

Mas allá de Plutón

(pero también mas acá)

Dolores
25 Enero 2019

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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.

Planetas Extrasolares (¿son así?)



Kepler-62 e



Gliese 667C c



Gliese 581 g*



Tau Ceti e*



Gliese 667C f



Kepler-22 b



Gliese 163 c



Kepler-61 b



HD 40307 g*



Kepler-62 f

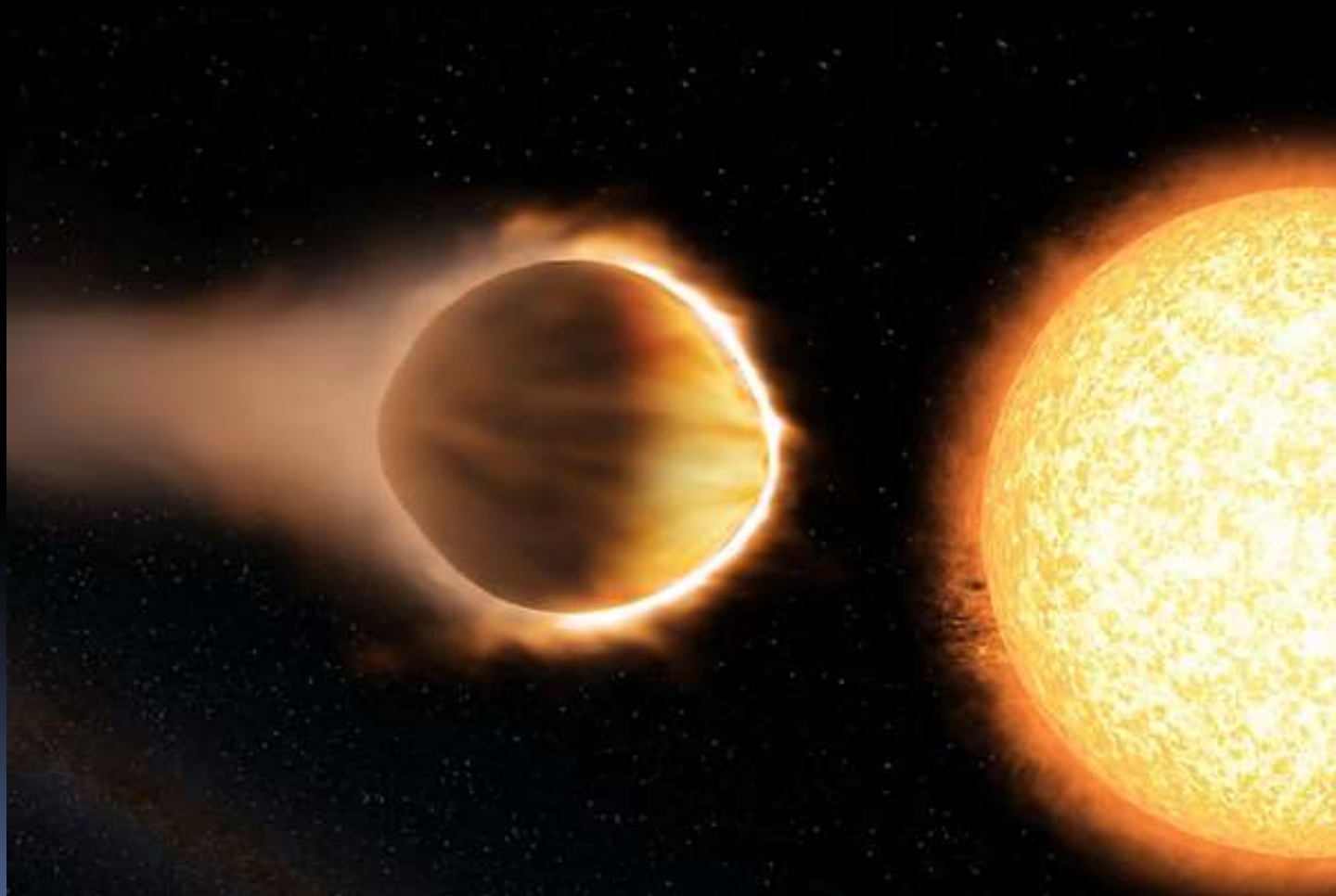


Gliese 667C e



Gliese 581 d

Hot Jupiters

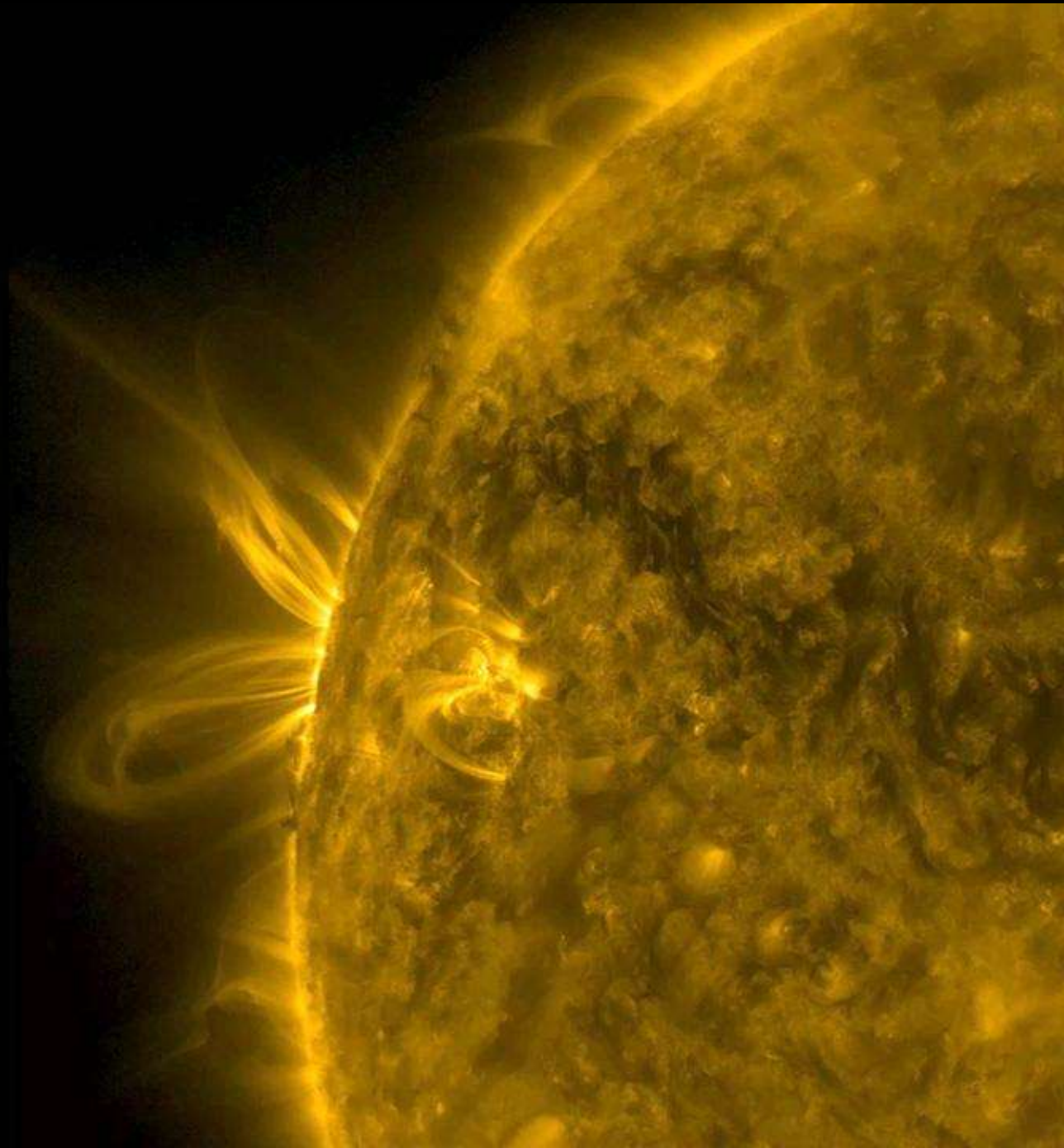


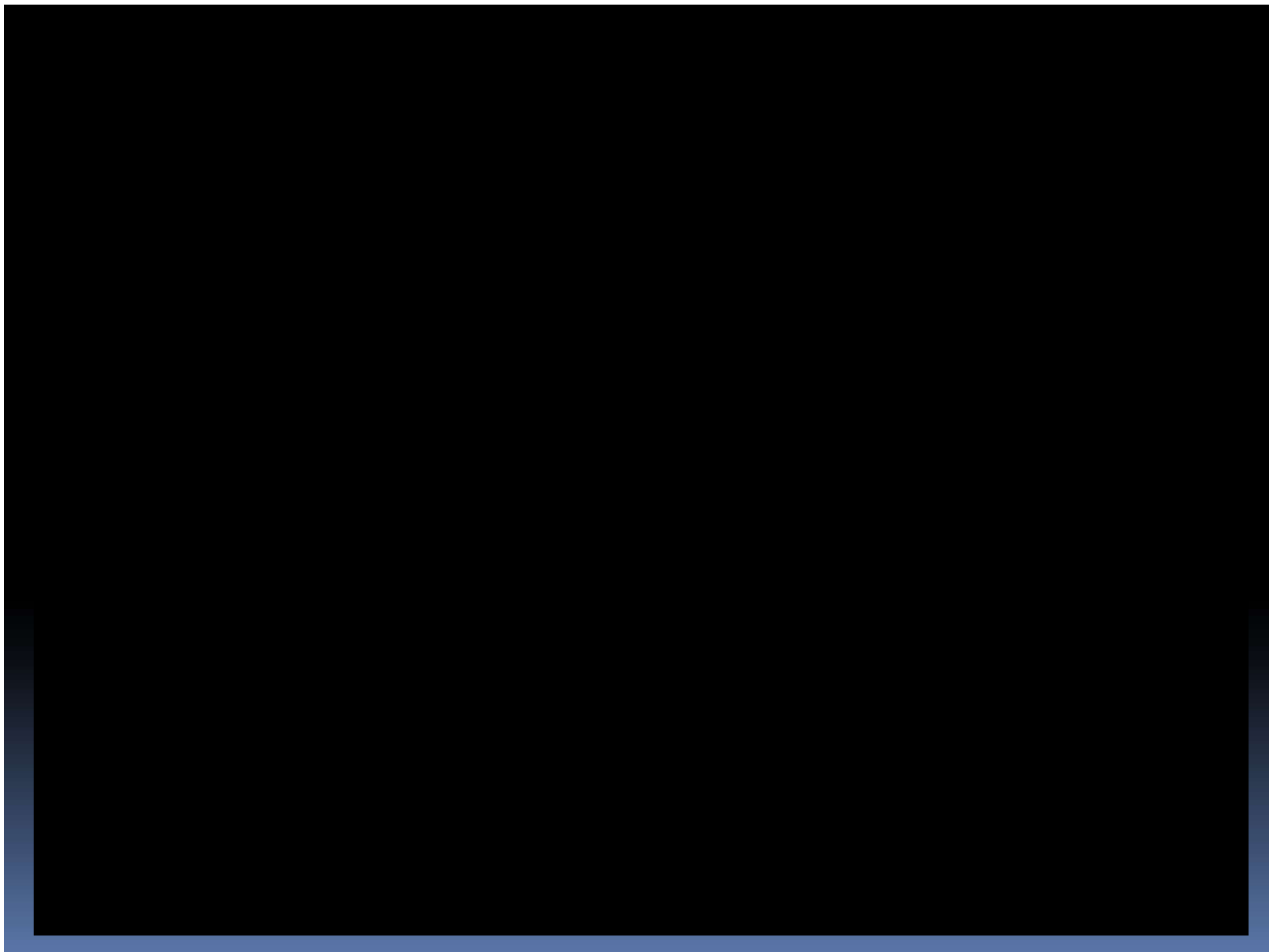
PLANETAS:

¿Cómo se forman?

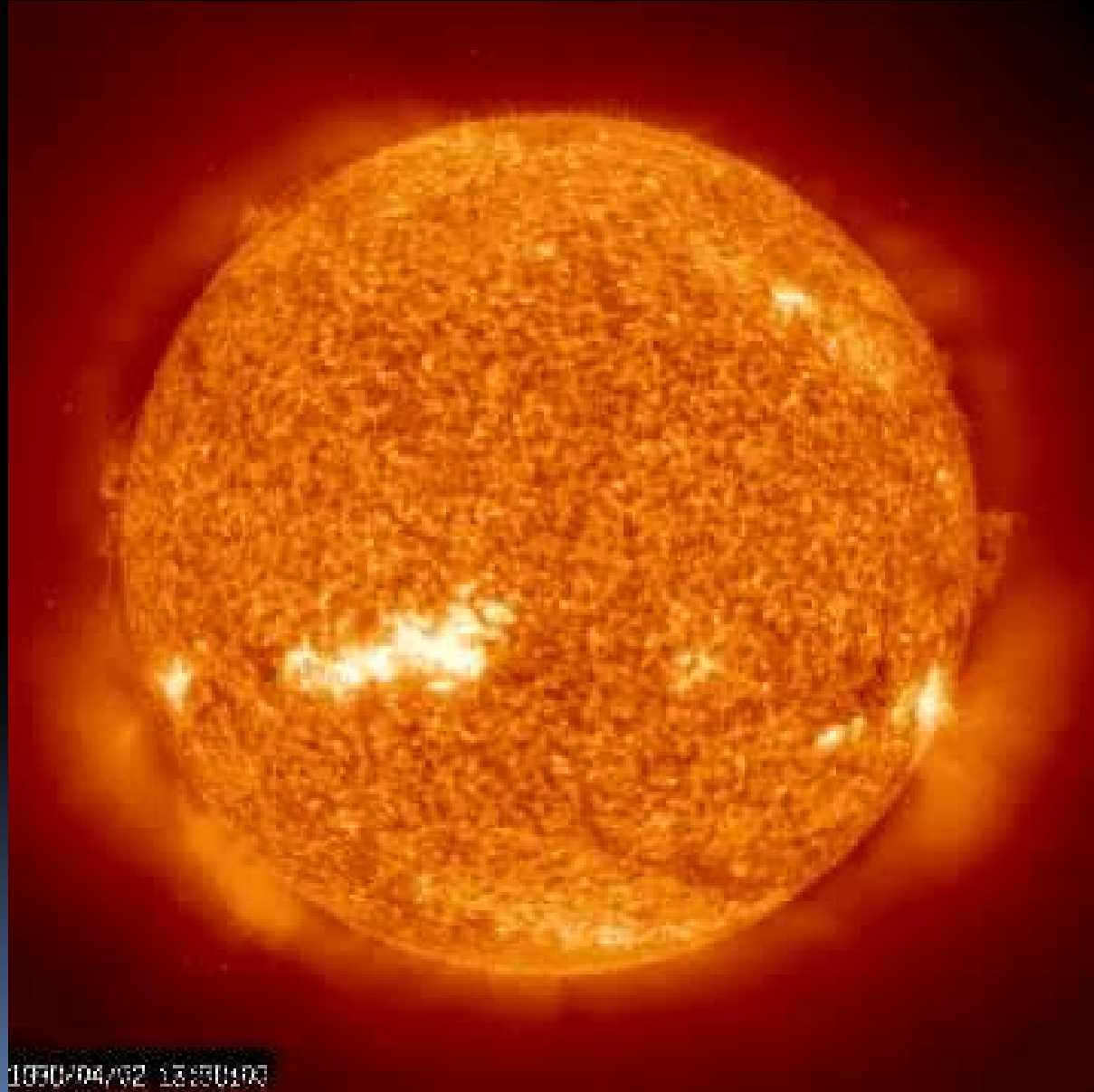
¿Cómo evolucionan?

Sol





Sol: reactor de fusión nuclear

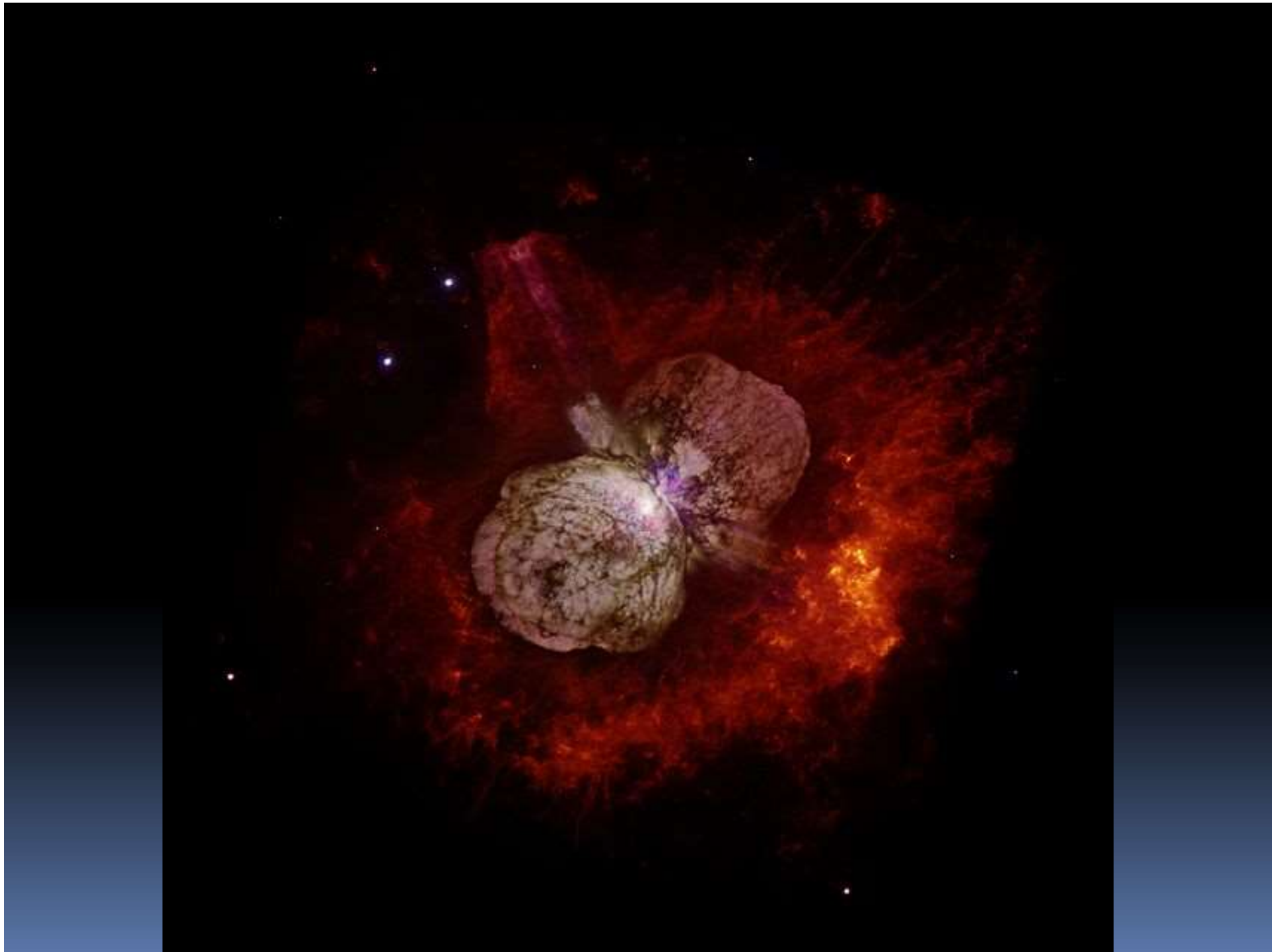


Muerte estelar

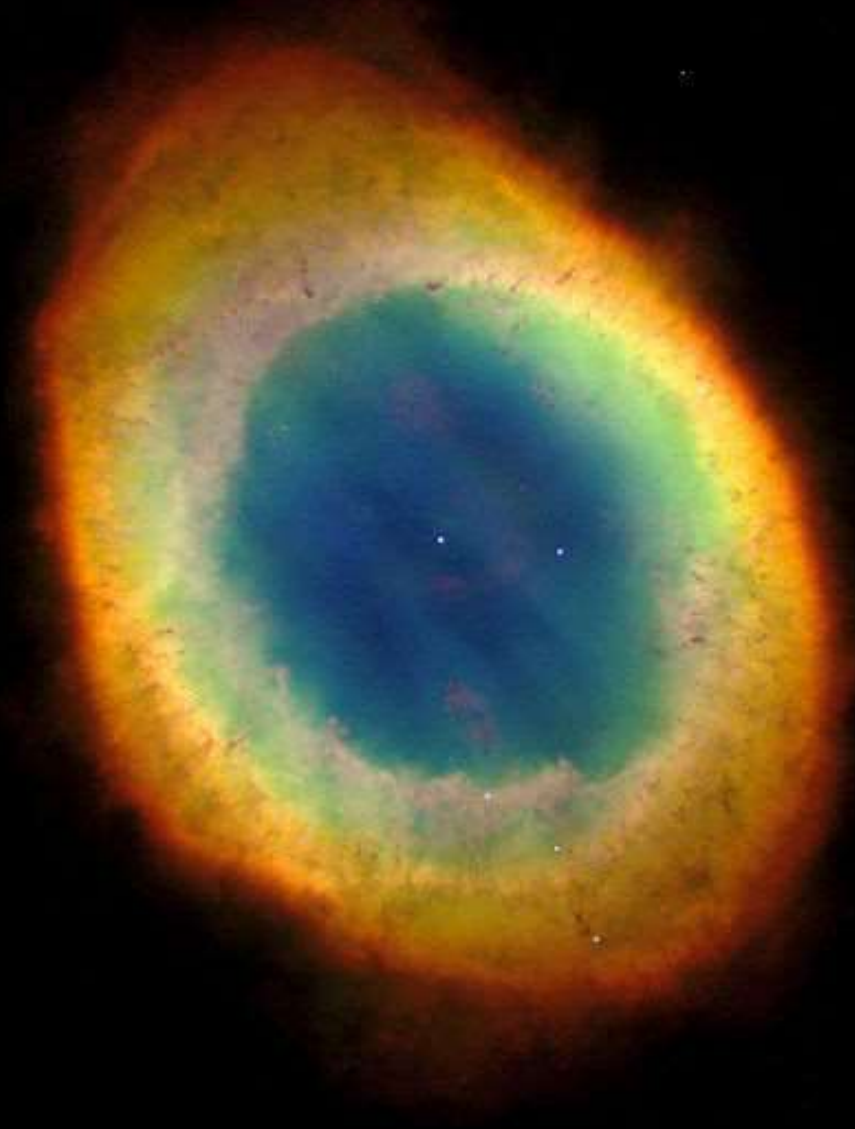




www.hubblesite.org



Medio interestelar enriquecido con “polvo” de estrellas.

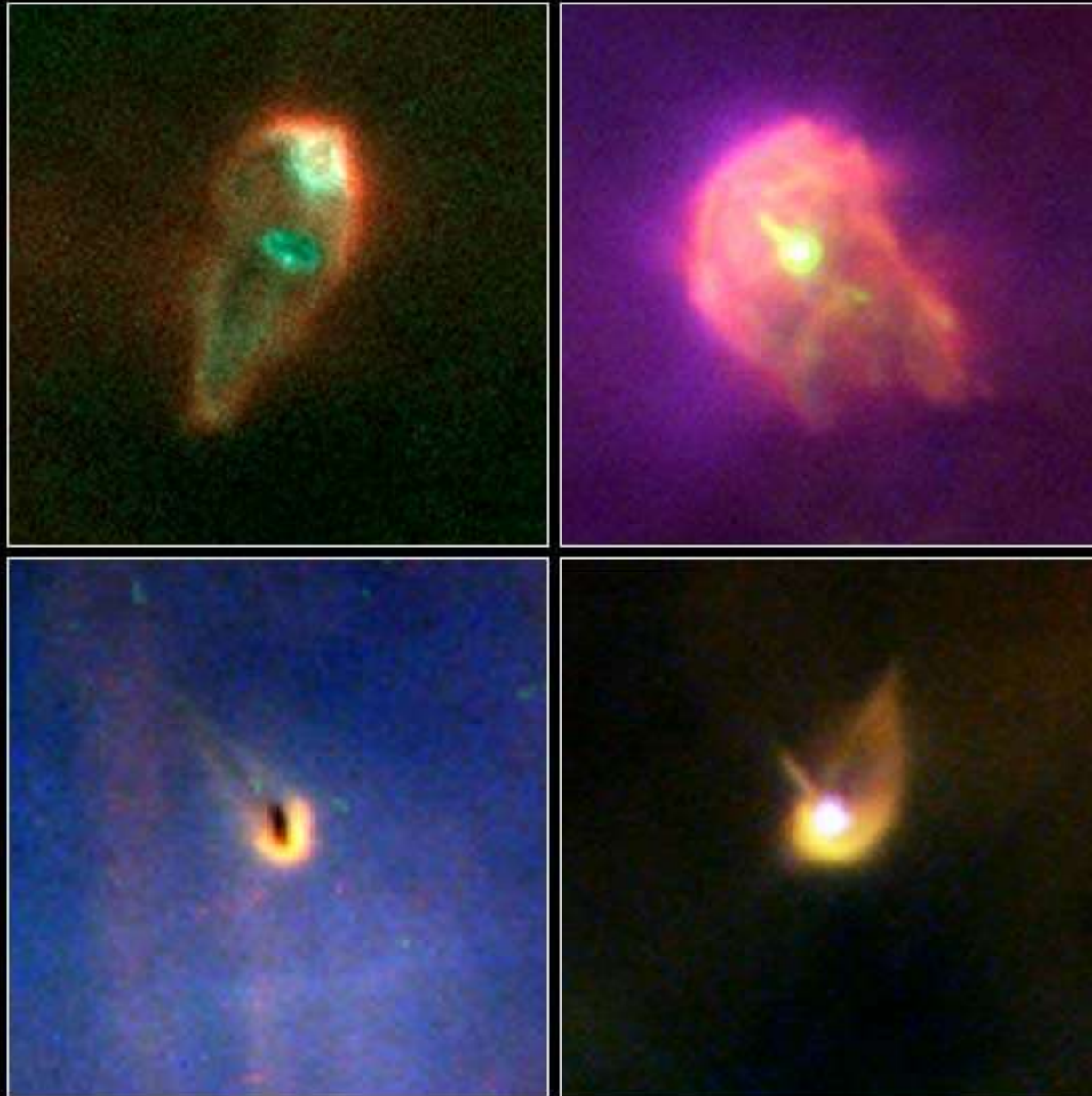


Principales elementos en el polvo: CHON



Formación estelar

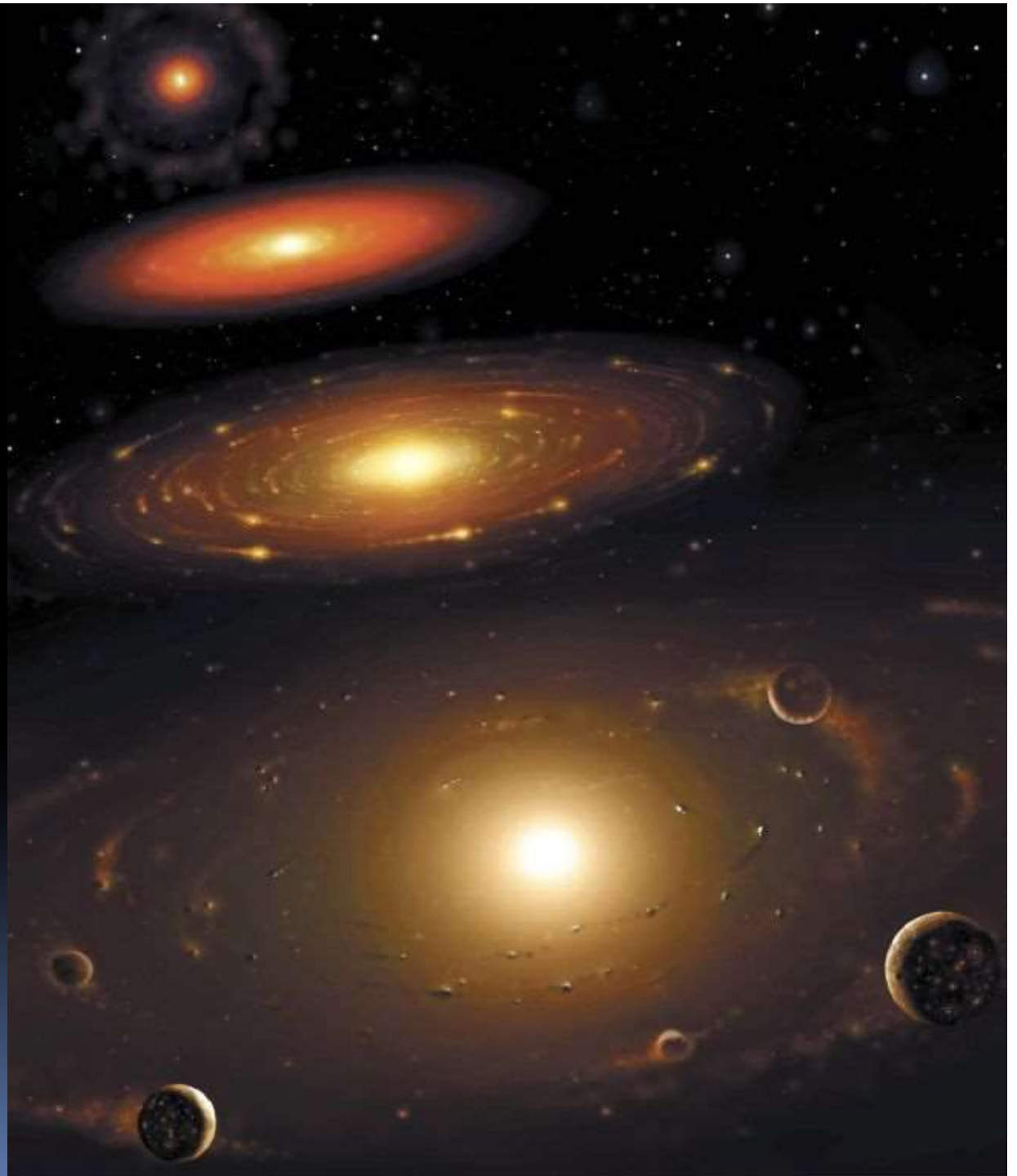




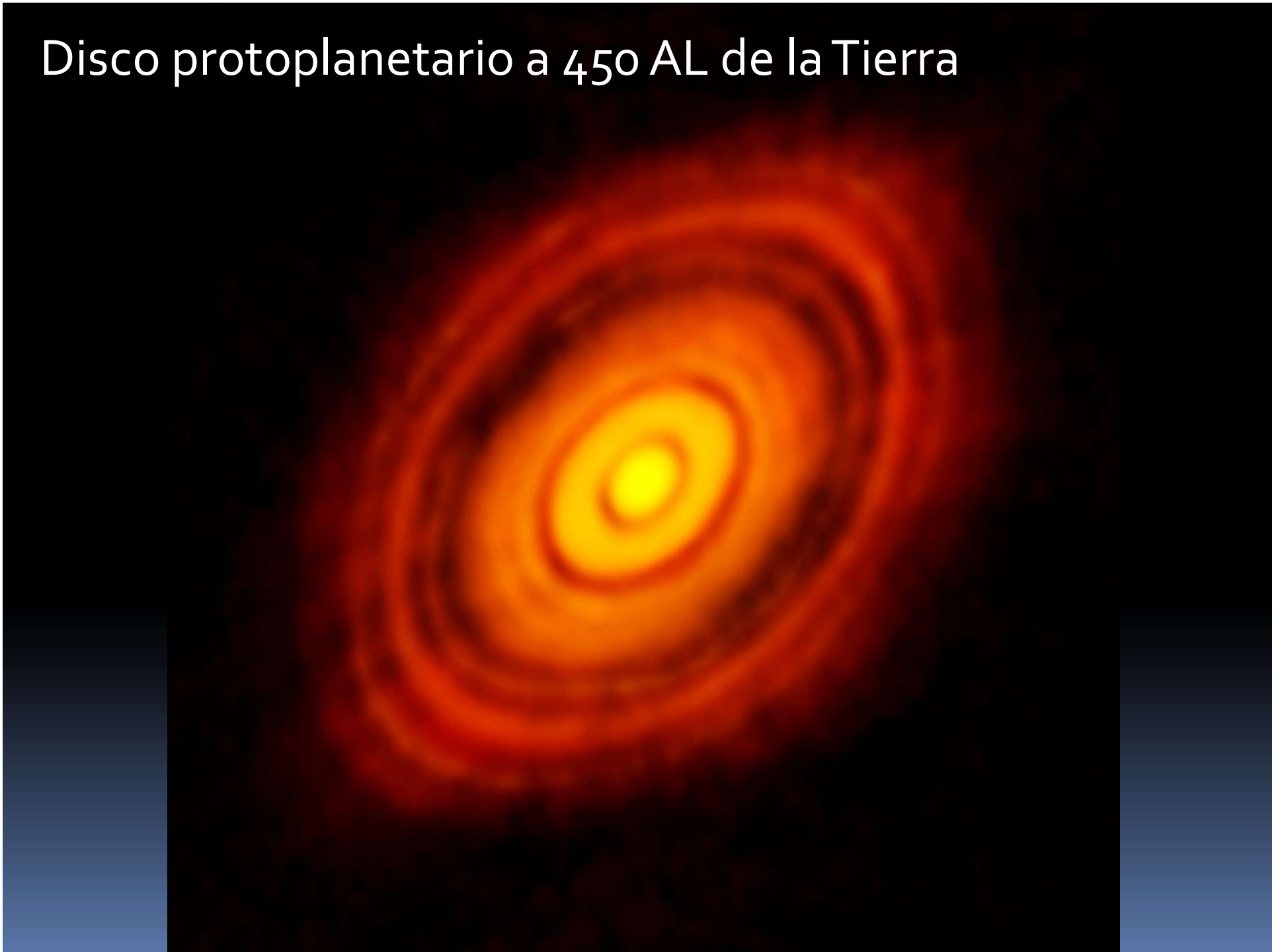
Protoplanetary Disks in the Orion Nebula HST • WFPC2

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

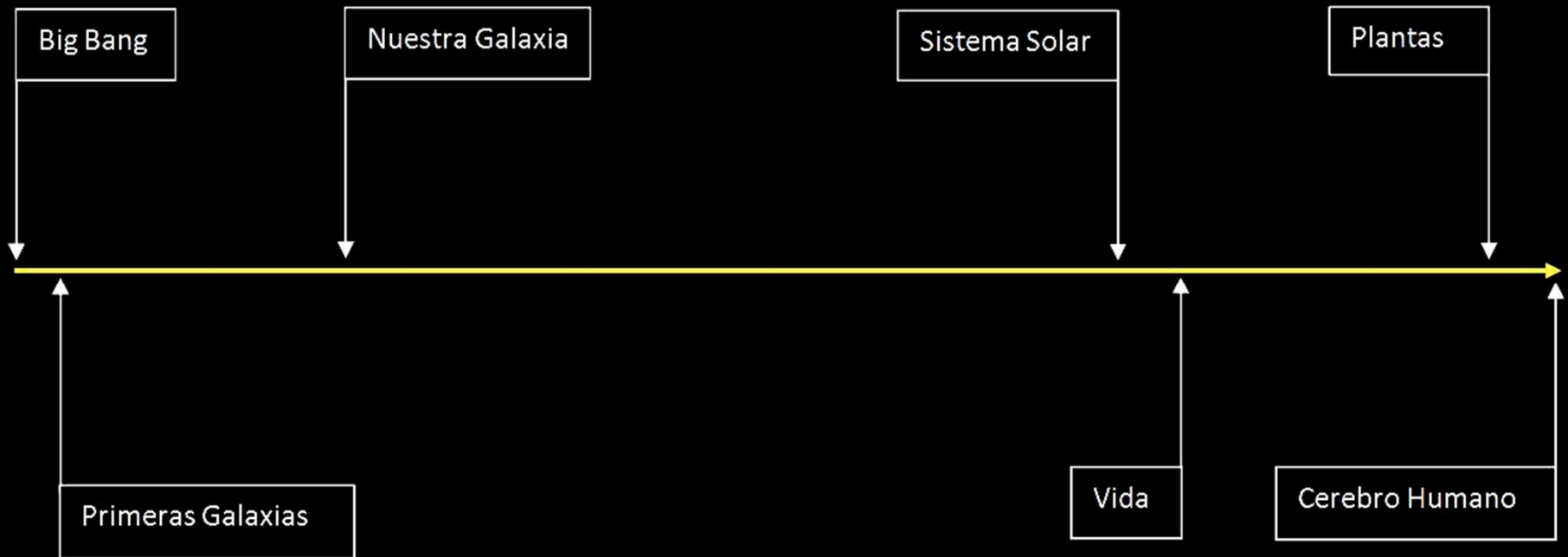
Formación del Sistema Solar



Disco protoplanetario a 450 AL de la Tierra

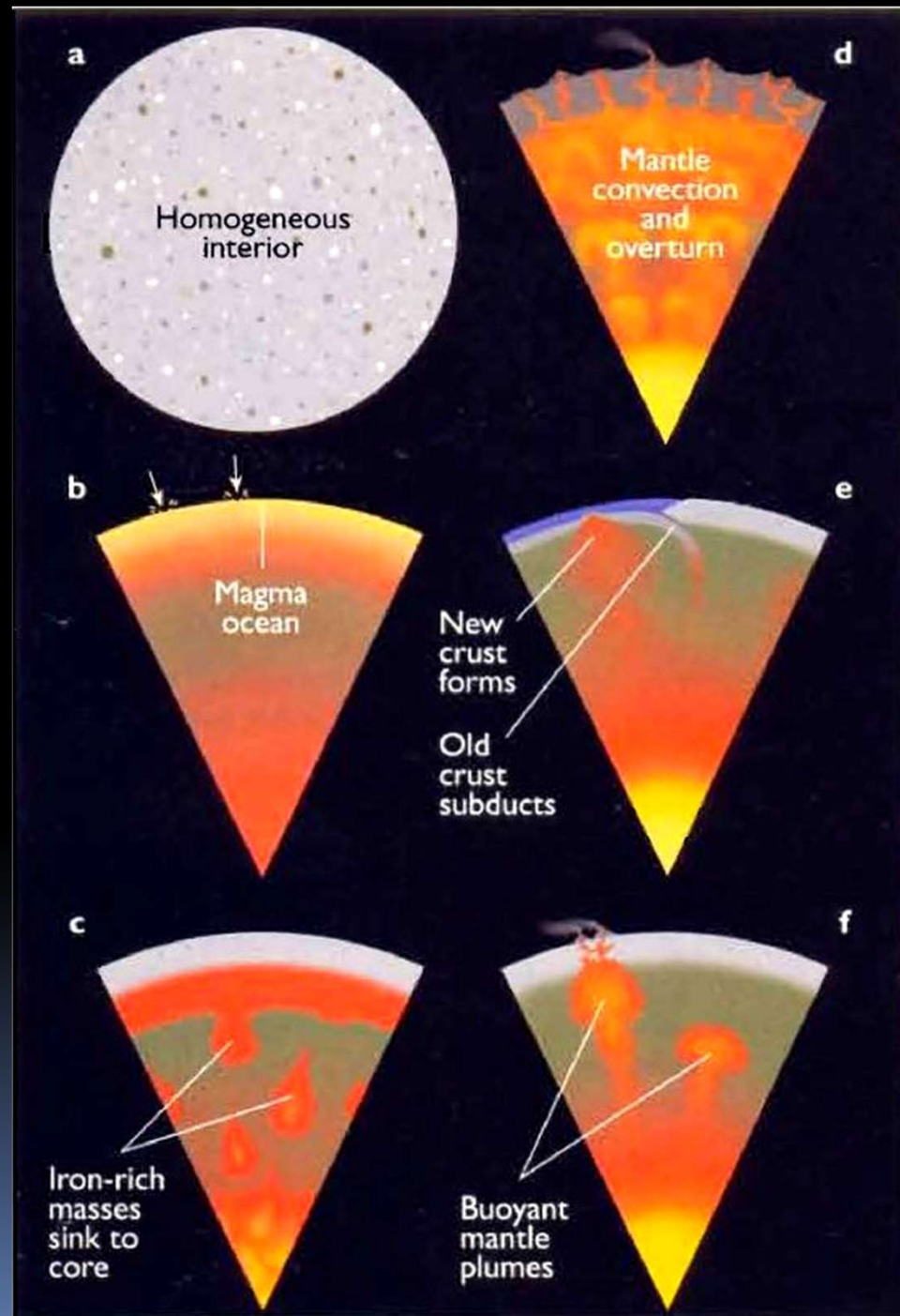


Cronología



Big Bang: hace 13.700 millones de años

Evolución planetaria

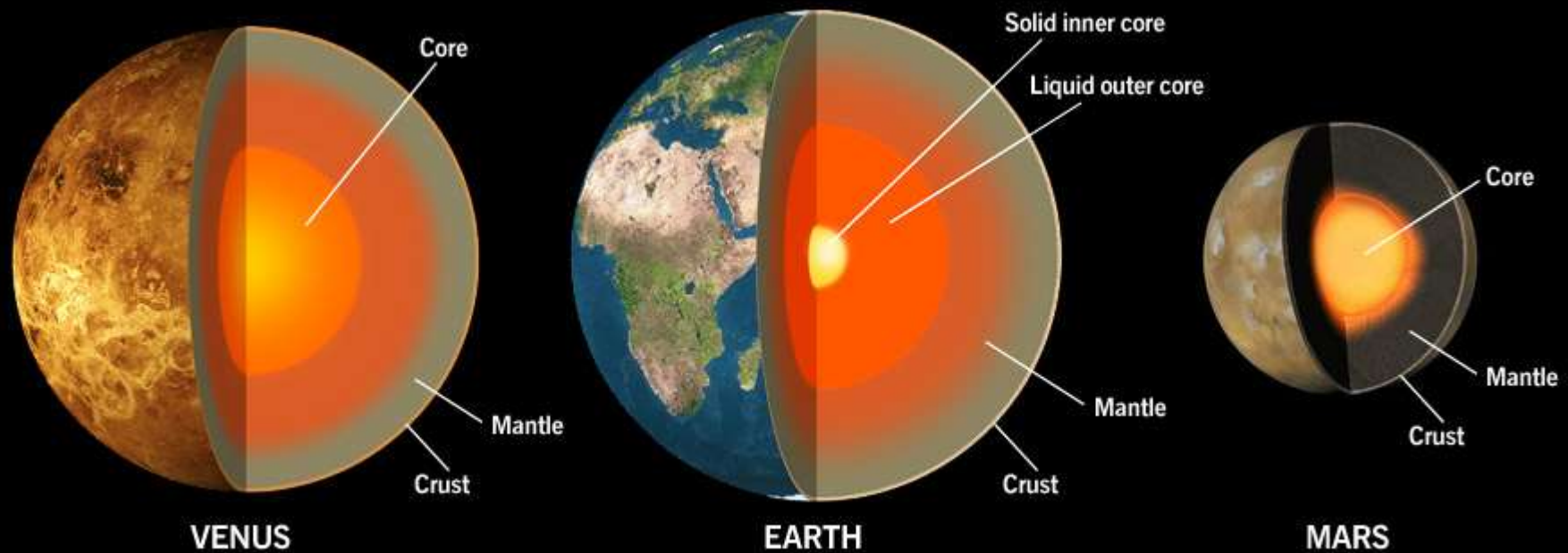


Meteorito: material primitivo

Meteorito de San Carlos



Evolución planetaria: administración del calor interno + geoquímica



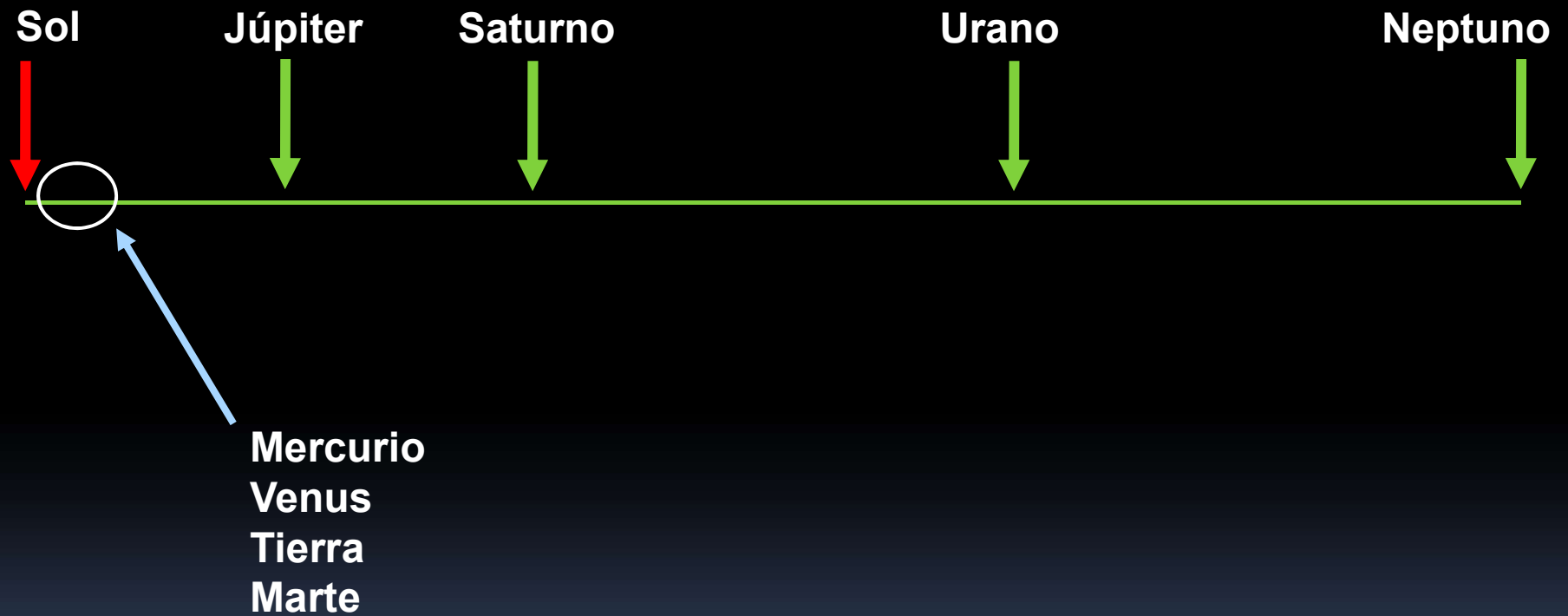
Sistema Solar

Mundos rocosos, gaseosos y helados



Sistema Solar

Distancias a escala



Evolución orbital

5.000.000 years of orbital evolution of
Jupiter, Saturn, Uranus and Neptune

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MUNDOS ROCOSOS

Mercurio: fosilizado y sin atmósfera

Día = 2 años mercurianos !

Resonancia por mareas

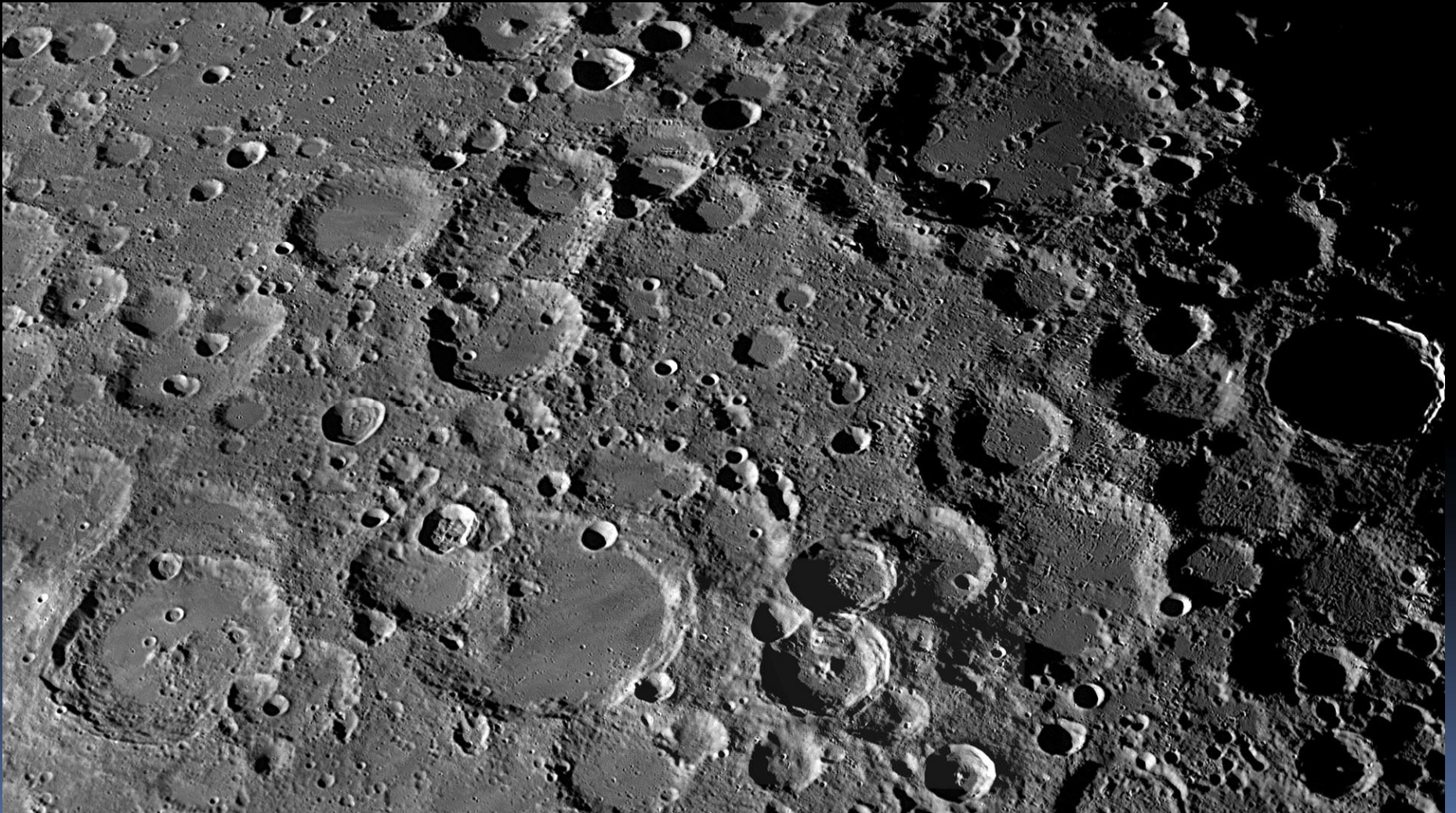
-170 C < Temperatura < 400 C

DIA

NOCHE



Cráteres lunares: bombardeo



Venus: atmósfera

Temperatura media = 500 C

Presión = 90 atm.

CO₂

No hay agua



Venus: superficie

Miles de volcanes inactivos
Imágenes de radar



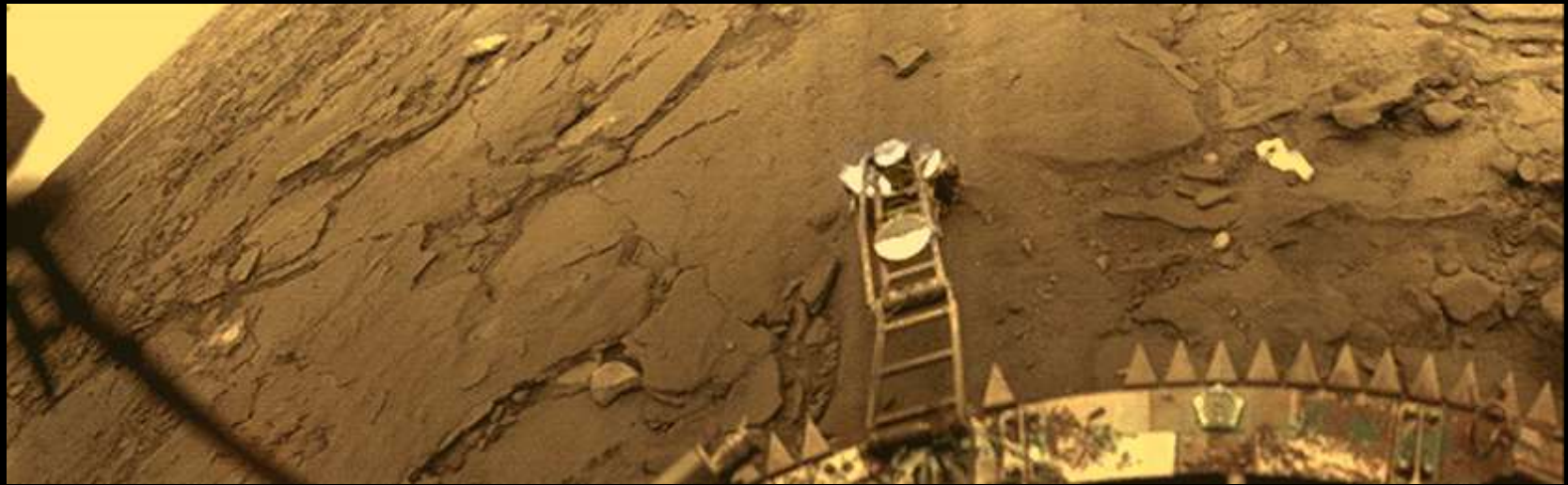
Venus

“panqueques” de lava muy viscosa



Venus

Roca sólida y seca (basaltos)

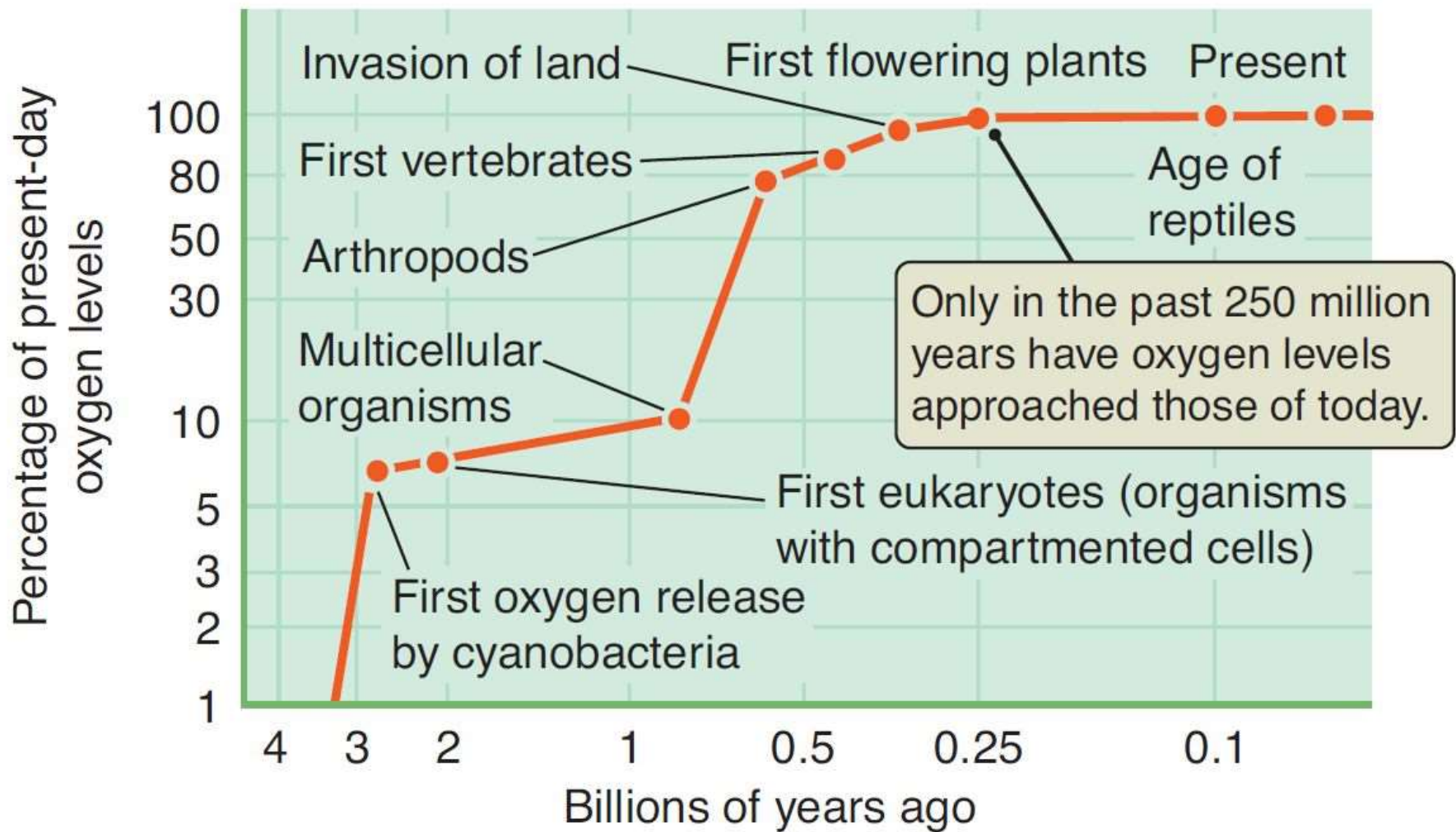


Agua sólida, líquida y gaseosa.

Única atmósfera rica en Oxígeno: energía y protección UV.

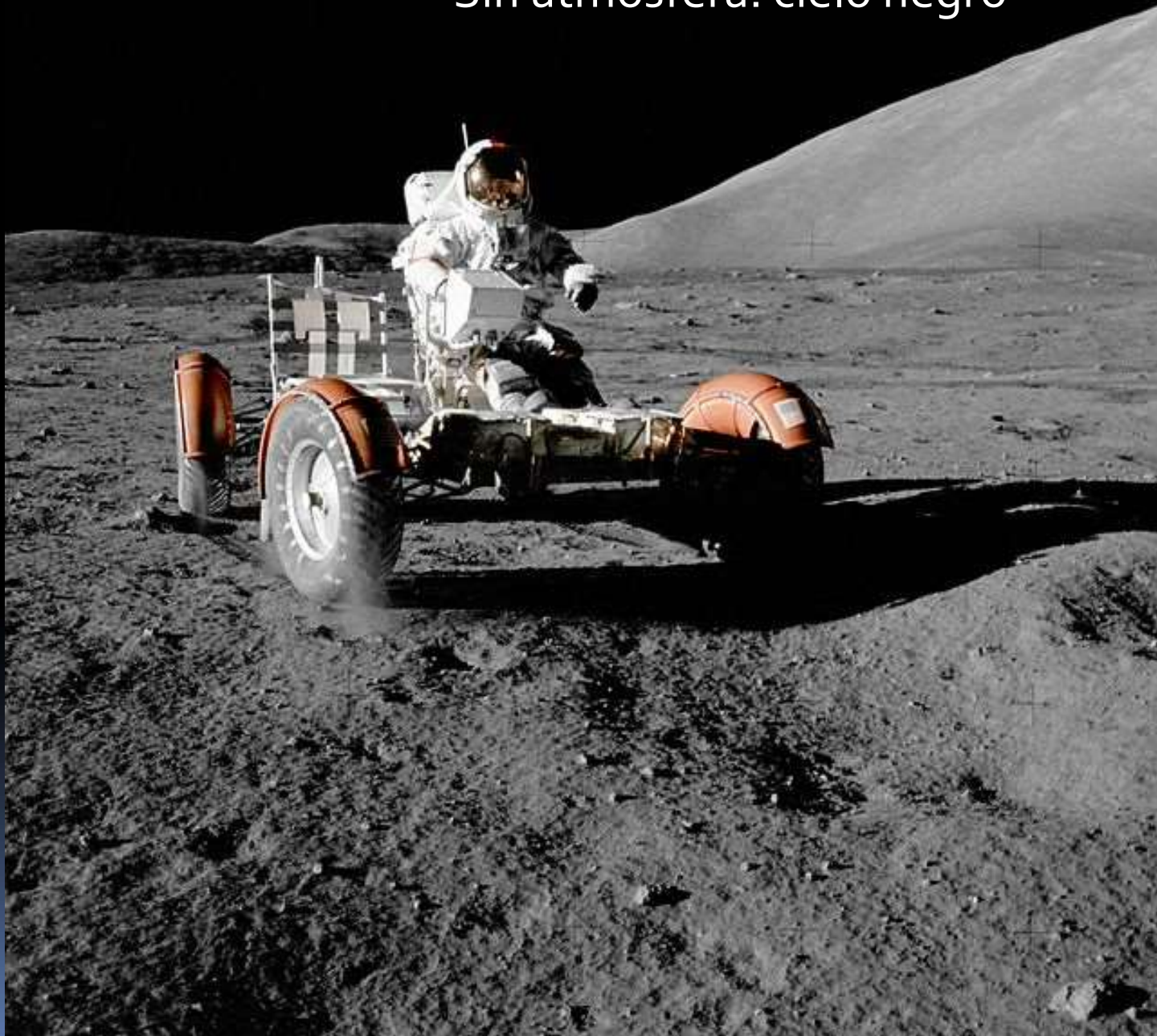


Evolución del Oxígeno



Luna

Sin atmósfera: cielo negro



Luna

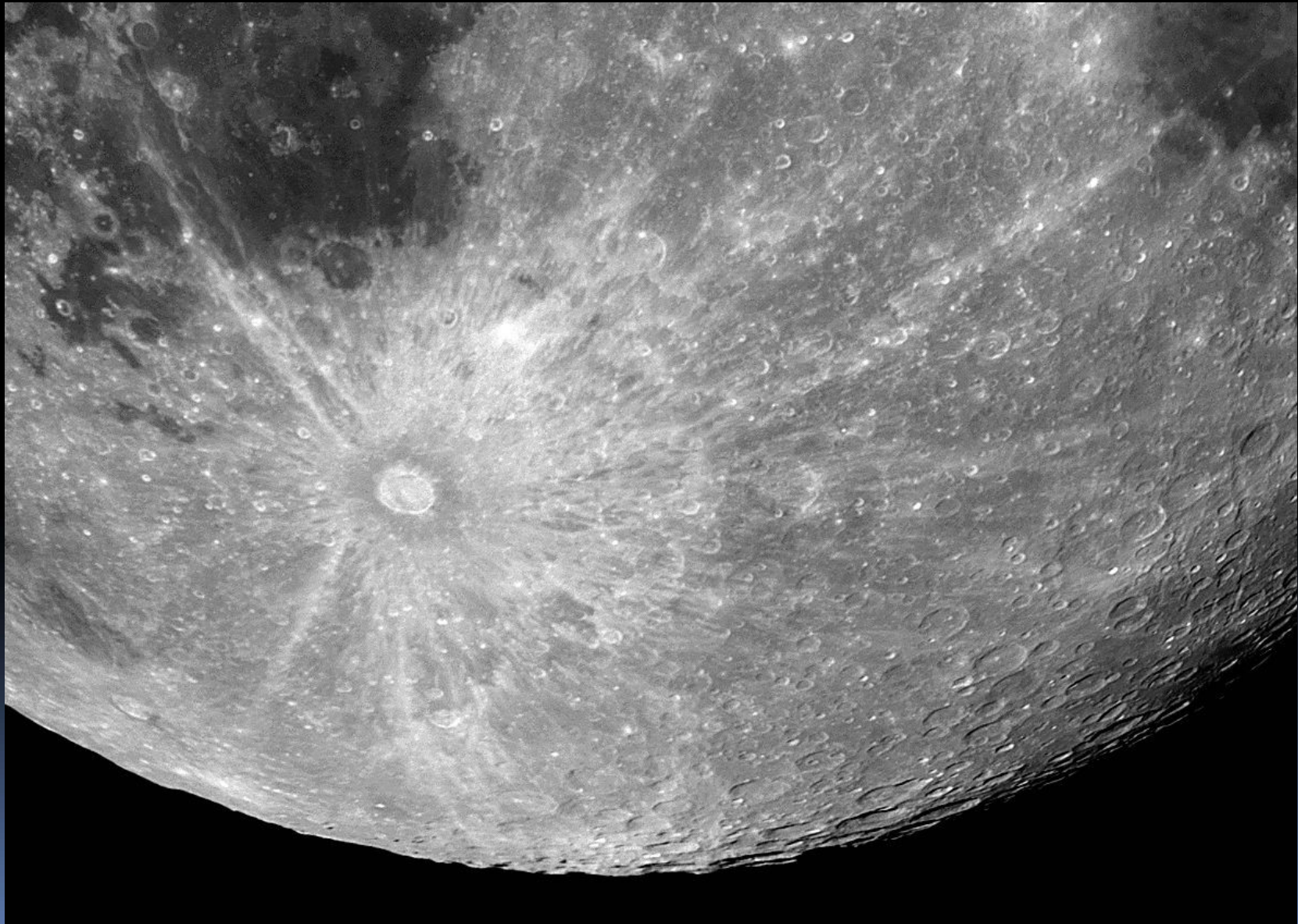
“Mares” de lava
(mas jóvenes)

Rotación sincrónica
por mareas



Cráter Tycho

"Joven" gran cráter (100 MA)

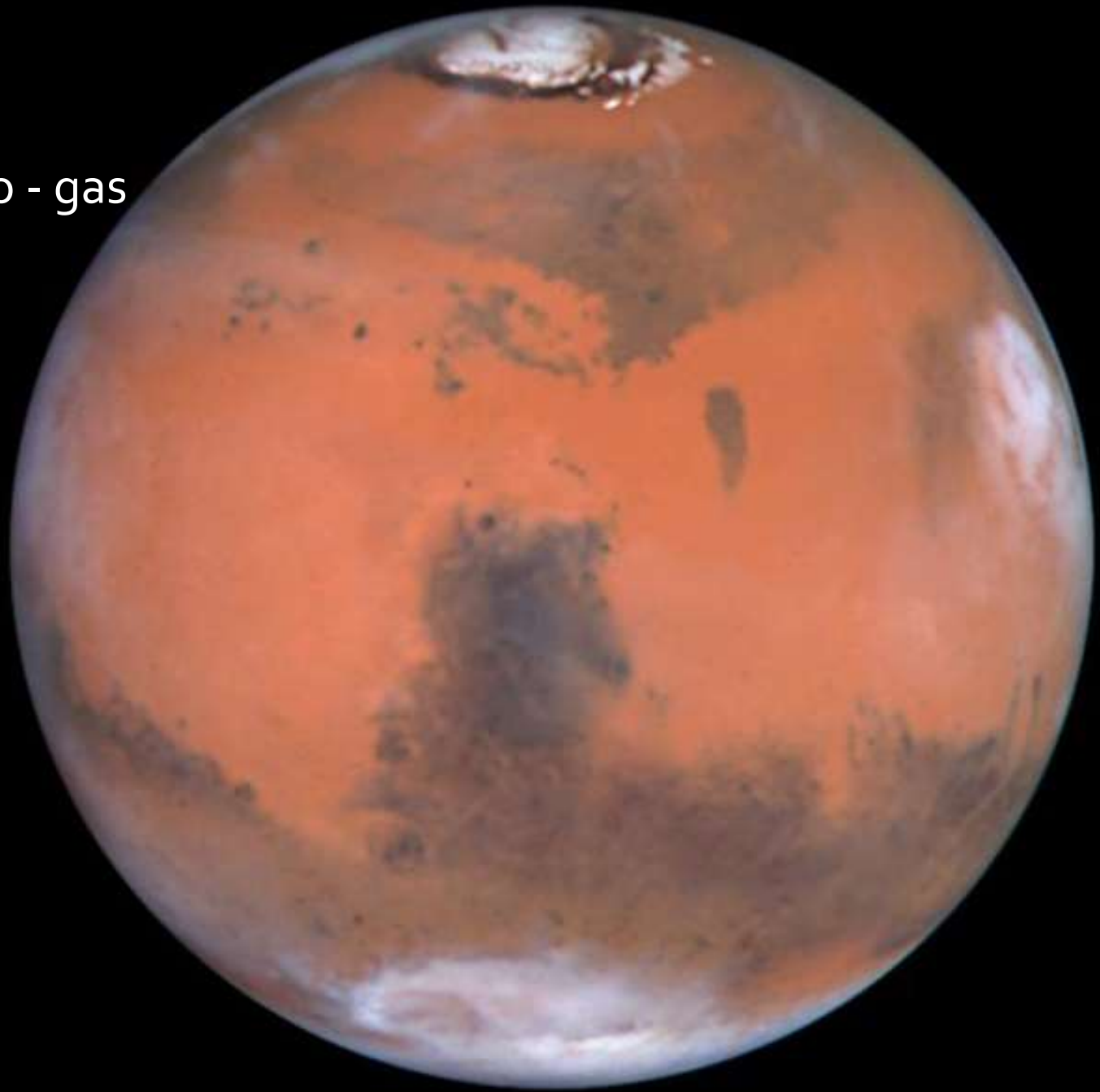


Cráter Arizona: hace 10.000 años



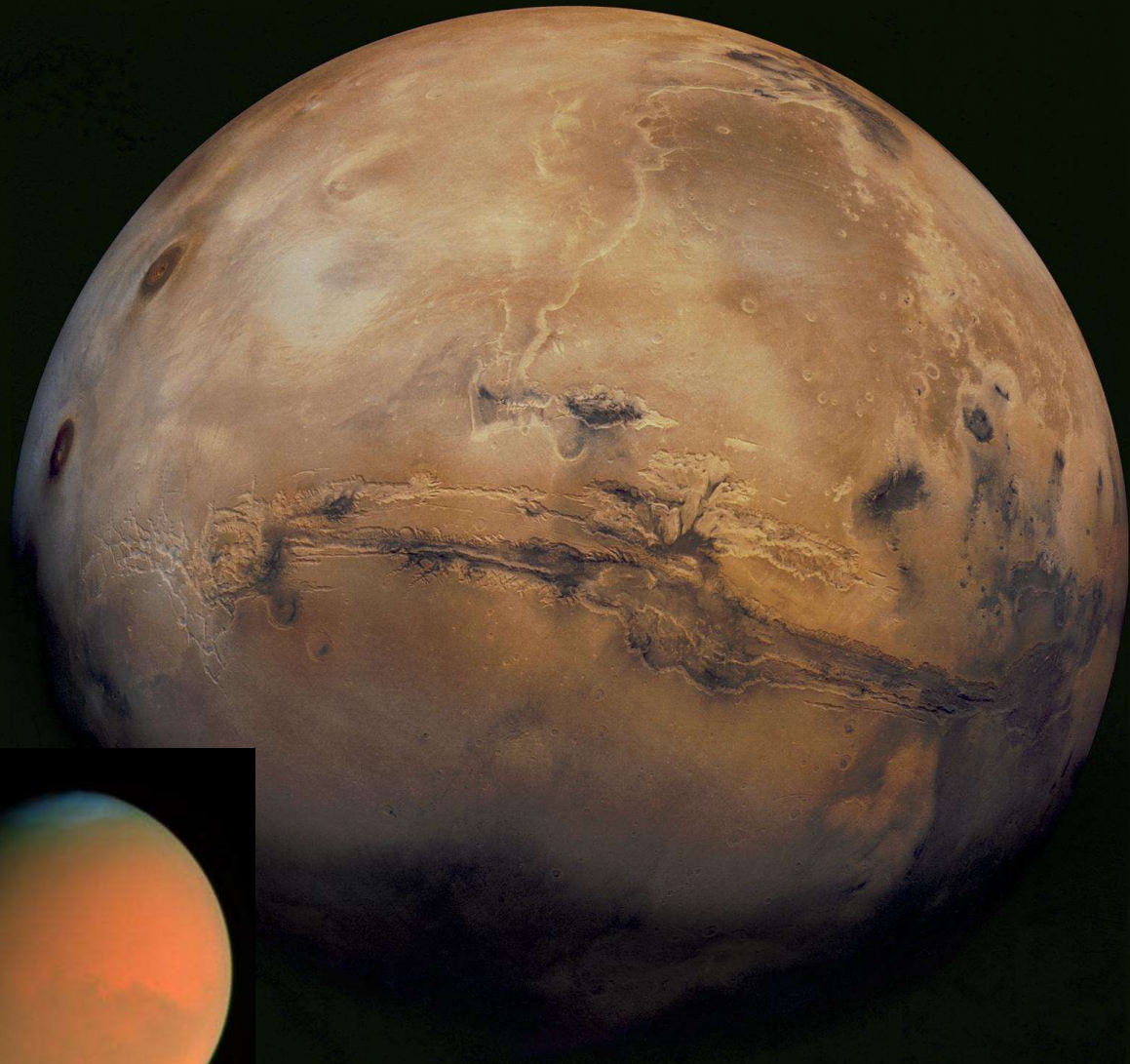
Marte

Ciclo CO₂ hielo - gas



Marte

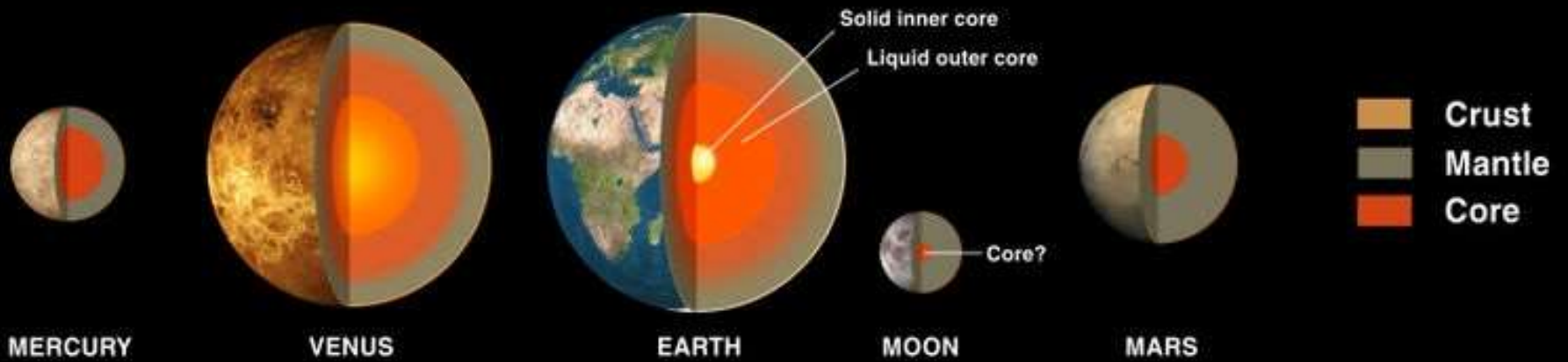
Volcanes fosilizados
Erosión por fluidos
Agua en el pasado



June 26, 2001

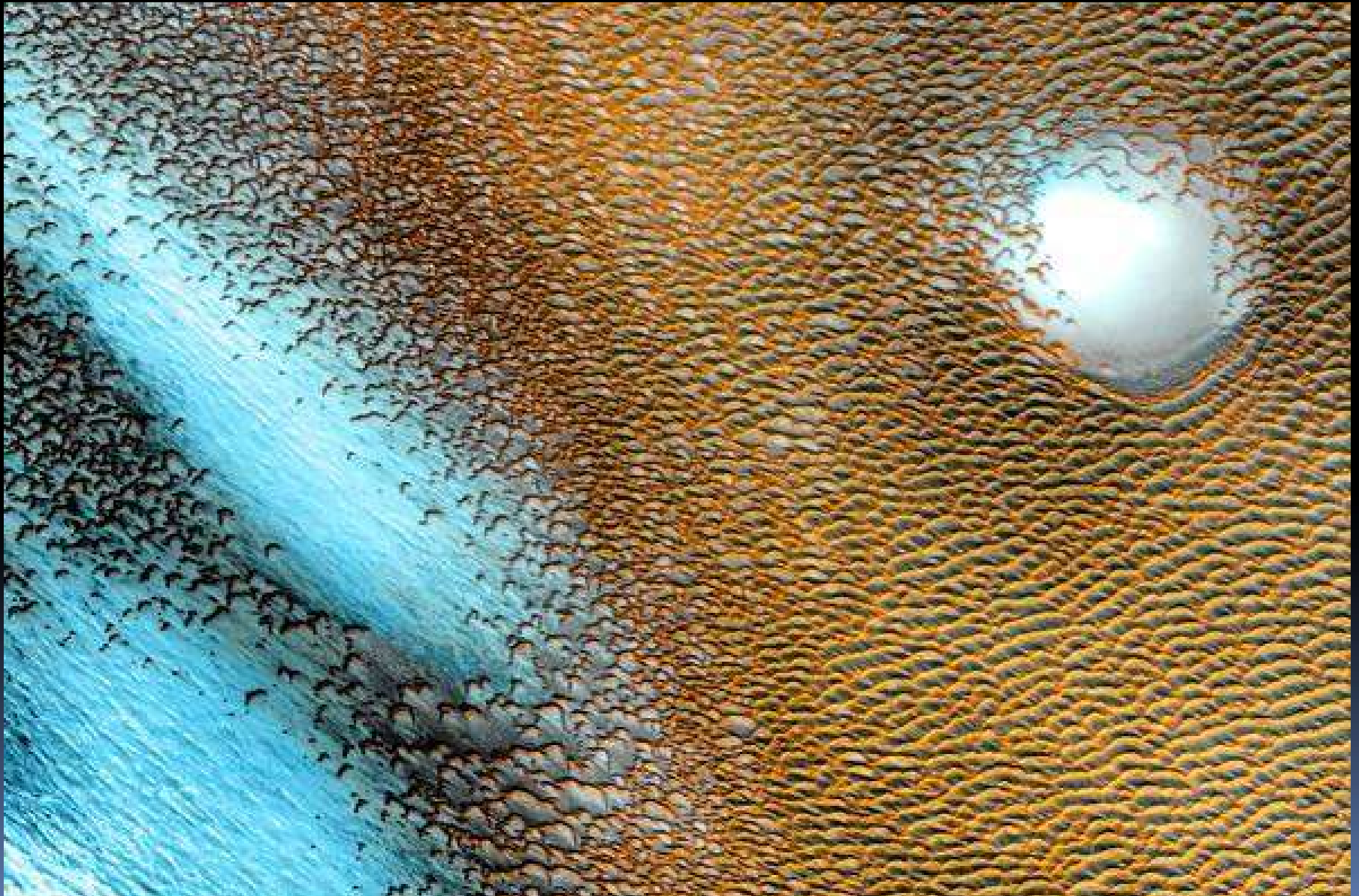


September 4, 2001



Marte

Dunas



Marte

Dunas: actividad eólica



Marte

Tornados



Tormenta de polvo



Marte

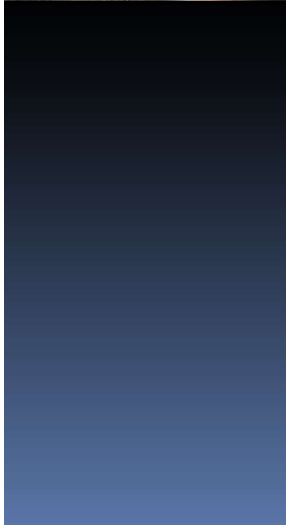
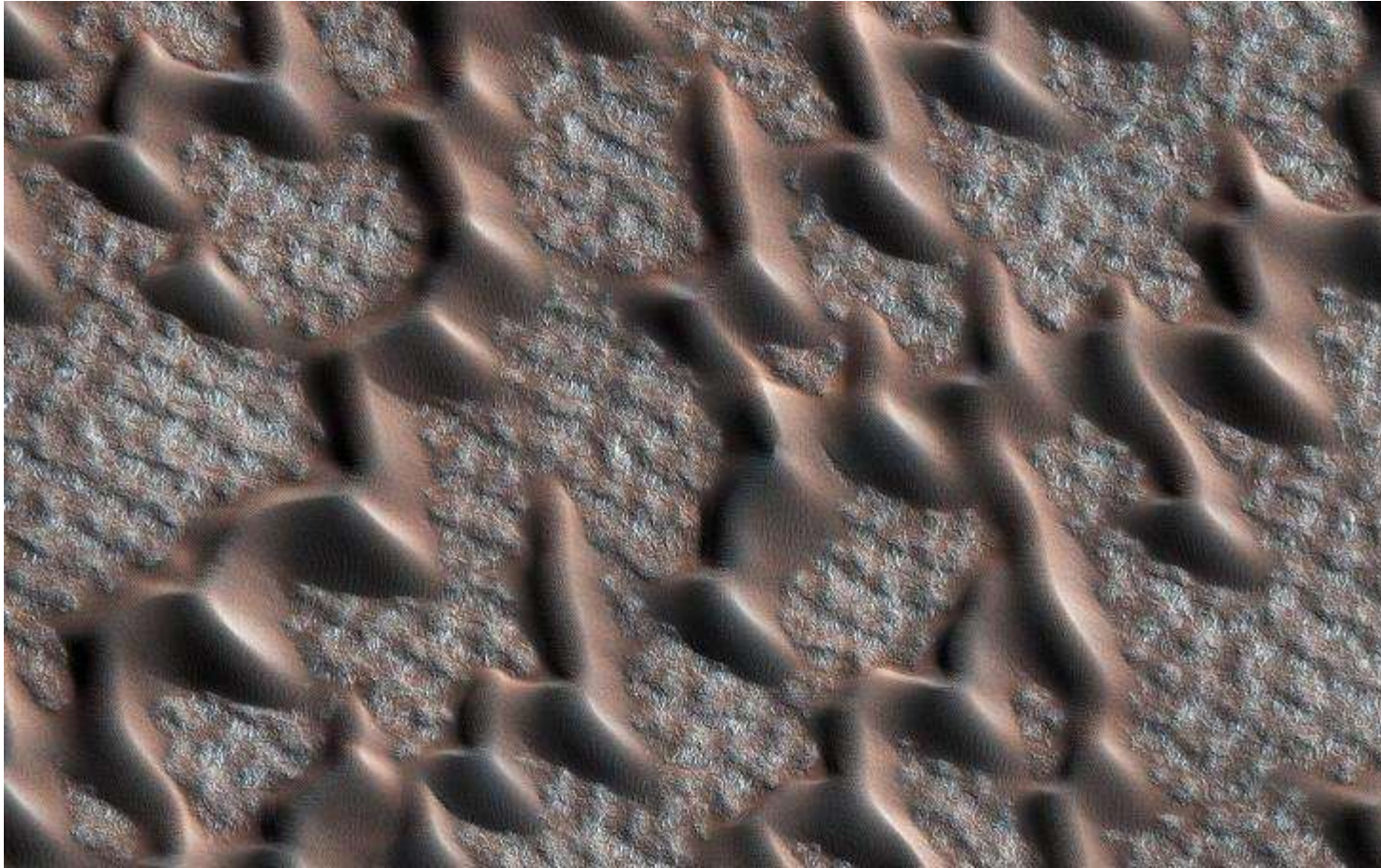
Dunas cubiertas de CO₂



Marte



Marte



Marte

Sin agua superficial.

Hielo subsuperficial (permafrost)



Deimos (satélite de Marte)



2 km

Fobos (satélite de Marte)



Astroide Eros



Itokawa

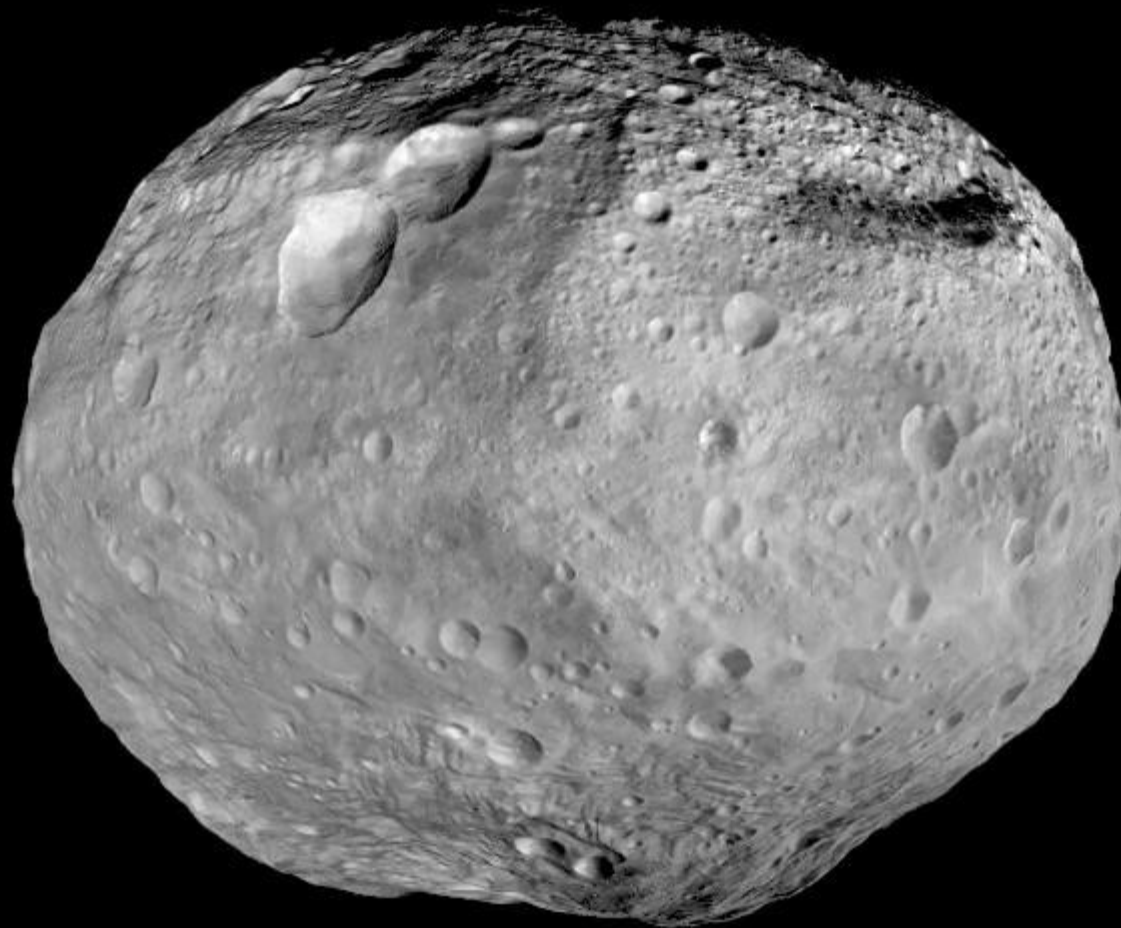
“Pila de escombros”

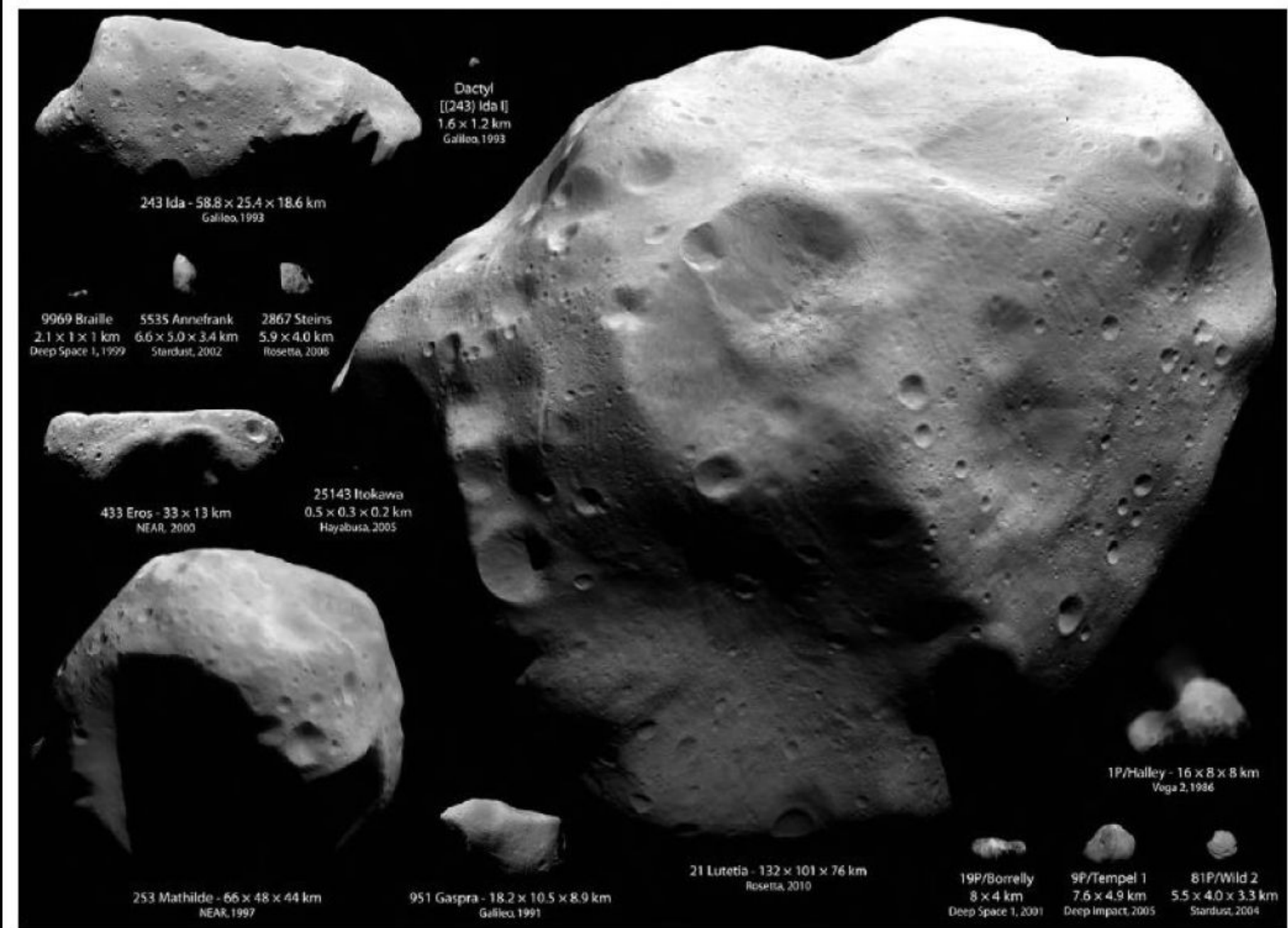


Ceres(planeta enano)



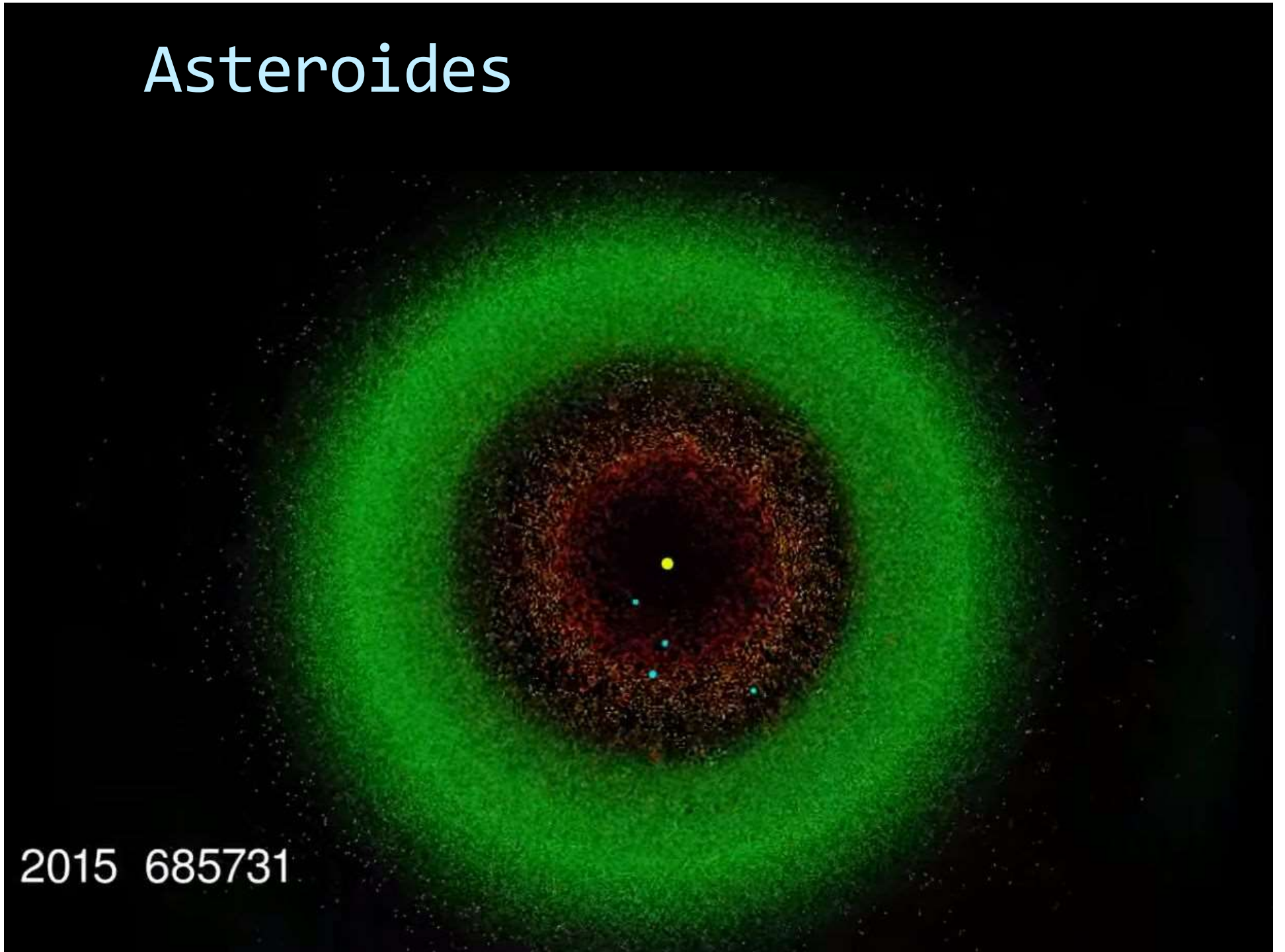
Vesta



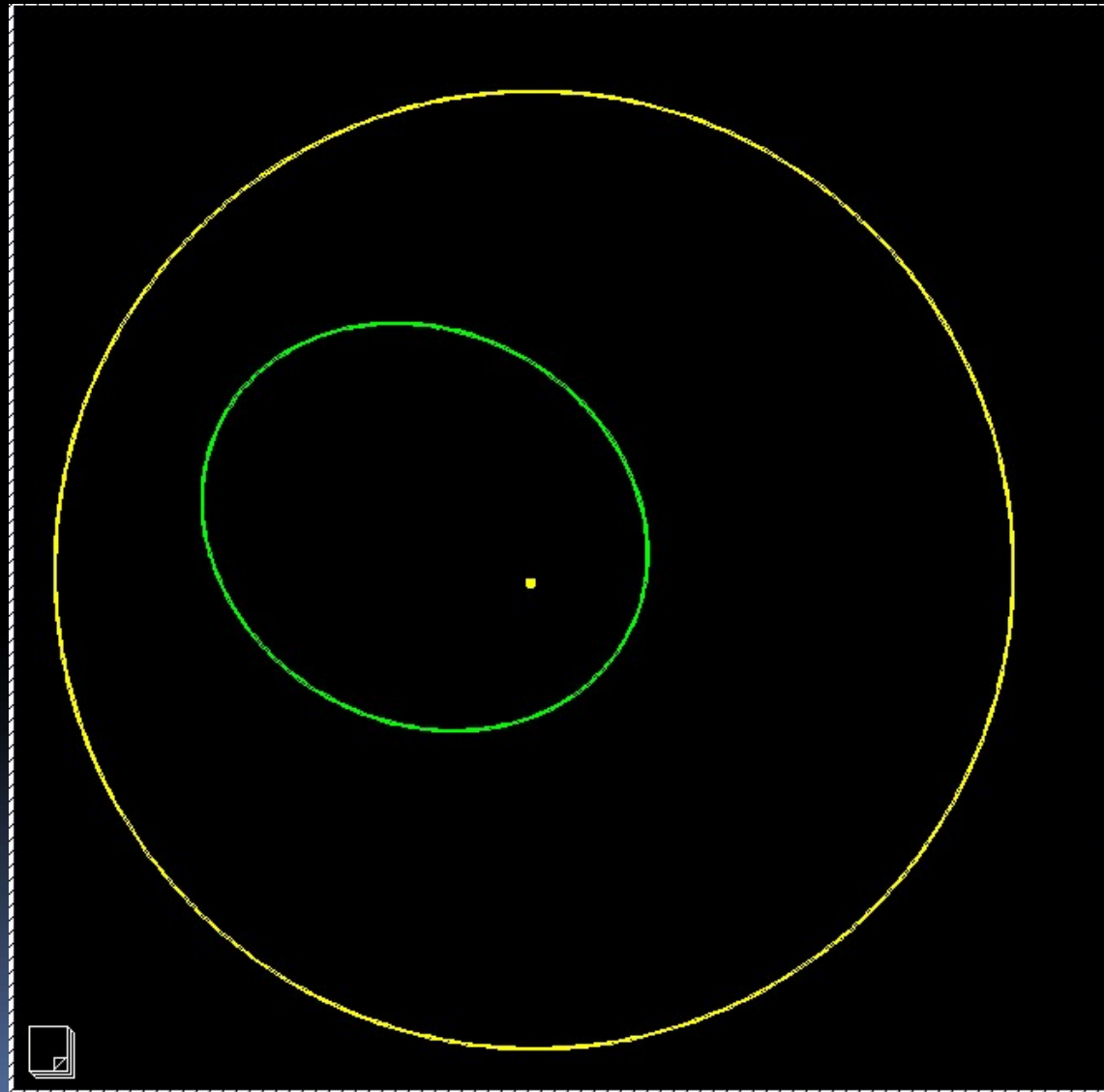


Asteroides

2015 685731

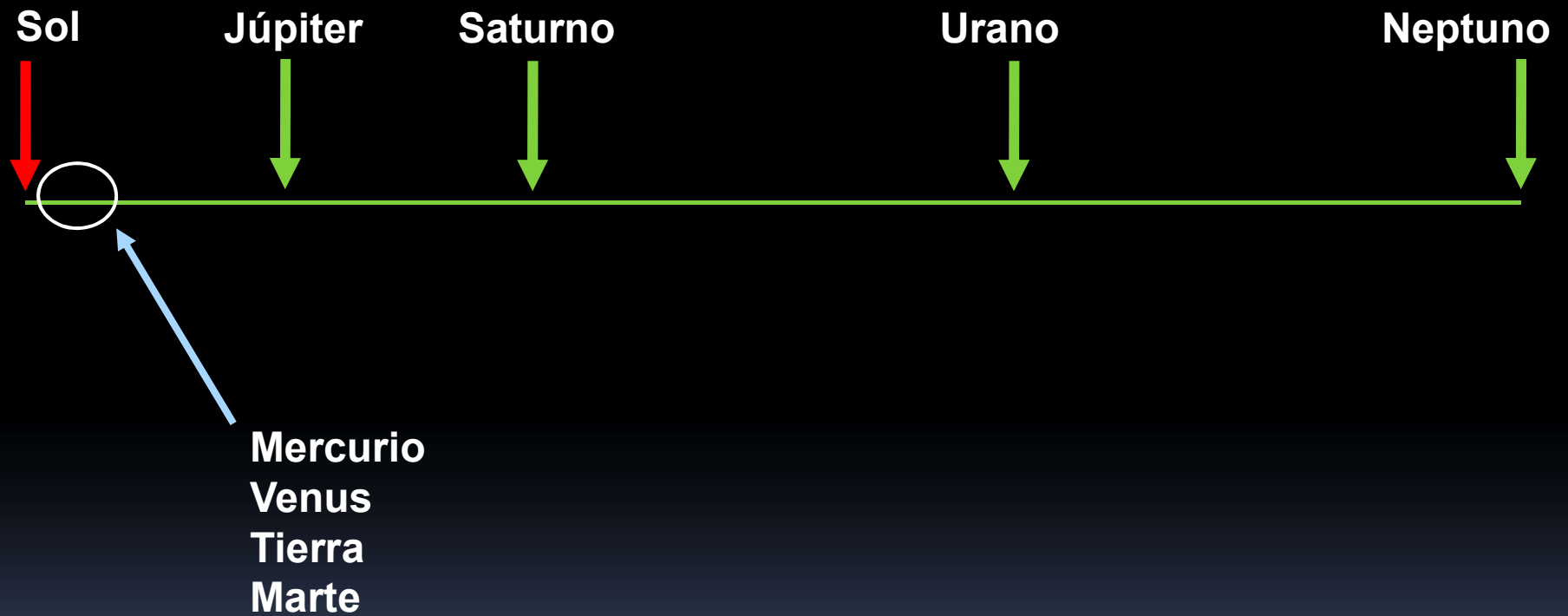


Evolution orbital de asteroide



Sistema Solar

Distancias a escala



MUNDOS GASEOSOS Y HELADOS

Júpiter

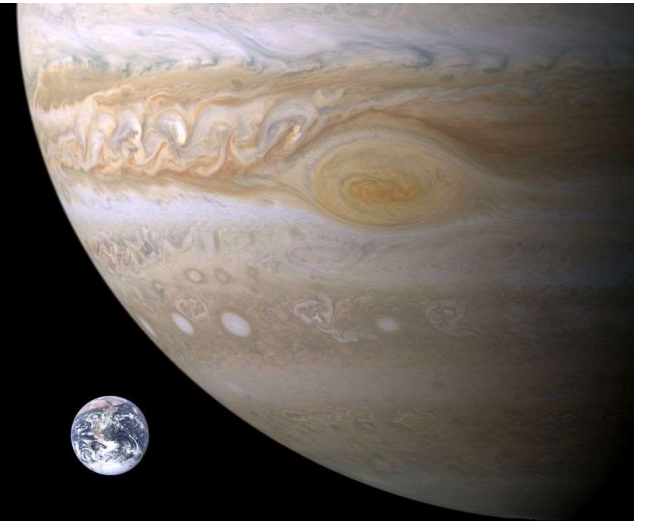
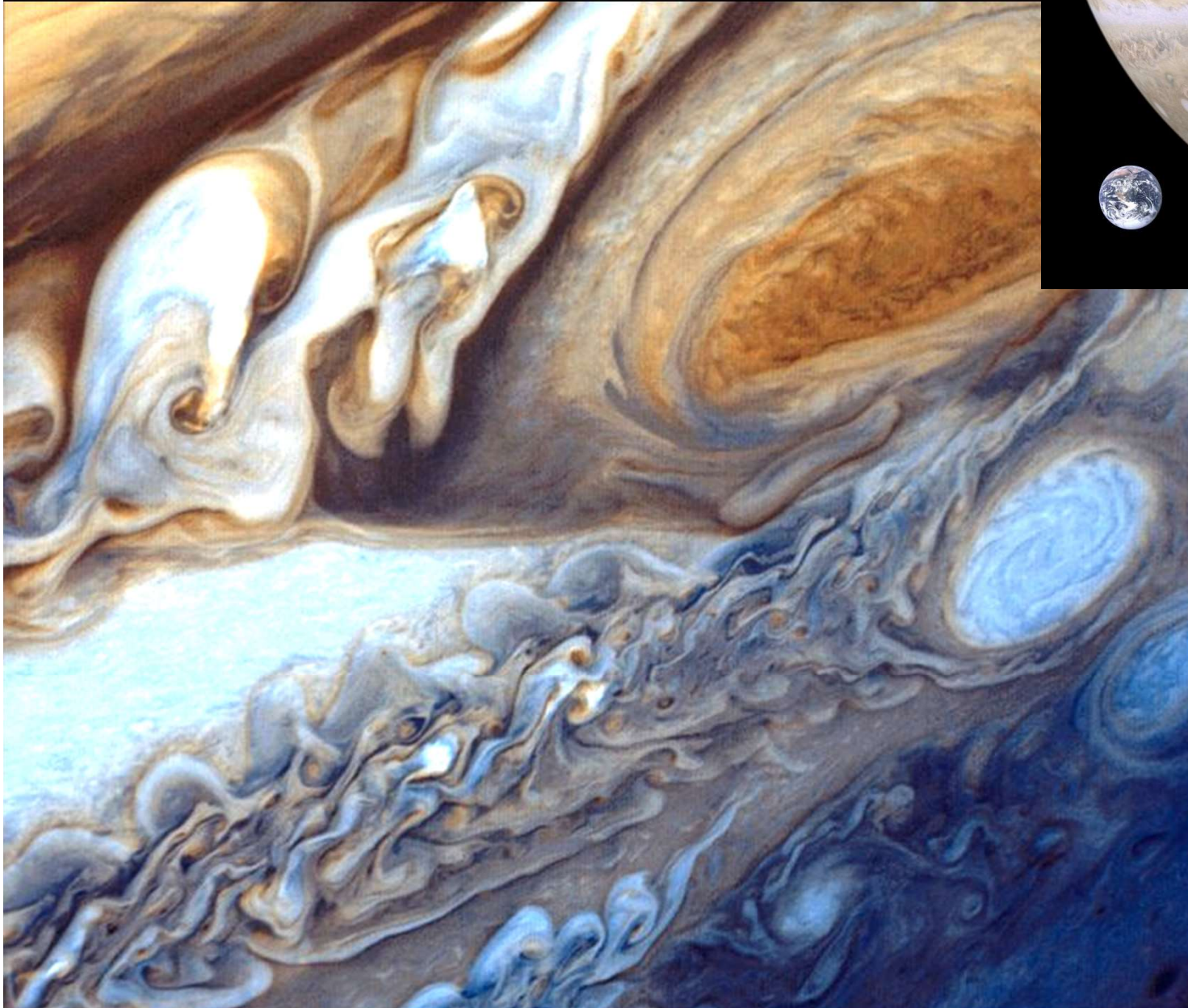
H + He

Temp.: -170 C

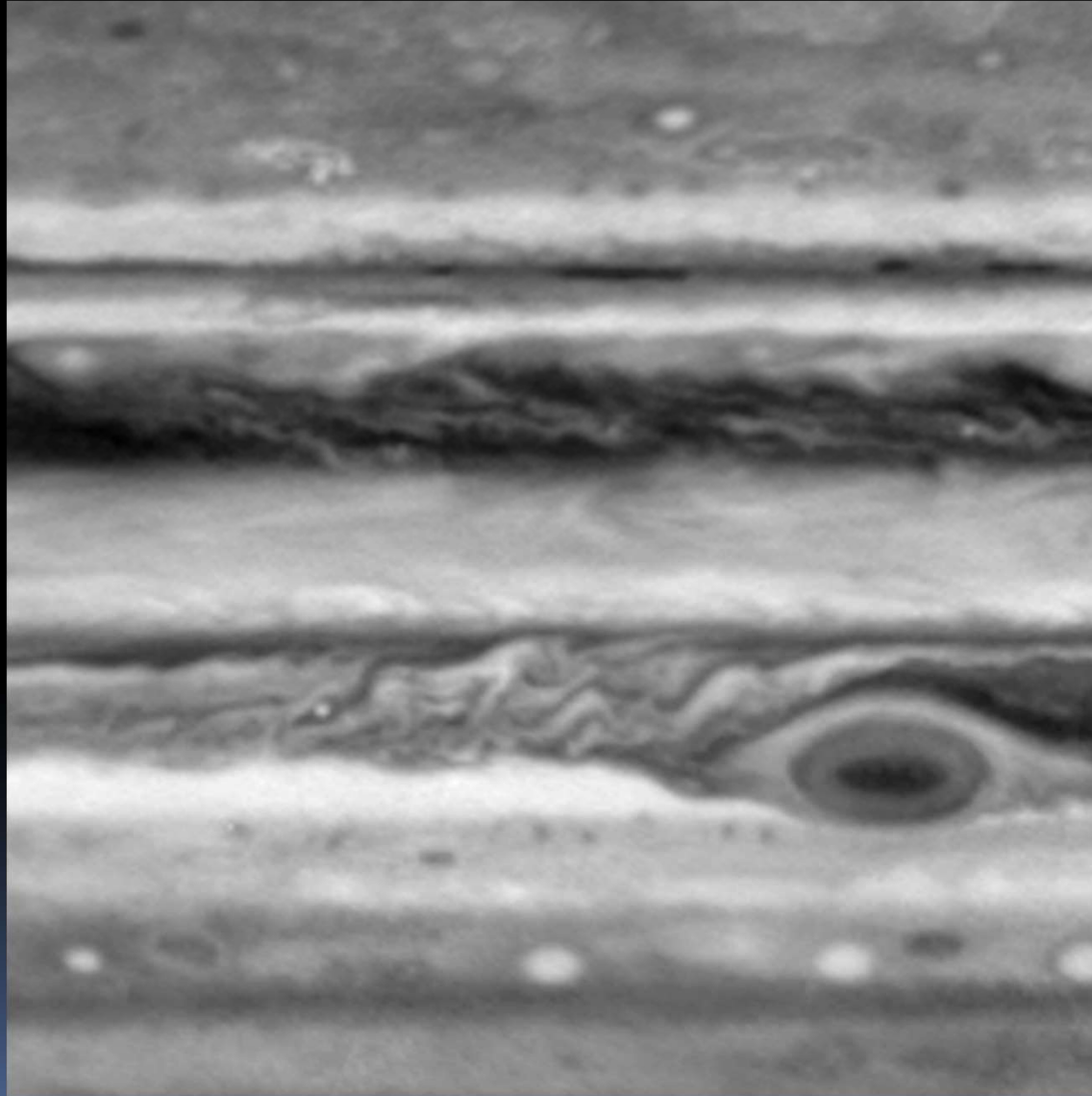
Masa $\approx$ 300 Tierras



Júpiter



Júpiter



Júpiter





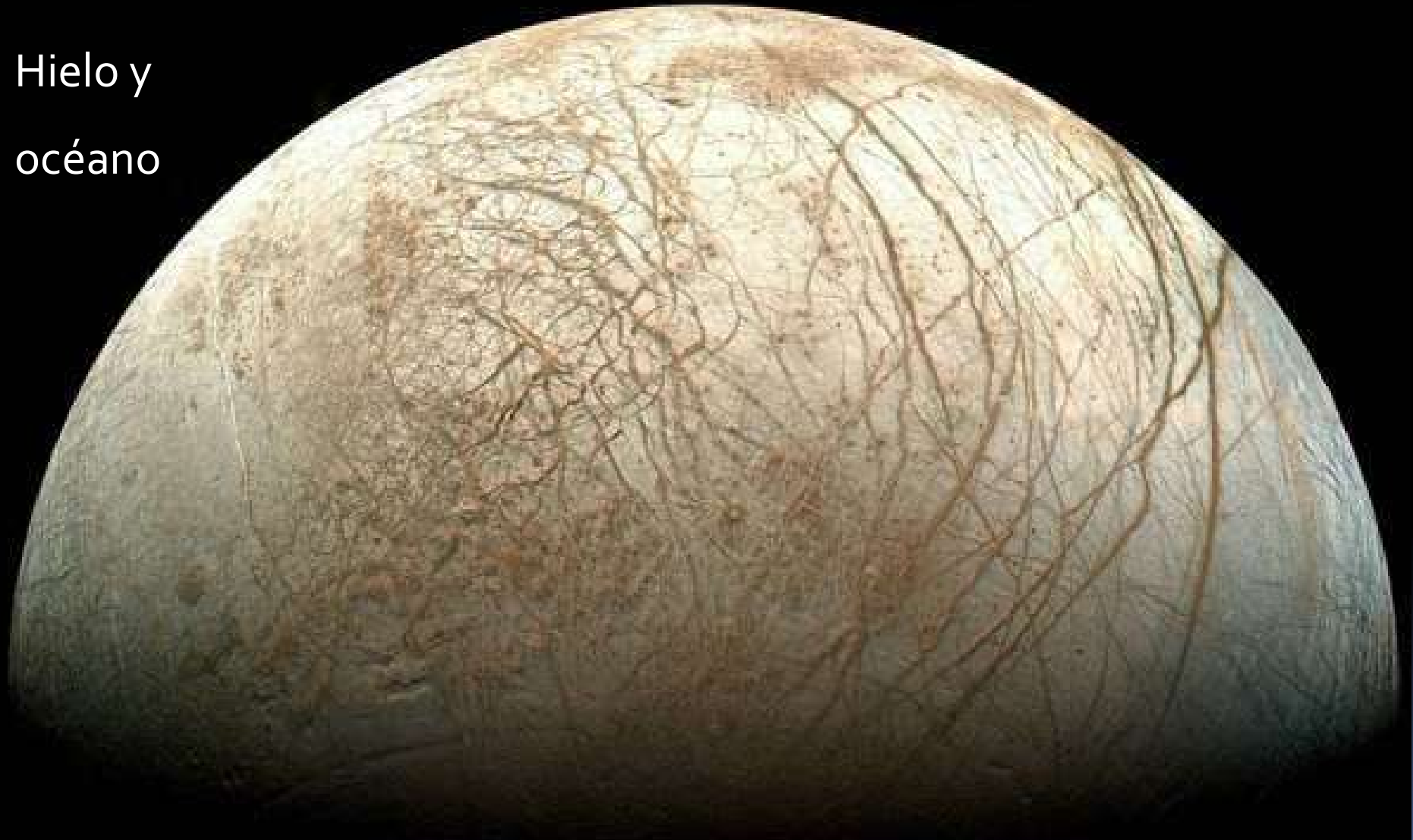
Satélites Galileanos



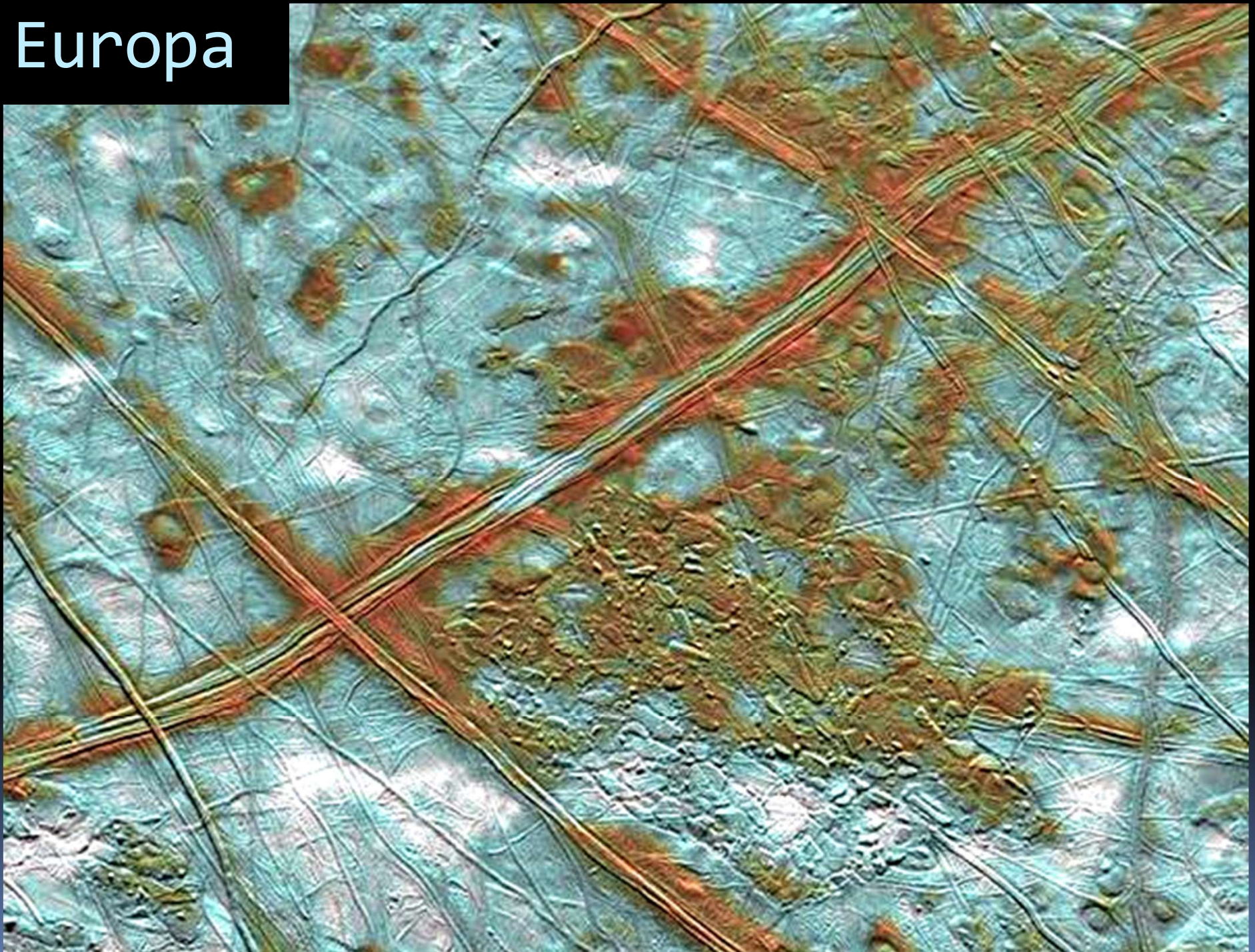
Rotación sincrónica por mareas

Europa (satélite)

Hielo y
océano

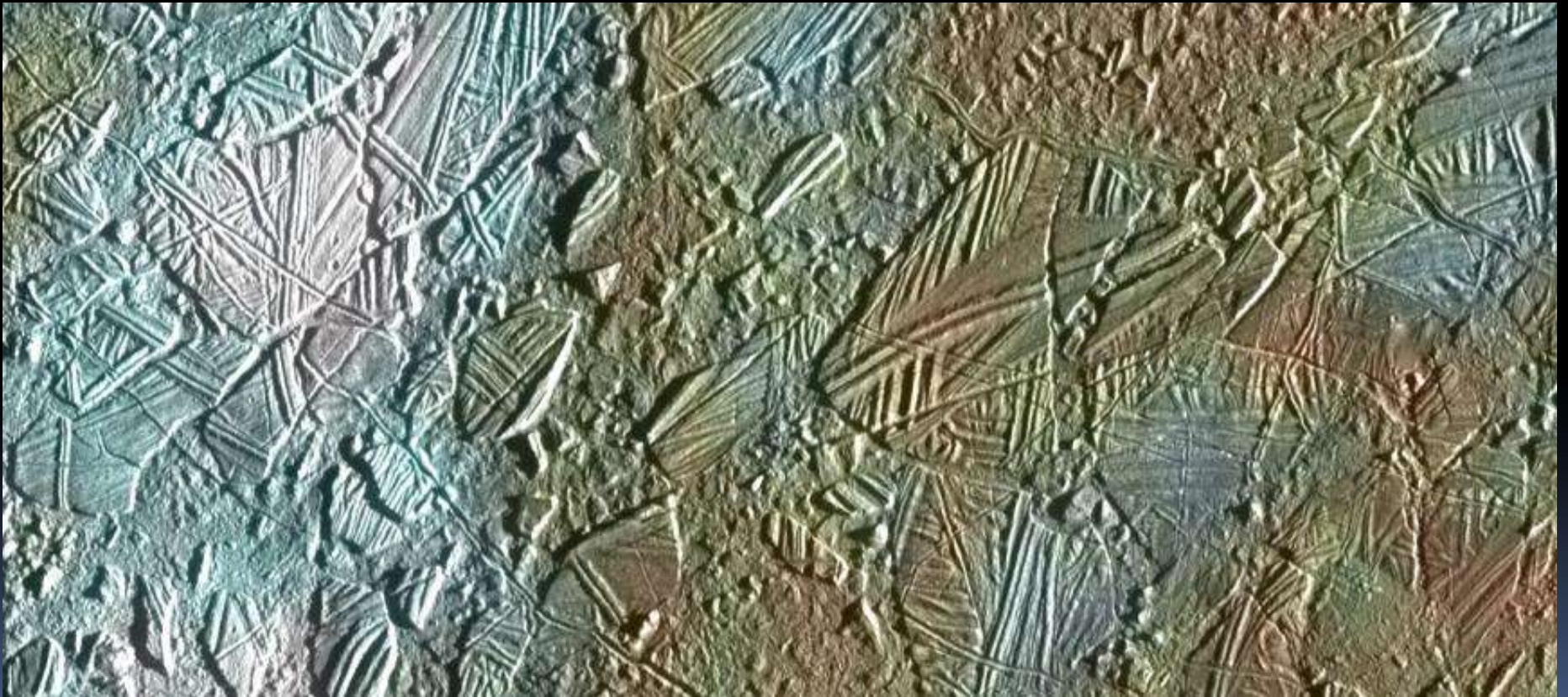


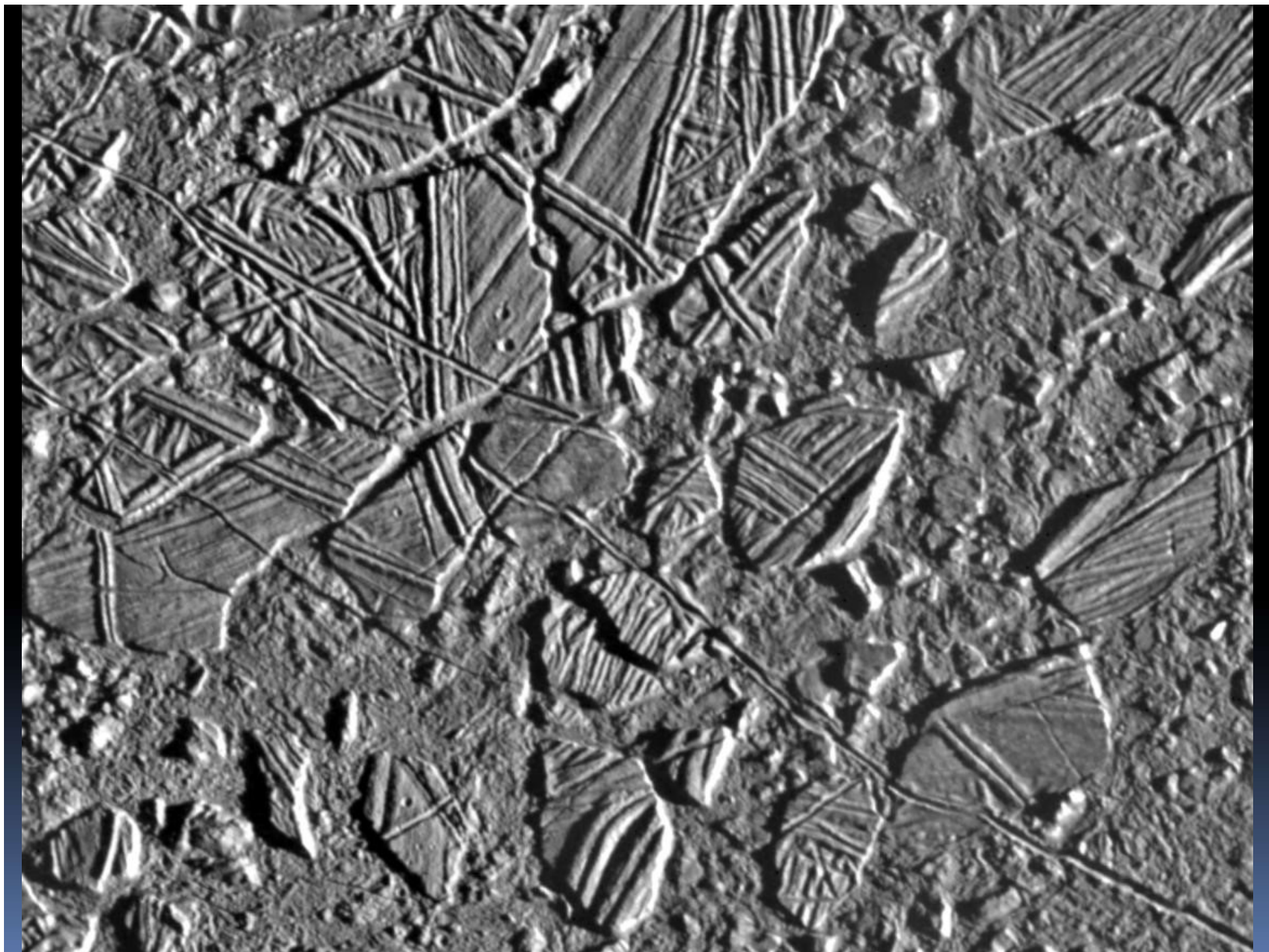
Europa

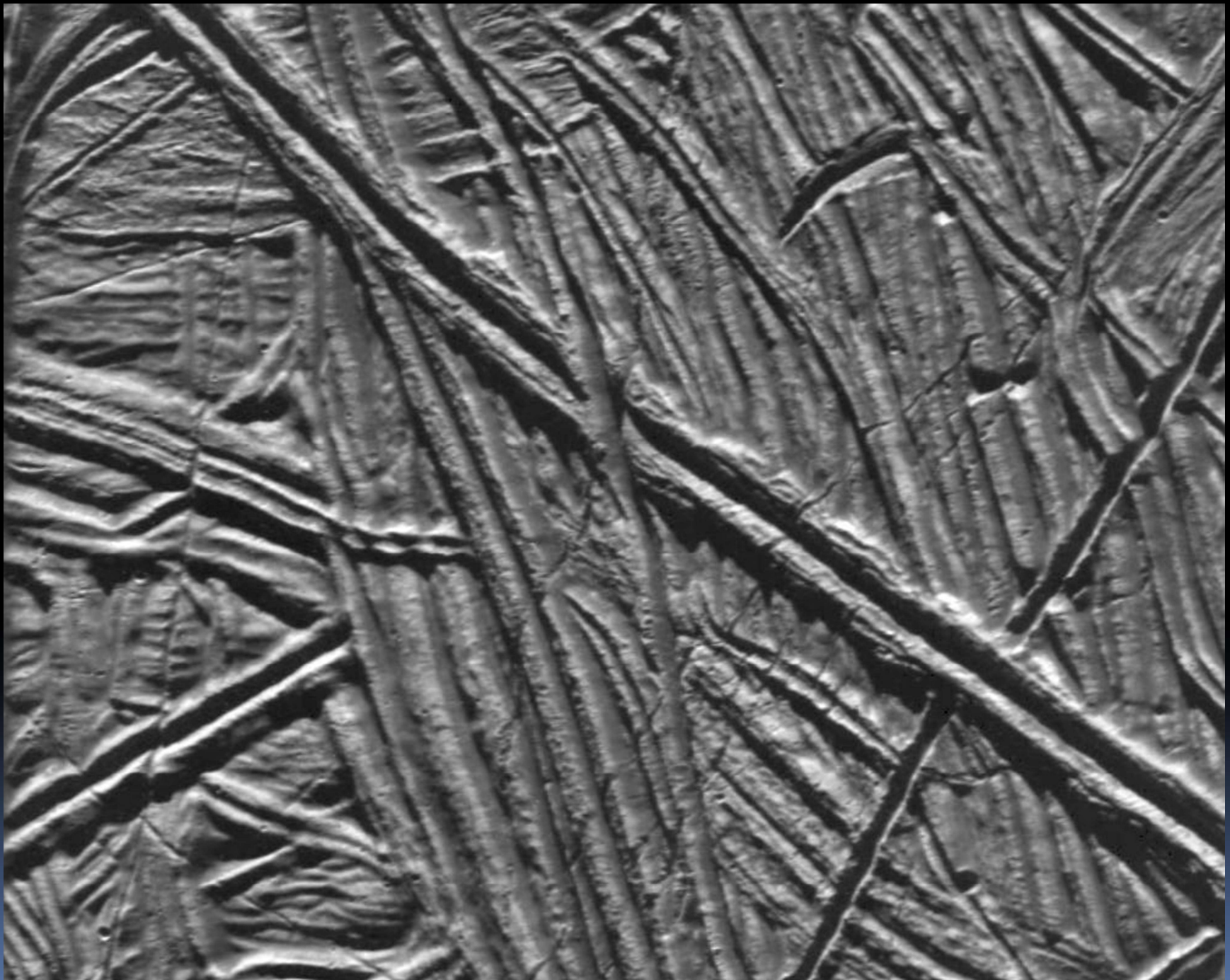


Europa

Manchas marrones: tholins



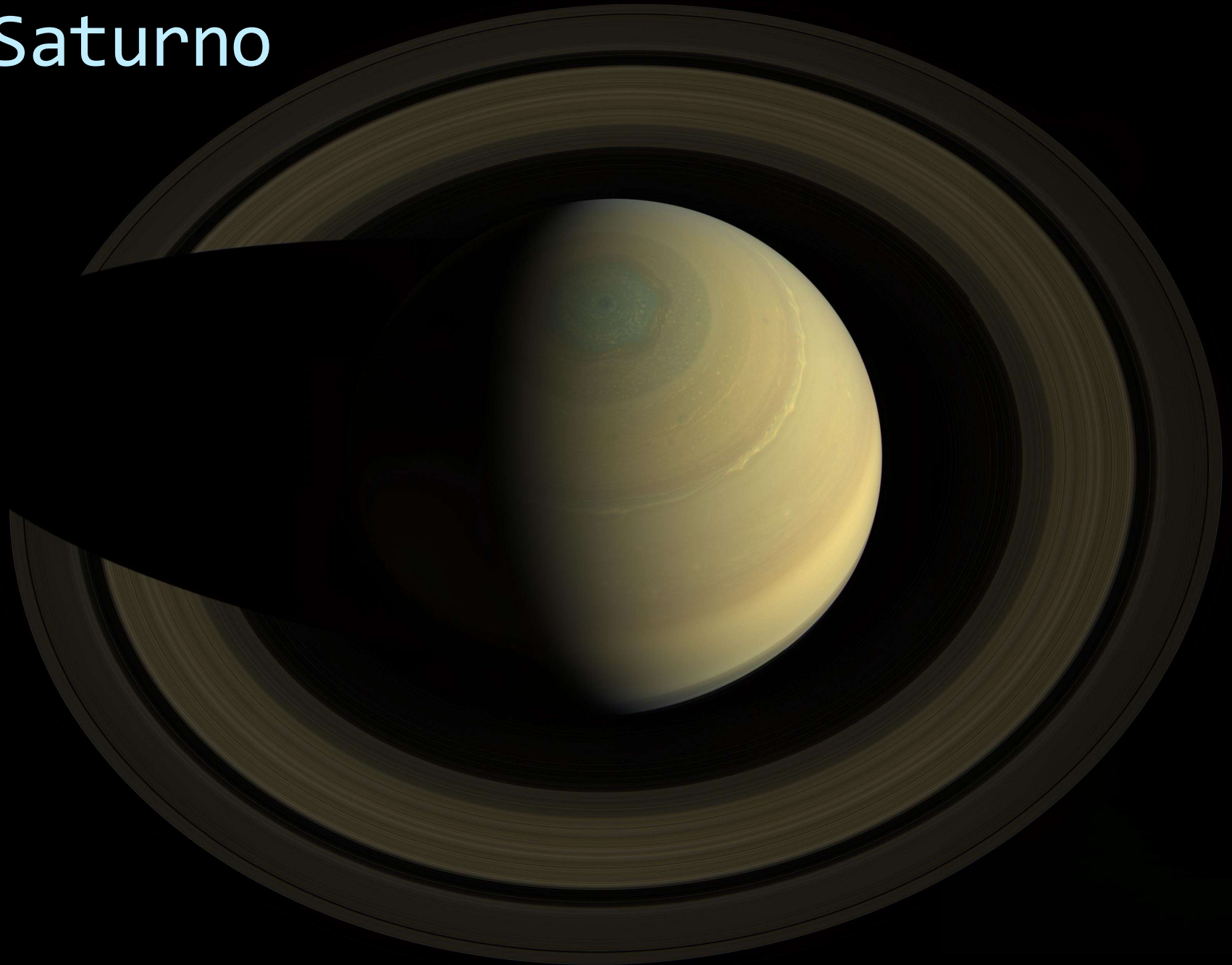




Ganímedes

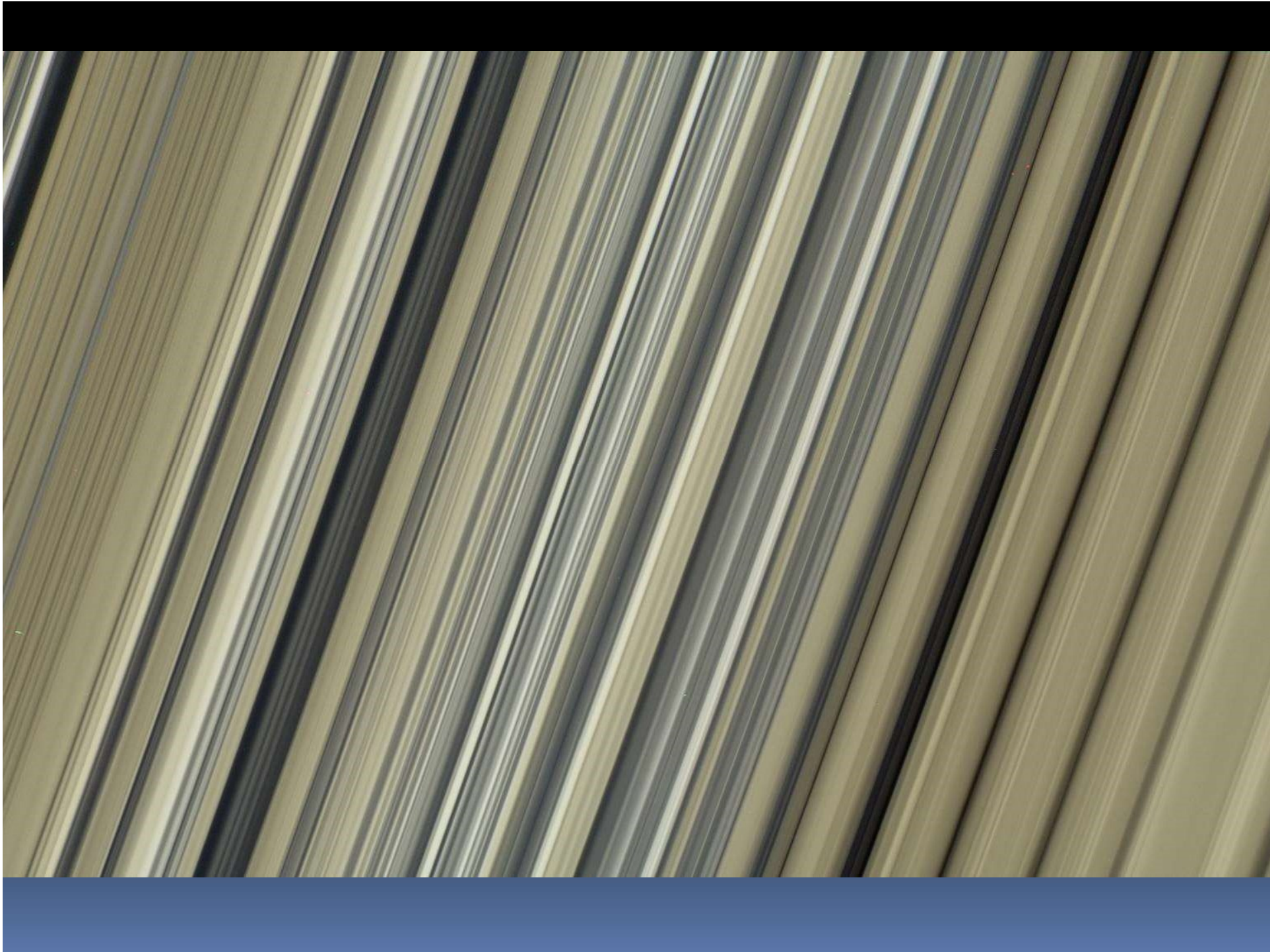


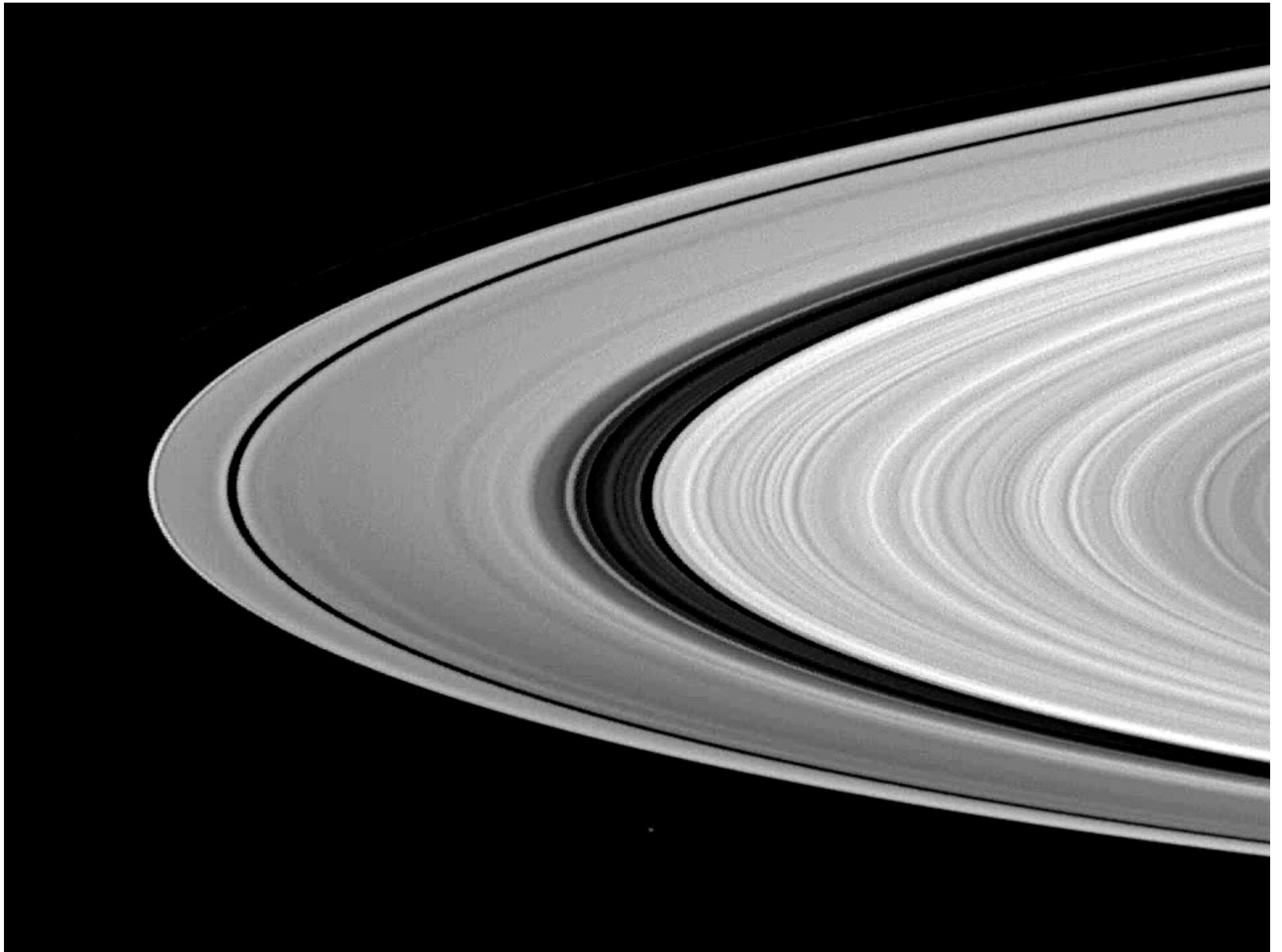
Saturno



Saturno

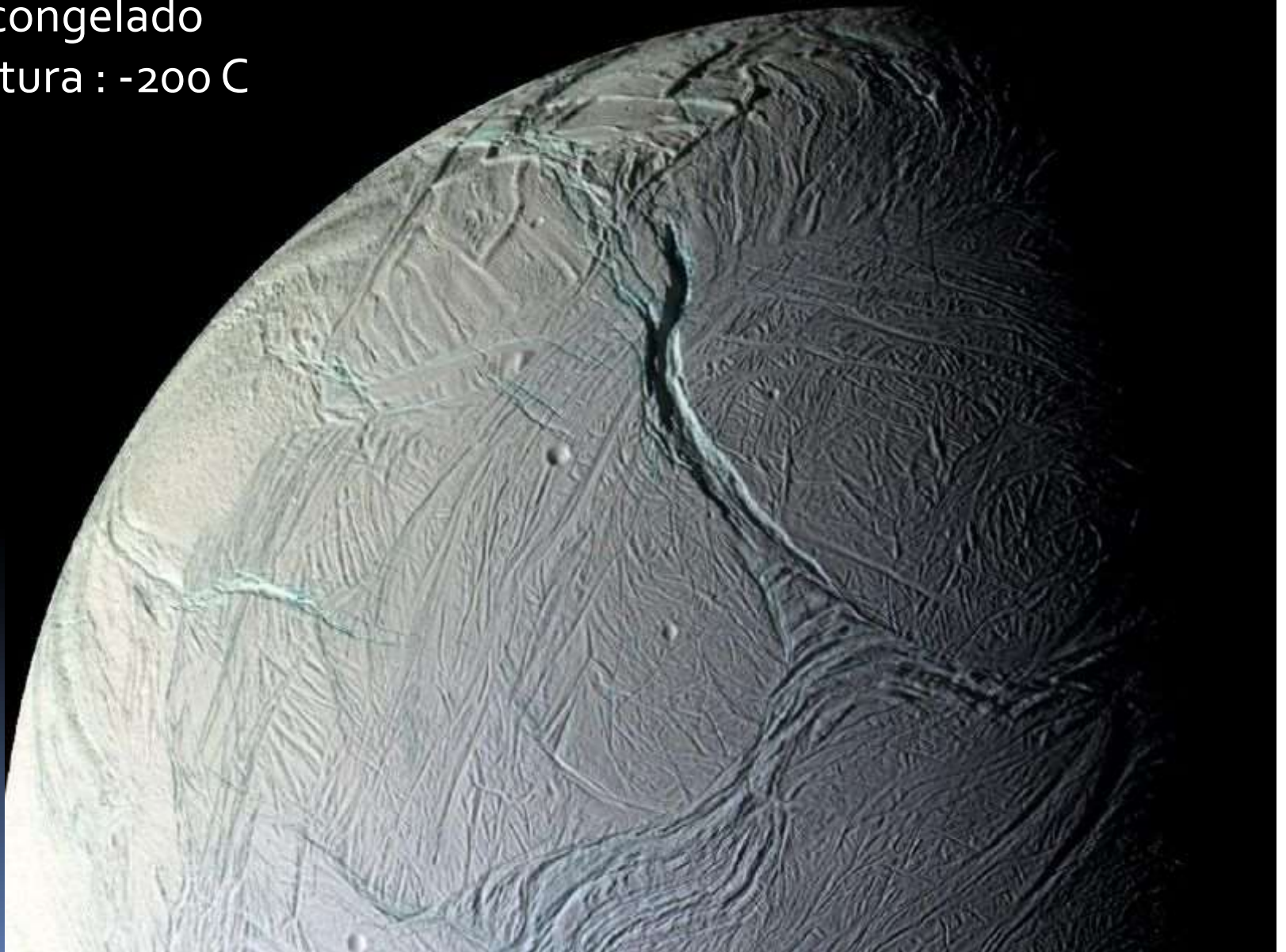






Encelado

Océano congelado
Temperatura : -200 C

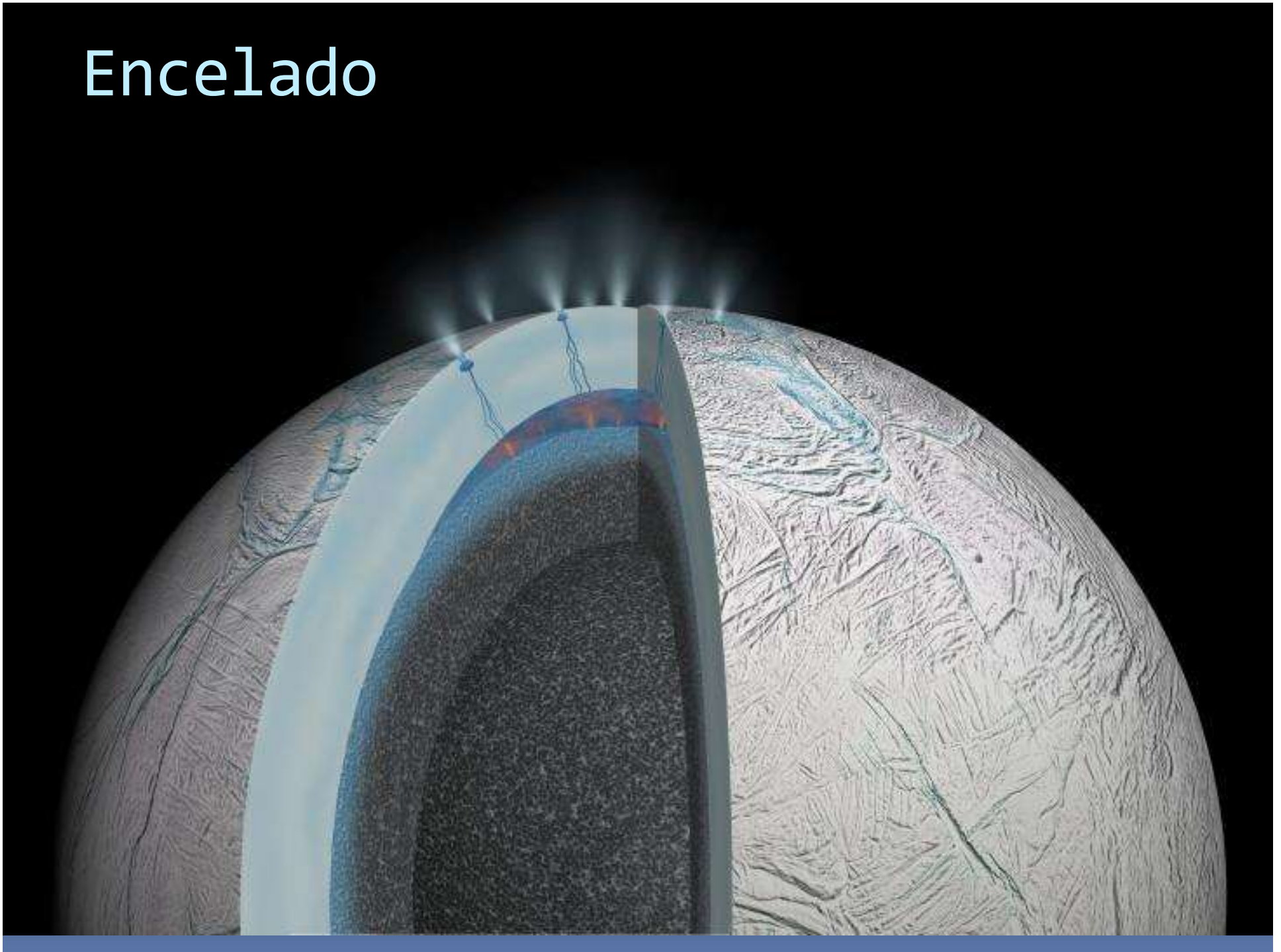


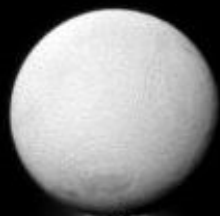
Encelado

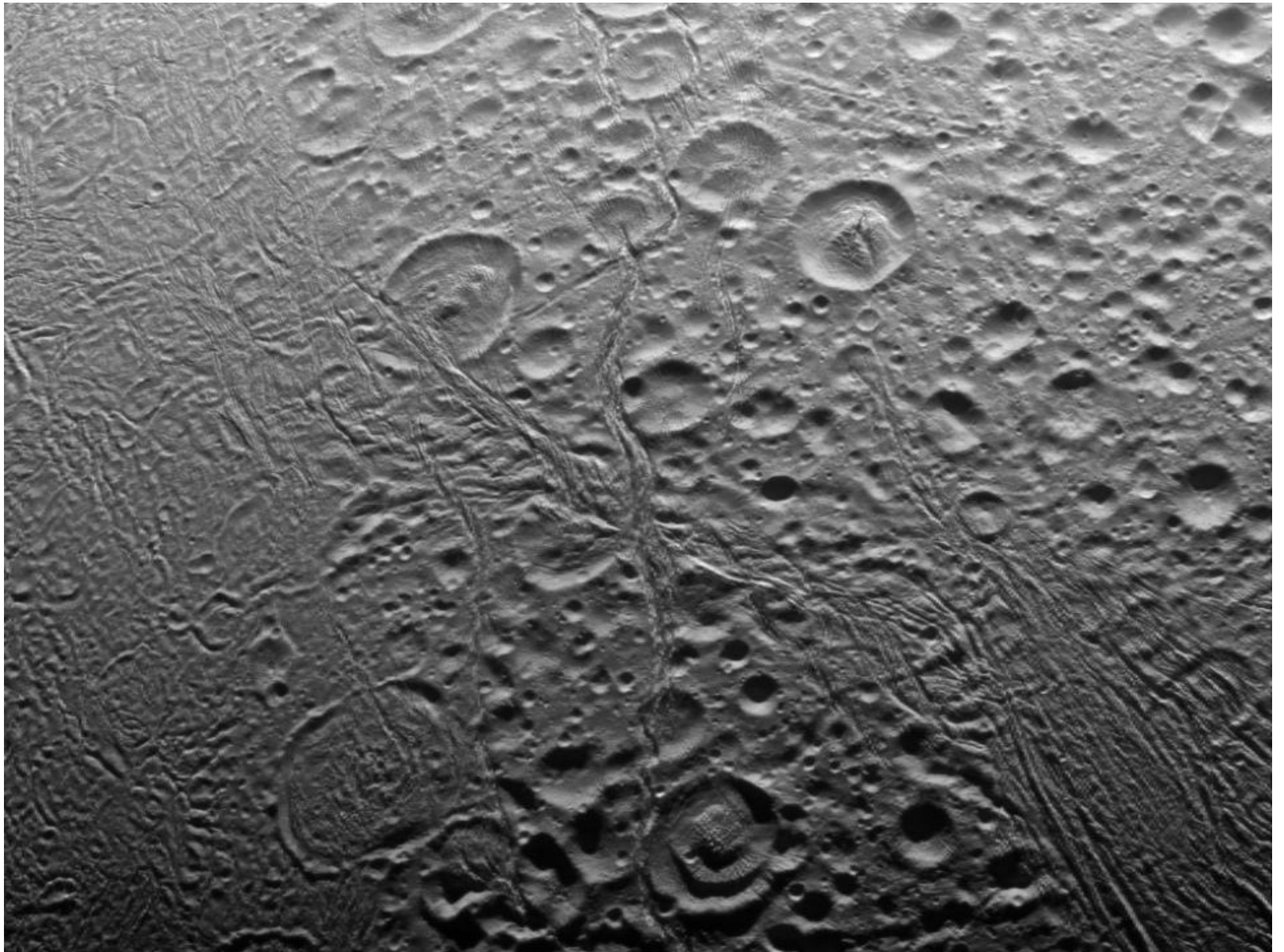
Compuestos orgánicos de 200 uma



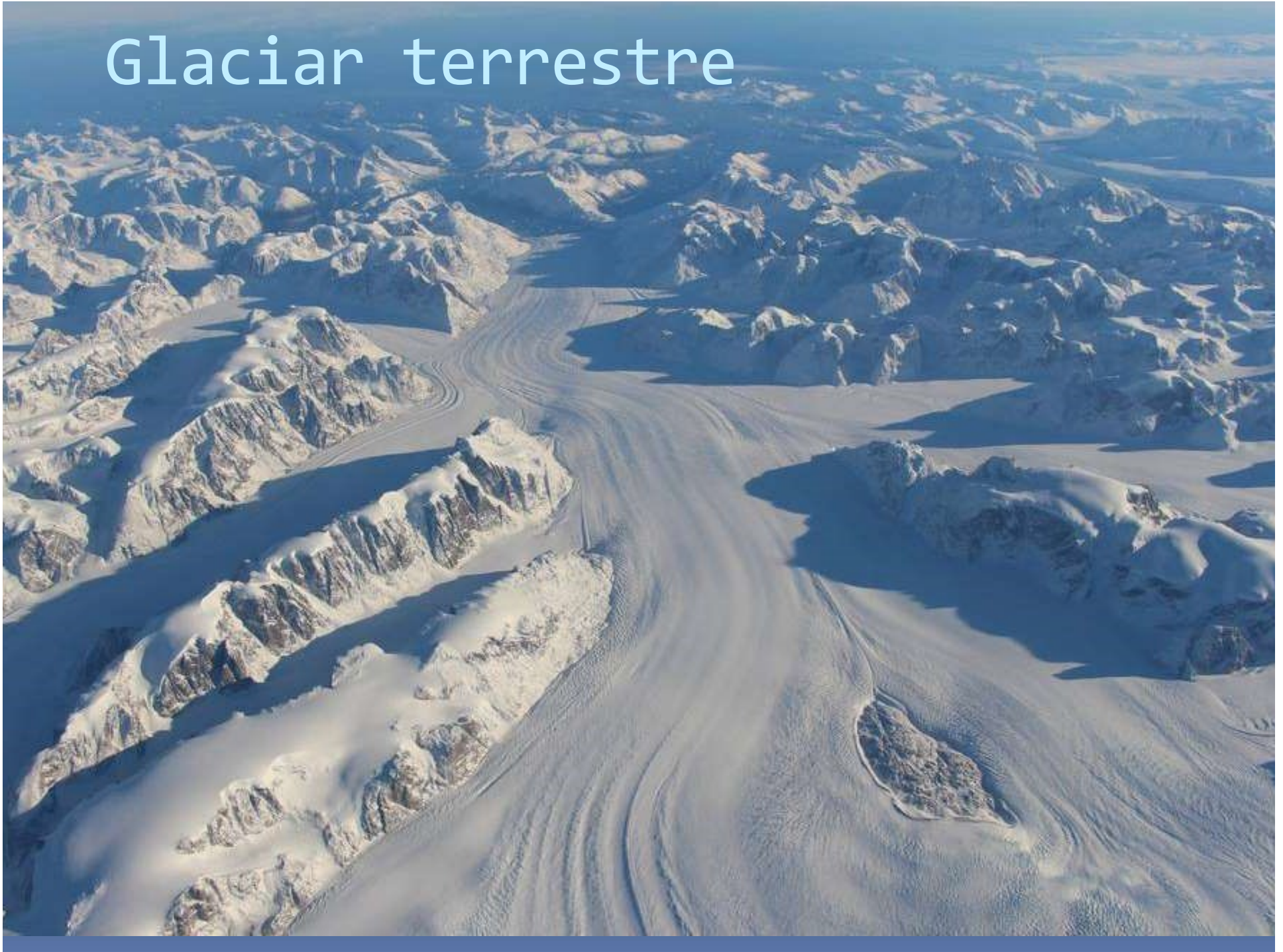
Encelado





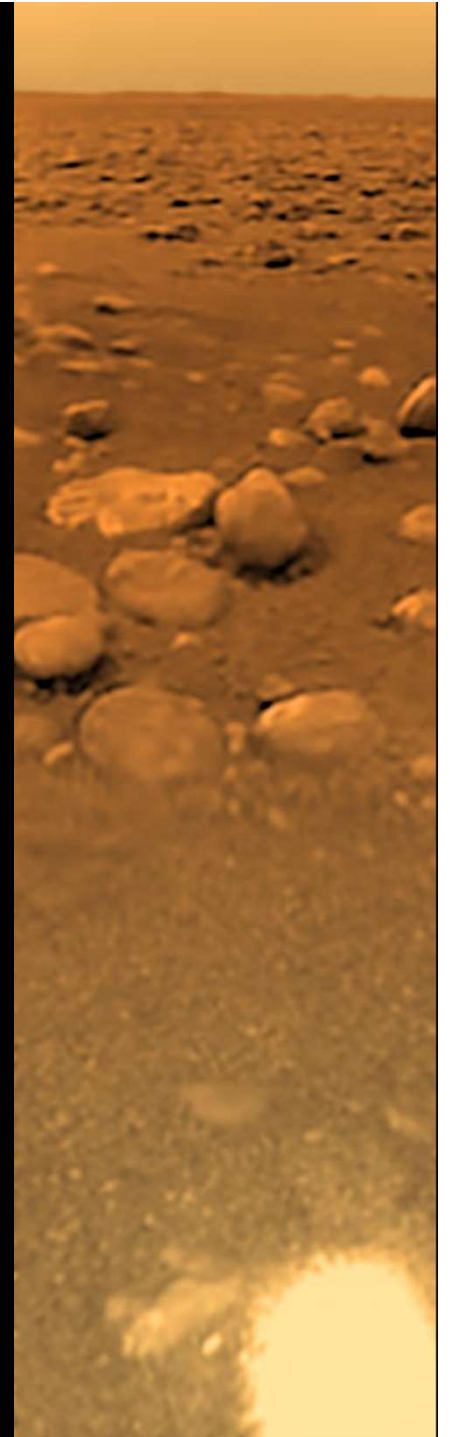


Glaciar terrestre

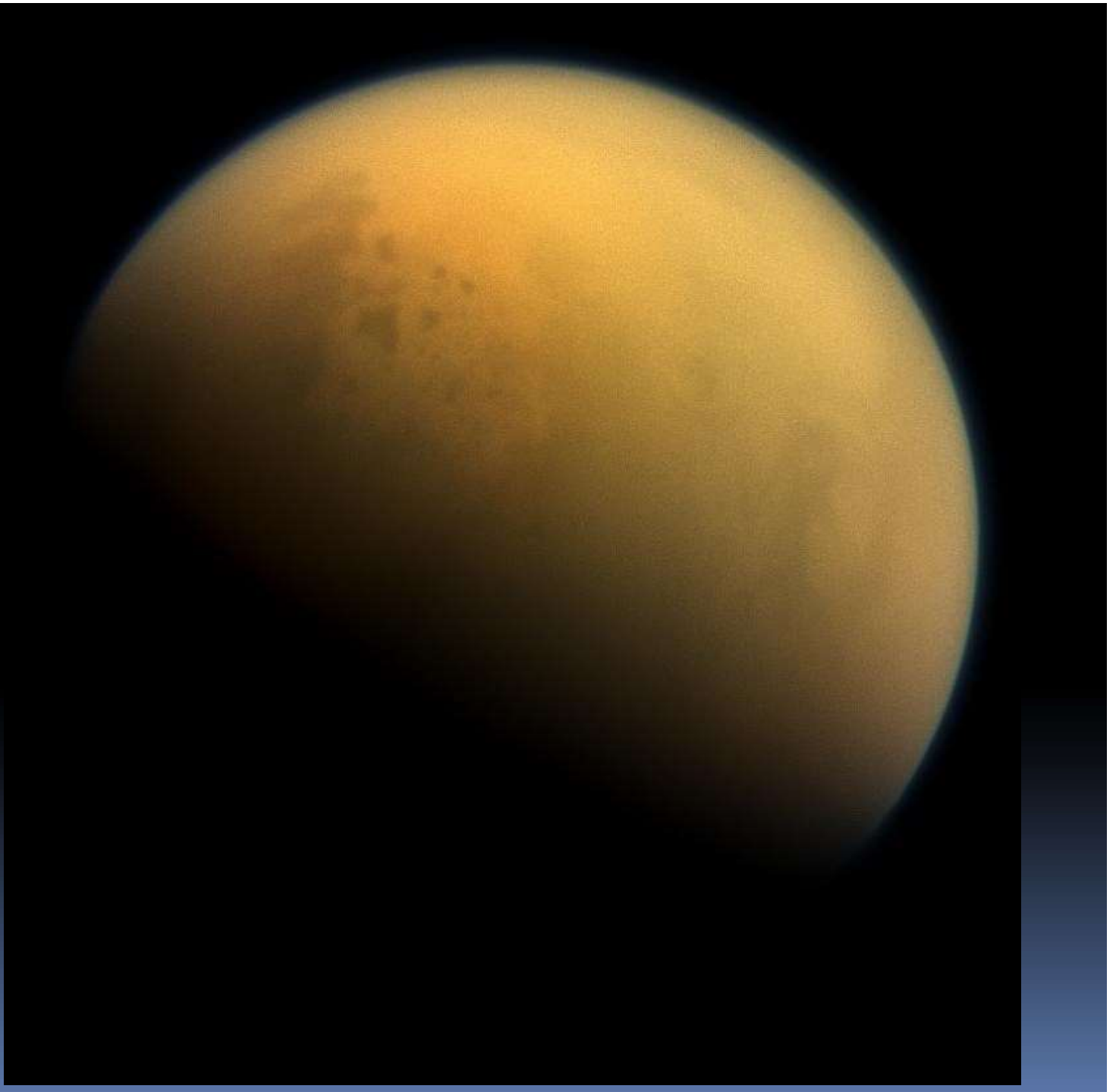


Titán

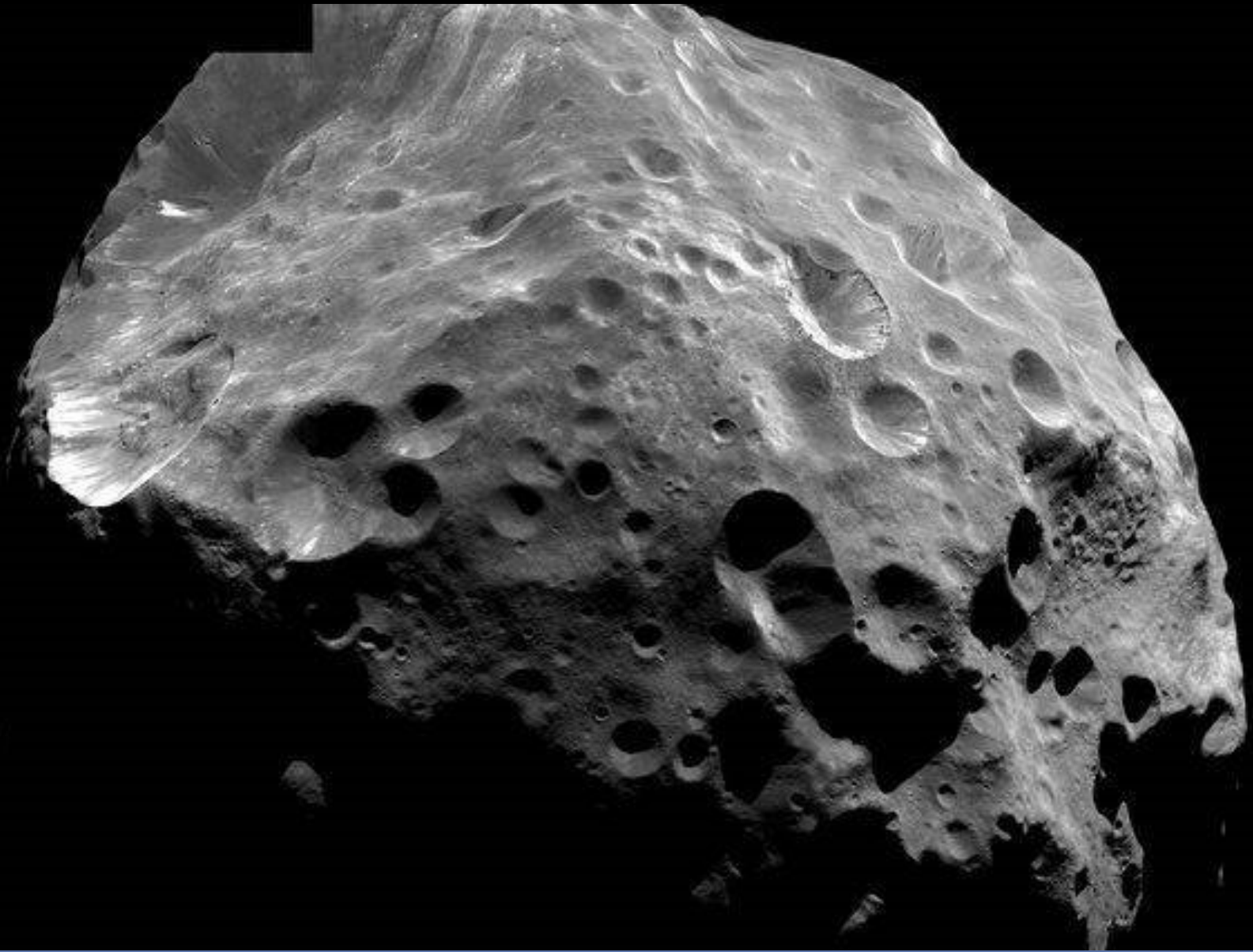
Atmósfera de Nitrógeno
Temperatura media = -170°C
Presión $> 1\text{ atm.}$
Metano sólido en superficie
Lagos de nitrógeno



Titán



Phoebe

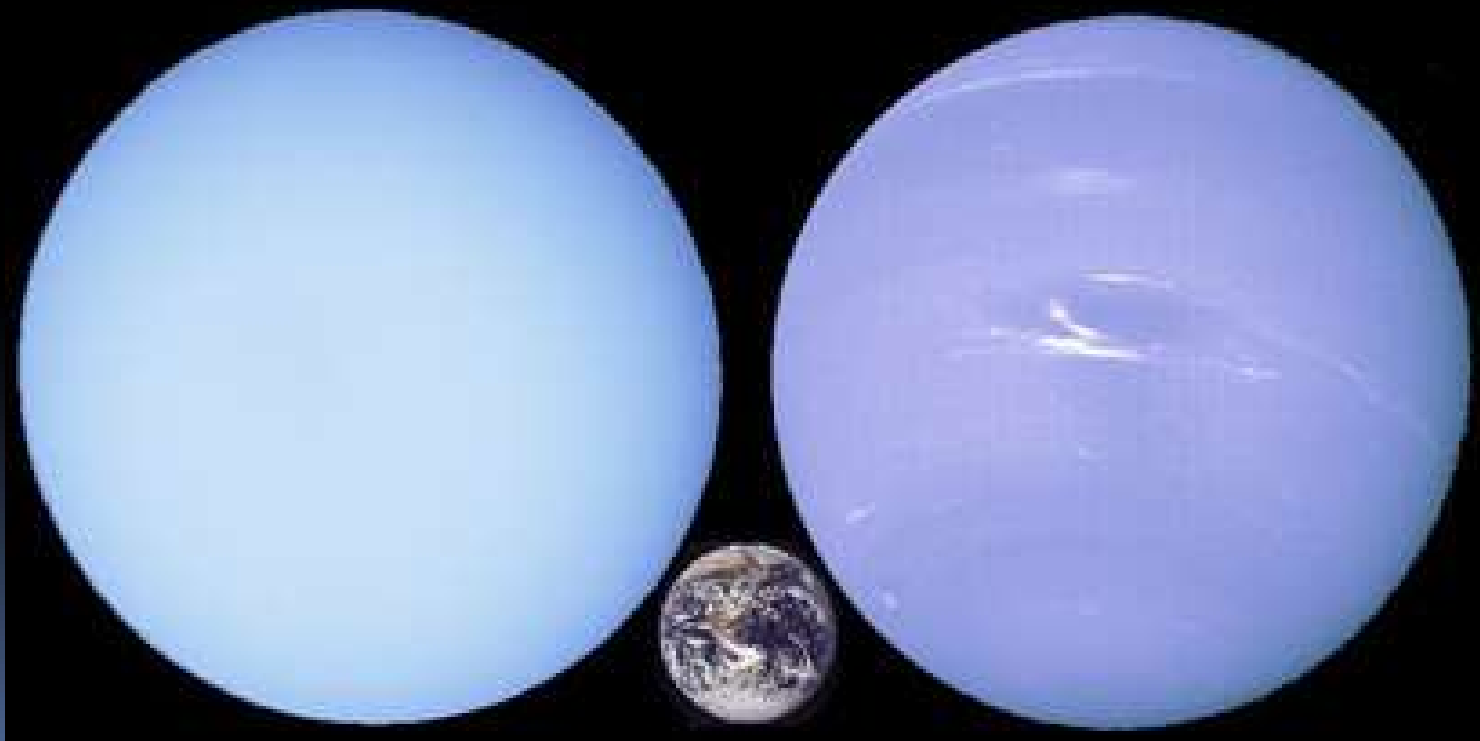


Urano y Neptuno

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

Eje MUY inclinado.

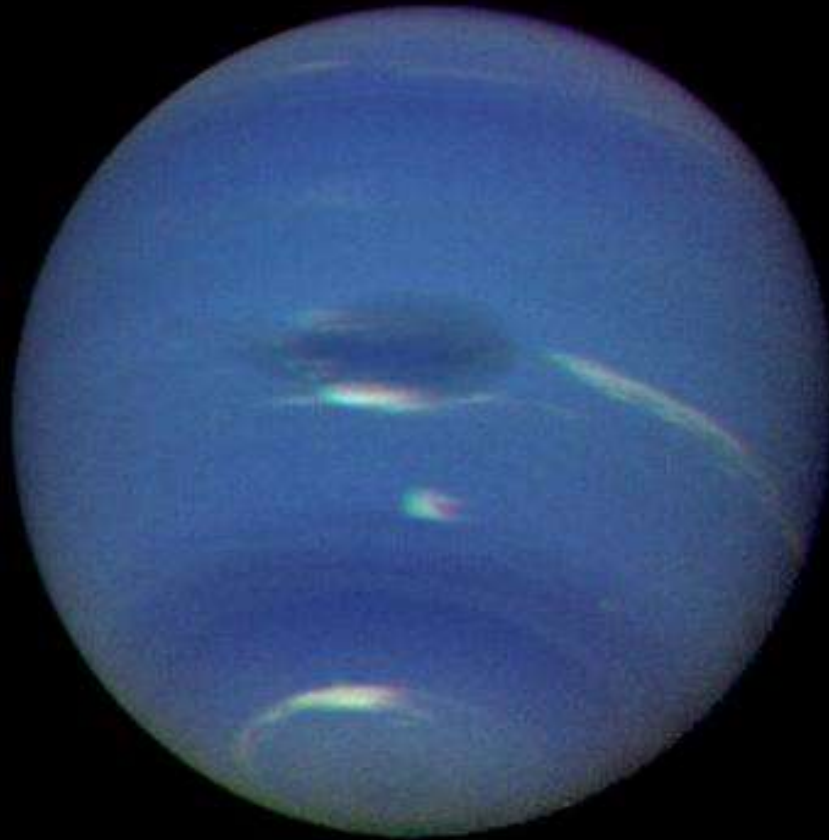
Pocos satélites.

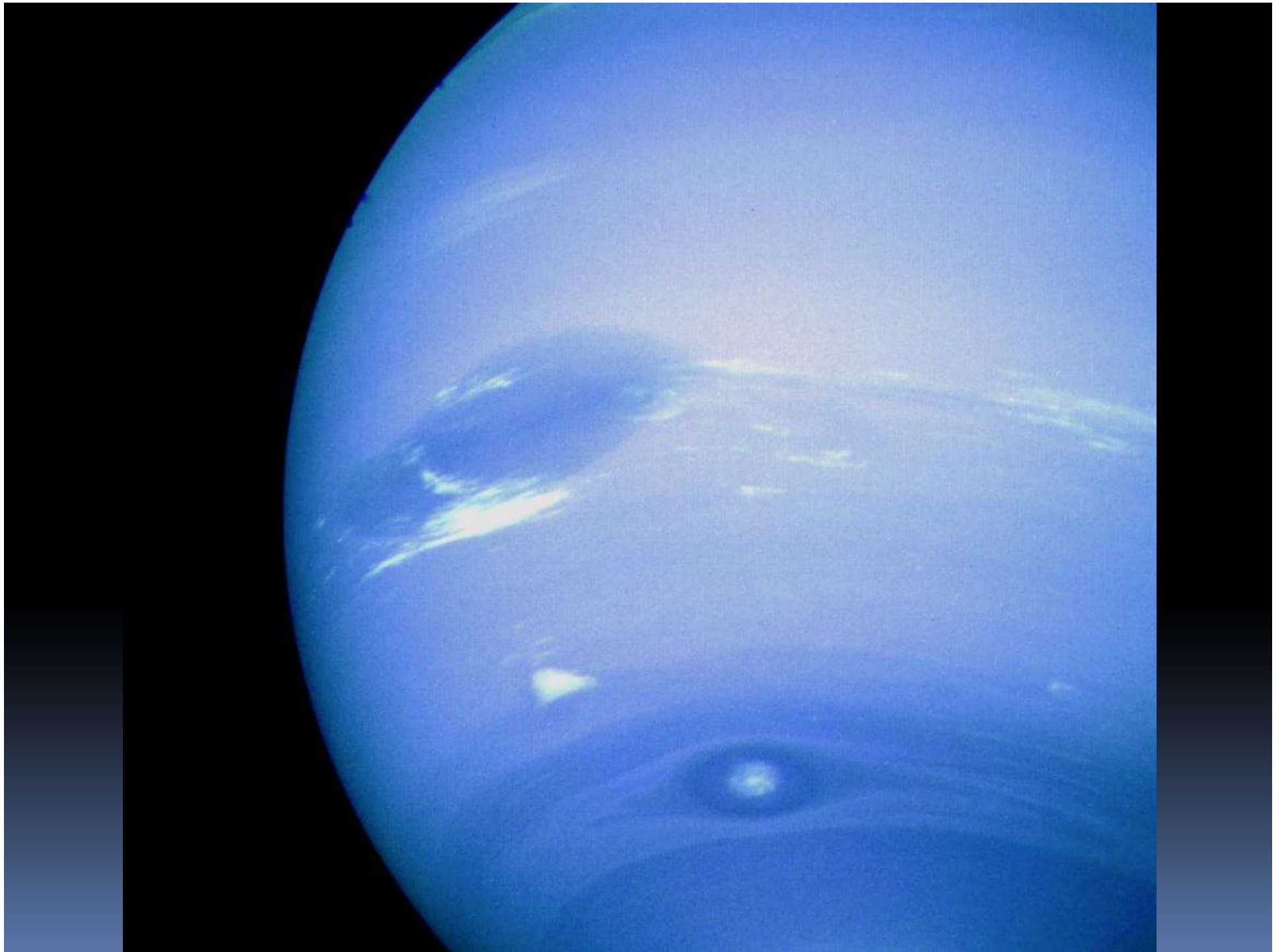


Ariel



Neptuno

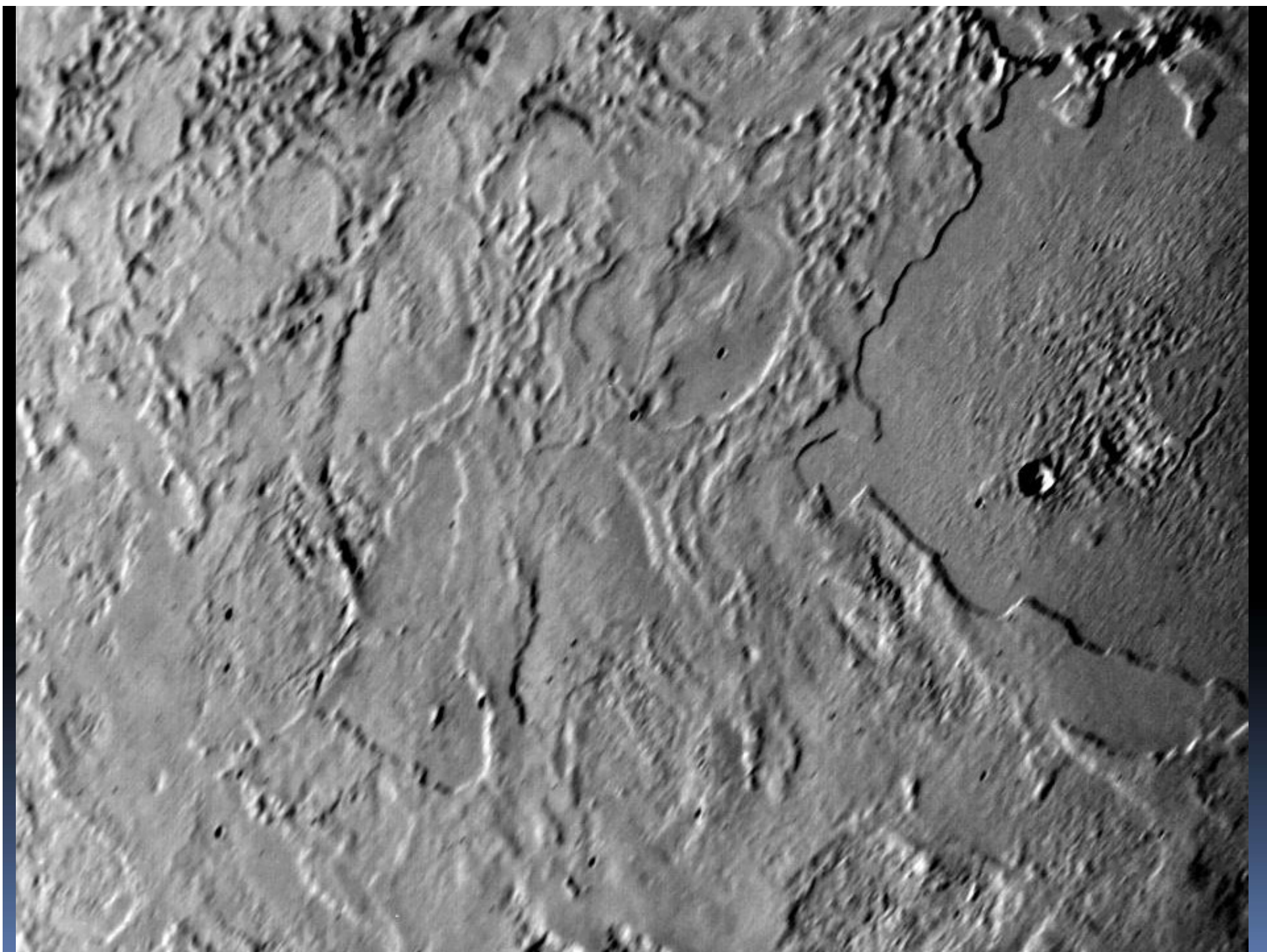




Tritón

Orbita retrograda





Mayores satélites del SS

Triton



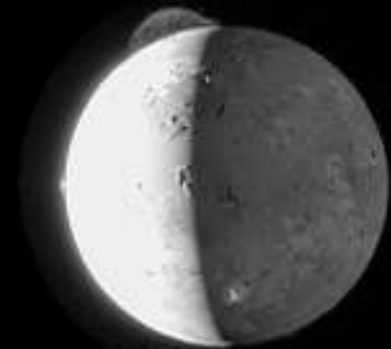
Europe



Lune



Io



Callisto



Titan



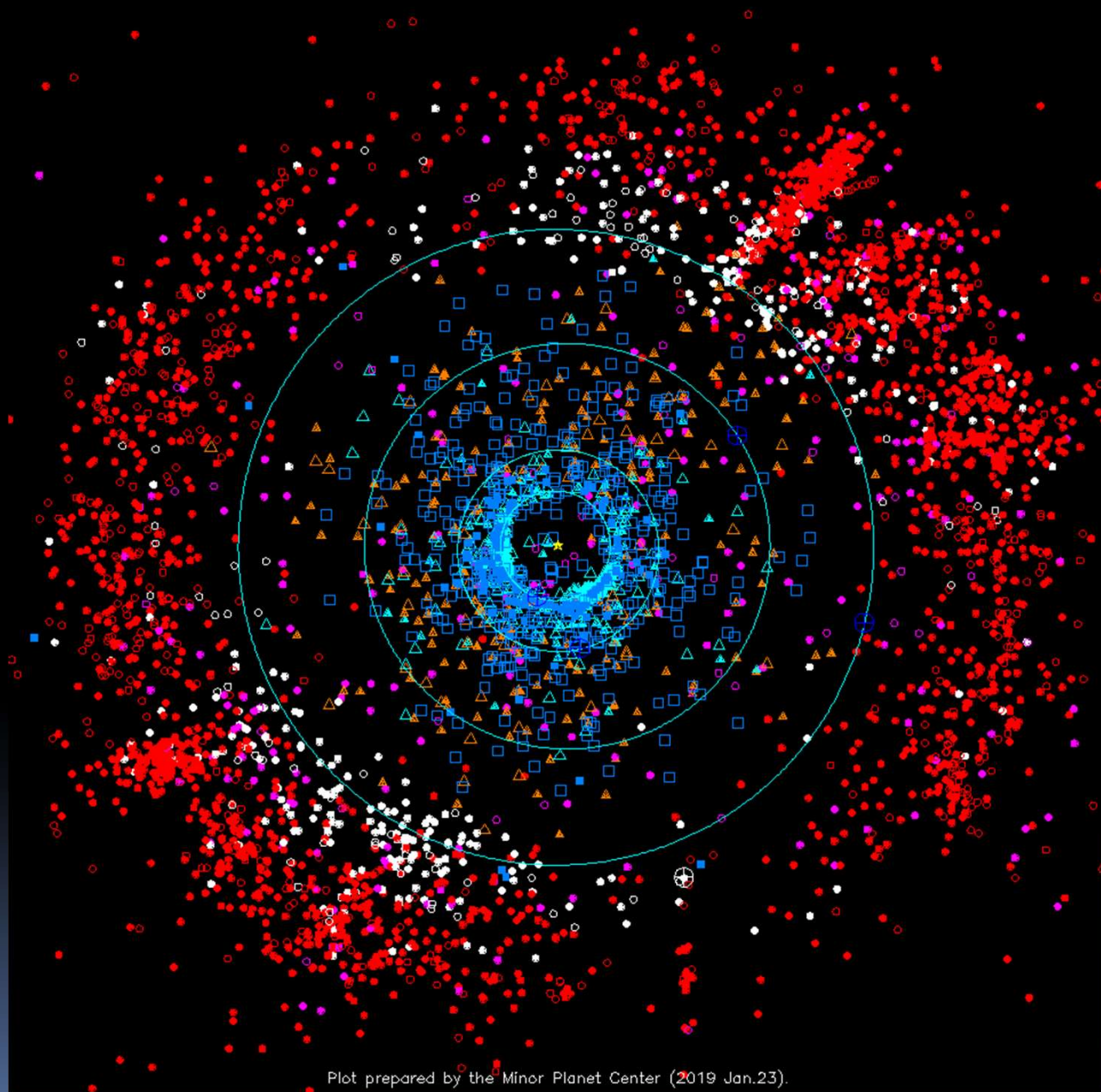
Ganymède

MAS ALLA DE NEPTUNO

Cinturón de Kuiper



© 2000 Don Dixon / cosmographica.com



Plutón y Caronte

Rotación sincrónica por mareas

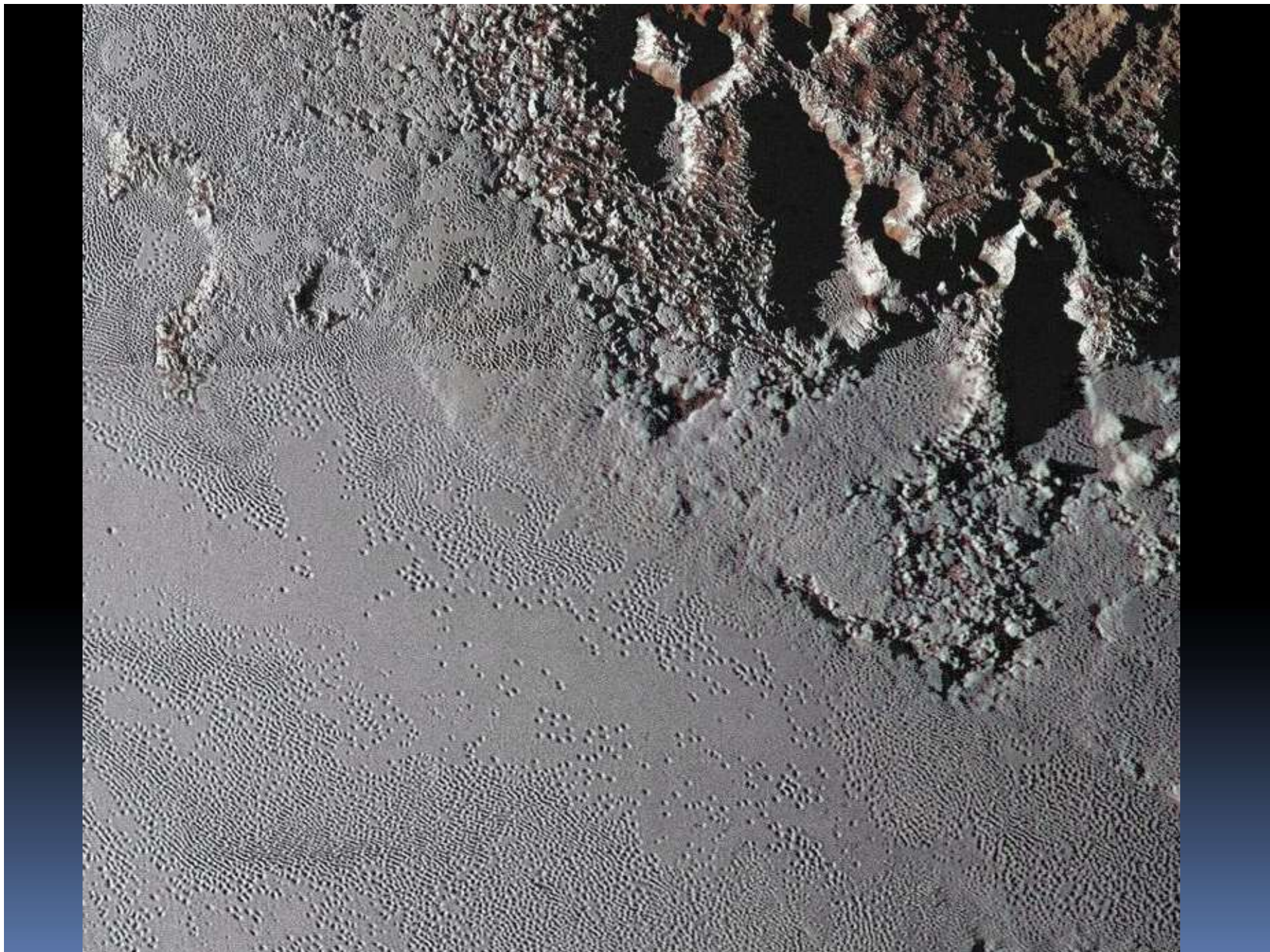


Plutón

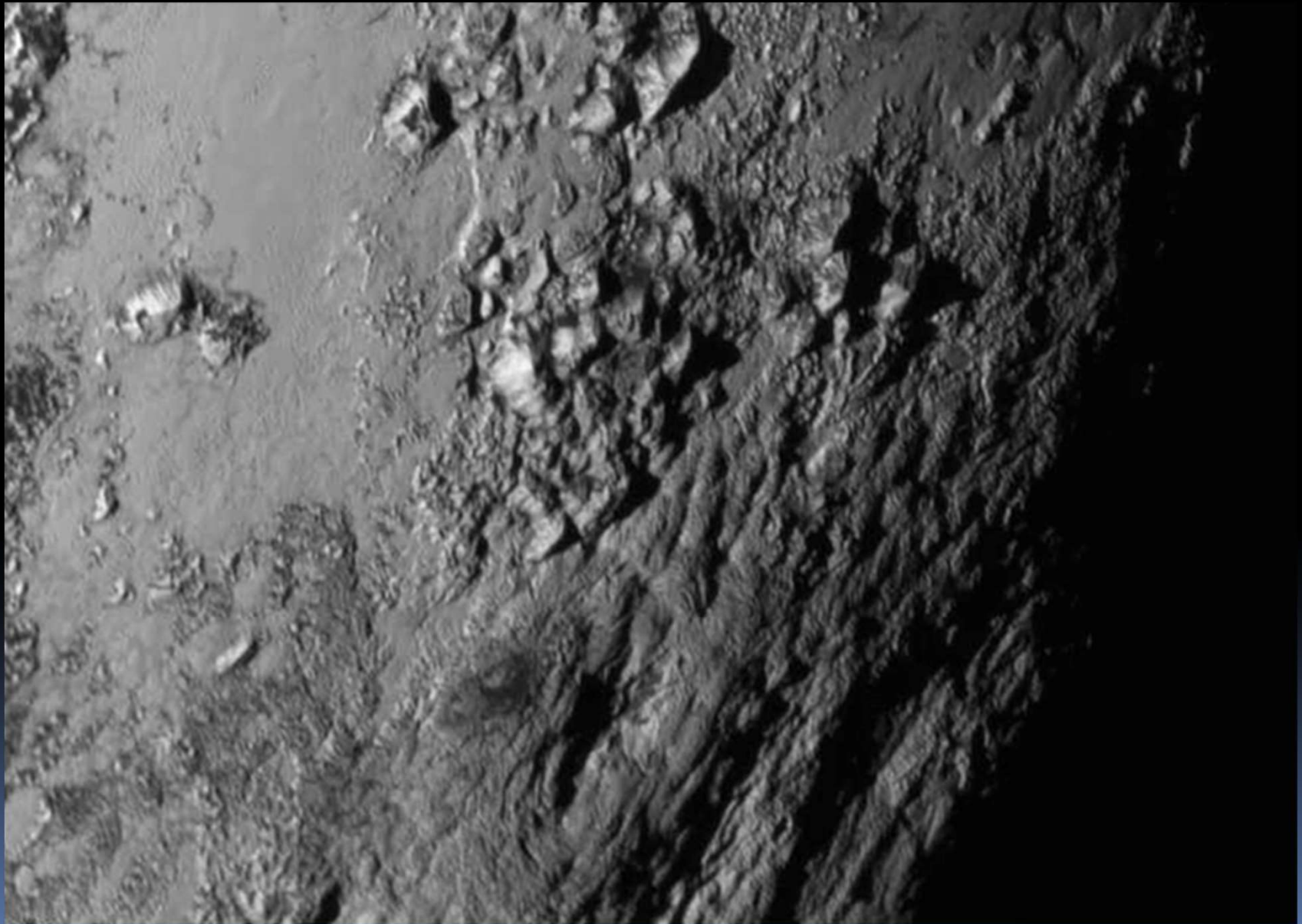


Manchas marrones: tholins

False Color



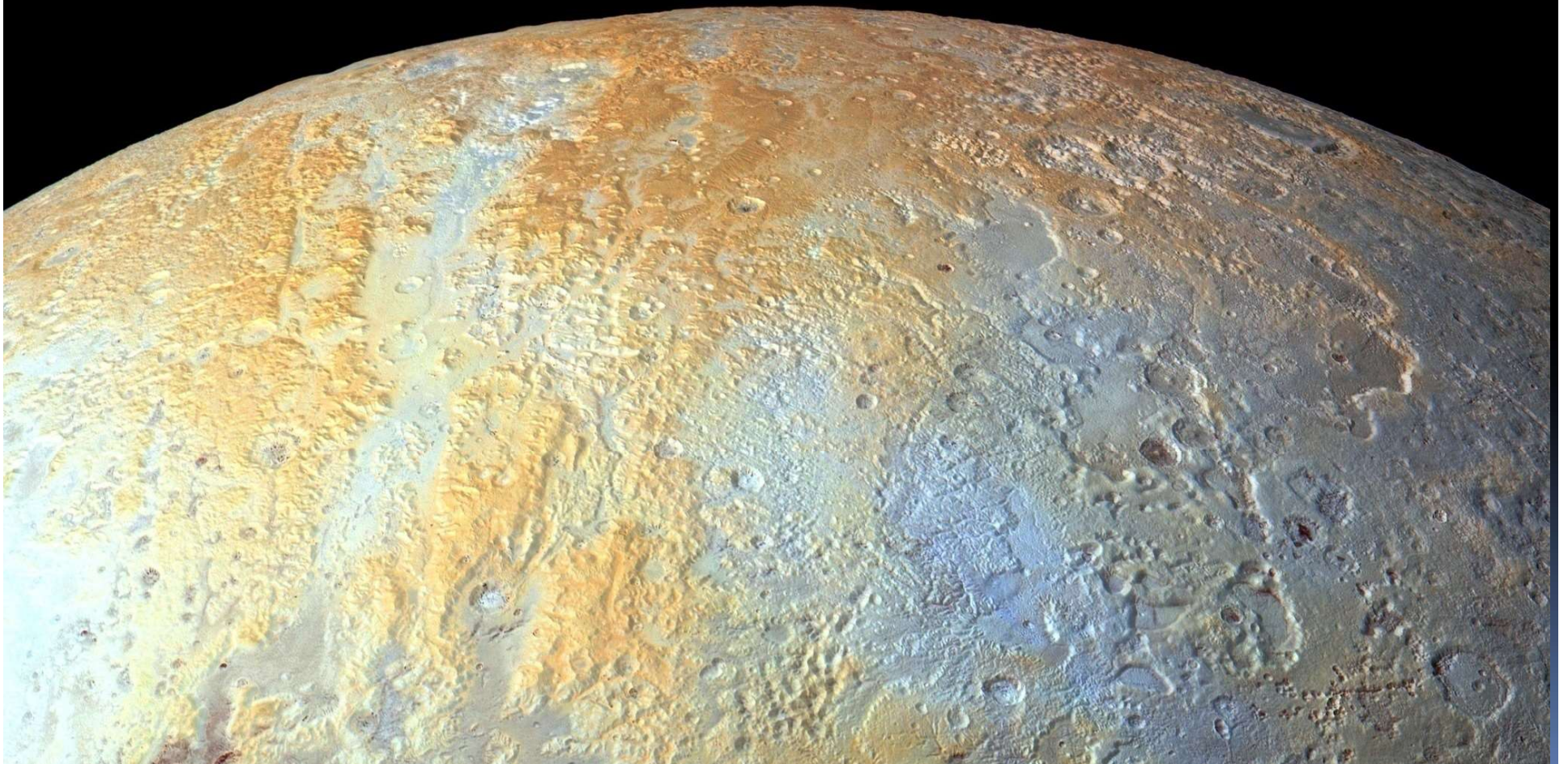
Plutón





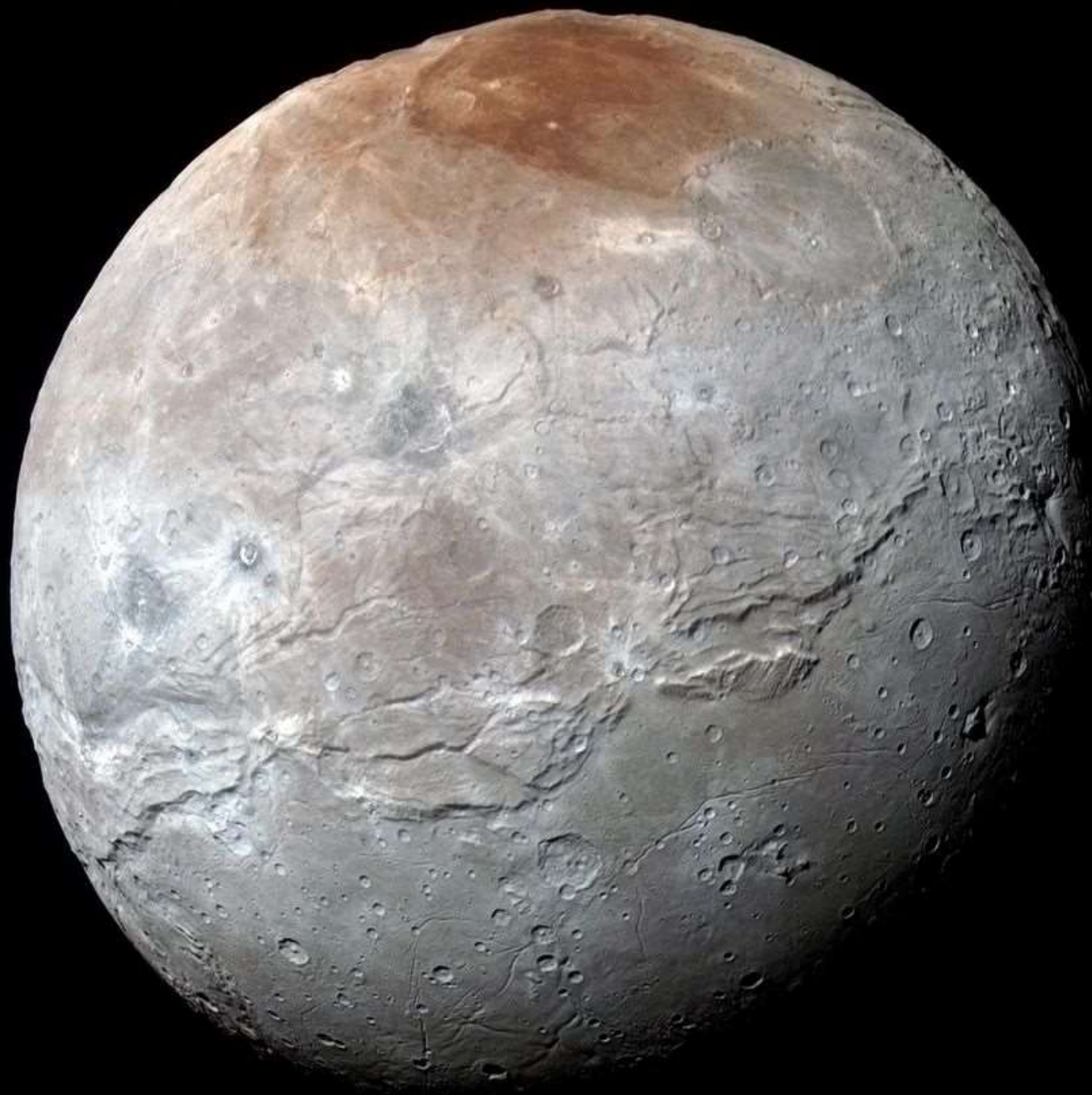
Jóvenes (100 millones de años...) montañas de hielo.

Plutón

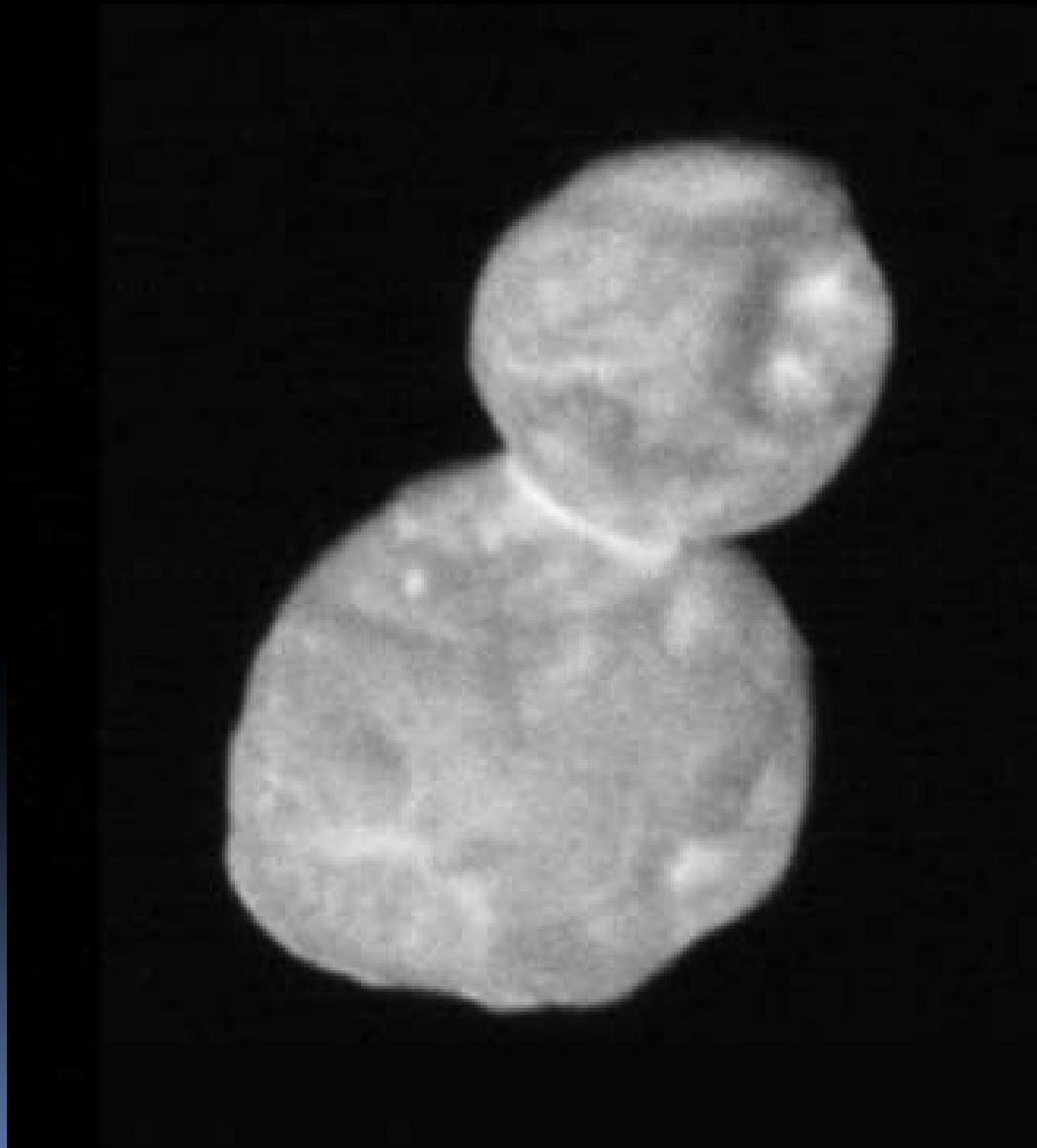


Caronte





Ultima Thule



Trans-Neptunianos



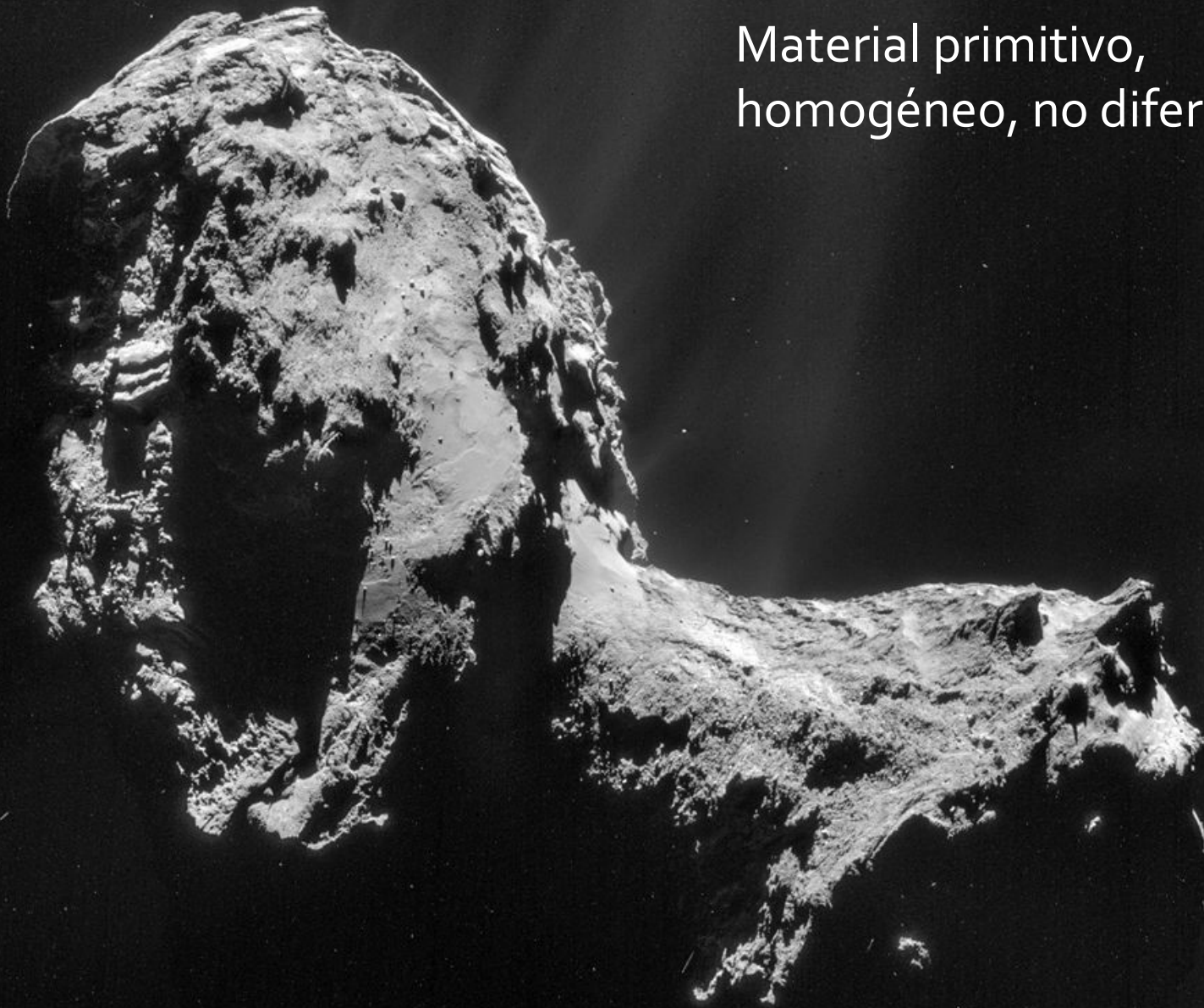
Cometa



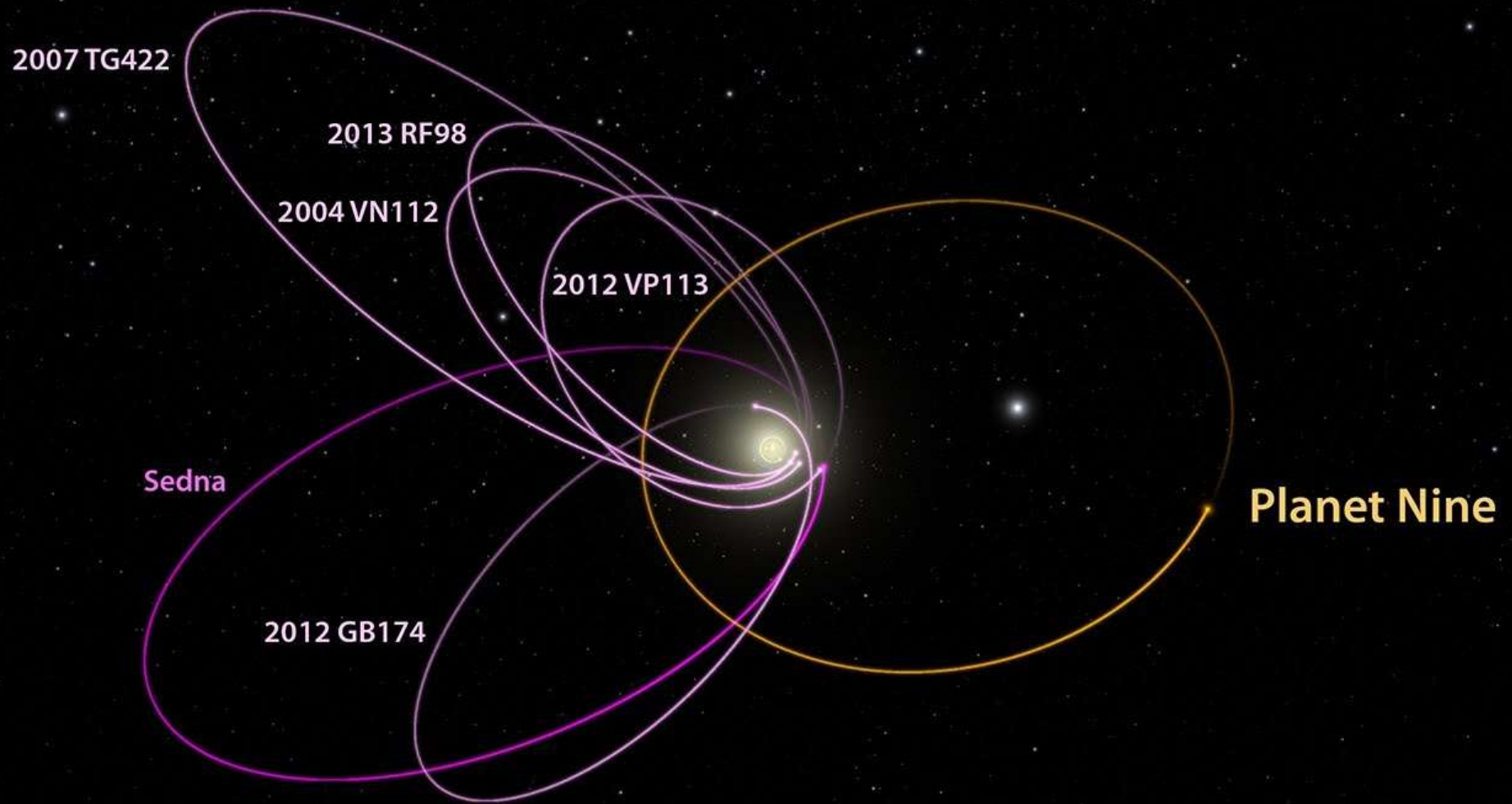
Núcleo cometario

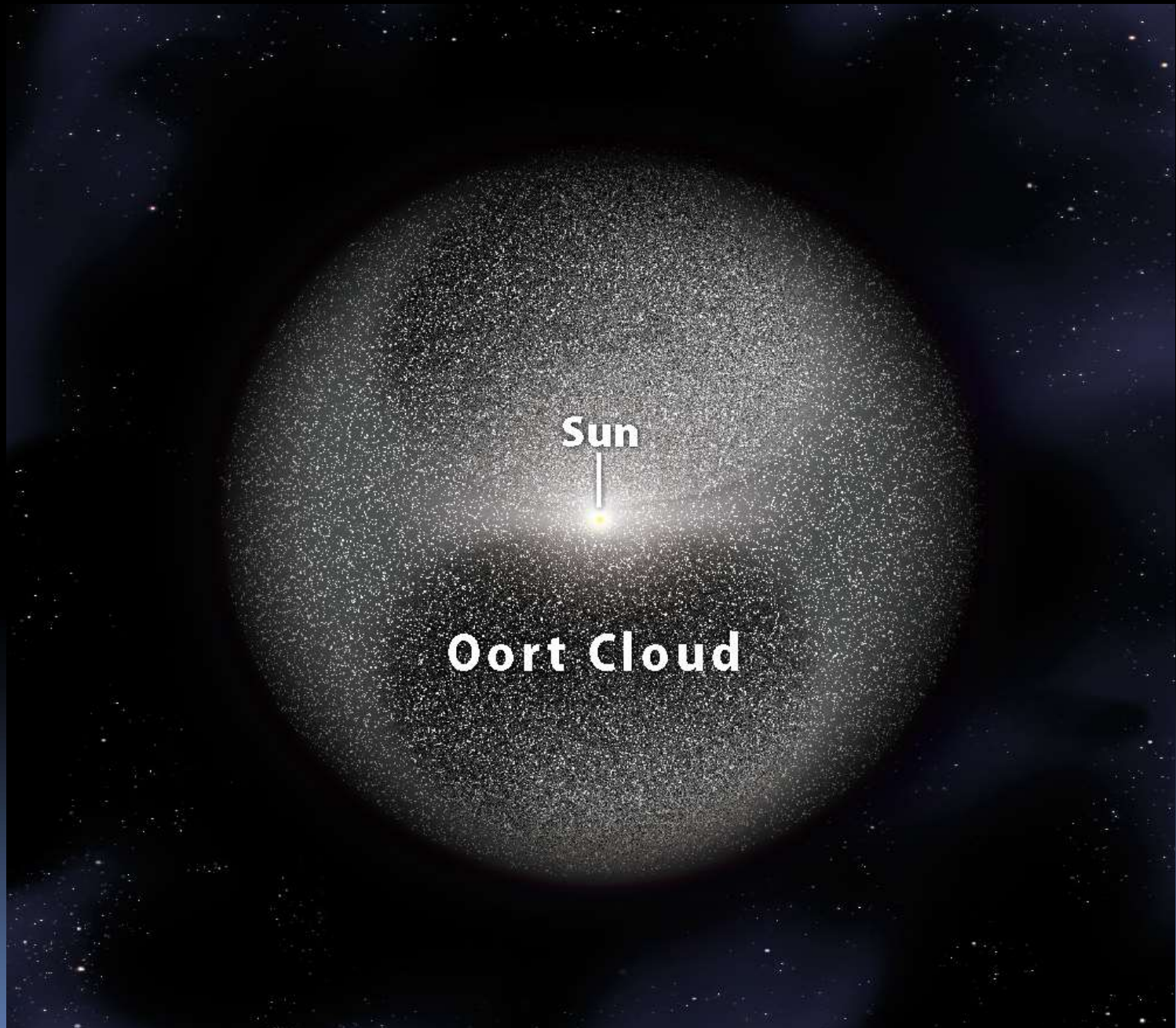


Material primitivo,
homogéneo, no diferenciado

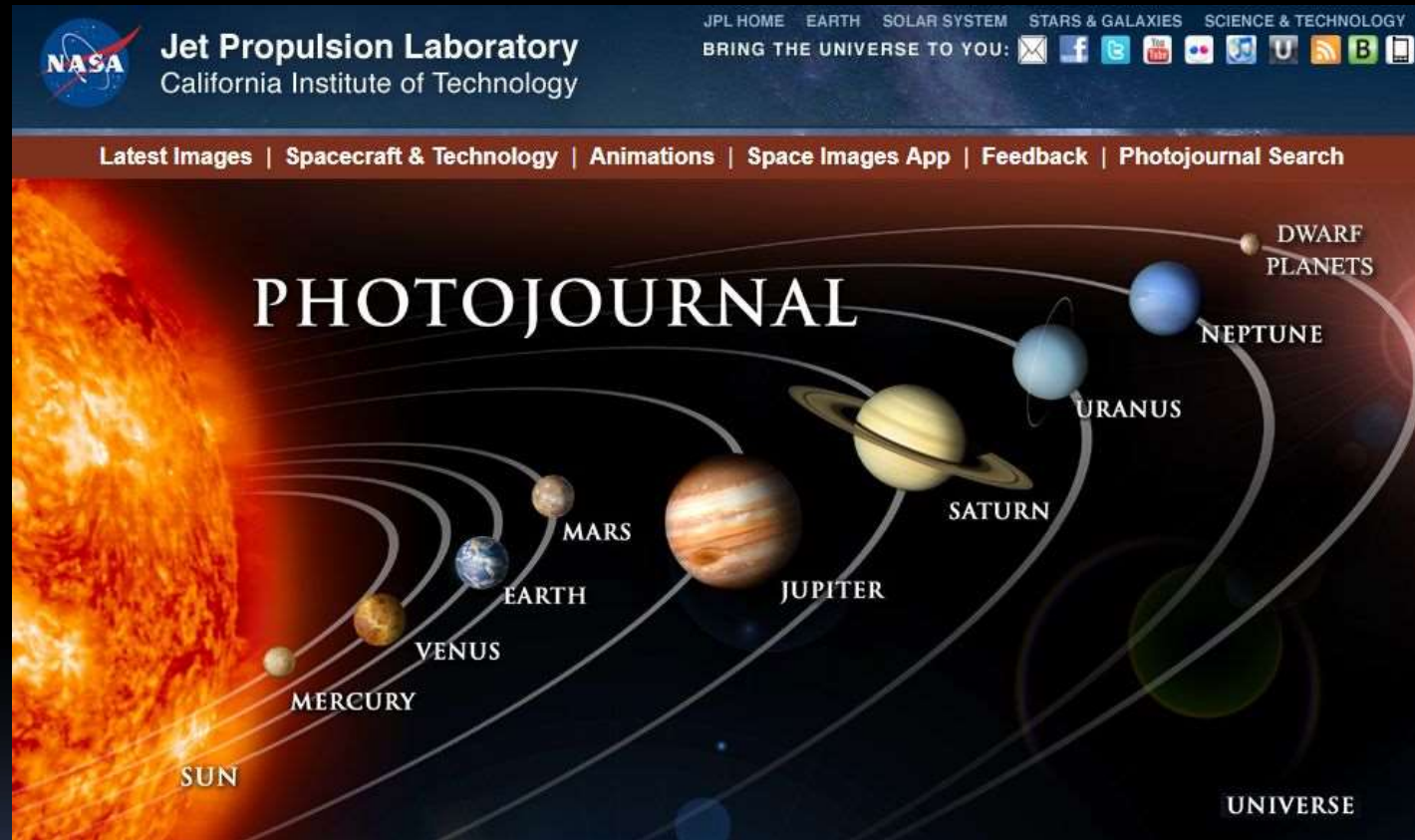


¿Planeta 9?





photojournal.jpl.nasa.gov



www.astronomia.edu.uy/sistemasolar

¡Gracias Dolores!

