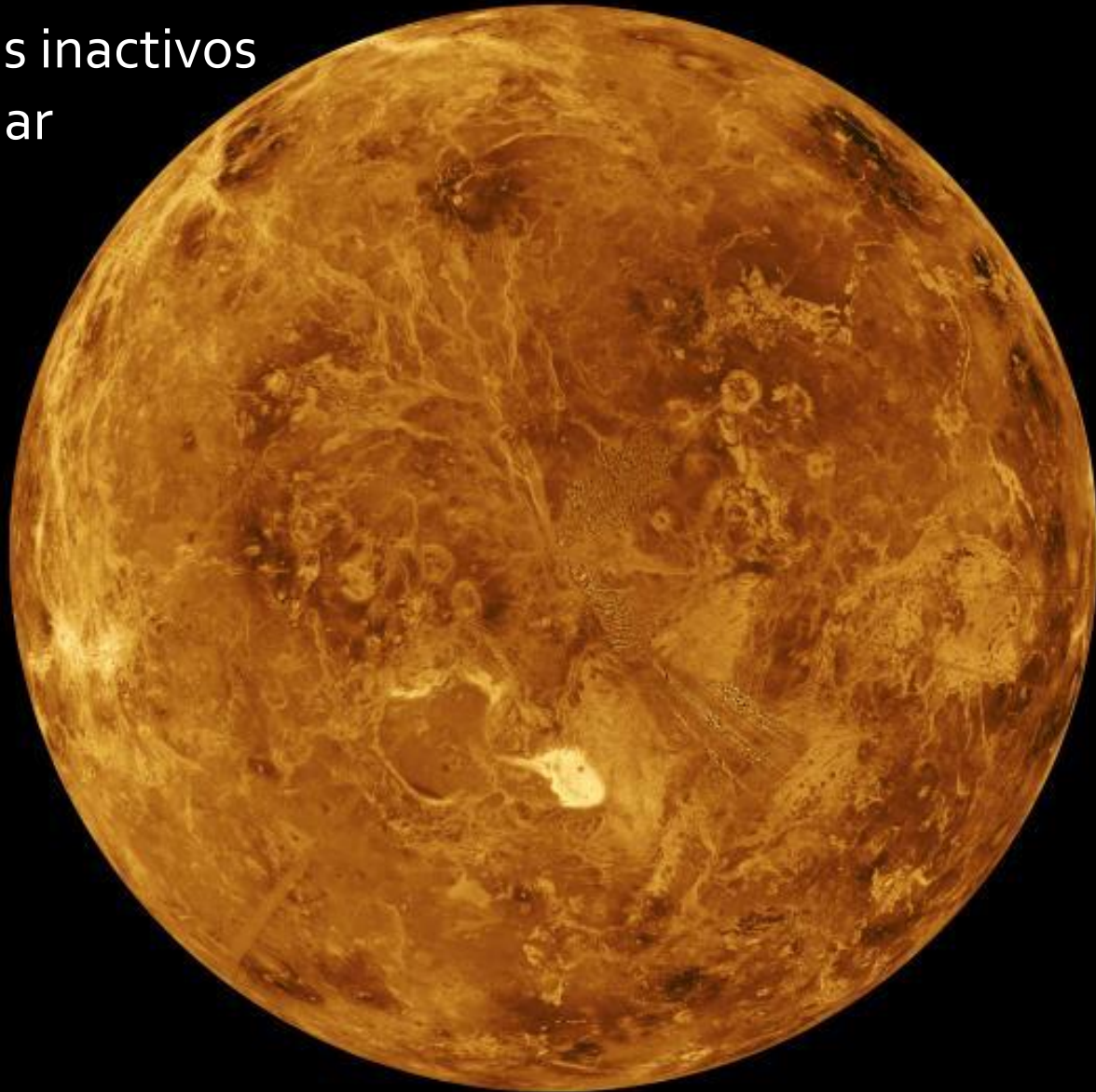
CO₂

No hay agua



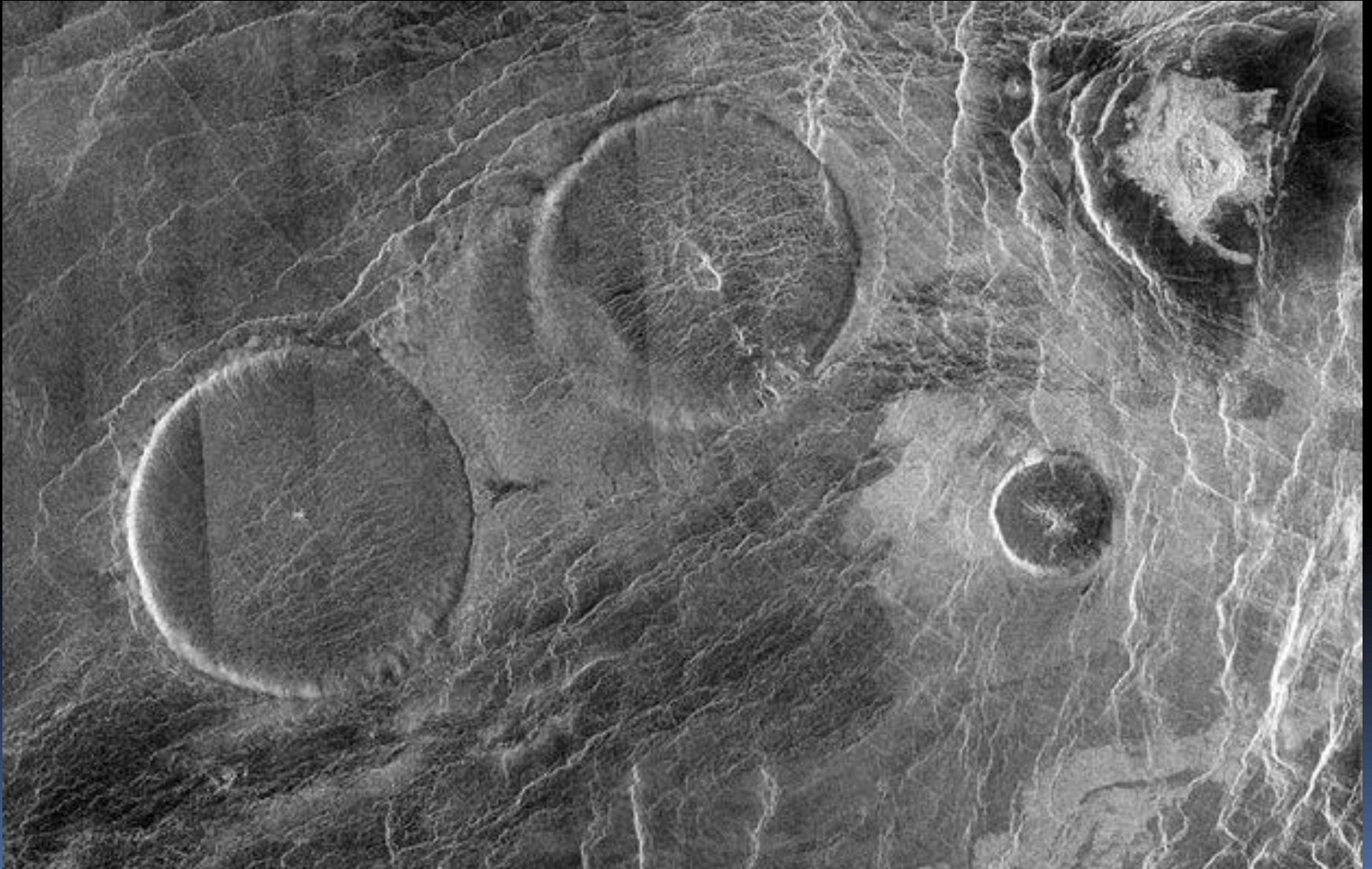
Venus

Miles de volcanes inactivos
Imágenes de radar

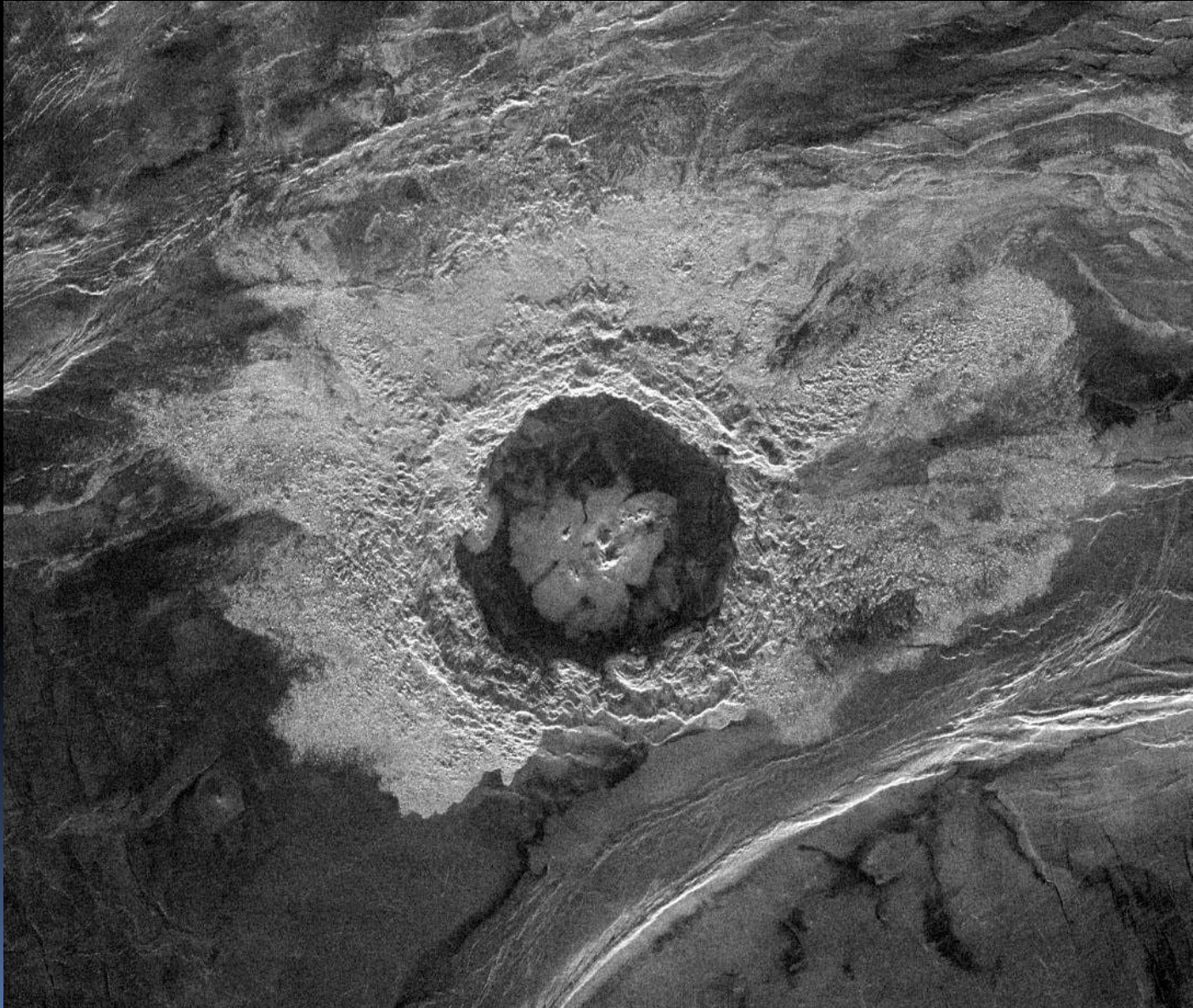


Venus

“panqueques”

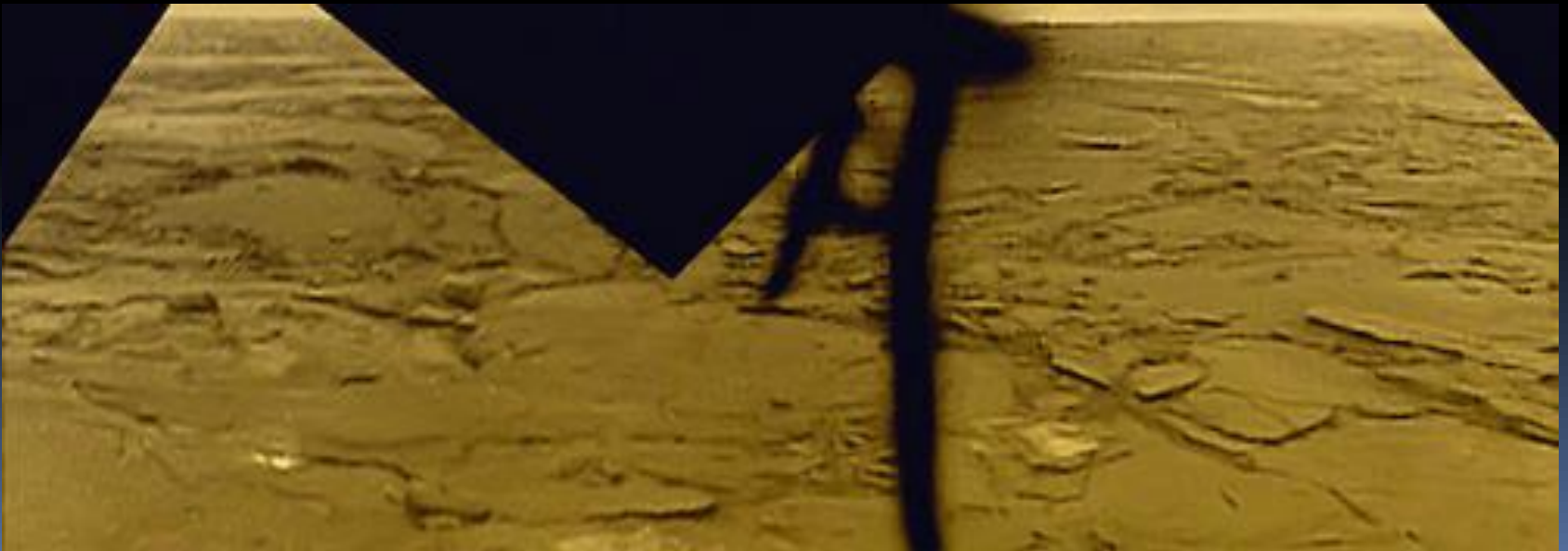


Cráter

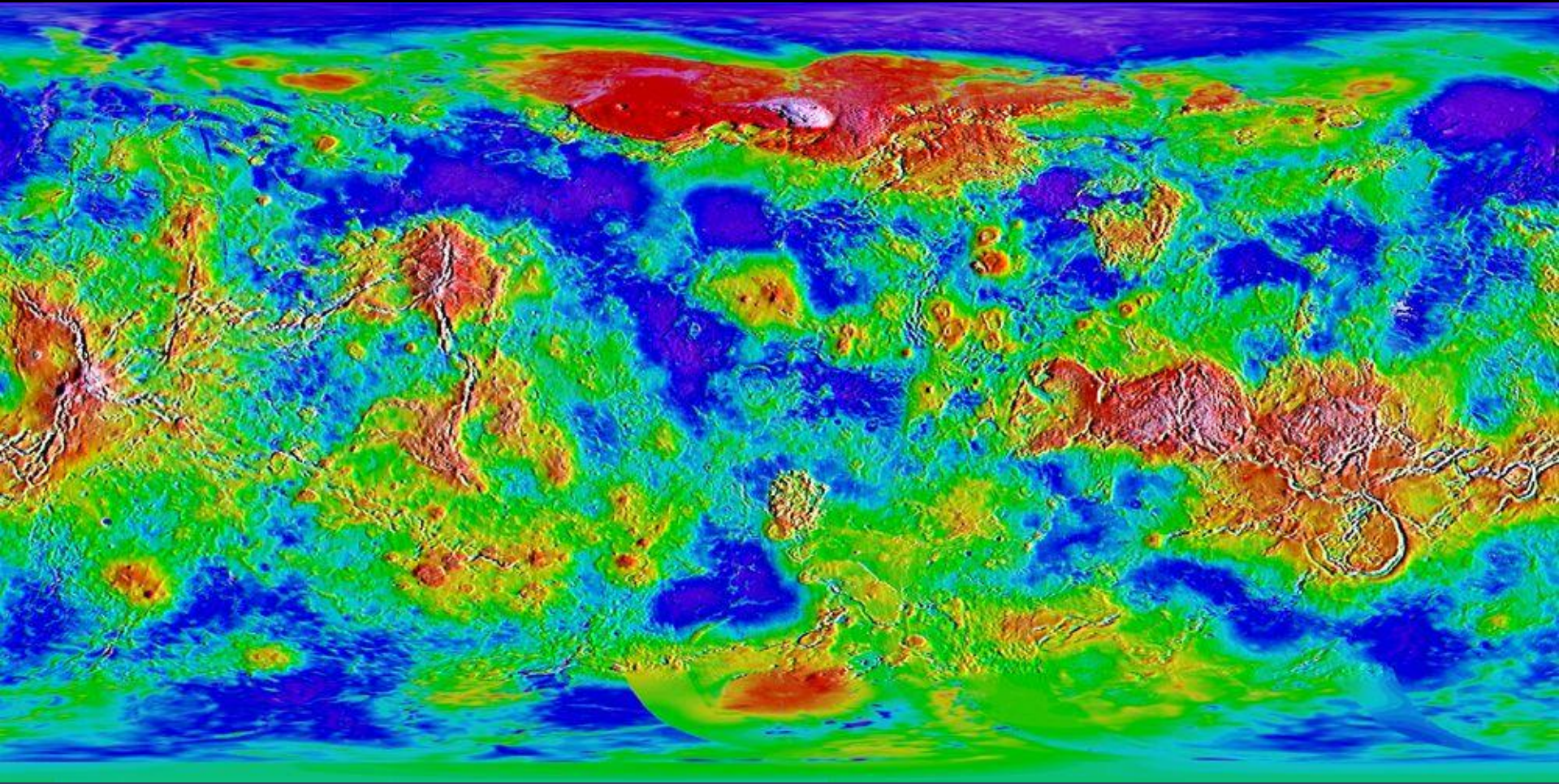


Venus

Roca sólida y seca (basaltos)



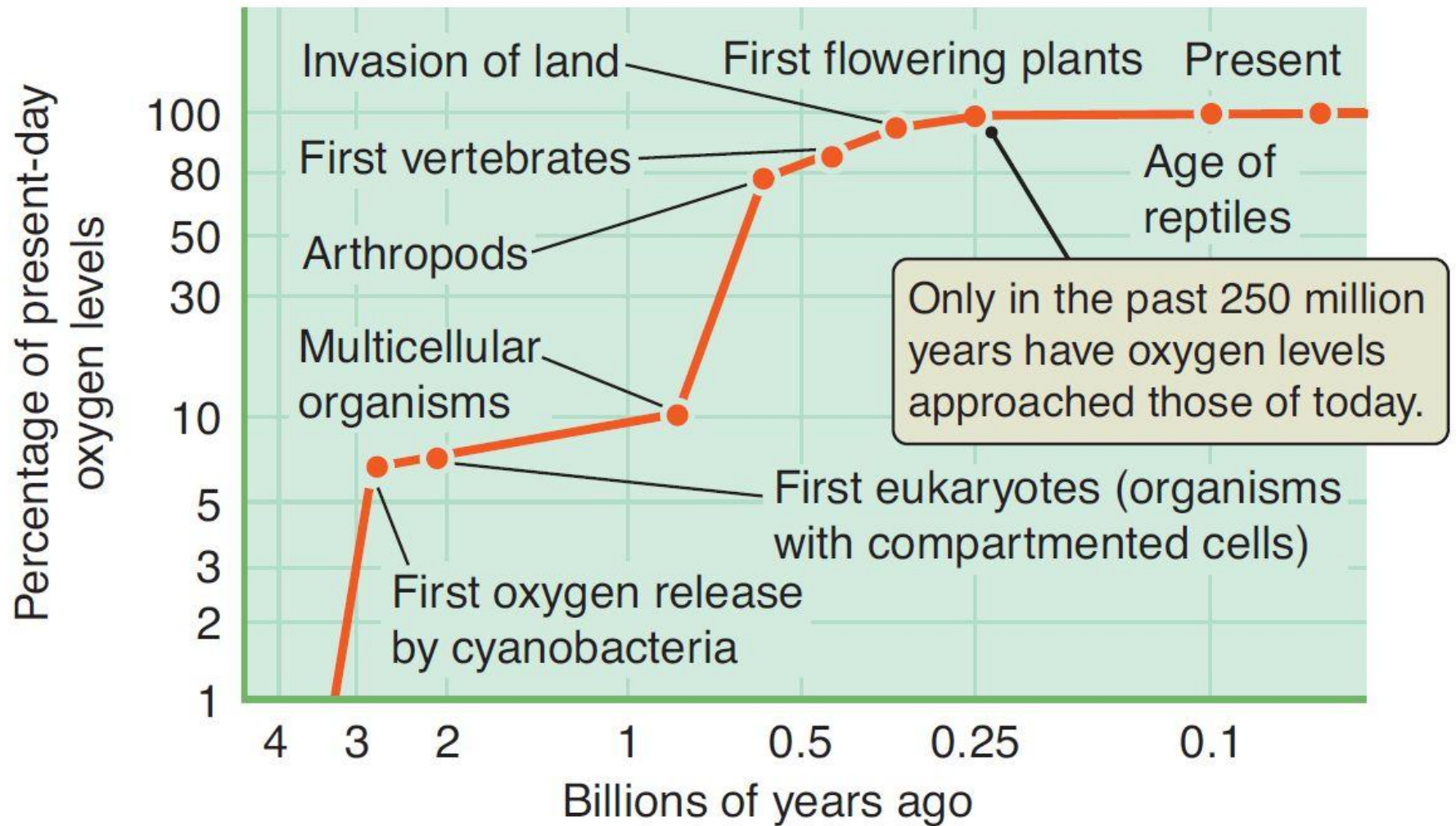
Mapa de Venus



Agua sólida, líquida y gaseosa.

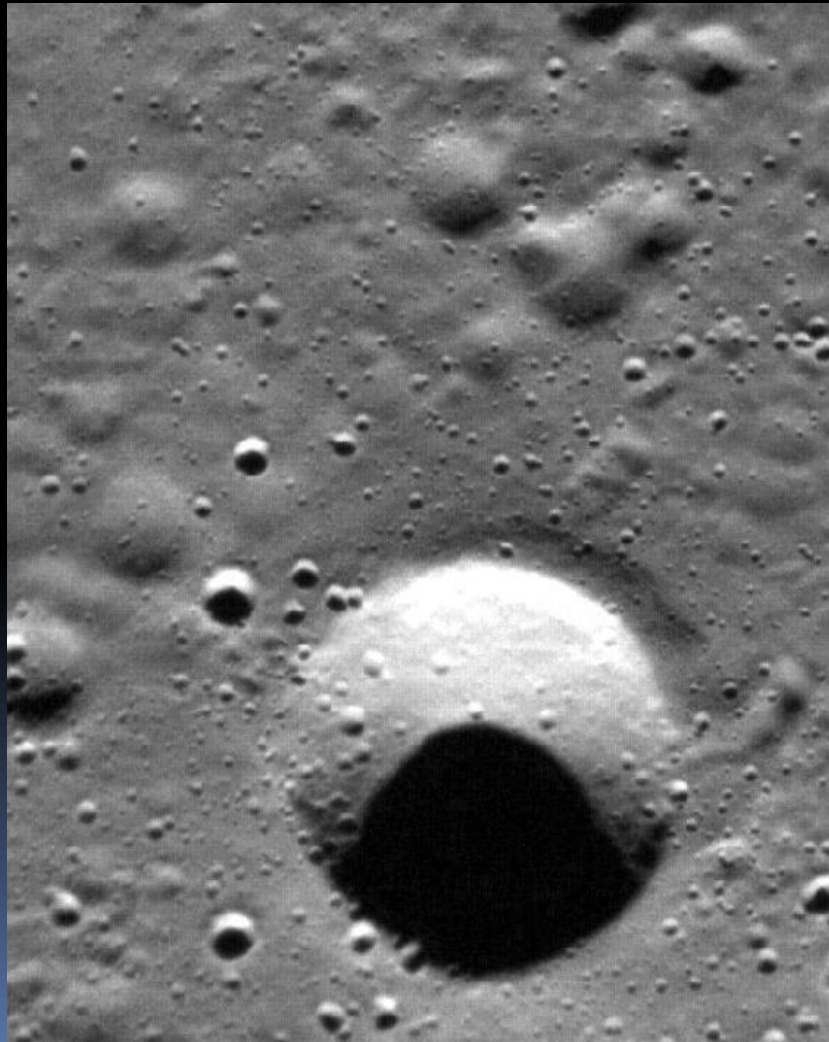
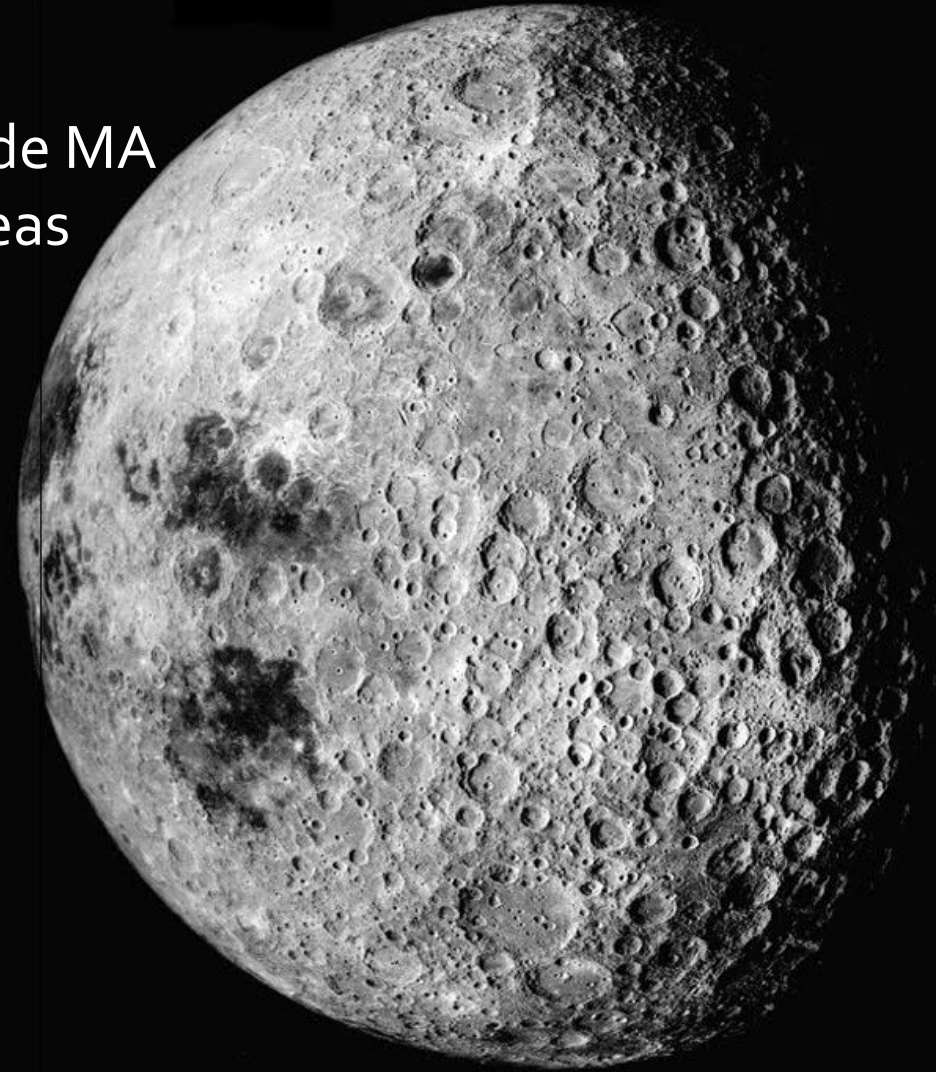
Única atmósfera rica en Oxígeno: energía y protección UV.





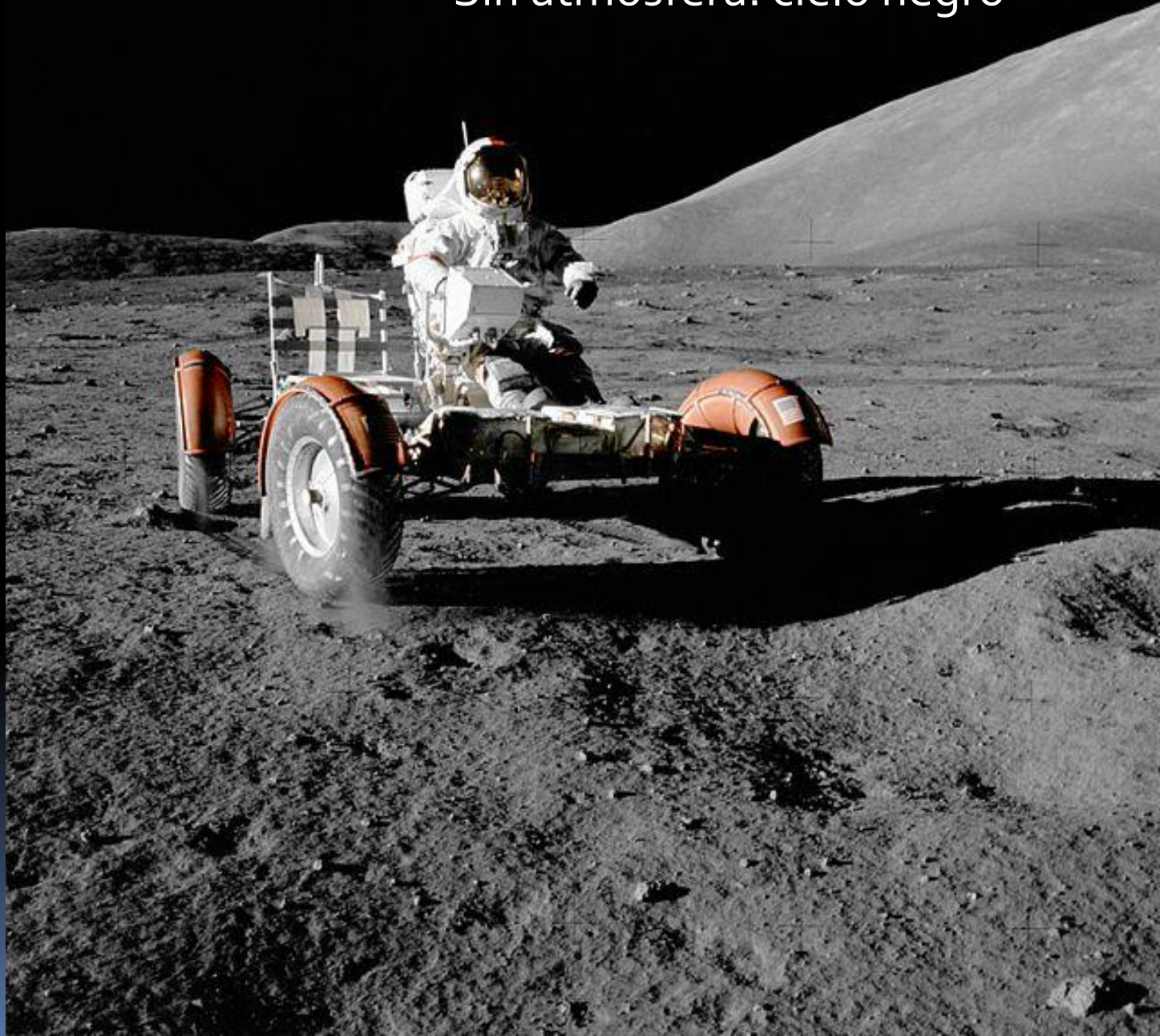
Luna

Fosilizada desde hace miles de MA
Rotación sincrónica por mareas
 $-170^{\circ}\text{C} < \text{Temp} < 130^{\circ}\text{C}$



Luna

Sin atmósfera: cielo negro

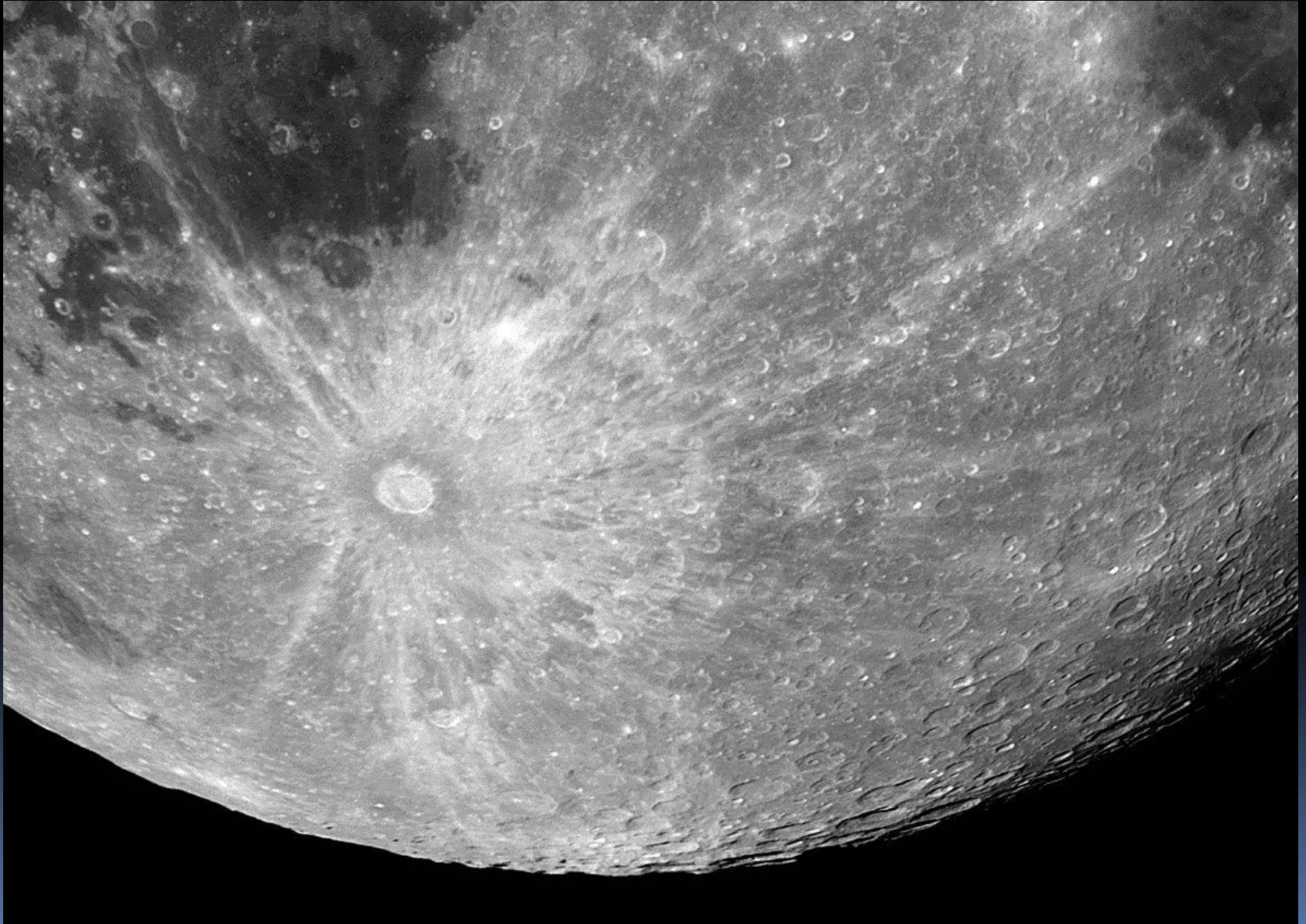


Luna



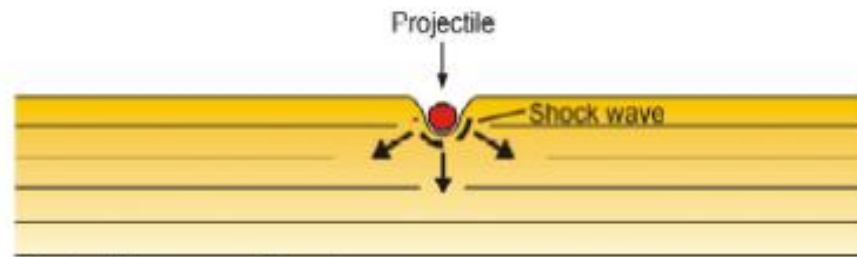
Cráter Tycho

"Joven" gran crater (100 MA)

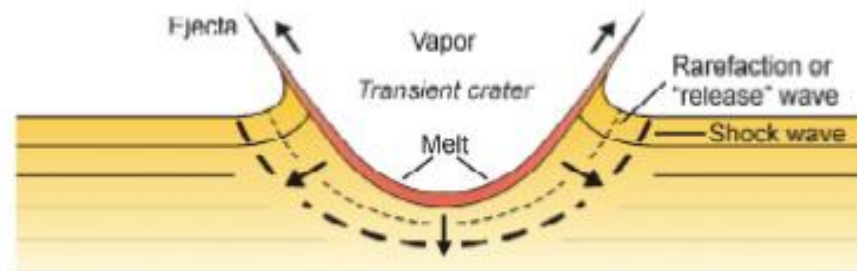


Cráter Arizona: hace 10.000 años

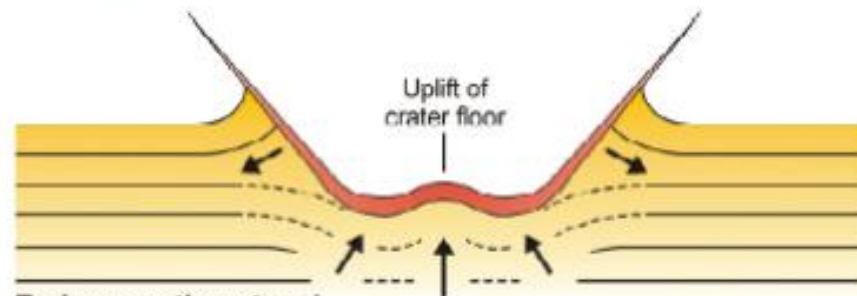




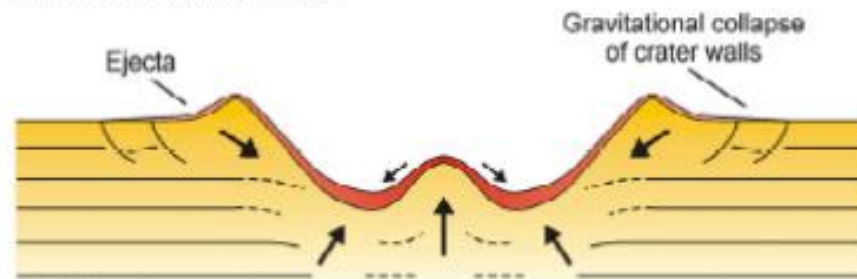
Contact/compression stage



Excavation stage

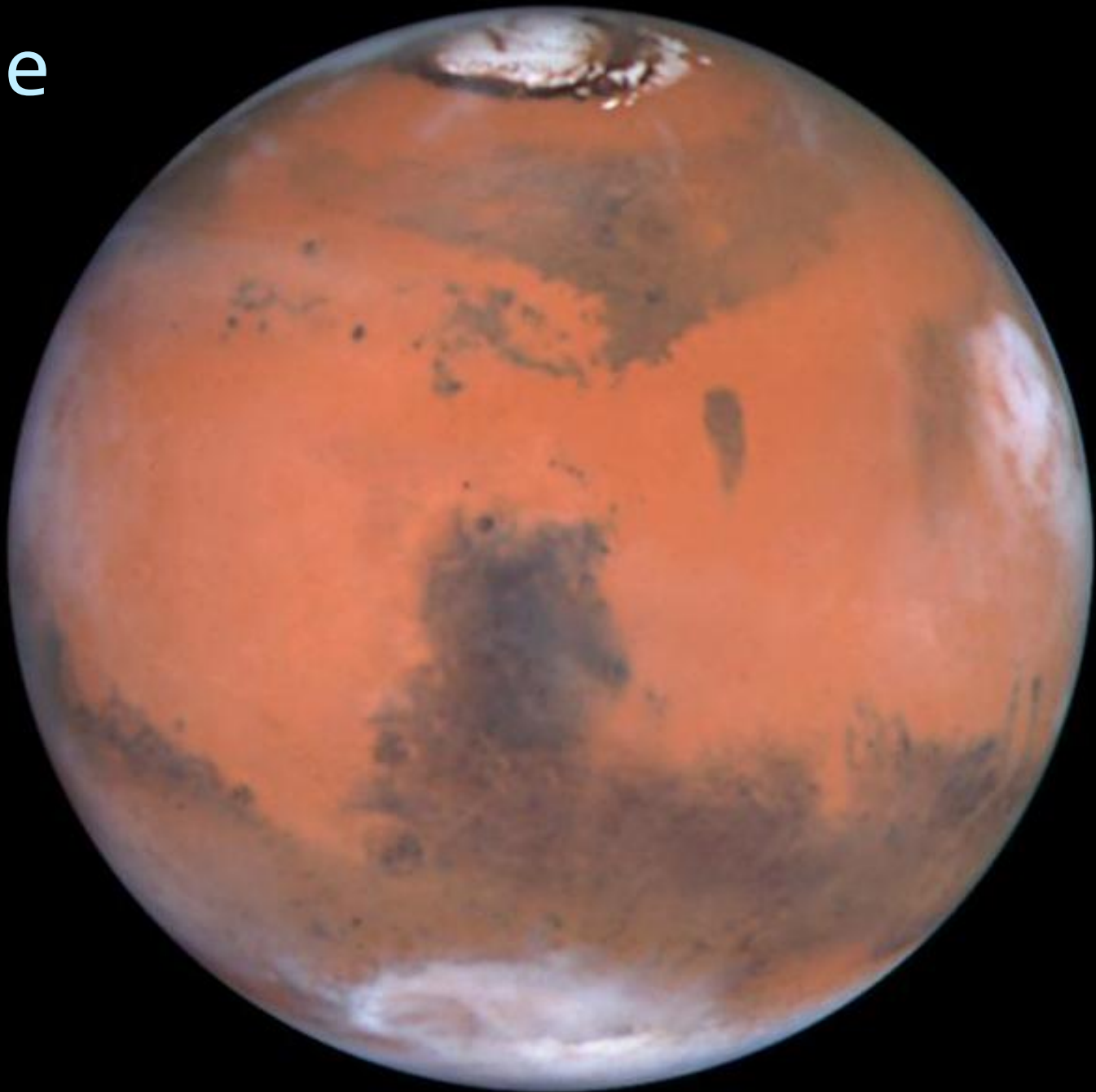


**End excavation stage/
start modification stage**



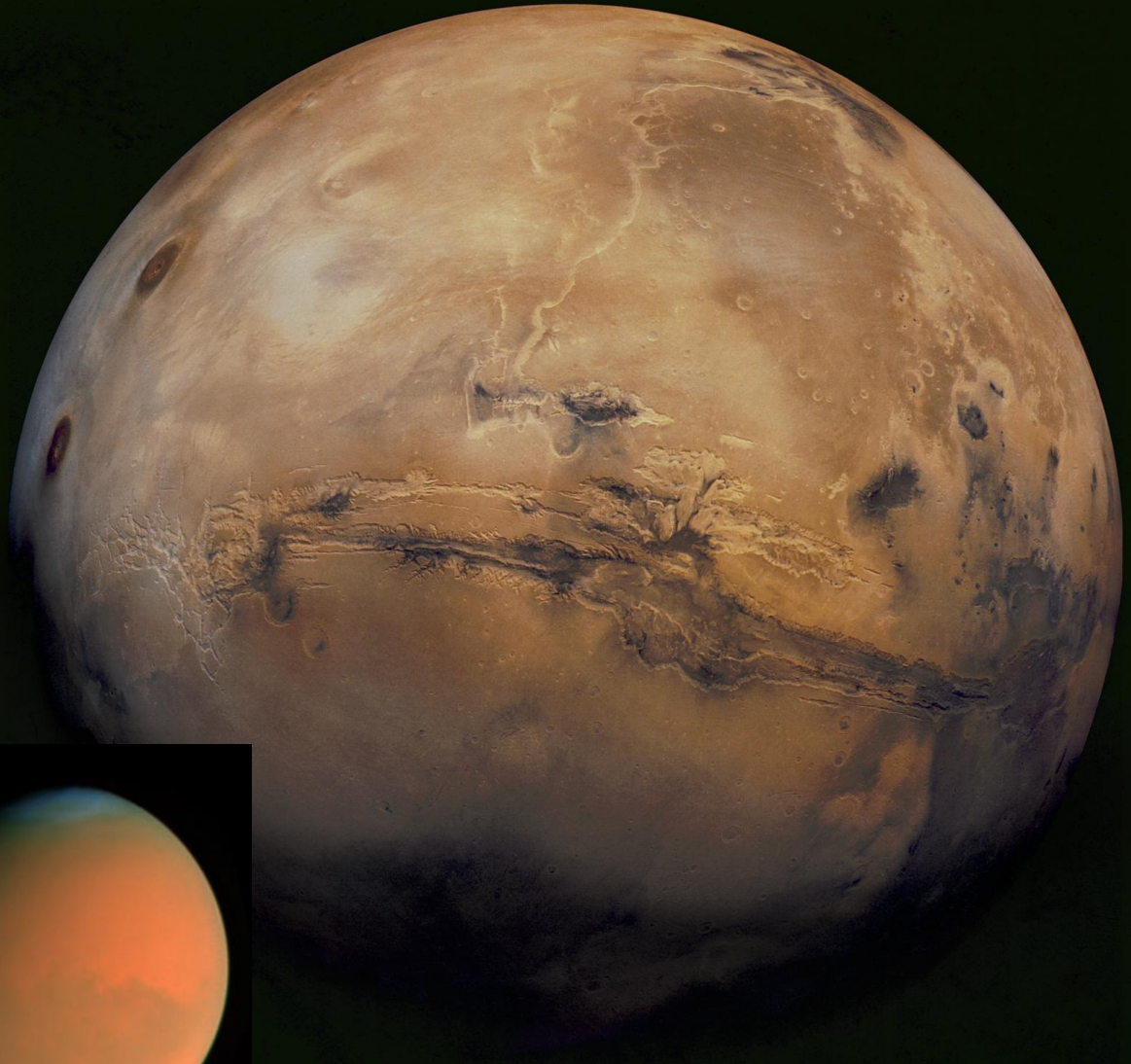
Modification stage

Marte



Marte

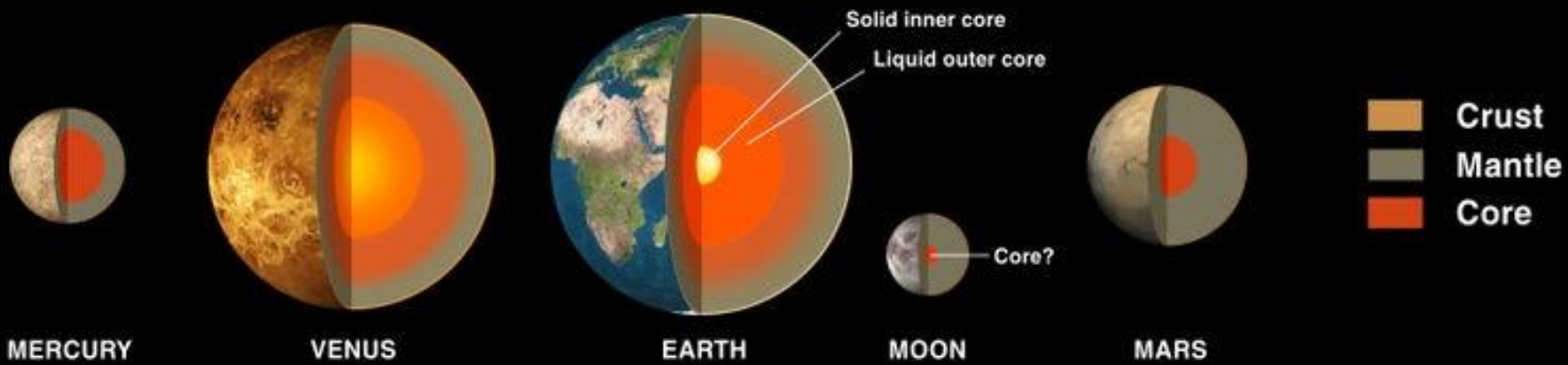
Volcanes fosilizados
Erosión por fluidos
Agua en el pasado



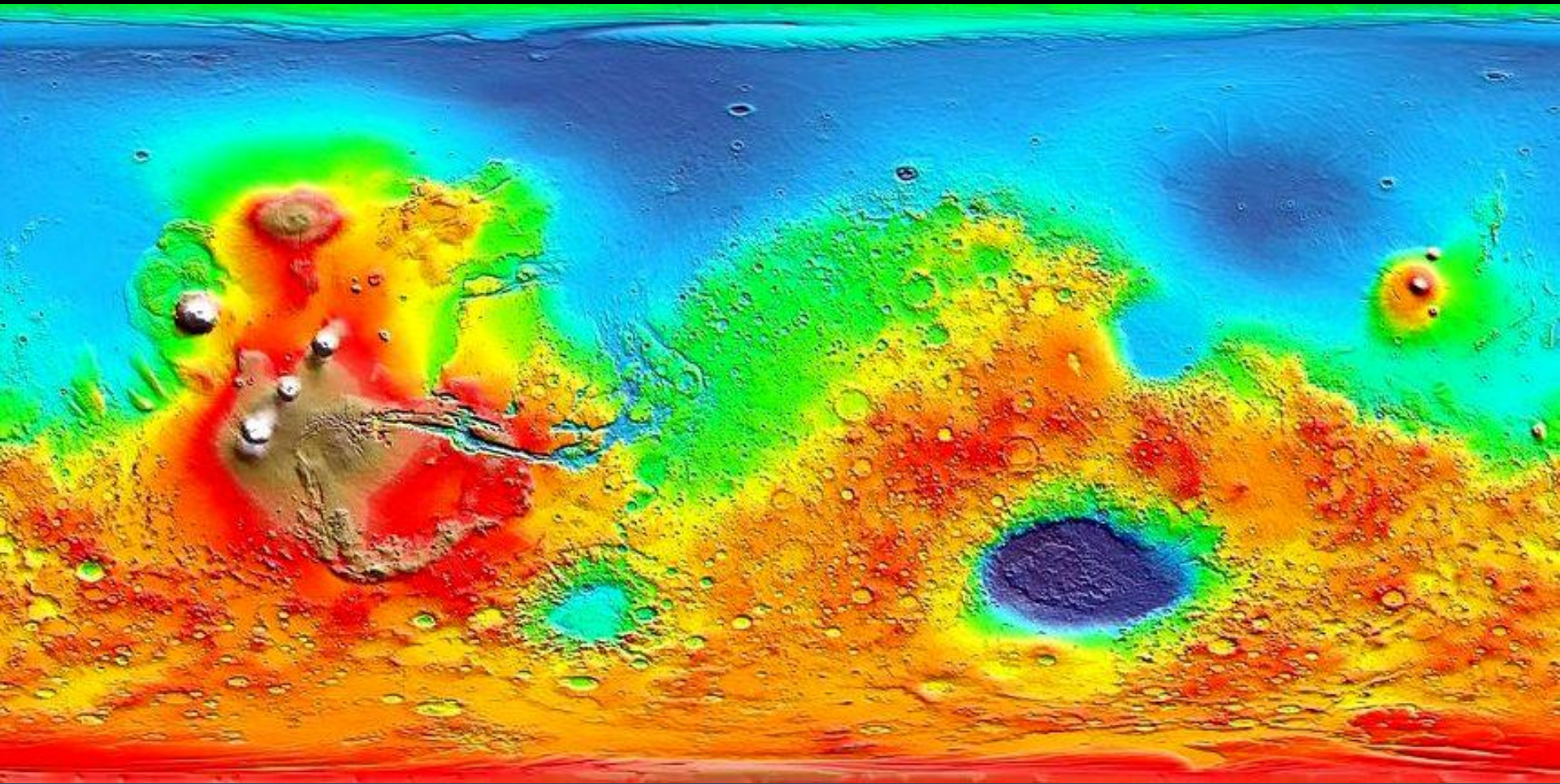
June 26, 2001



September 4, 2001

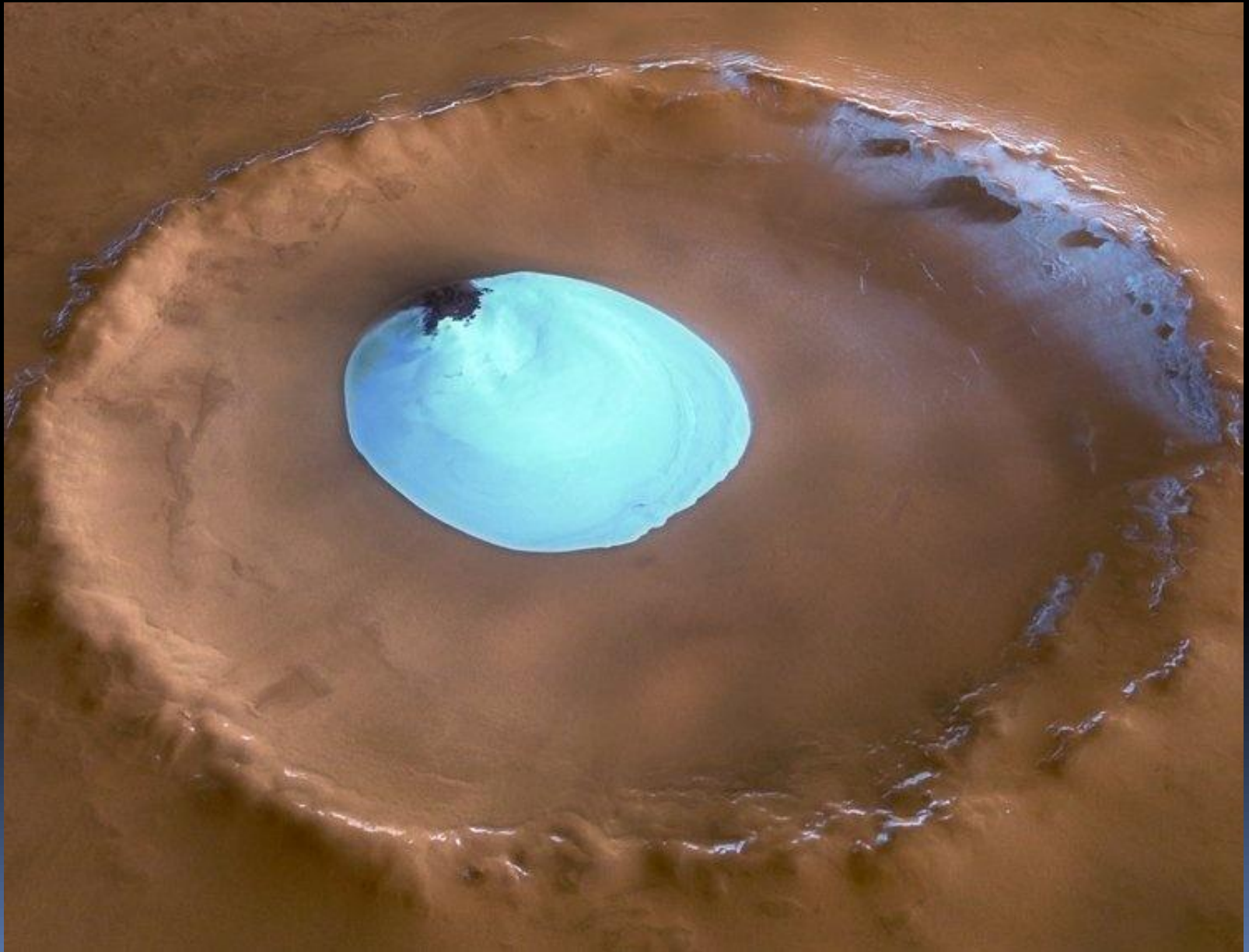


Marte



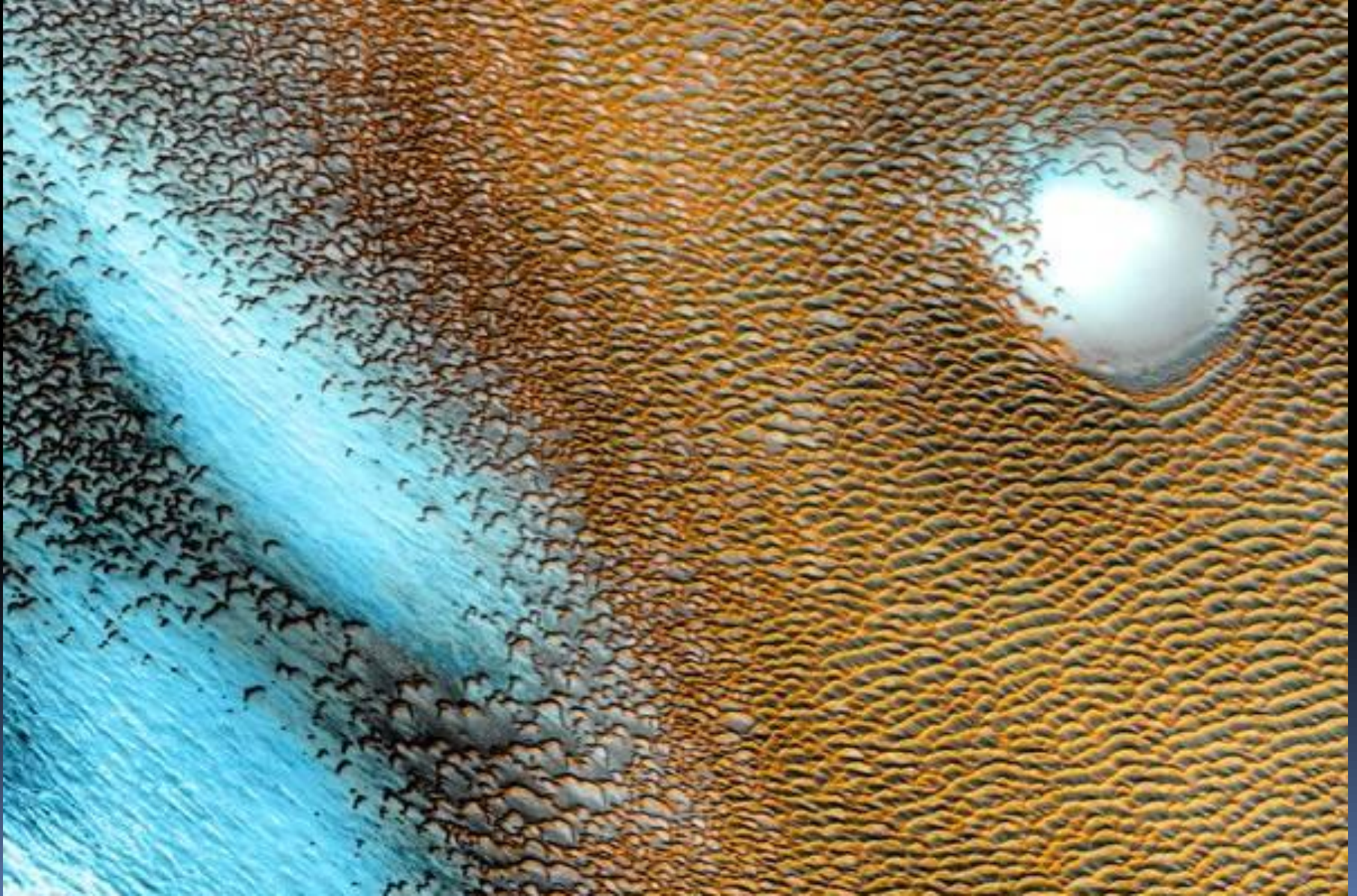
Marte

CO₂ sólido y gaseoso



Marte

Dunas



Marte

Dunas: actividad eólica



Marte

Tornados





Marte

Dunas cubiertas de CO₂



Marte



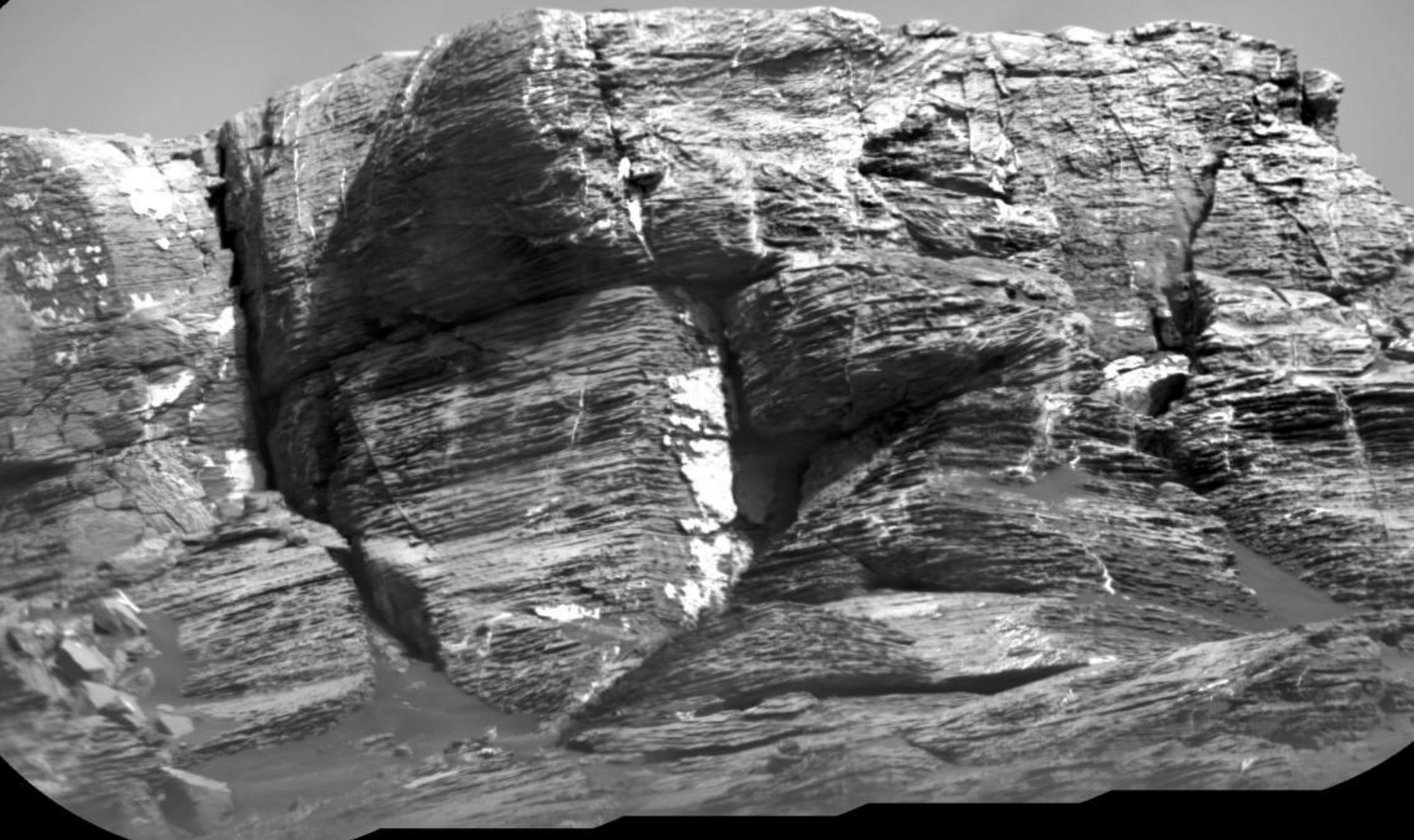


Marte

Sin agua superficial.

Hielo subsuperficial (permafrost)





Deimos (satélite de Marte)



2 km

Astroide Eros

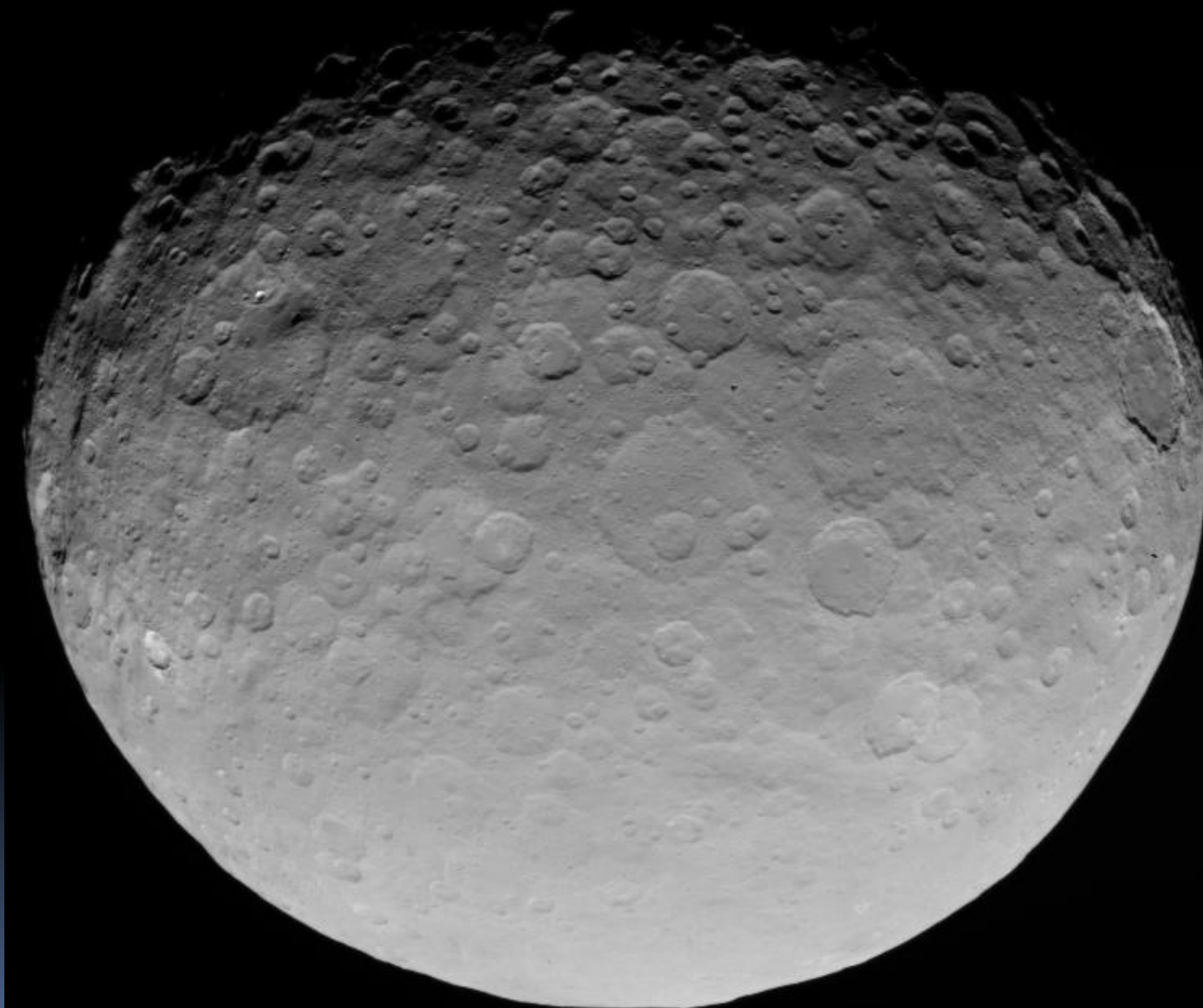


Itokawa

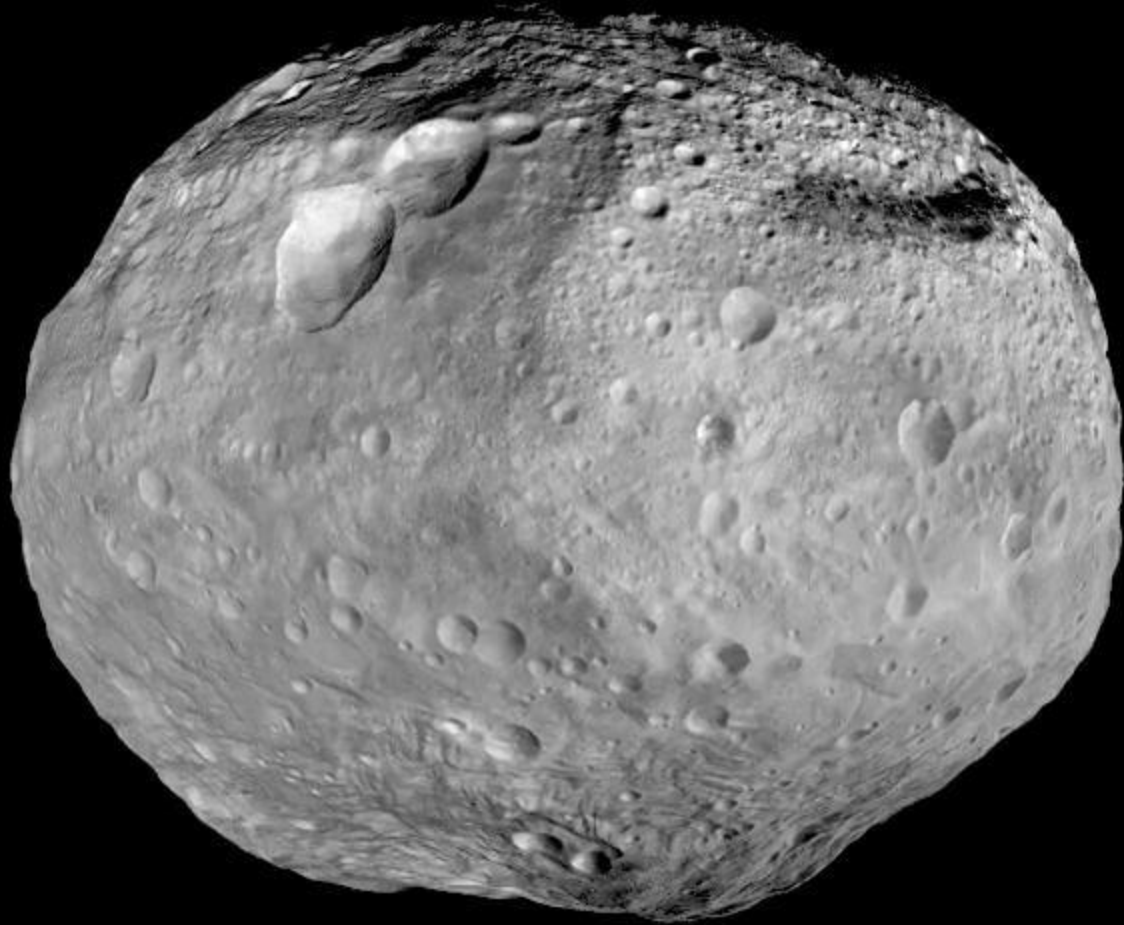
“Pila de escombros”



Ceres(planeta enano)



Vesta





243 Ida - $58.8 \times 25.4 \times 18.6$ km
Galileo, 1993

Dactyl
[[243] Ida I]
 1.6×1.2 km
Galileo, 1993



9969 Braille
 $2.1 \times 1 \times 1$ km
Deep Space 1, 1999



5535 Annefrank
 $6.6 \times 5.0 \times 3.4$ km
Stardust, 2002



2867 Steins
 5.9×4.0 km
Rosetta, 2006



433 Eros - 33×13 km
NEAR, 2000

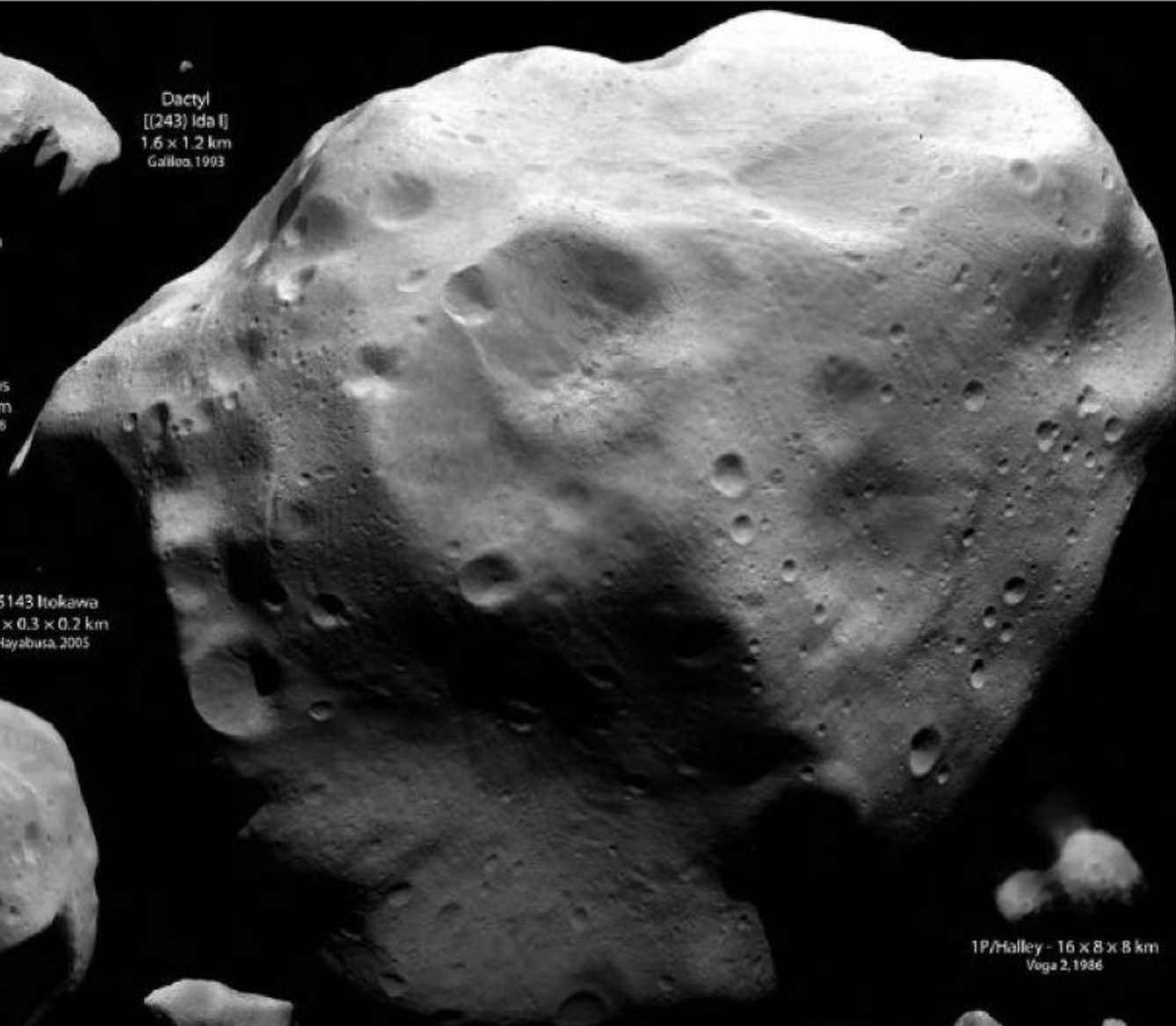
25143 Itokawa
 $0.5 \times 0.3 \times 0.2$ km
Hayabusa, 2005



253 Mathilde - $66 \times 48 \times 44$ km
NEAR, 1997



951 Gaspra - $18.2 \times 10.5 \times 8.9$ km
Galileo, 1991



21 Lutetia - $132 \times 101 \times 76$ km
Rosetta, 2010



1P/Halley - $16 \times 8 \times 8$ km
Vega 2, 1986



19P/Borrelly
 8×4 km
Deep Space 1, 2001



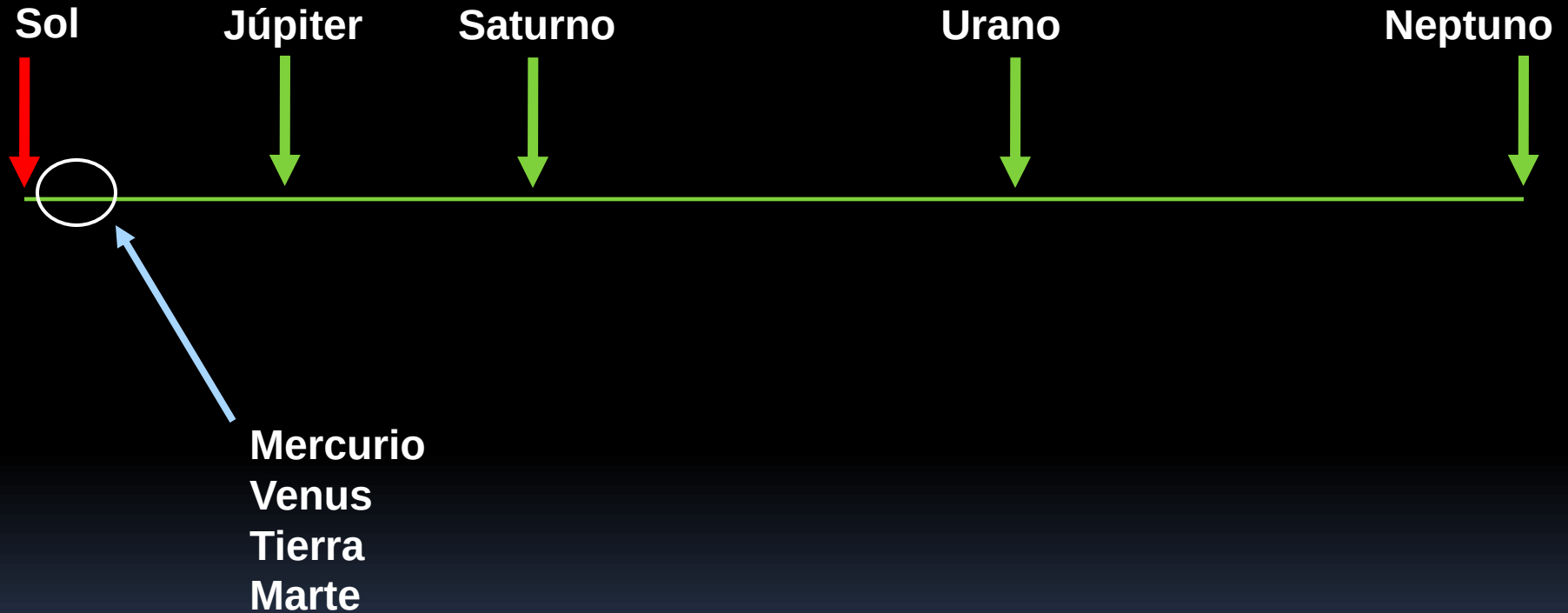
9P/Tempel 1
 7.6×4.9 km
Deep Impact, 2005



81P/Wild 2
 $5.5 \times 4.0 \times 3.3$ km
Stardust, 2004

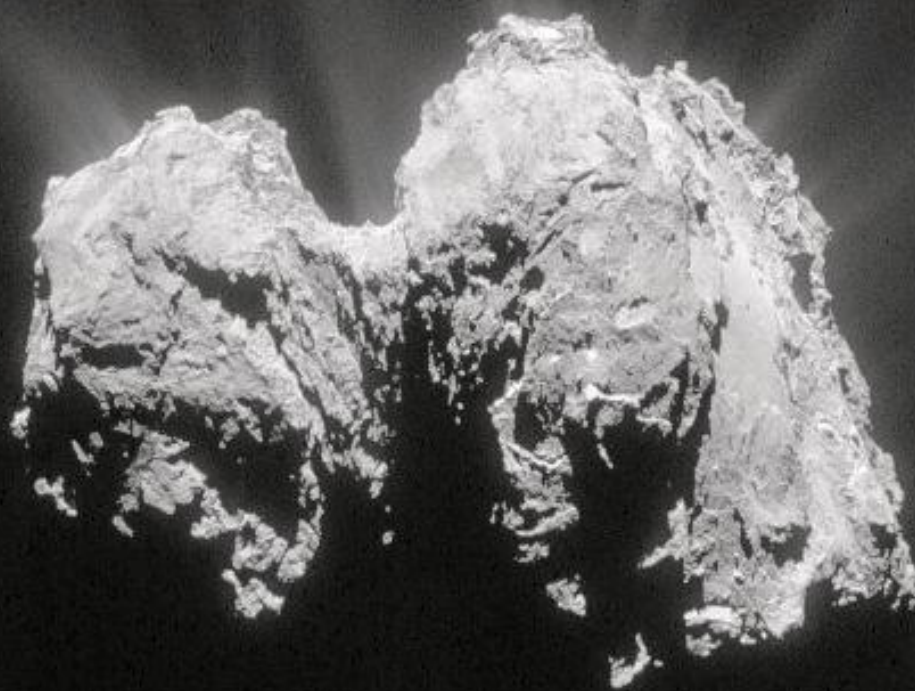
Sistema Solar

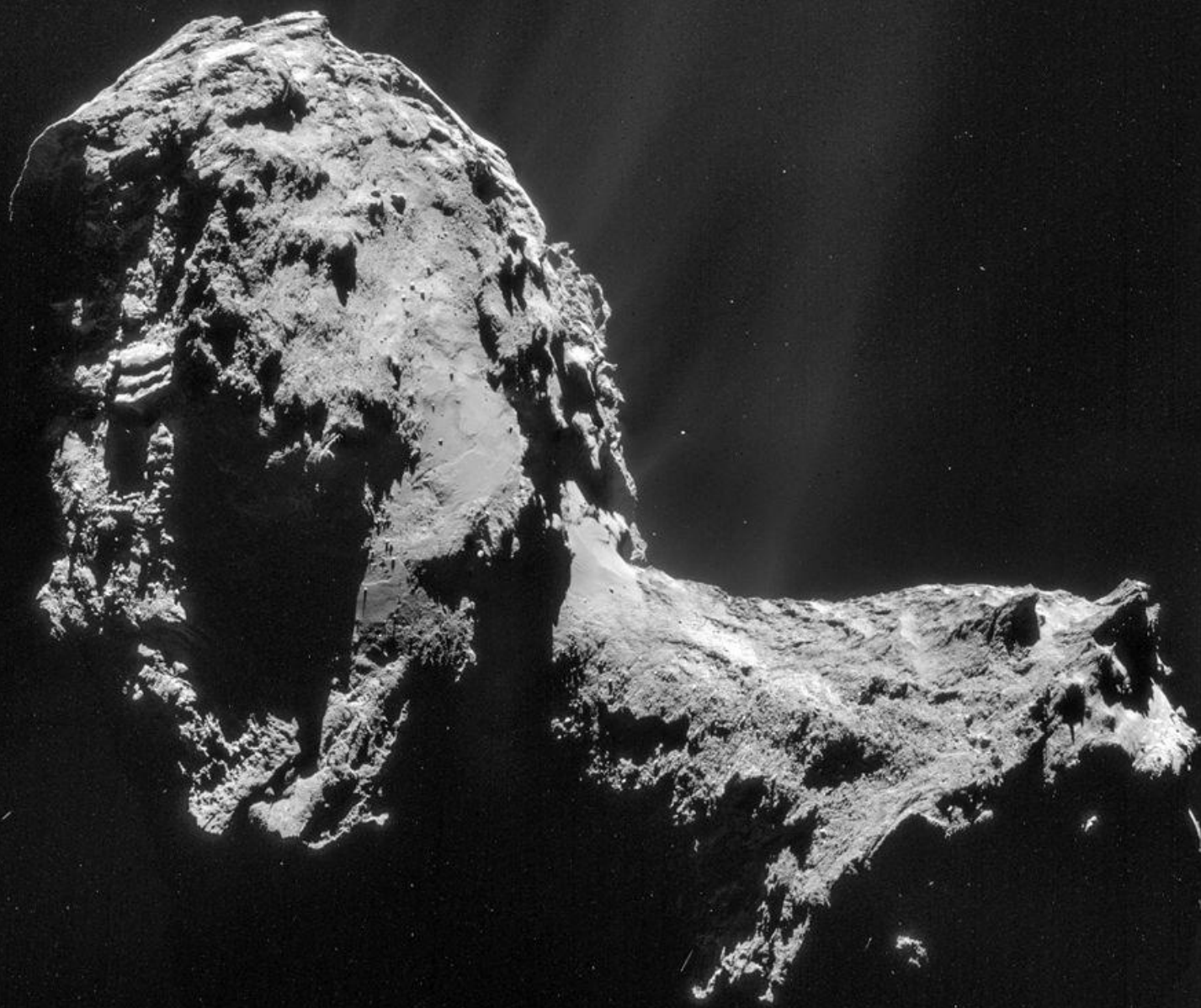
Distancias a escala



Núcleo cometario







Núcleo cometario

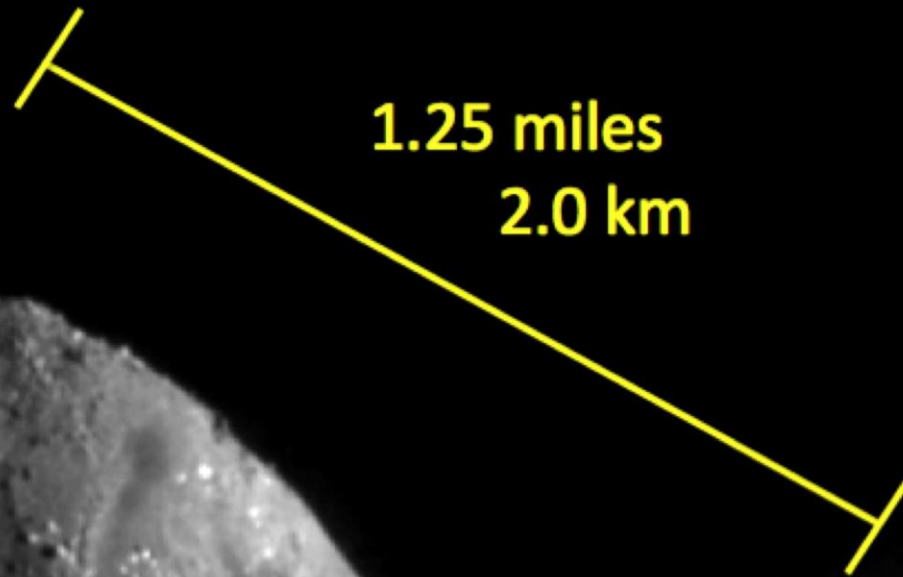




Cometa



Núcleo cometario



Meteoroid

19 km/s

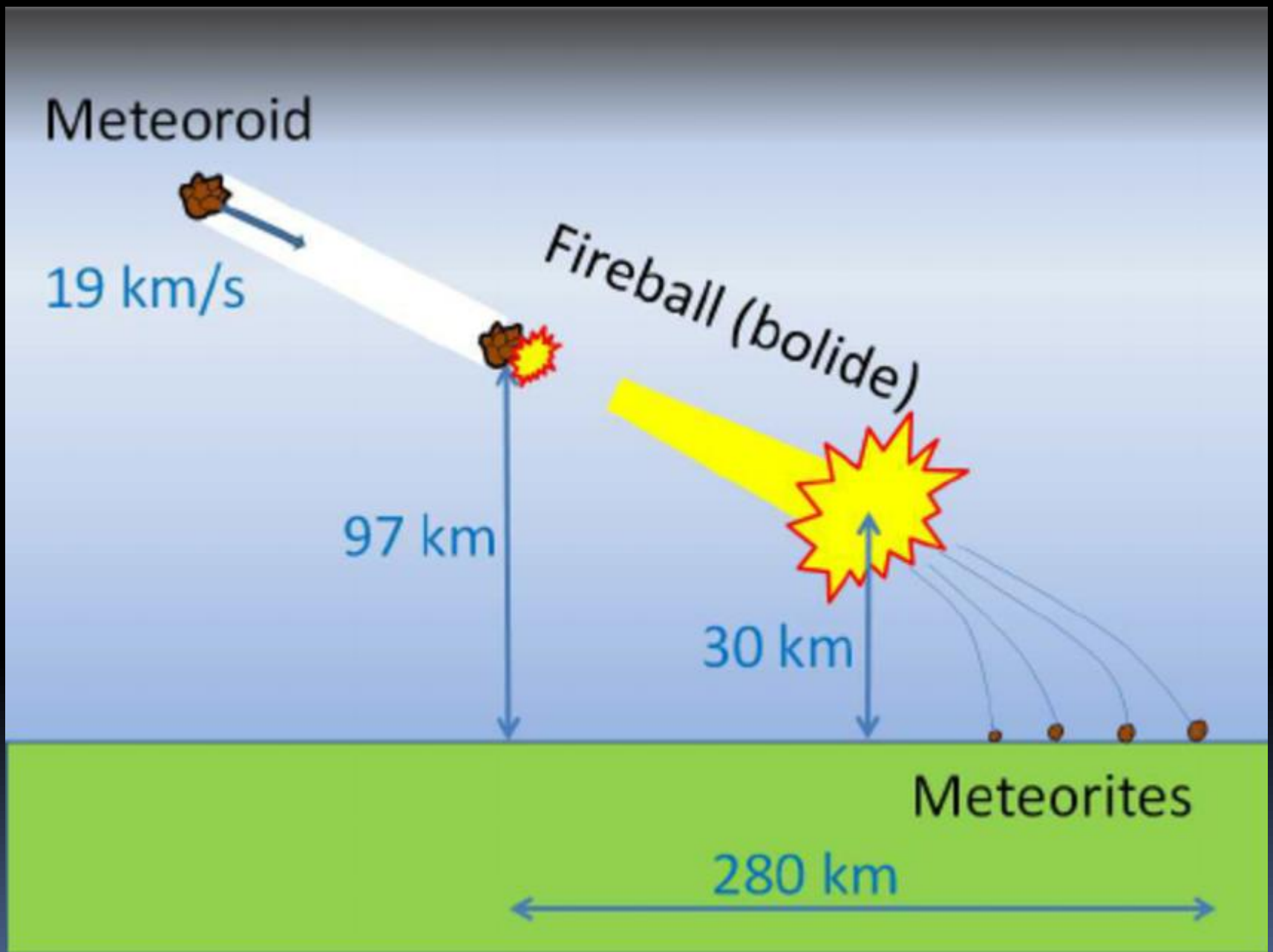
97 km

Fireball (bolide)

30 km

Meteorites

280 km



Tunguska 1908: 1000 bombas Hiroshima



Meteoritos

- Fragmentos de asteroides y cometas
- Fragmentos de Marte y Luna
- Sobreviven al ingreso en la atmósfera
- Metálicos, rocosos y carbonosos
- Se encontraron aminoácidos



Frecuencia de impactos actual

- Asteroide de 1km cada 1 millón de años
- Catástrofe regional
- “Invierno nuclear” durante algunos meses

MUNDOS GASEOSOS Y HELADOS

Júpiter

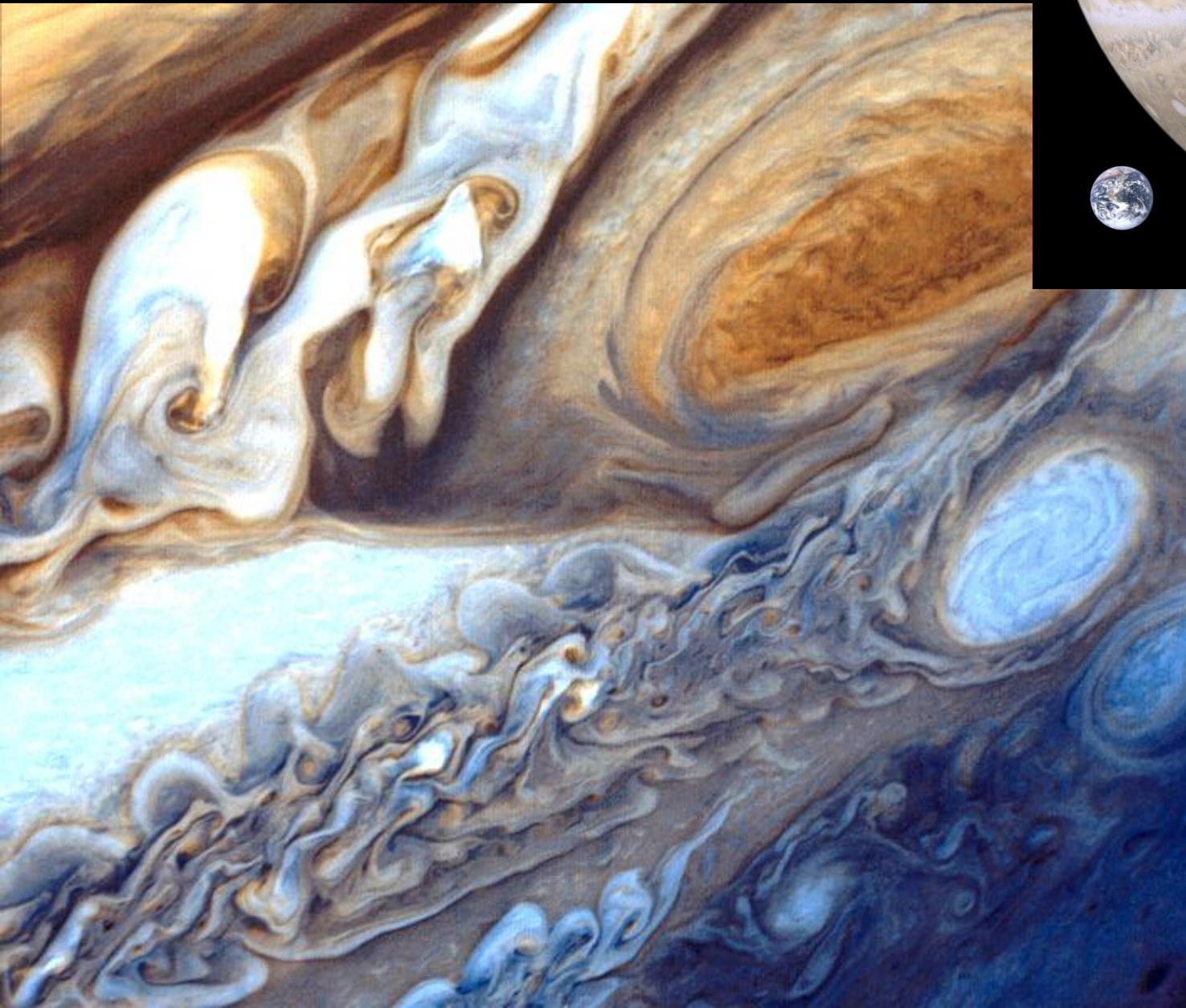
H + He

Temp.: -170 C

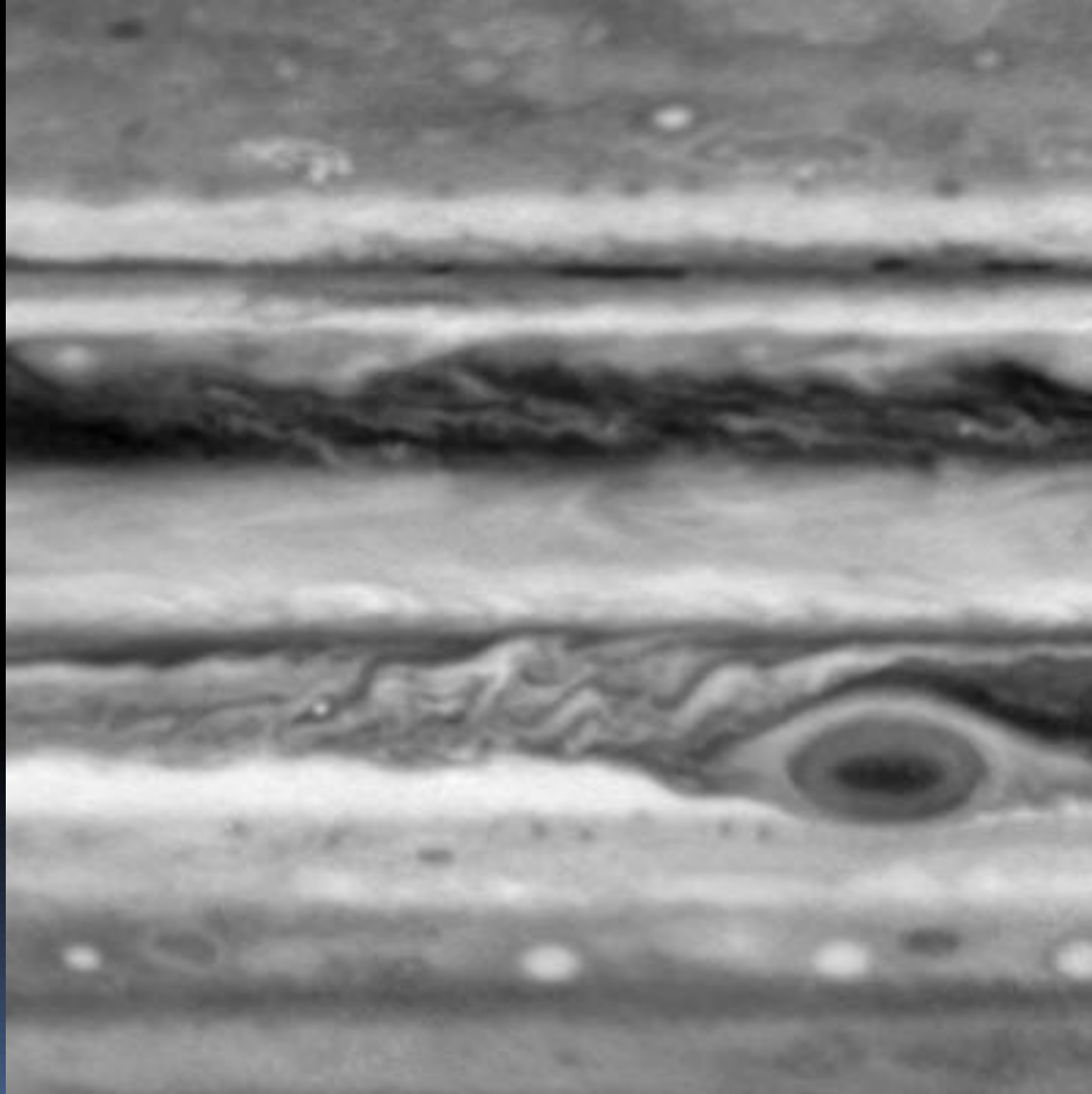
Masa $\approx$ 300 Tierras



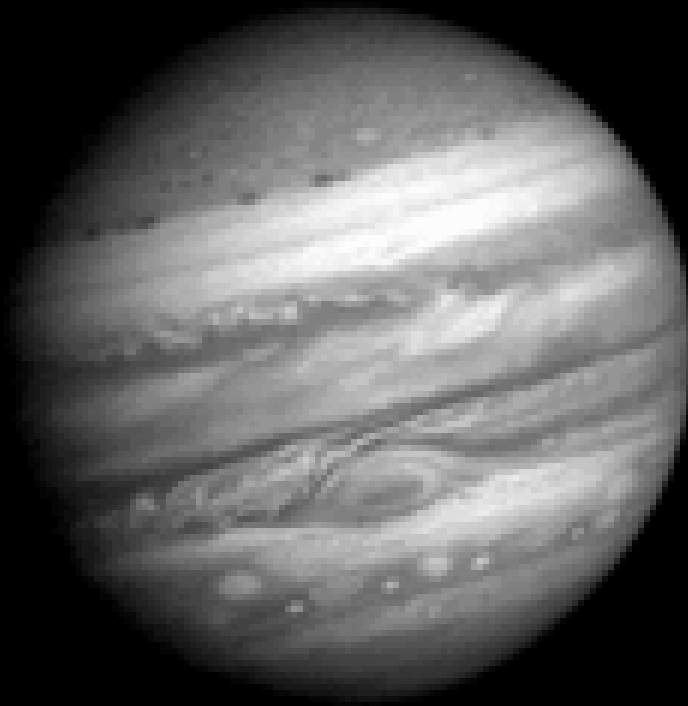
Júpiter



Júpiter

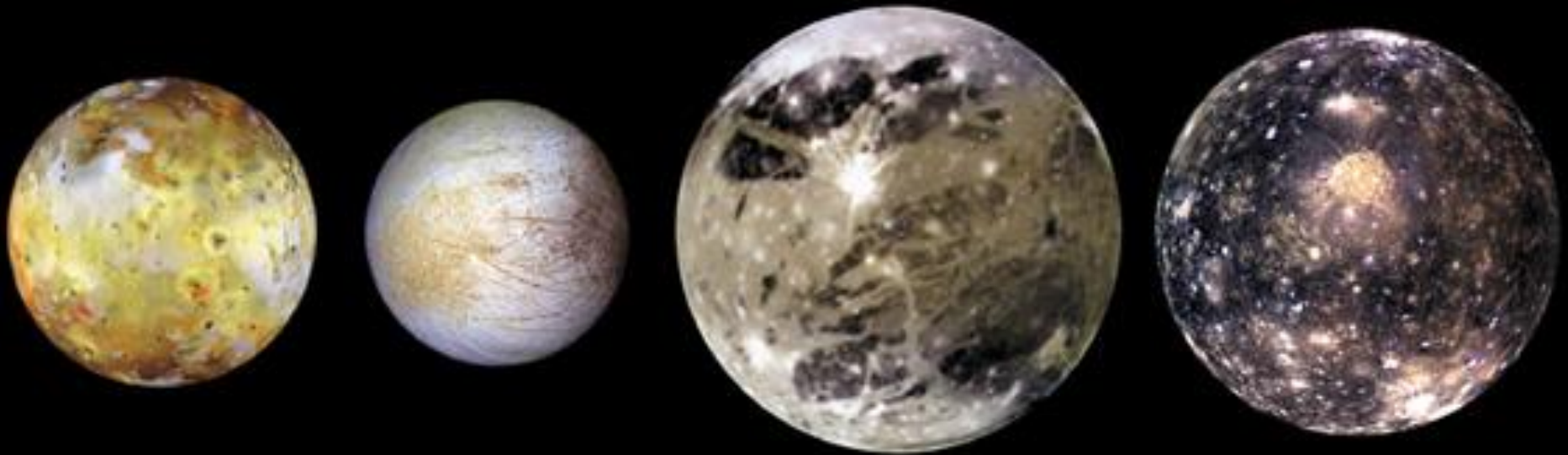


Júpiter



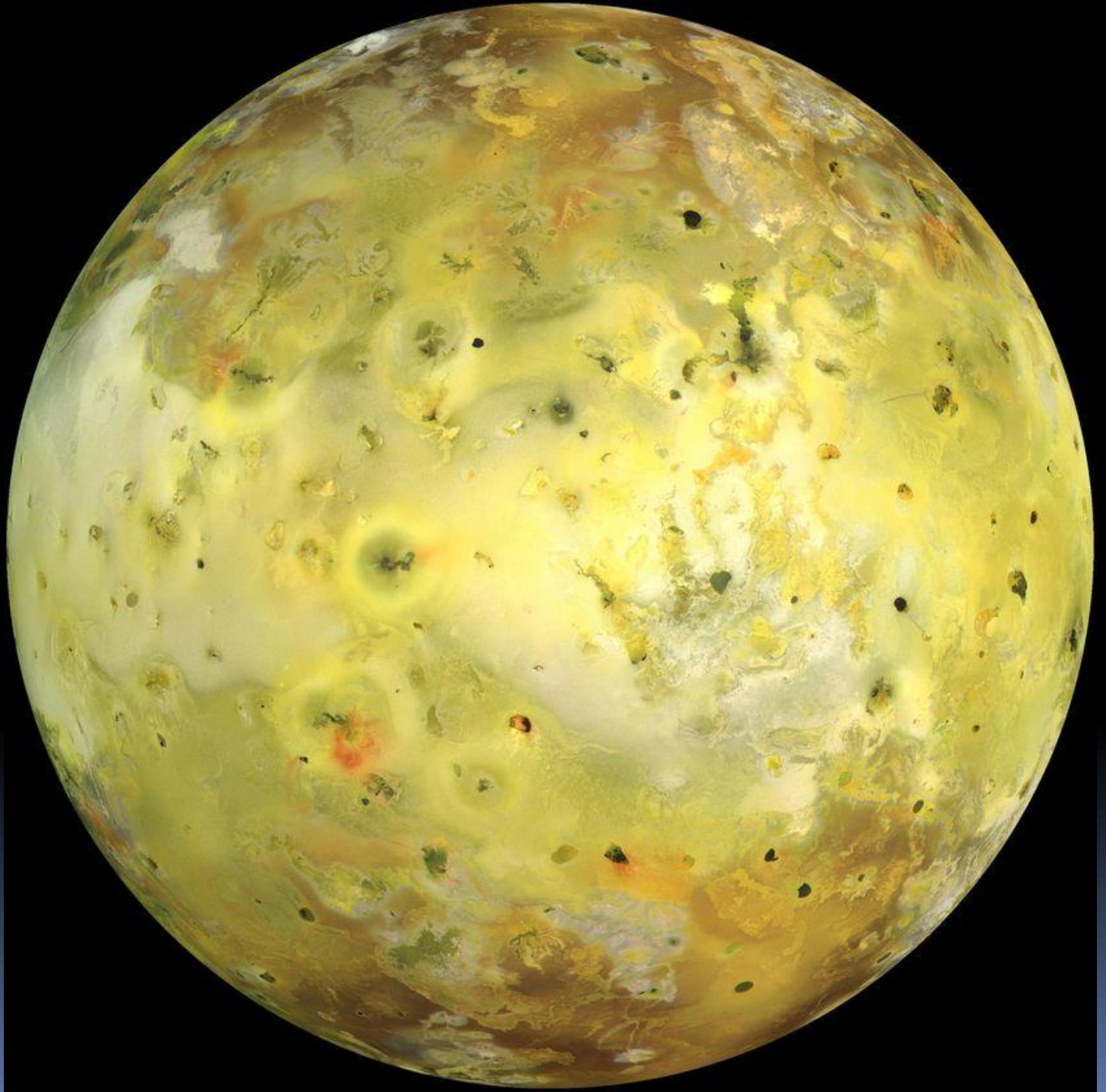


Satélites Galileanos



Io

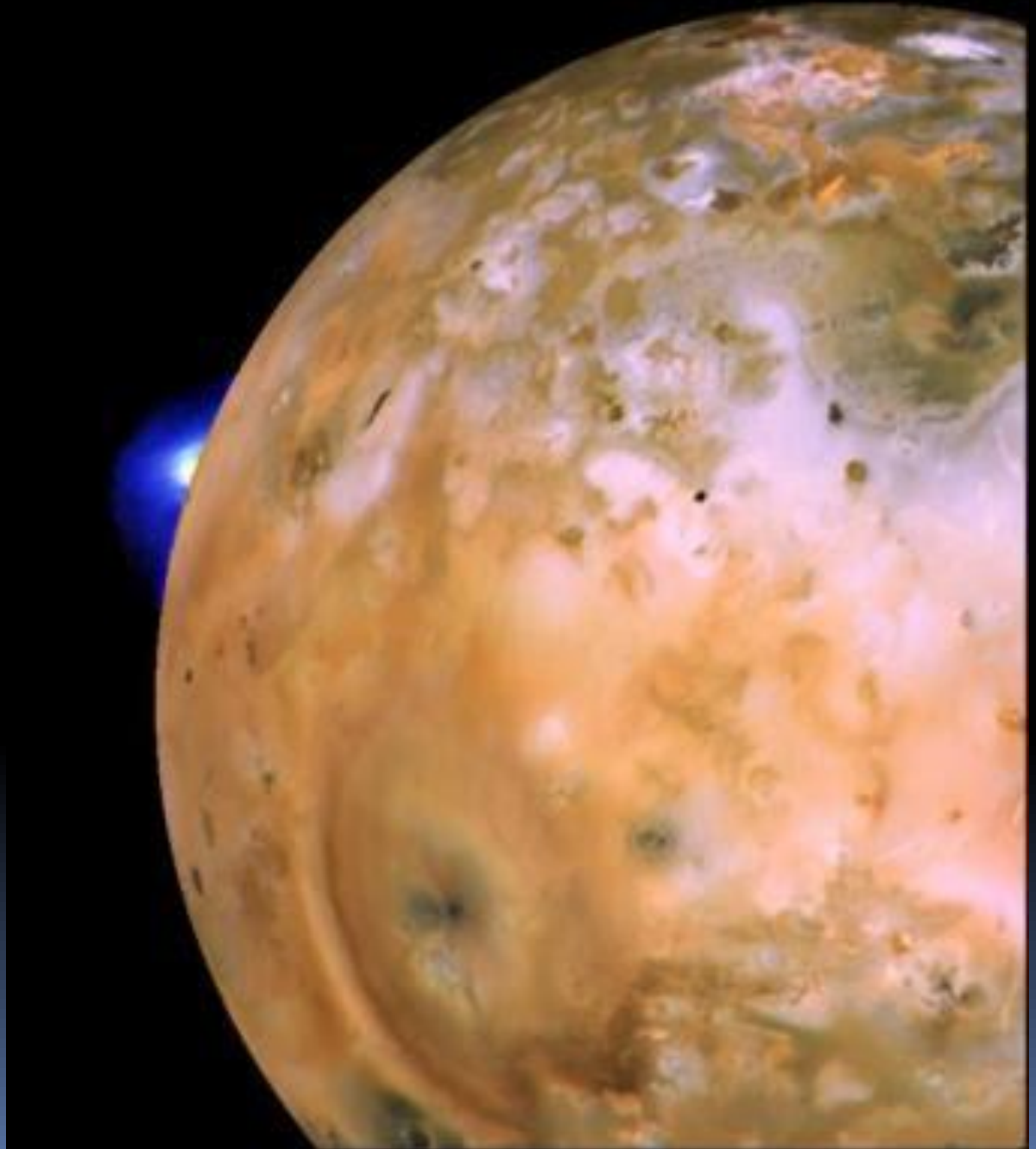
volcanes



Io

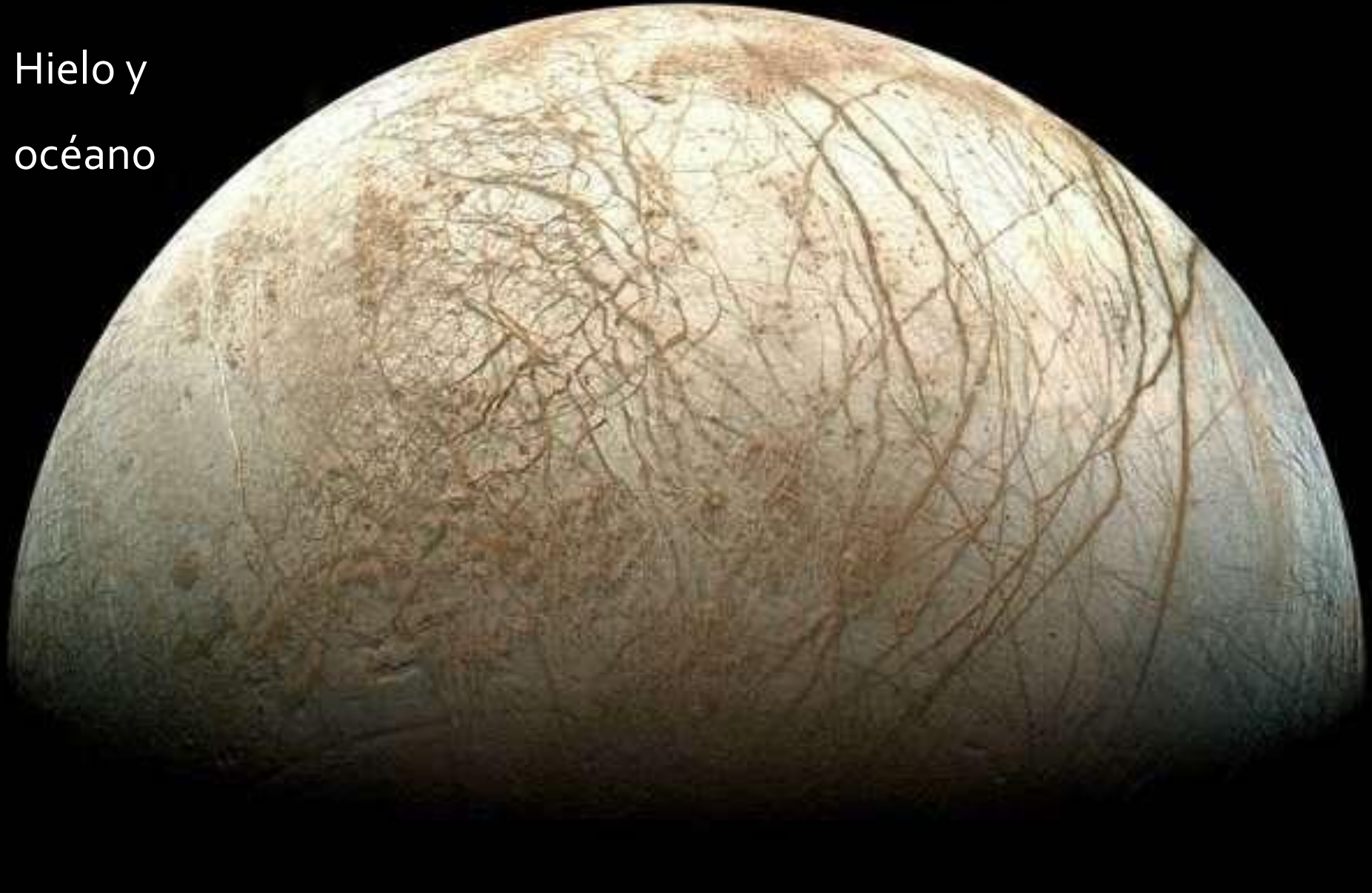
Volcanes activos

Mareas jovianas

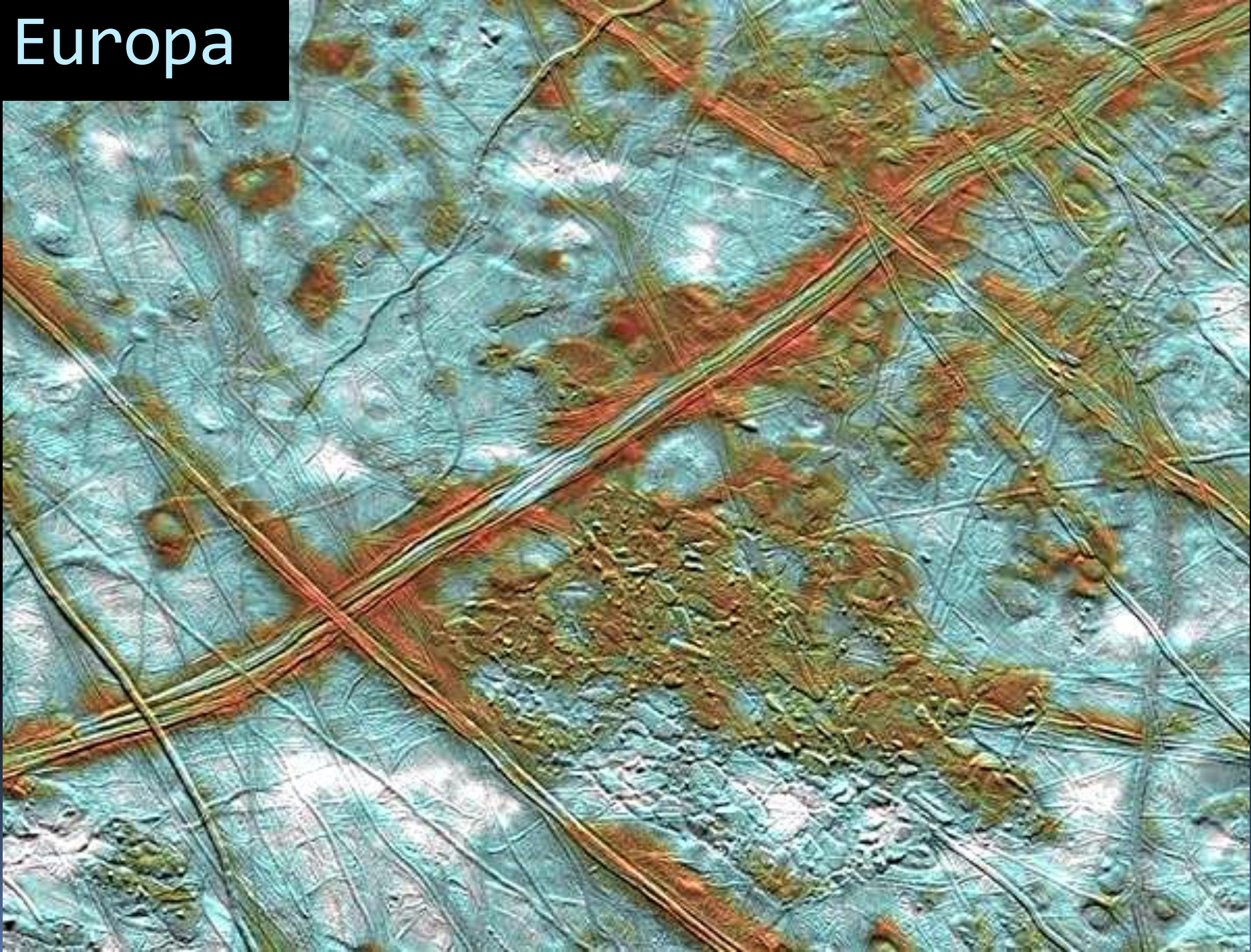


Europa (satélite)

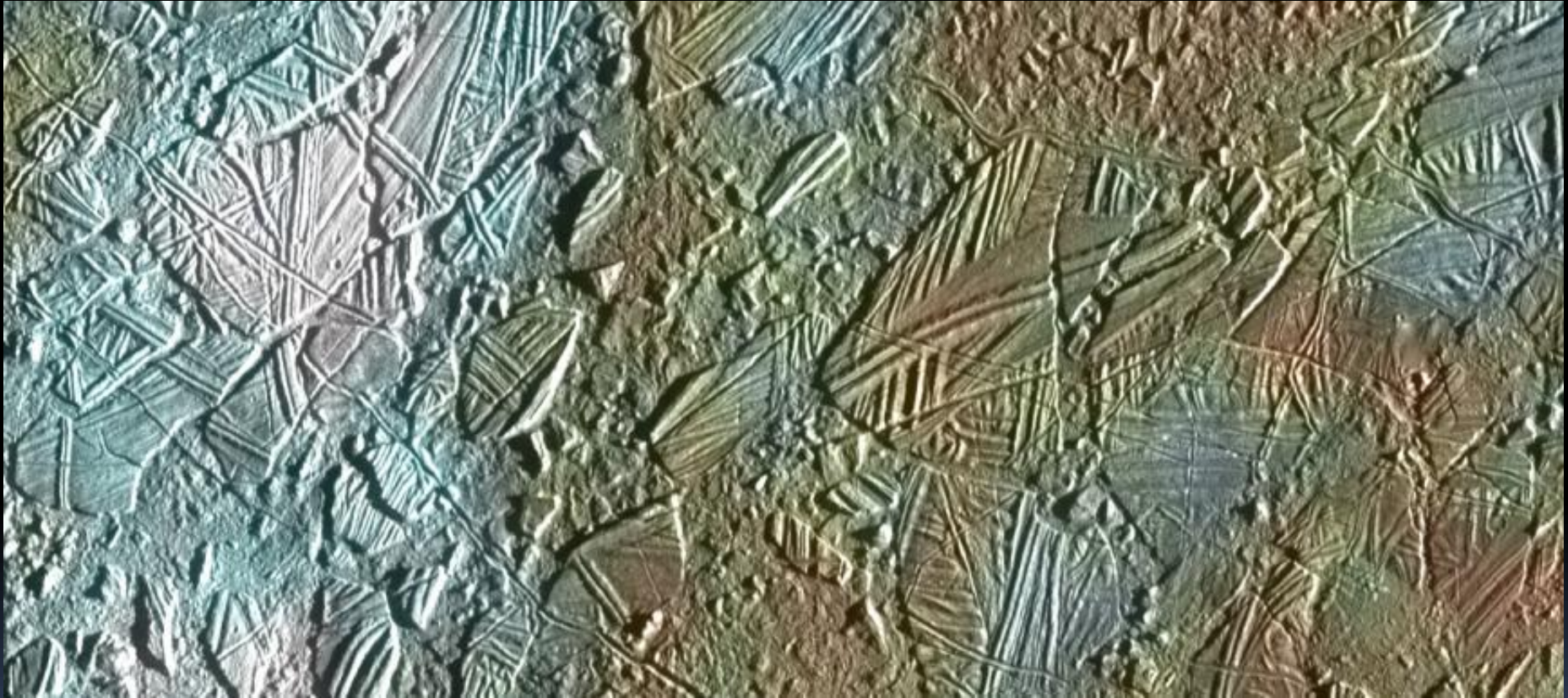
Hielo y
océano

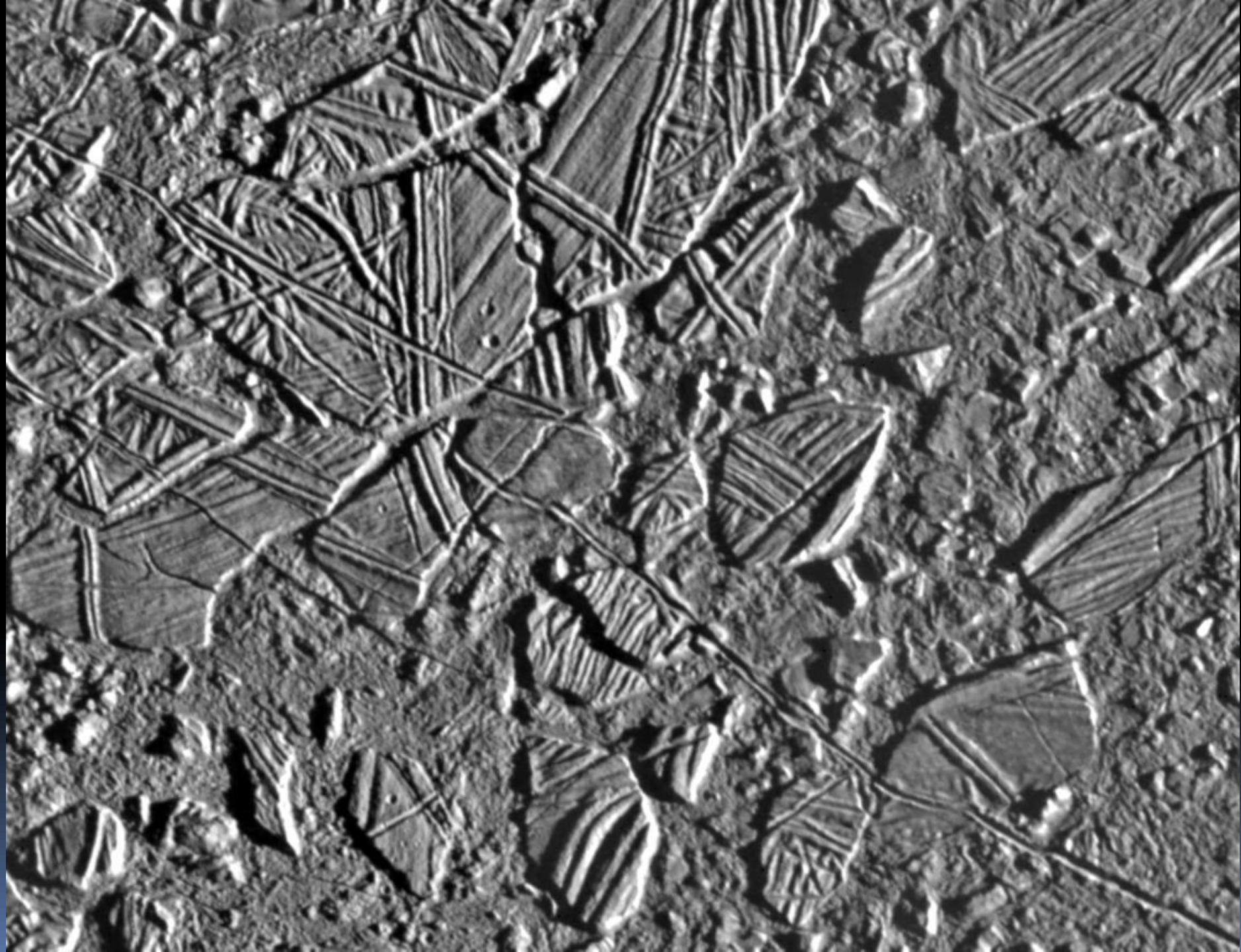


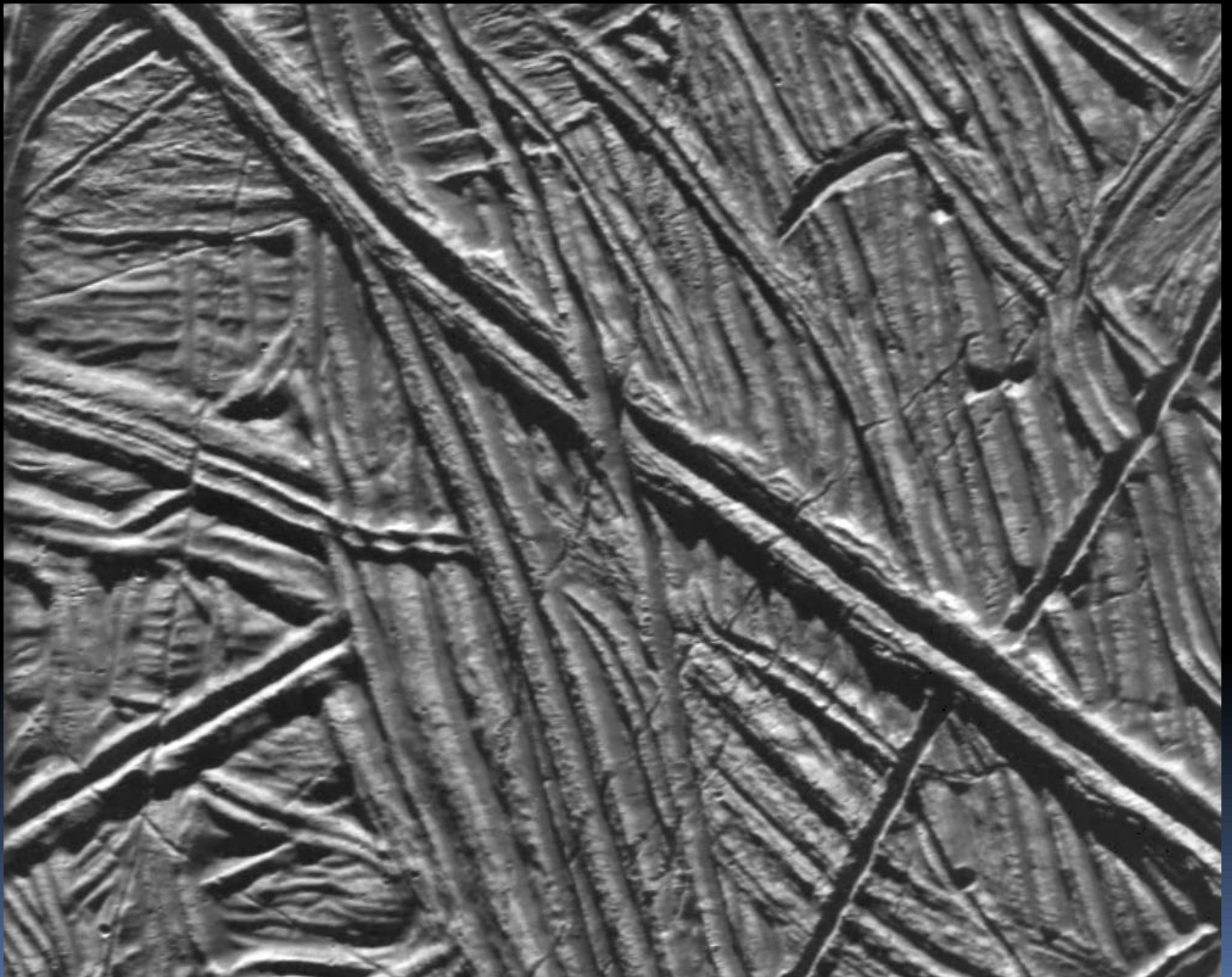
Europa



Europa





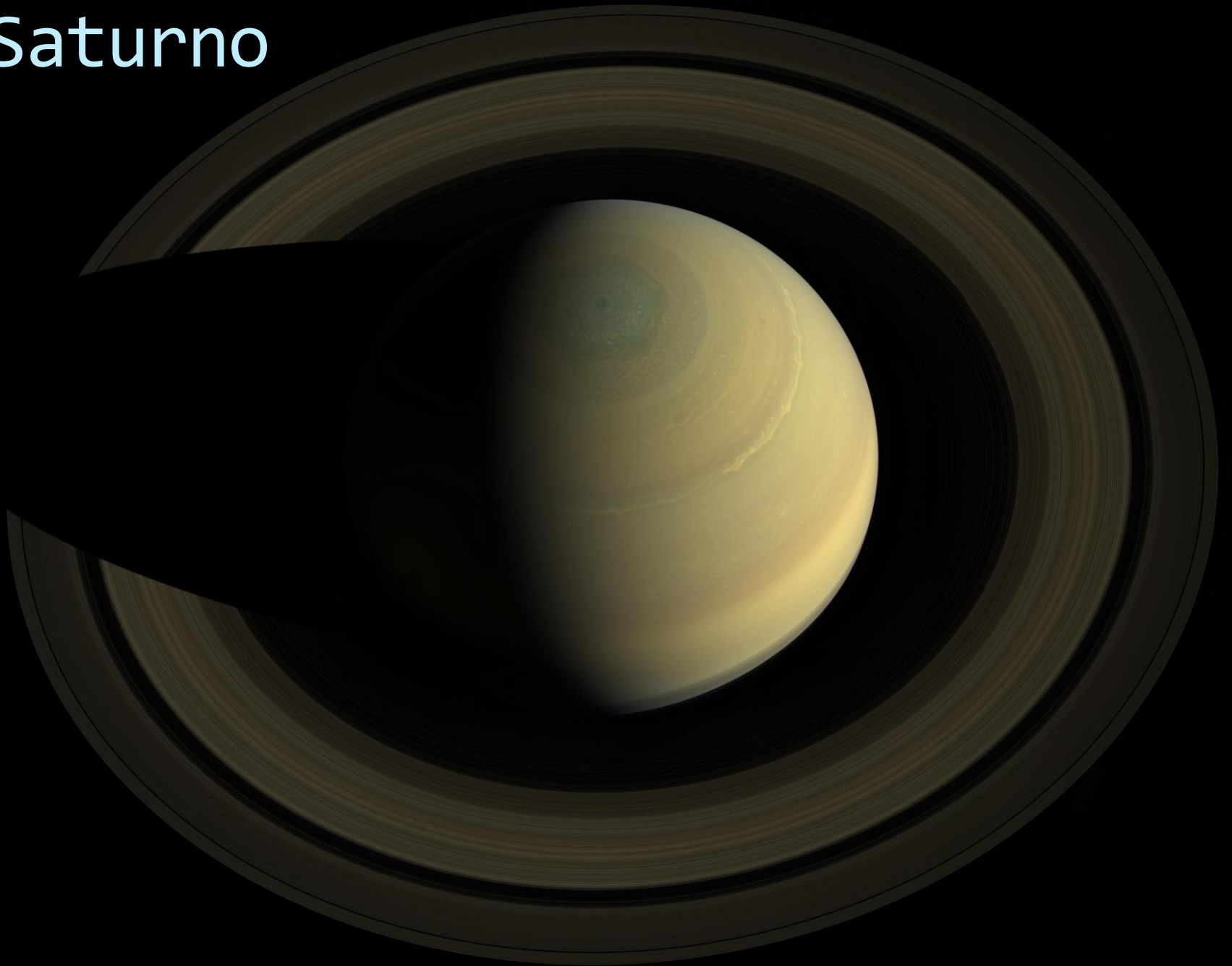


Ganímedes



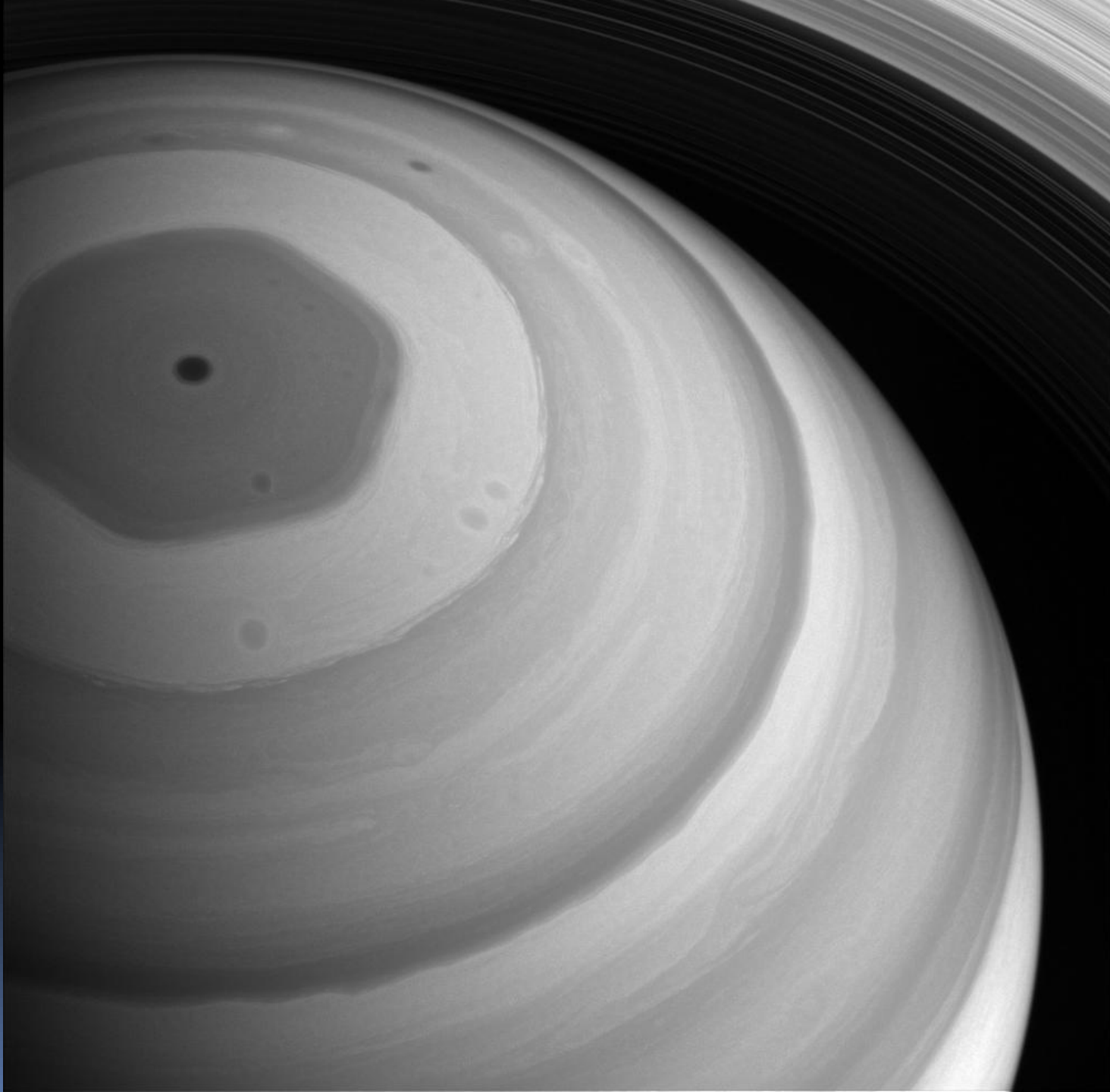


Saturno

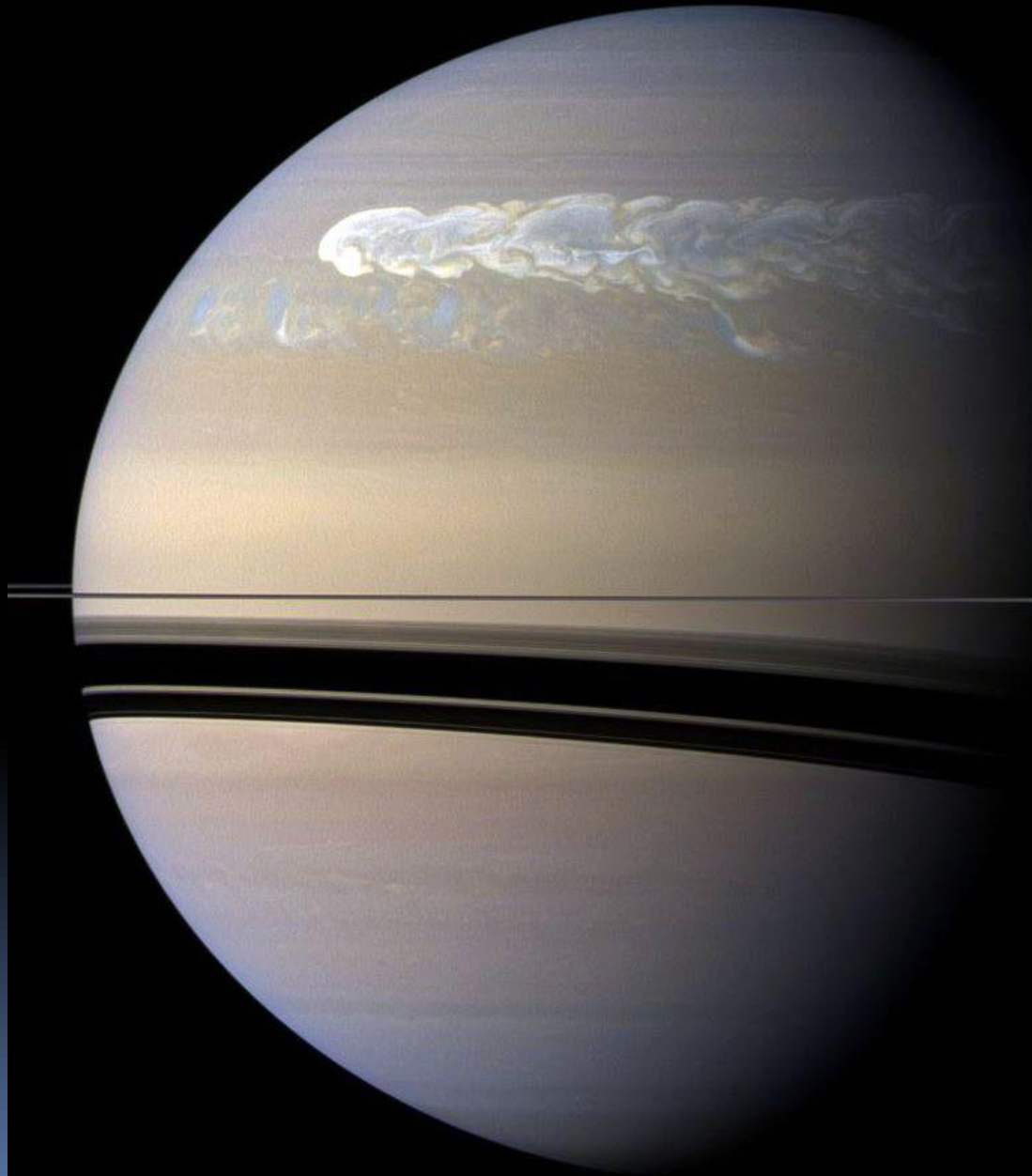


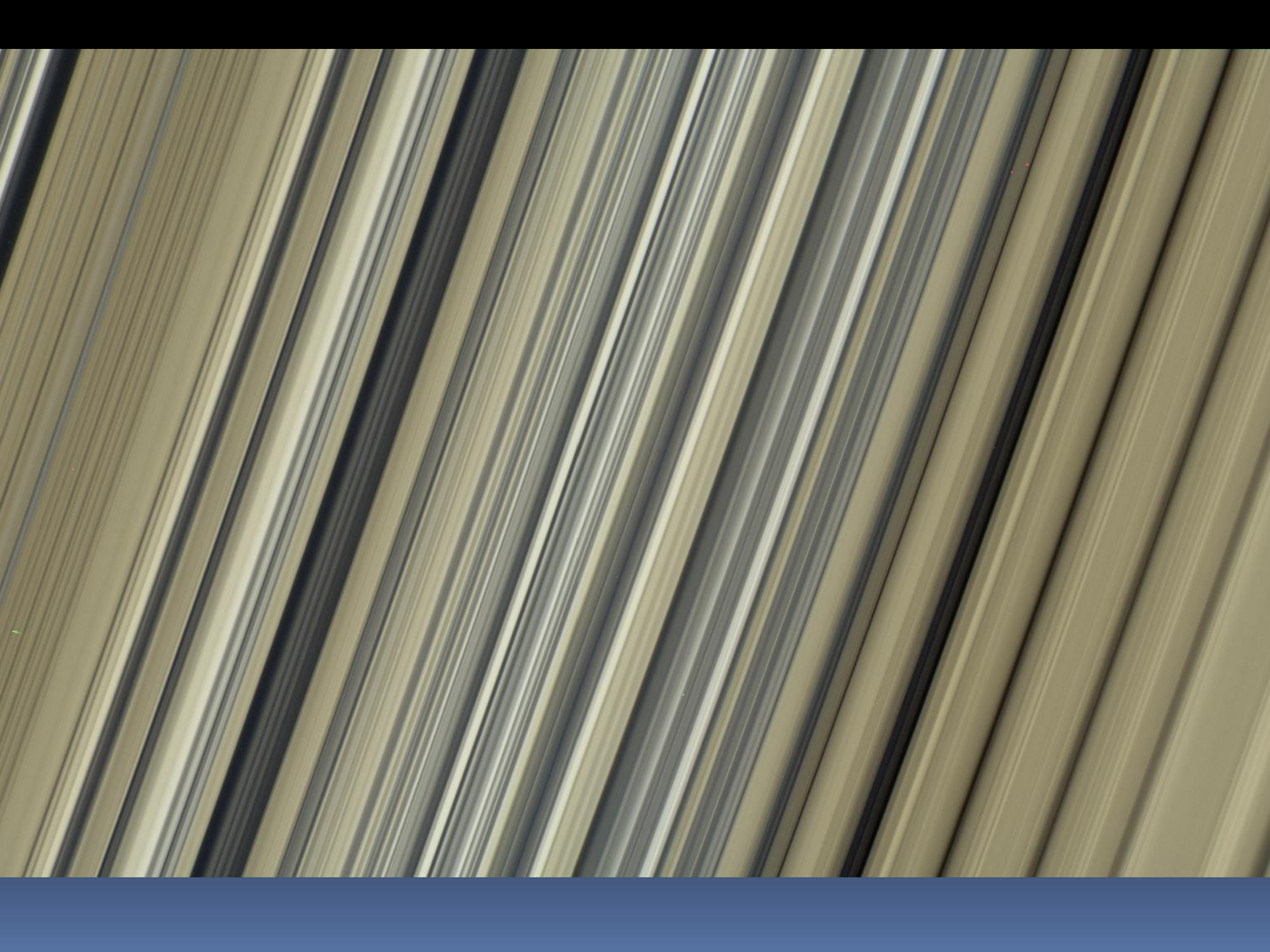
Saturno

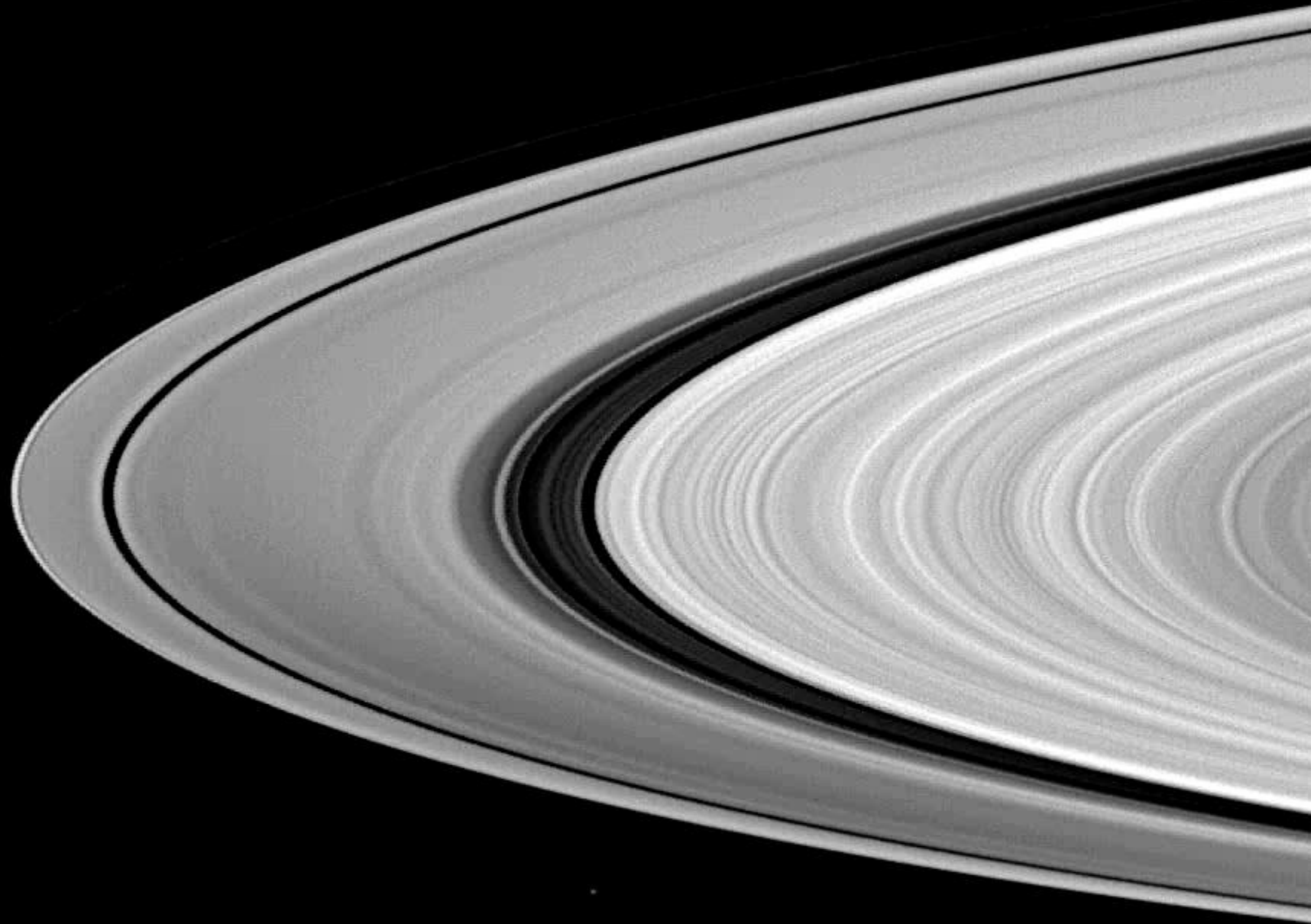




Tormenta



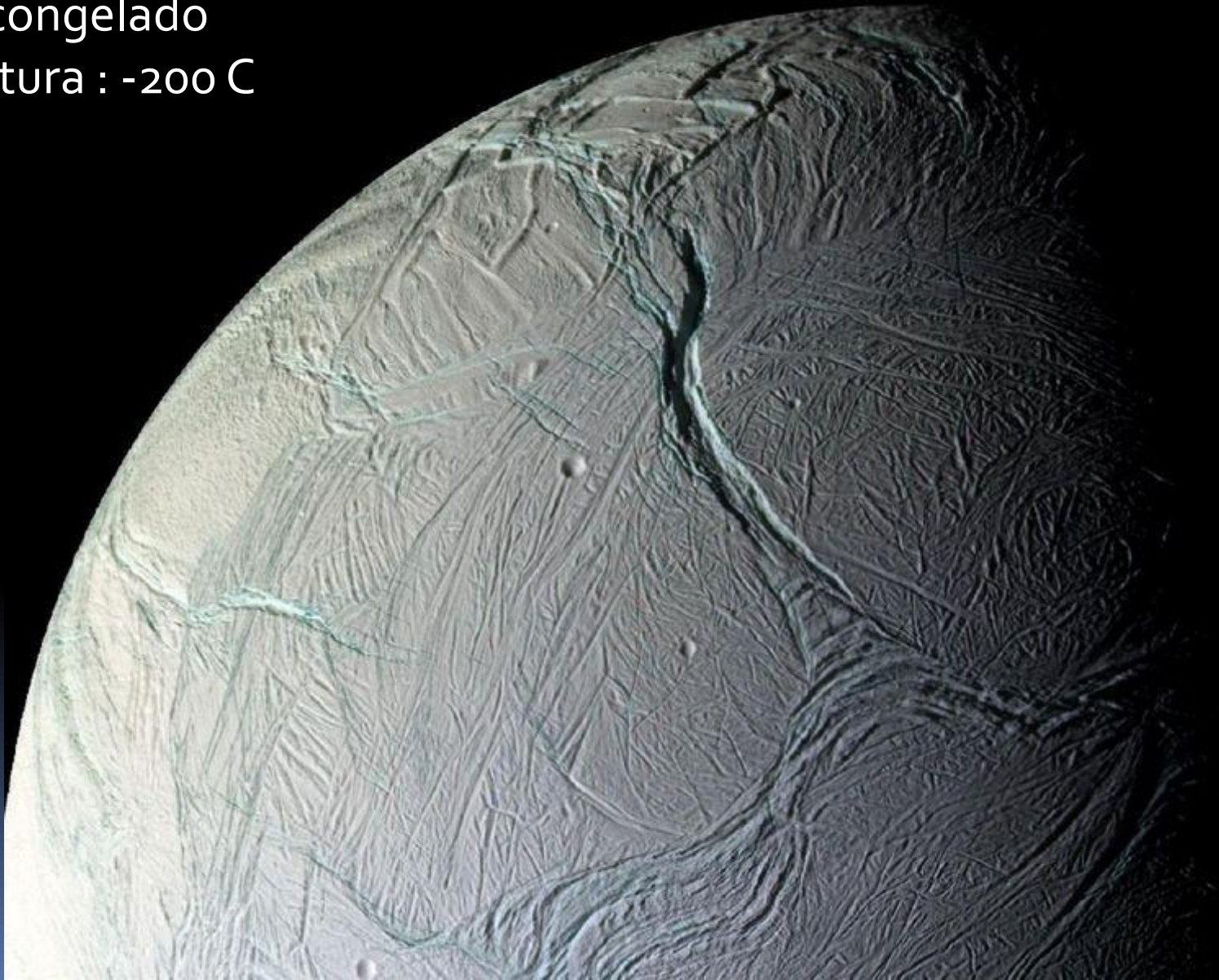




Encelado

Océano congelado

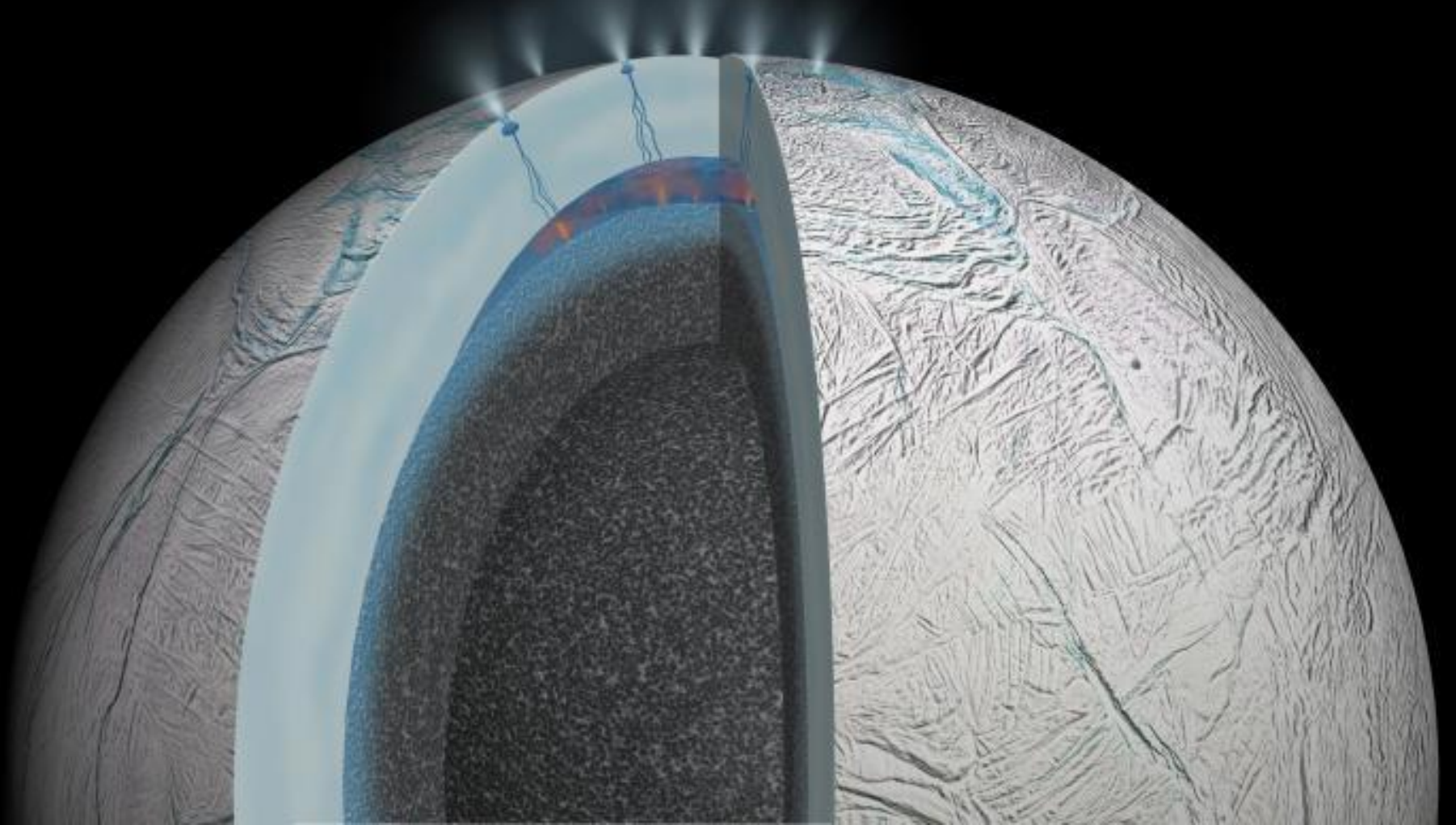
Temperatura : -200 C



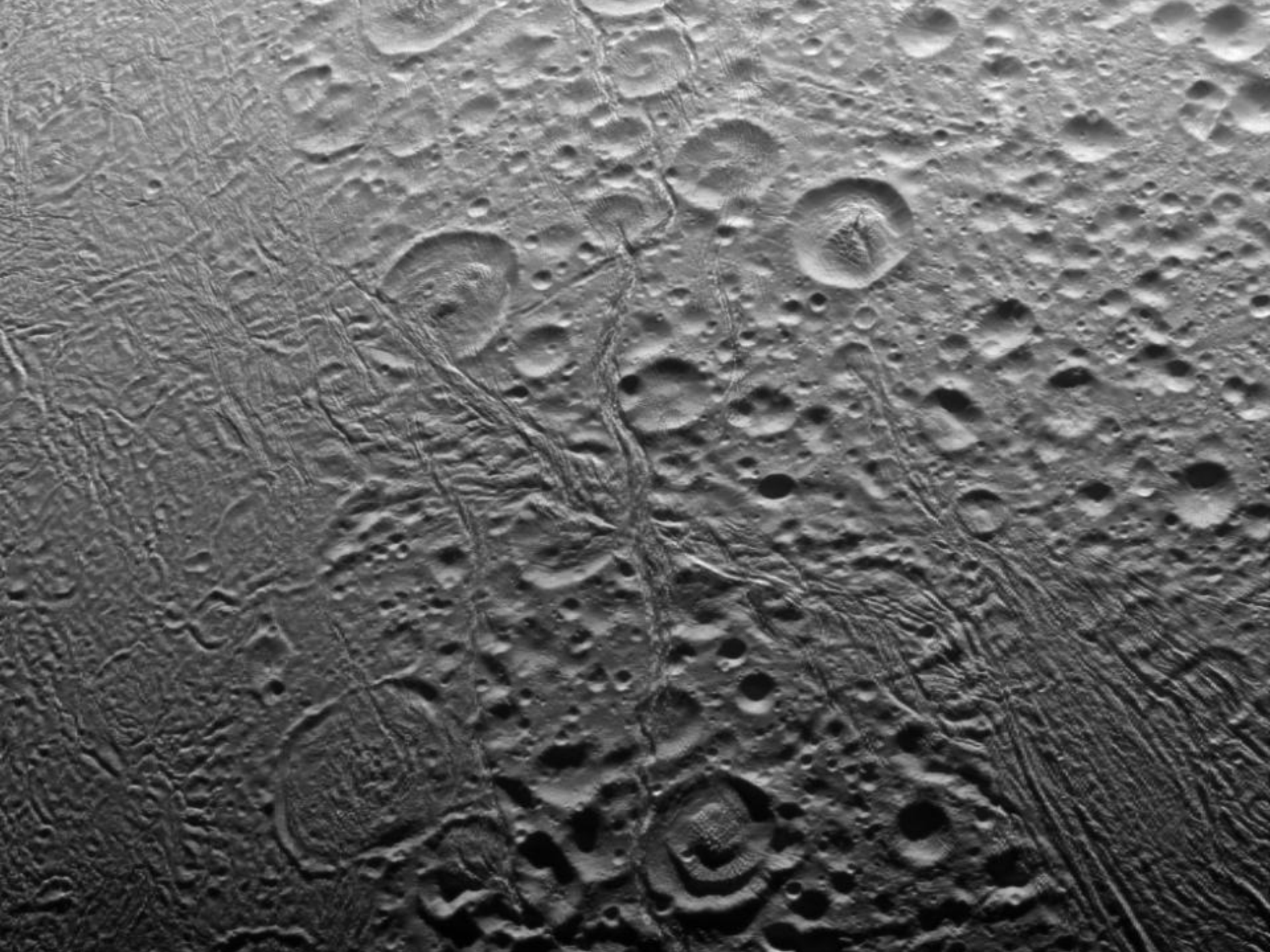
Encelado



Encelado







Glaciar terrestre

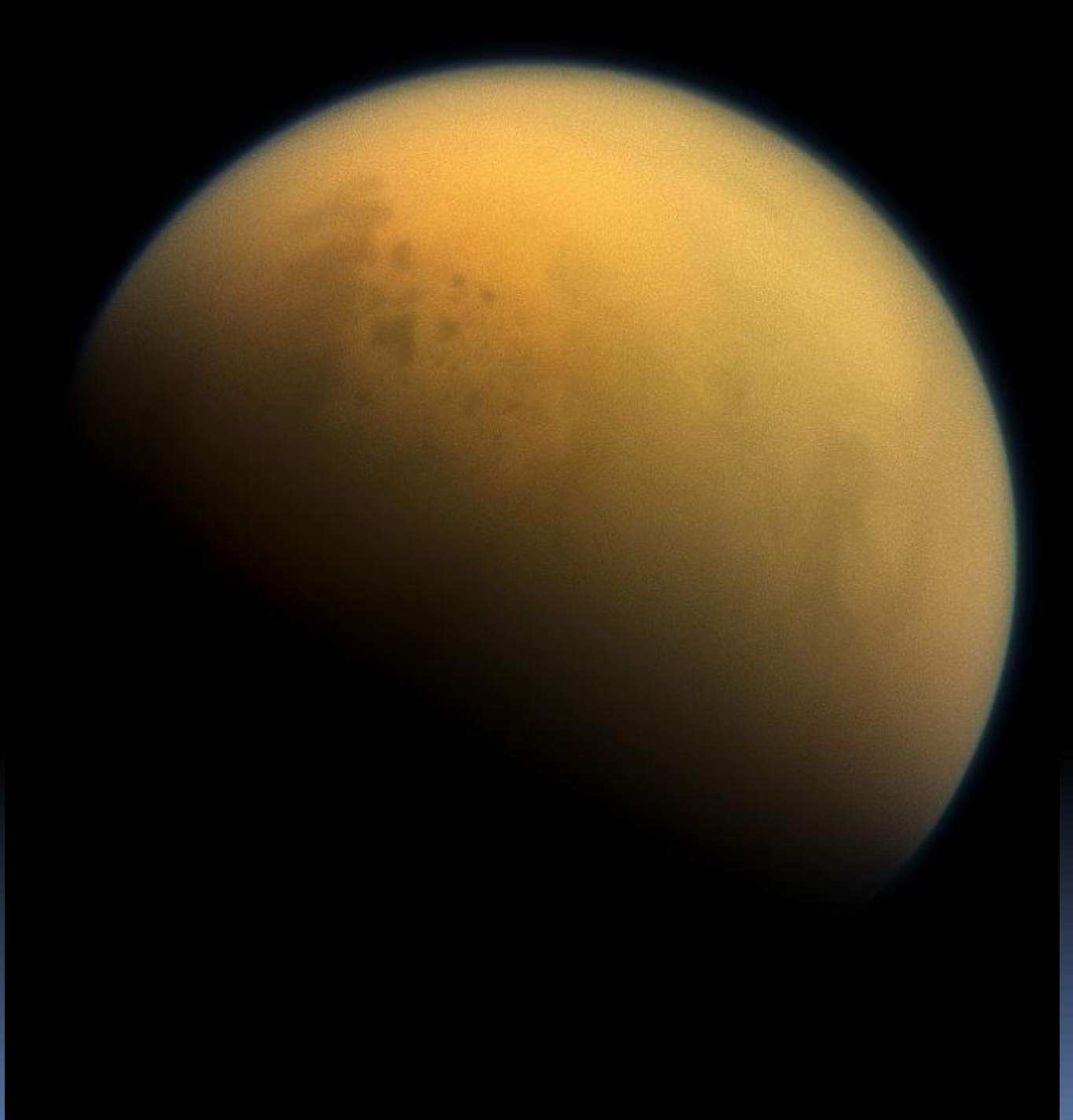


Titán

Atmósfera de Nitrógeno
Temperatura media = -170°C
Presión $> 1\text{ atm.}$
Metano sólido en superficie
Lagos de nitrógeno

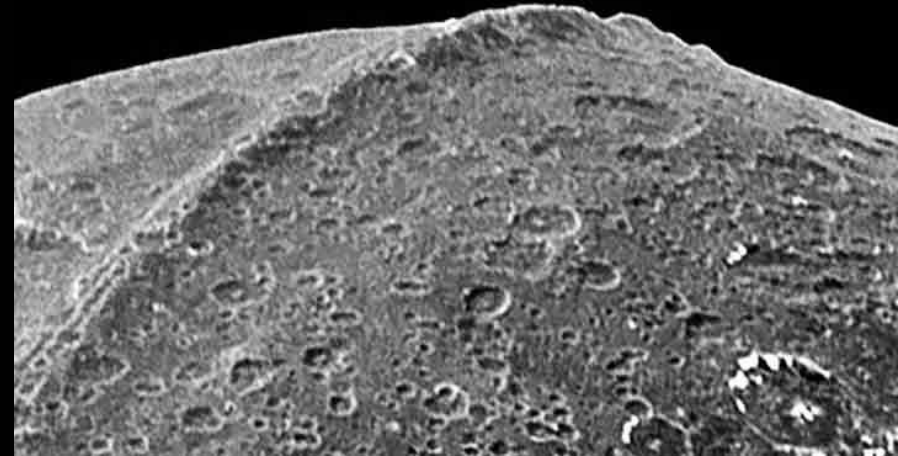
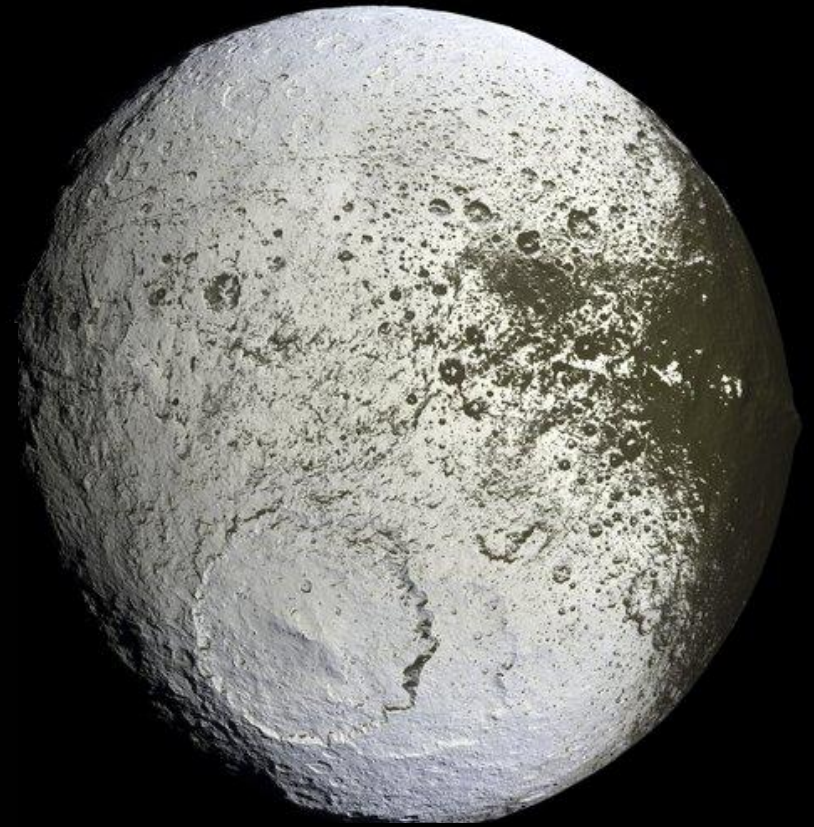


Titán

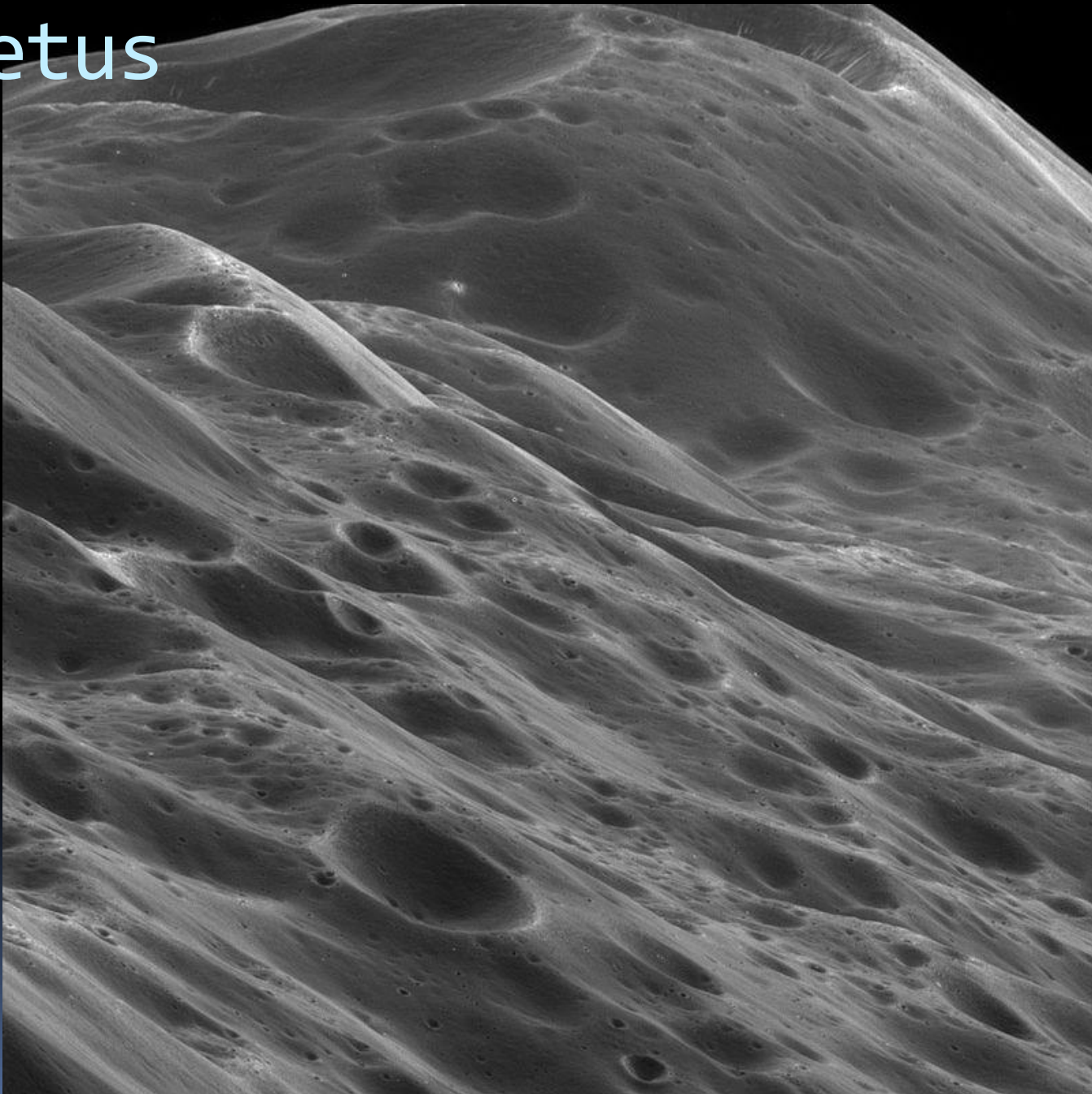


Iapetus

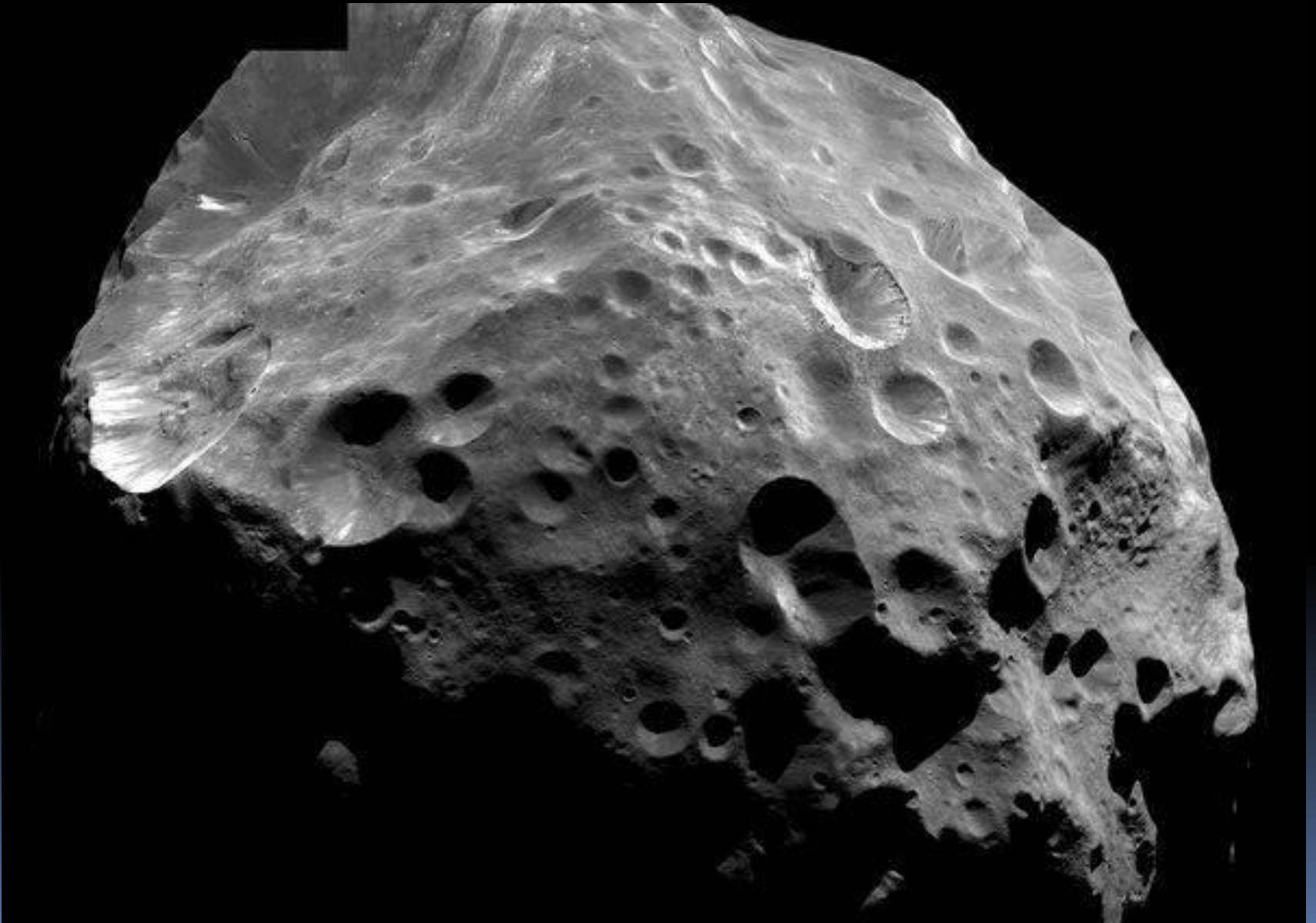
Compuestos de carbono



Iapetus

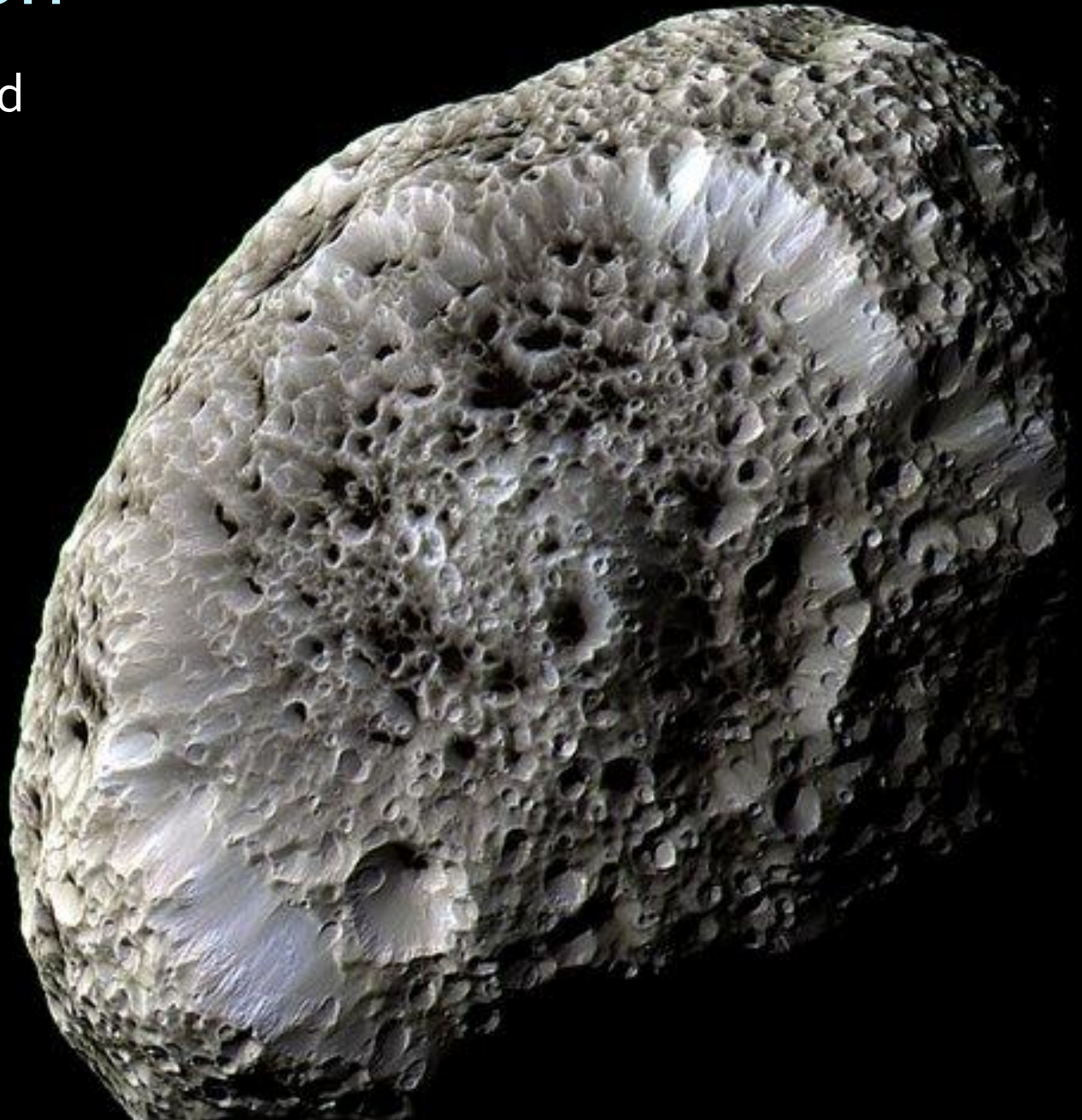


Phoebe



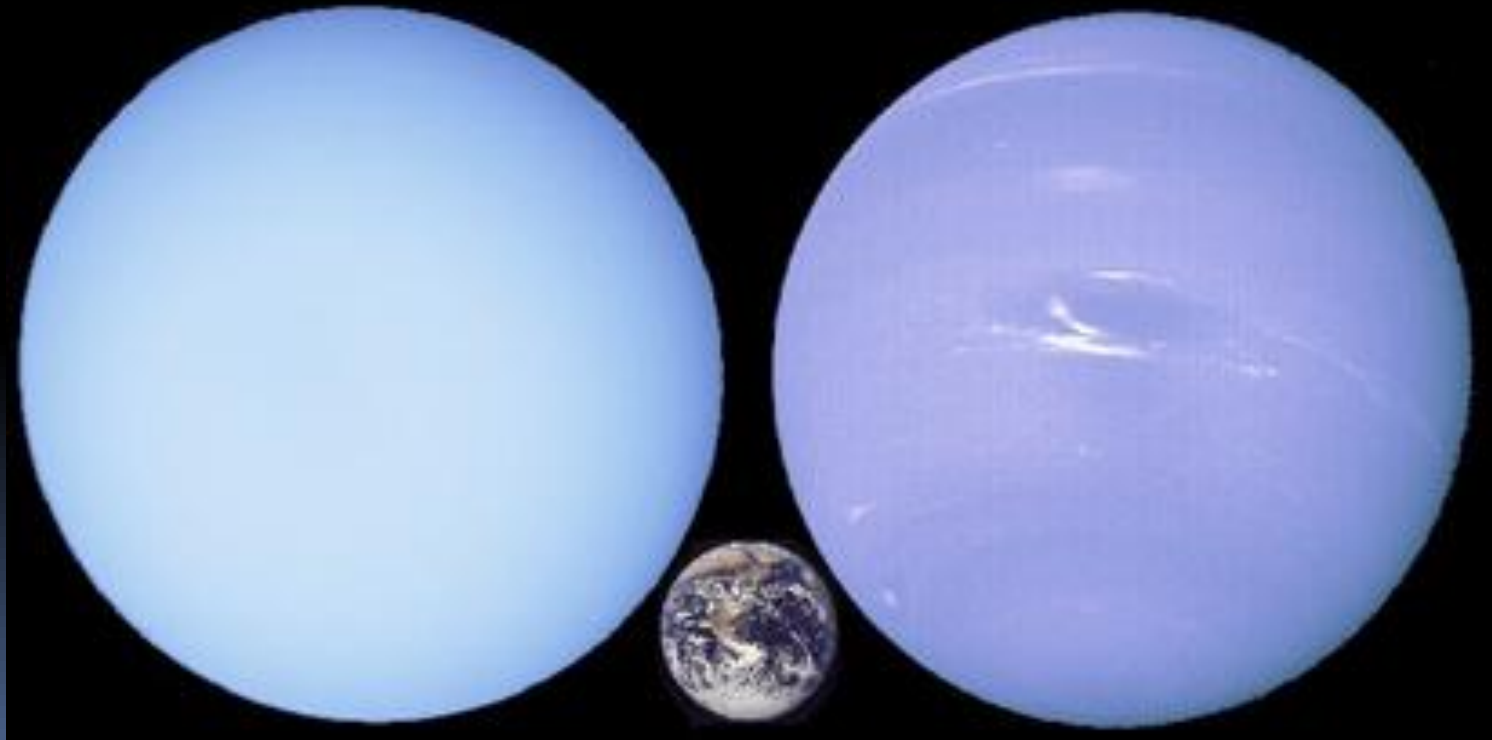
Hiperion

Alta porosidad



Urano y Neptuno

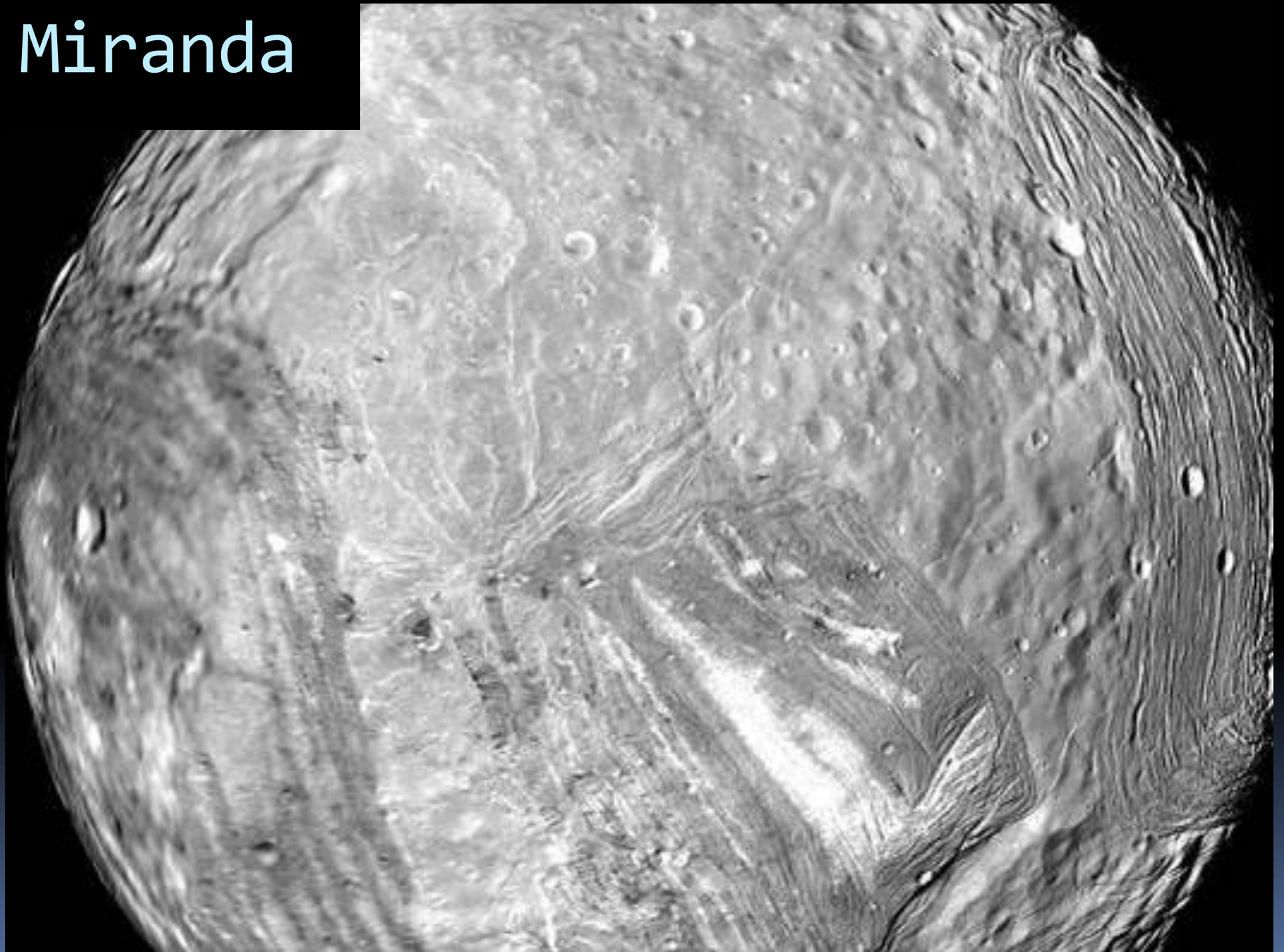
$\text{CH}_4 + \text{NH}_3$
Temp: -220 C

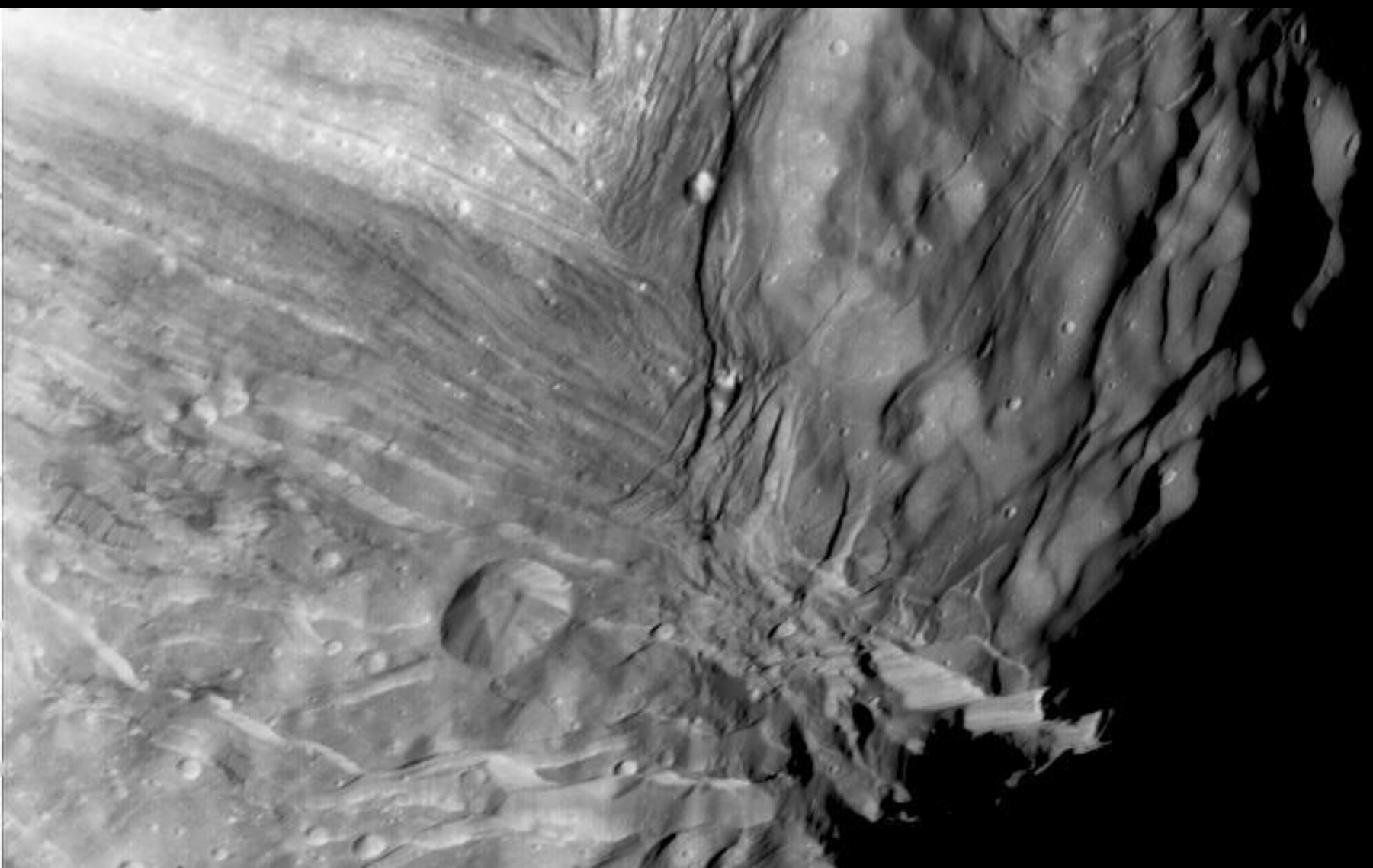


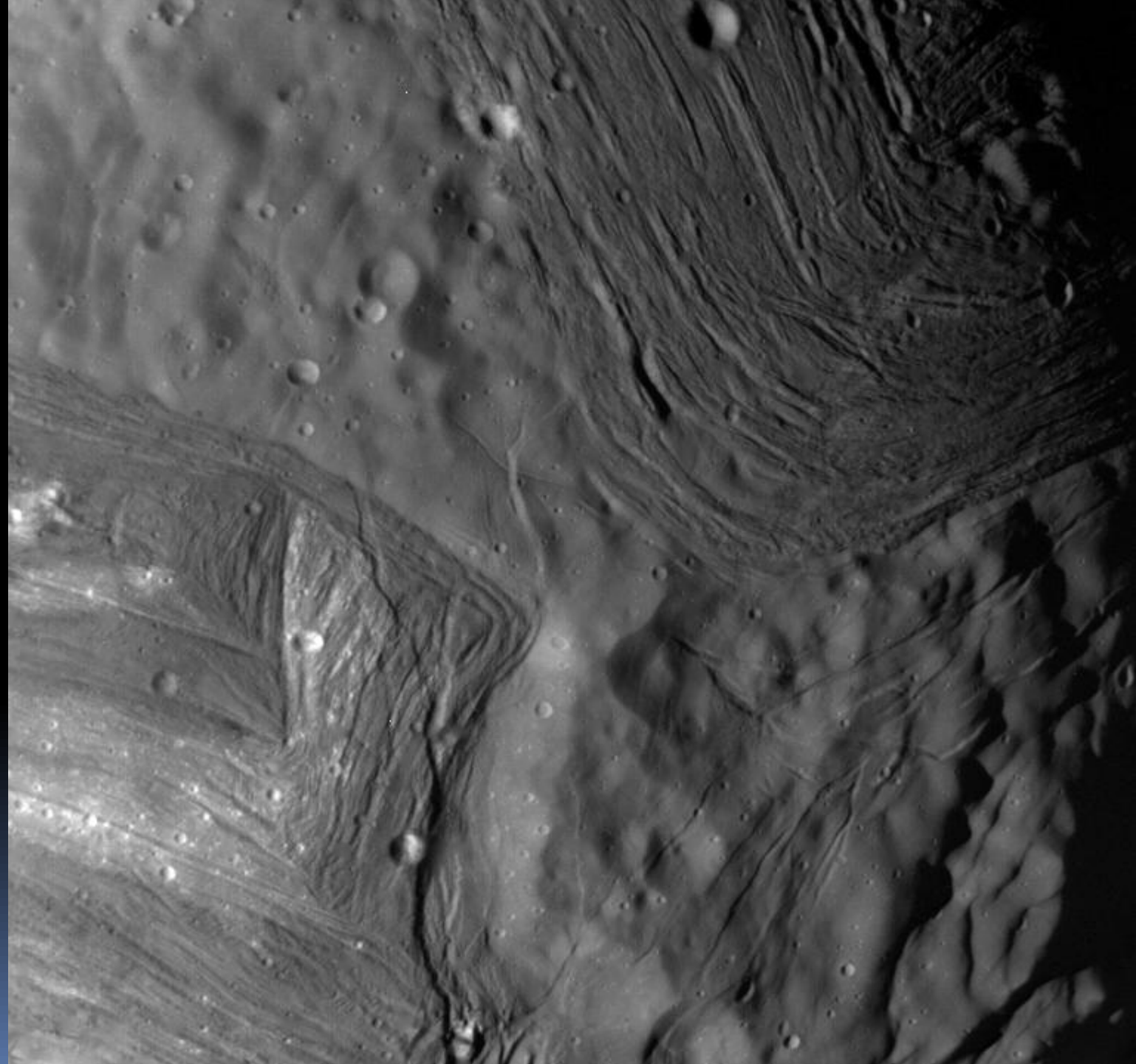
Ariel



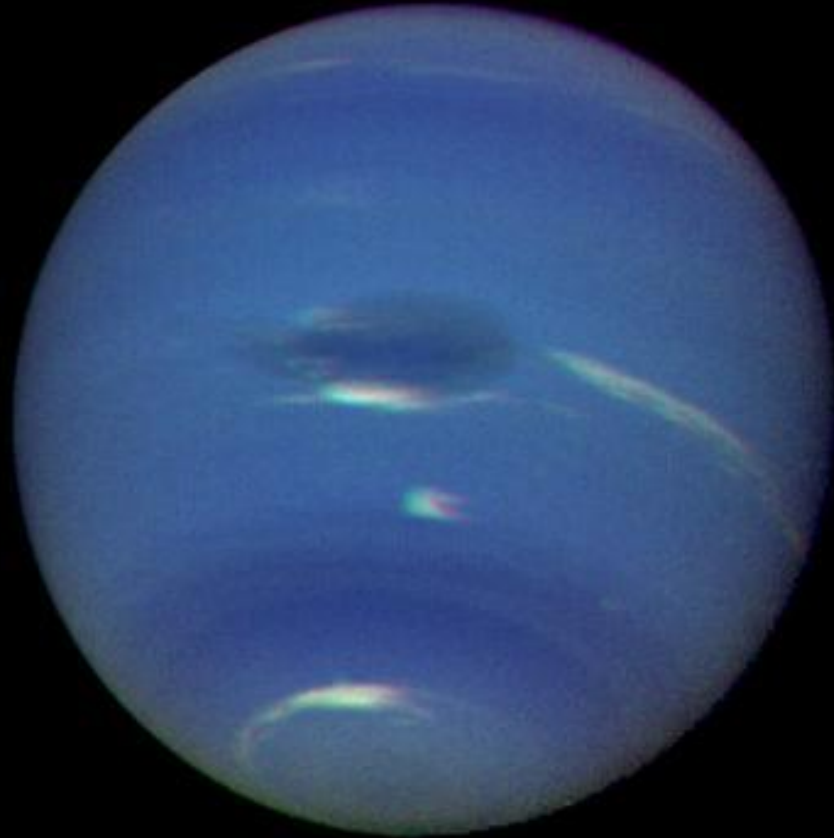
Miranda

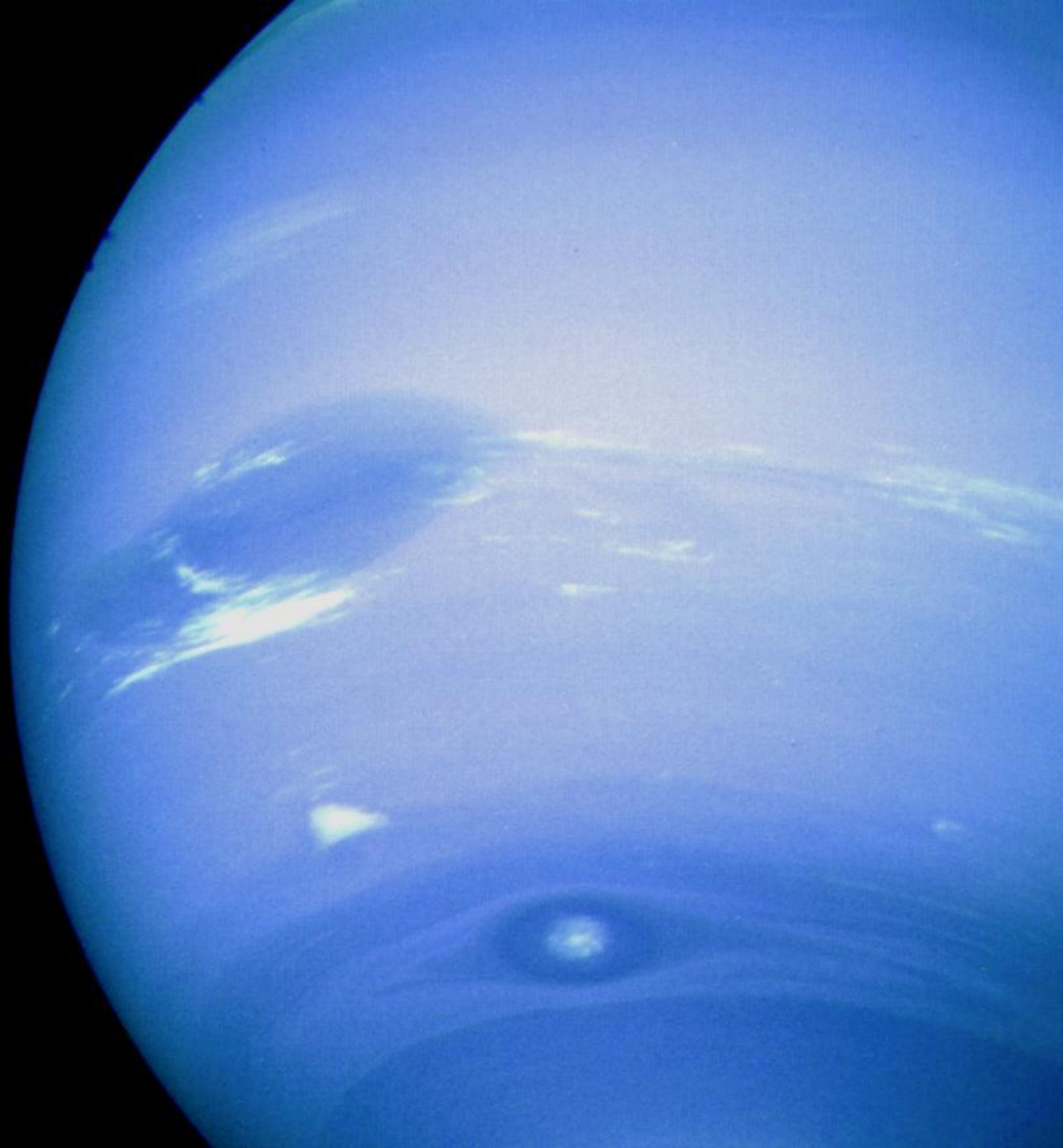




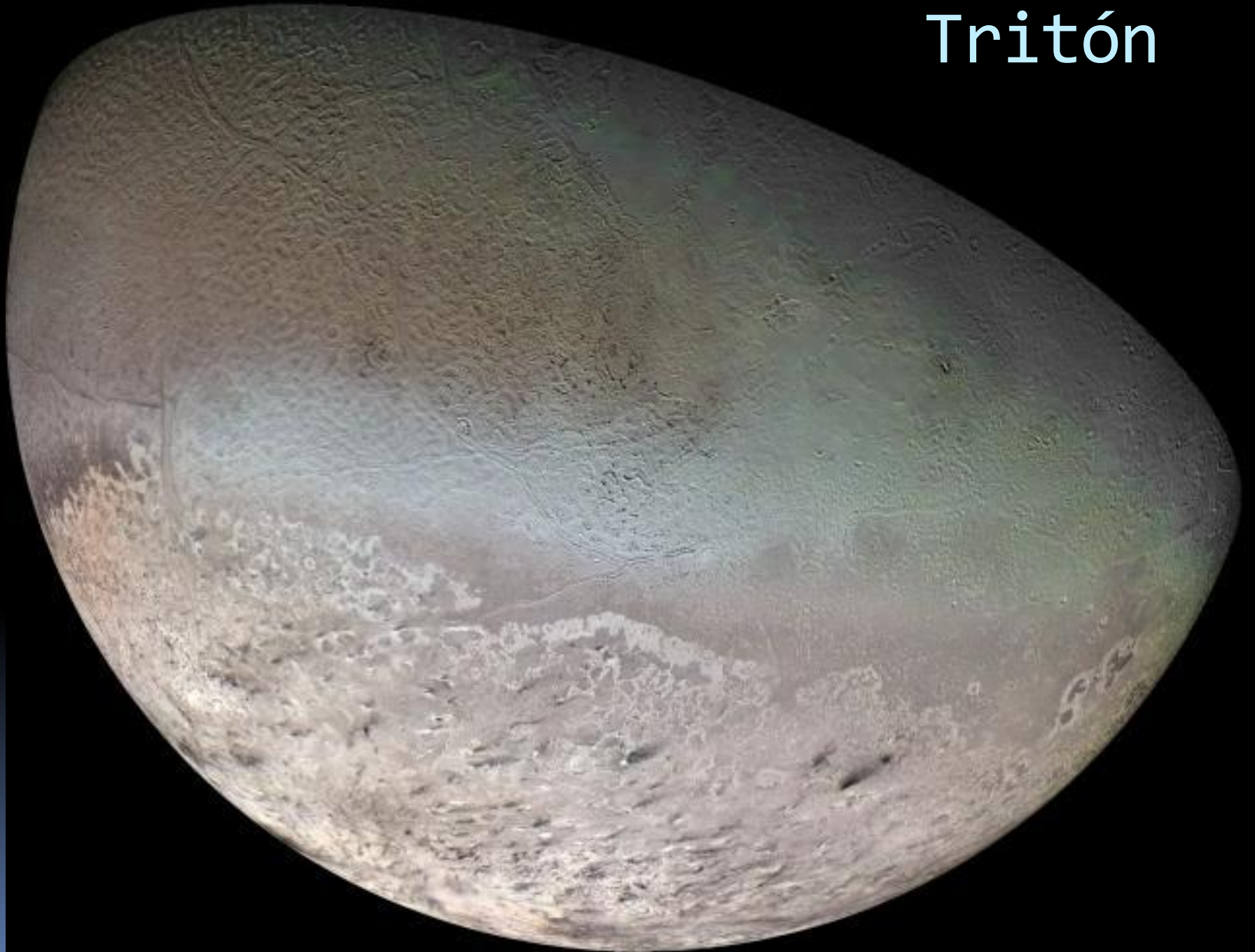


Neptuno





Tritón





Mayores satélites del SS

Triton



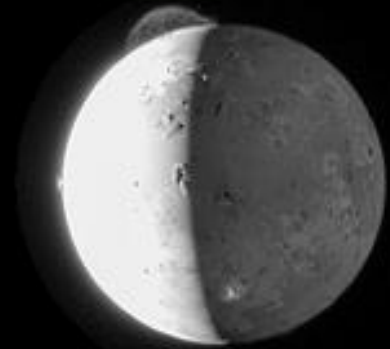
Europe



Lune



Io



Callisto



Titan



Ganymède

MAS ALLA DE NEPTUNO

Cinturón de Kuiper



Plutón y Caronte



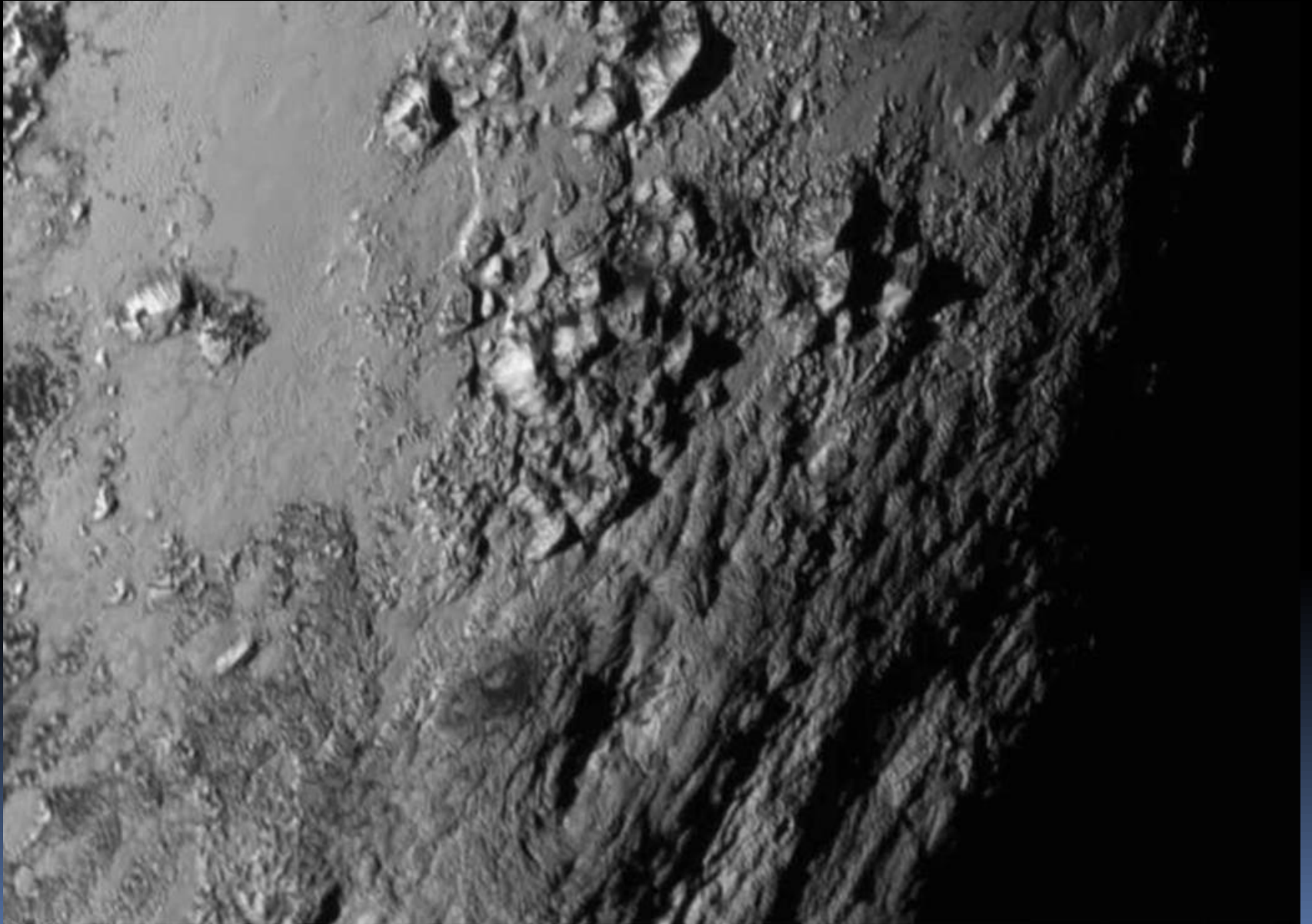
Plutón

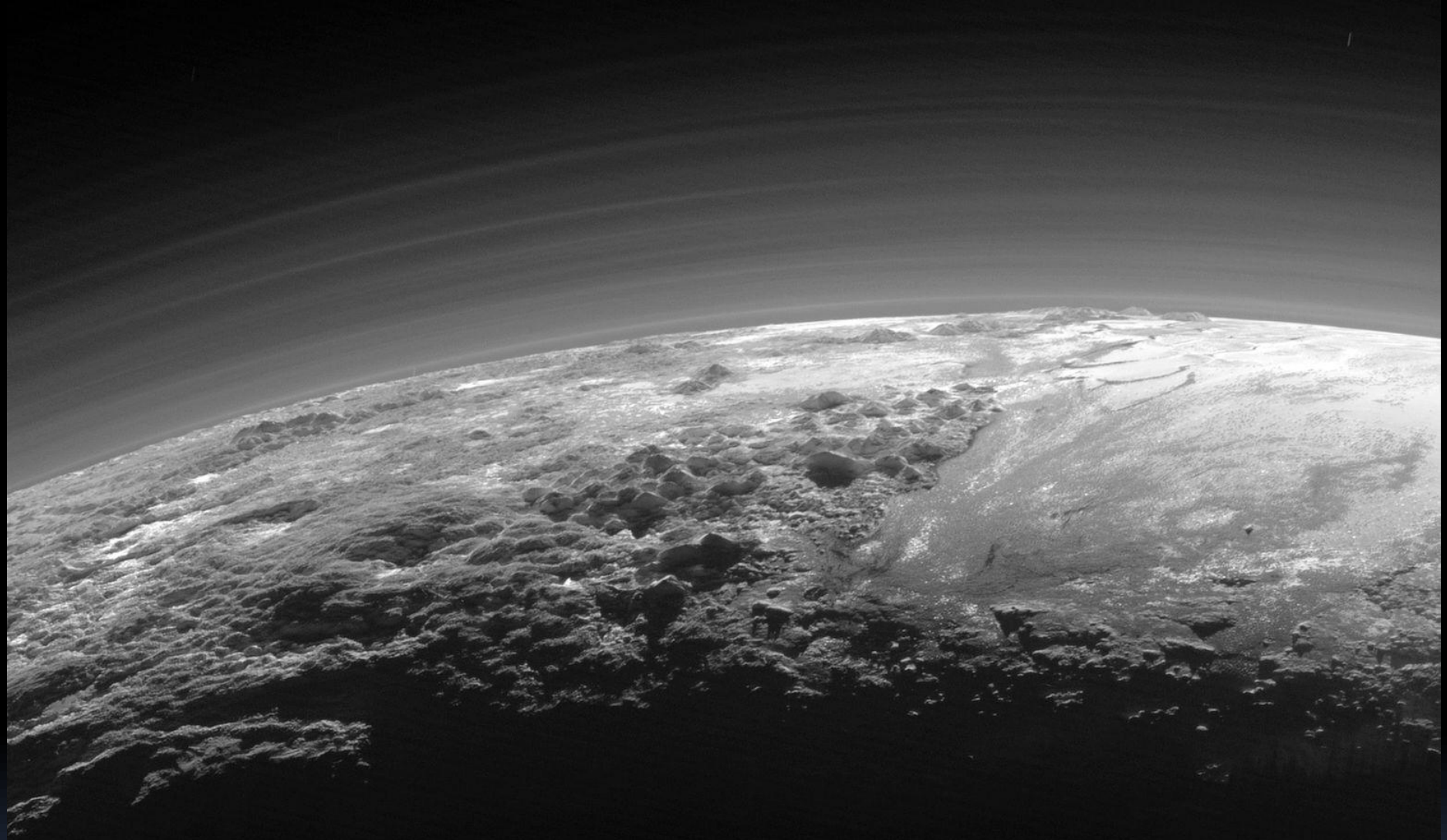


False Color



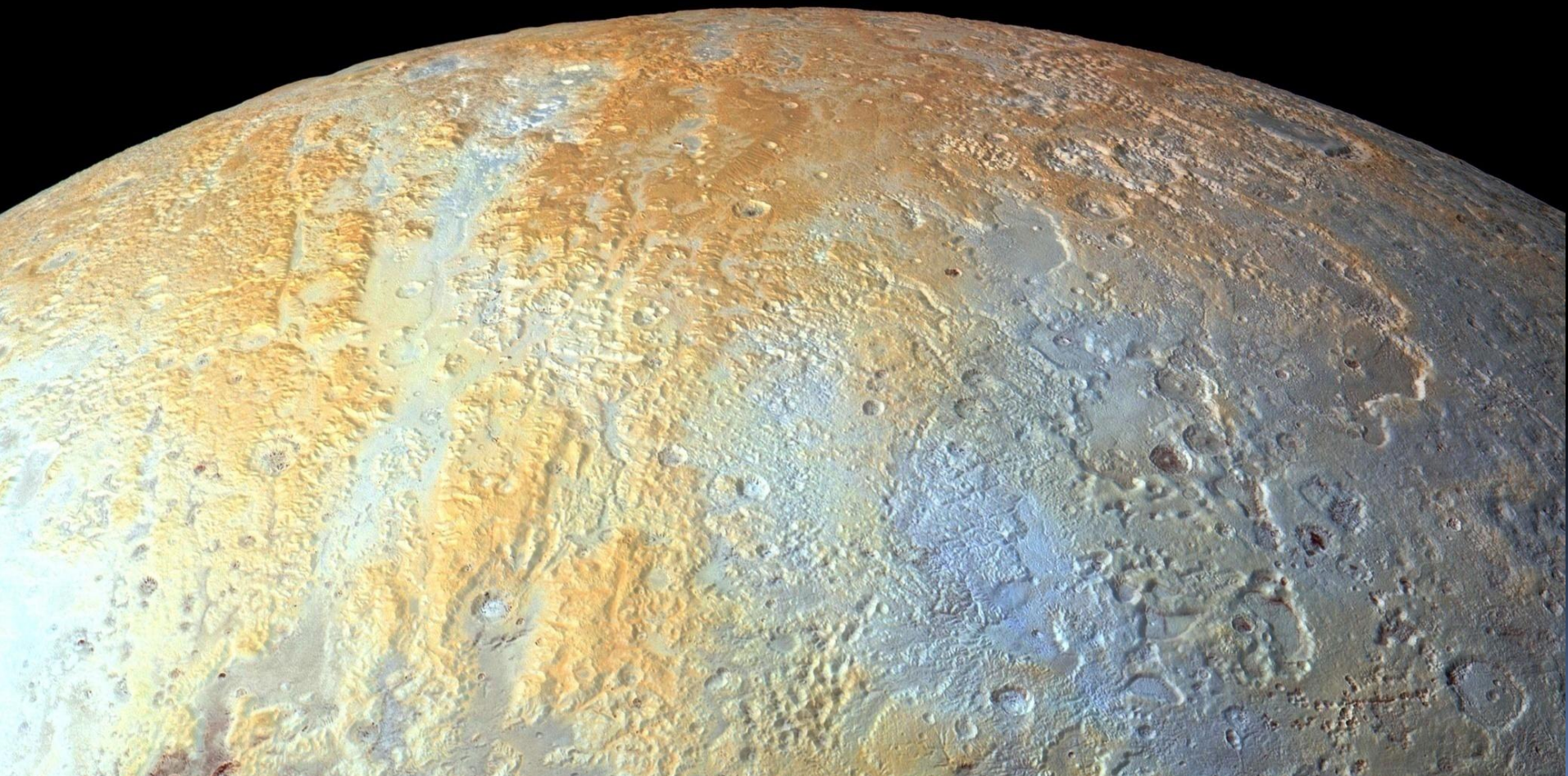
Plutón





Jóvenes (100 millones de años...) montañas de hielo.

Plutón

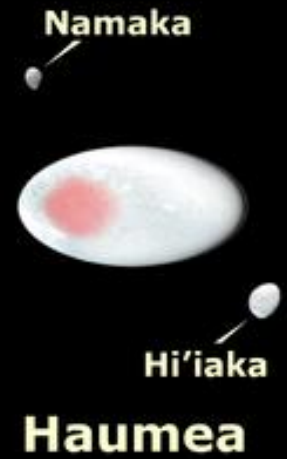


Caronte





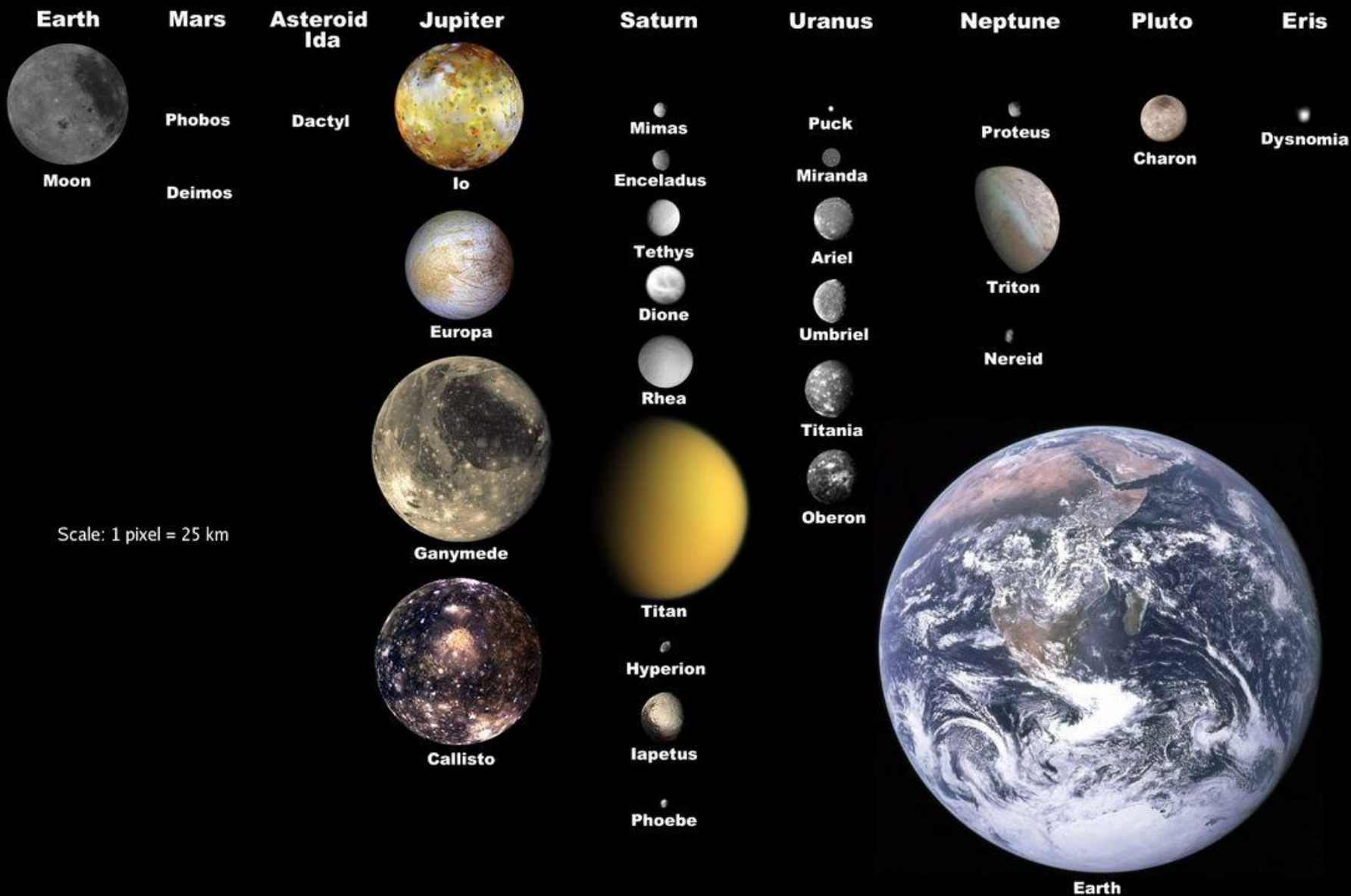
Largest known trans-Neptunian objects (TNOs)



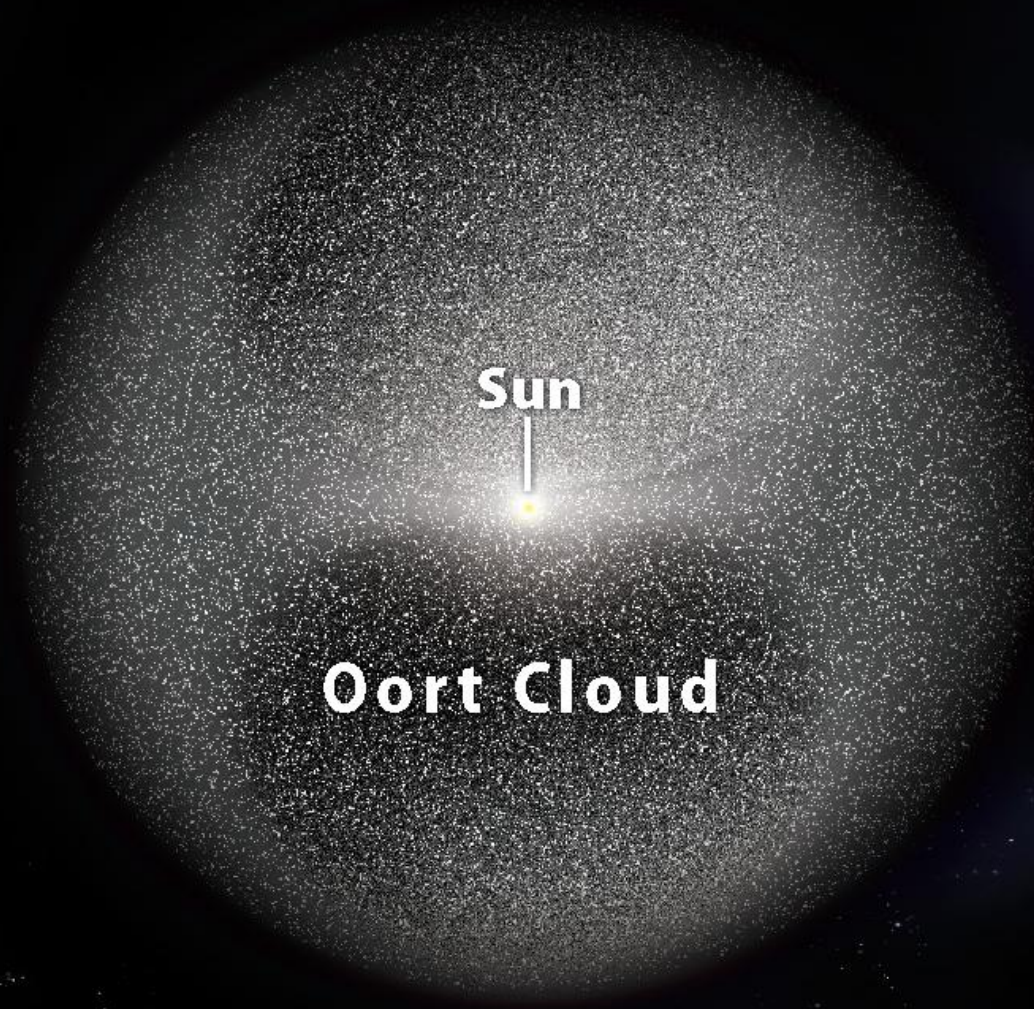
2000 km

A horizontal scale bar with a yellow line and black ends, representing 2000 km.

Selected Moons of the Solar System, with Earth for Scale



Nube de Oort



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- Trabajar distancias
- Tamaños y características
- Línea de distancias al Sol

photojournal.jpl.nasa.gov



Jet Propulsion Laboratory
California Institute of Technology

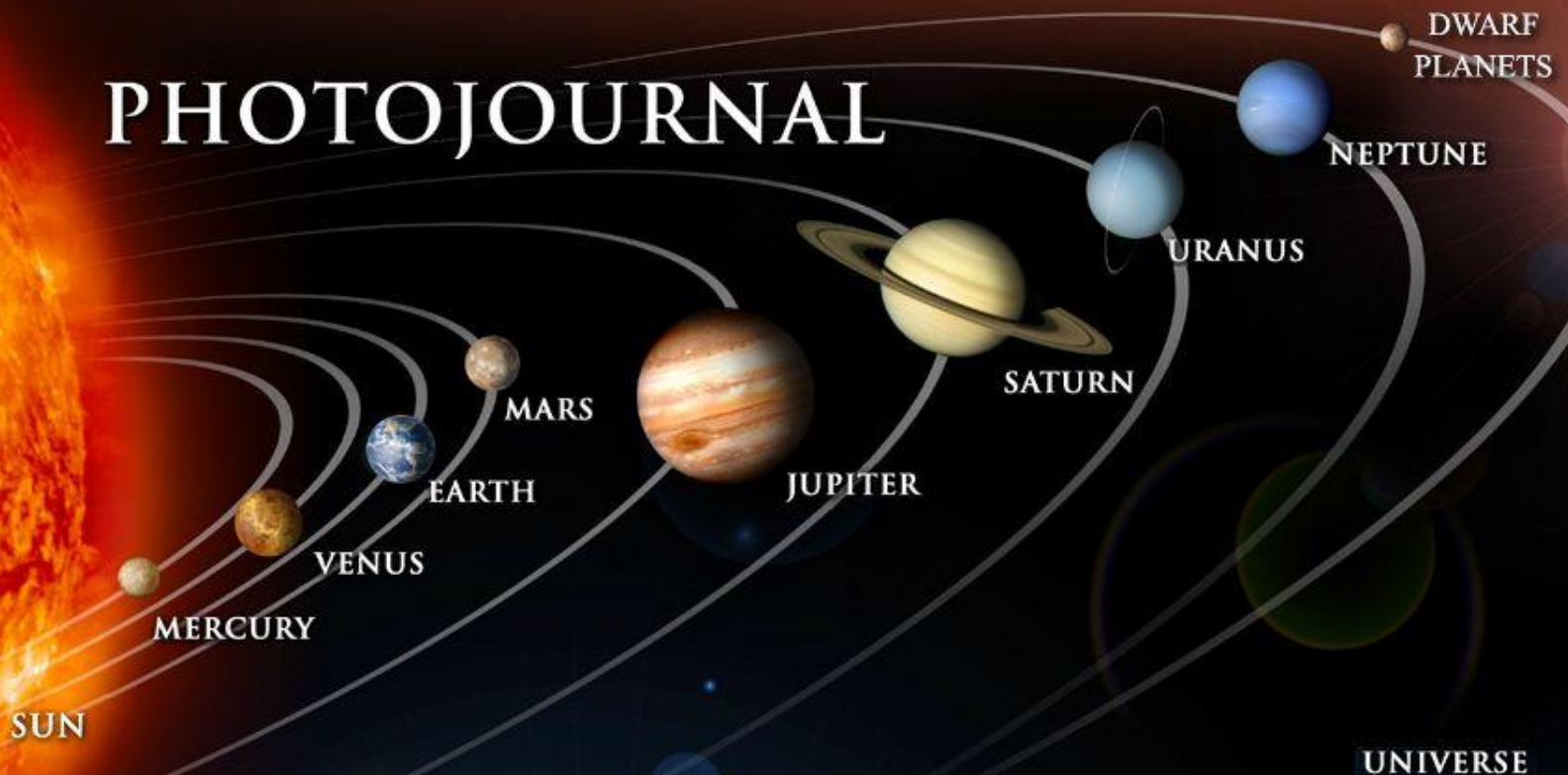
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