Except Europa

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California Institute of Technology

(based on a presentation developed by Robert Pappalardo and Cynthia Phillips)

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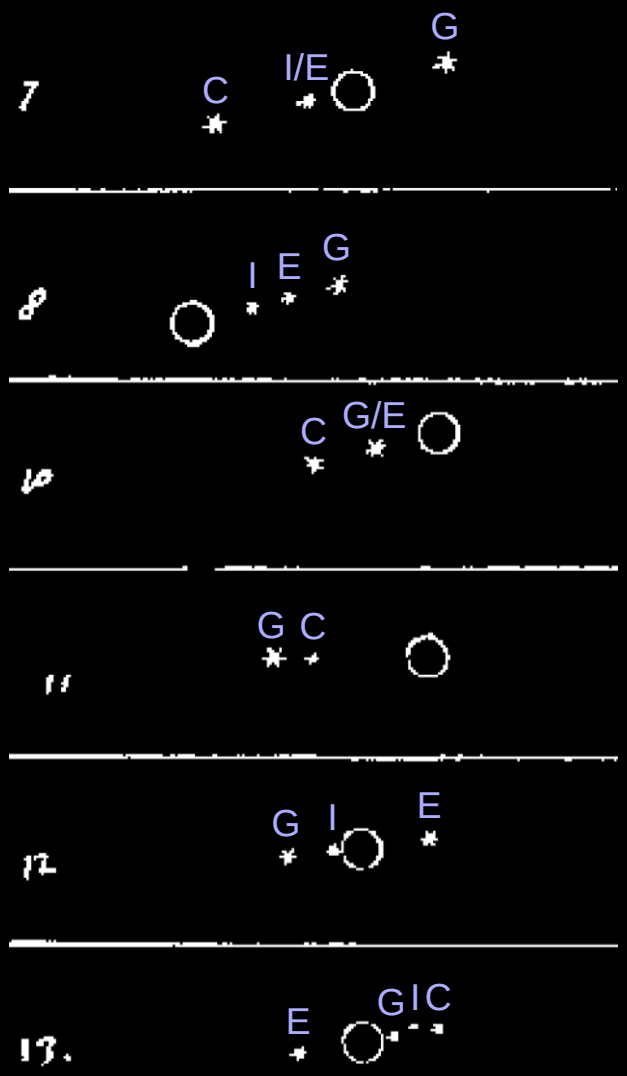
Jupiter

Jupiter from the Earth

The Galilean Moons: January 1610

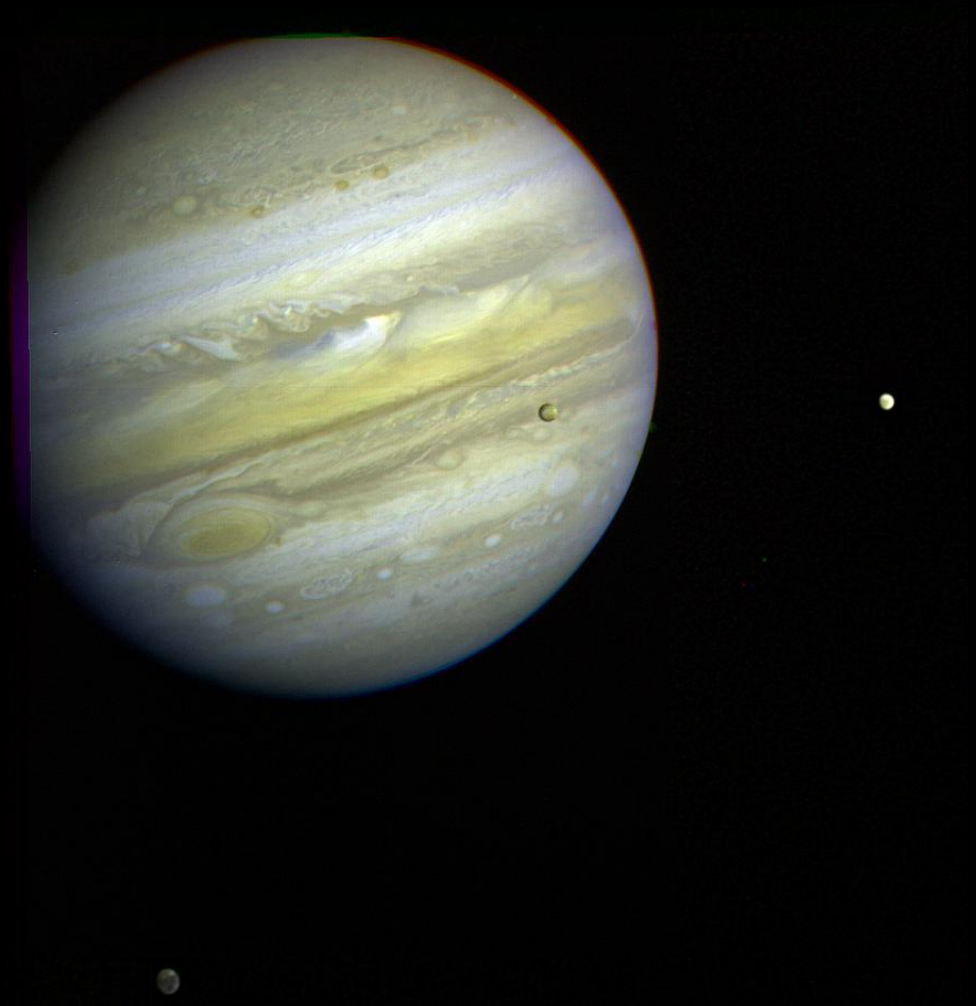


I - Io
E - Europa
G - Ganymede
C - Callisto

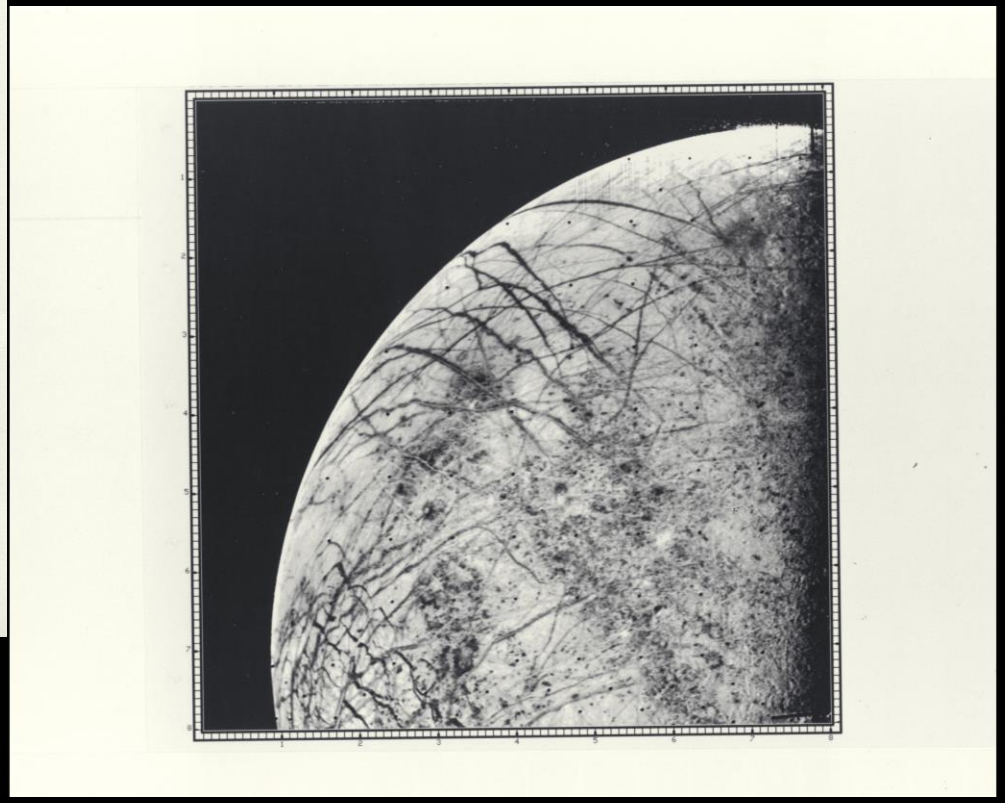
Jupiter Close Encounters

9 spacecraft:

- 1973: Pioneer 10
- 1974: Pioneer 11
- 1979: Voyager 1
- 1979: Voyager 2
- 1992: Ulysses
- 1995-2003: Galileo
- 2000: Cassini
- 2007: New Horizons
- 2016: Juno

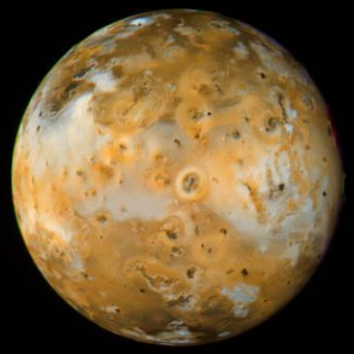


Europa and Voyager 2



Europa and Voyager 2

Io

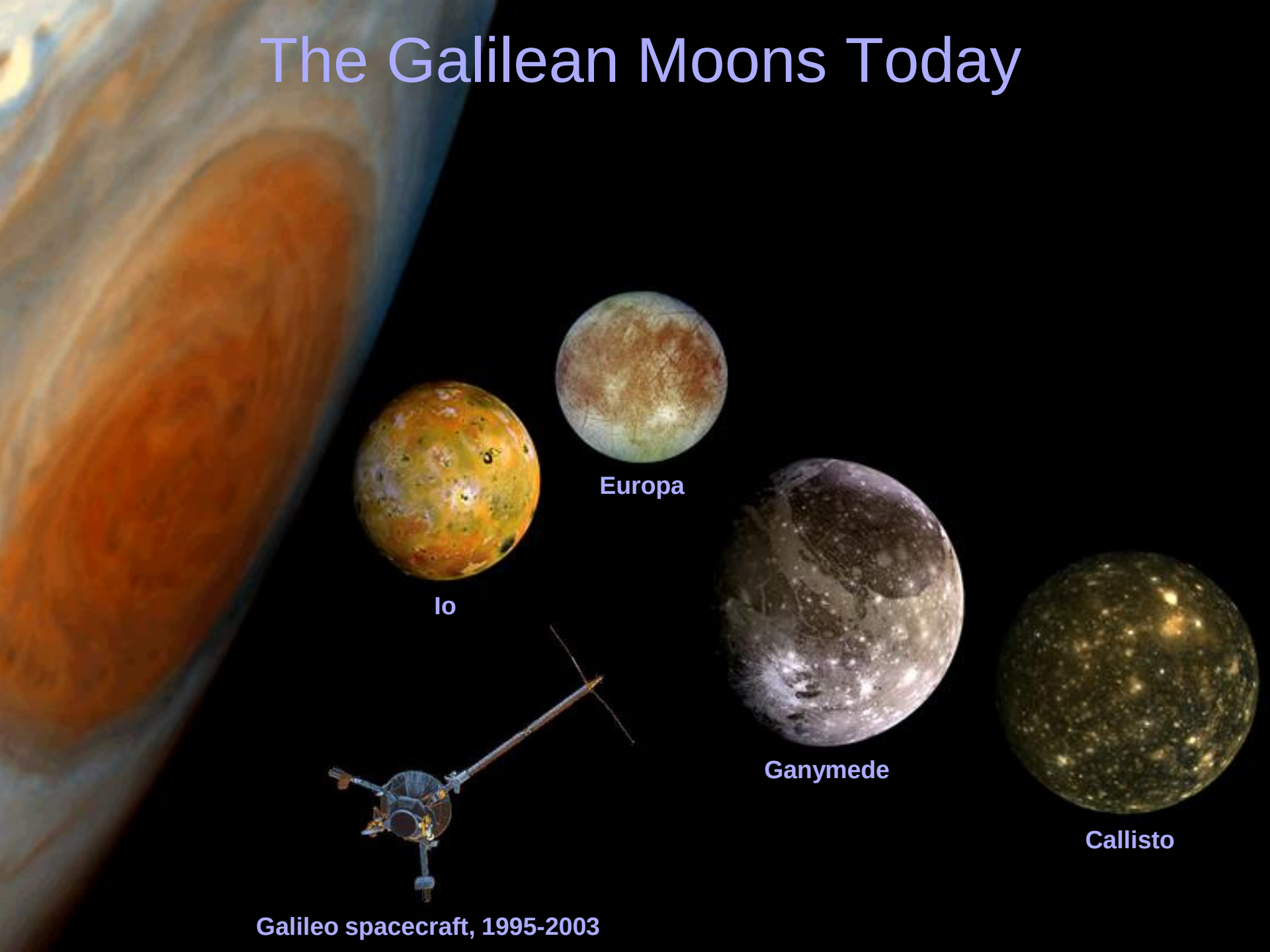


Europa

Ganymede

Callisto

The Galilean Moons Today

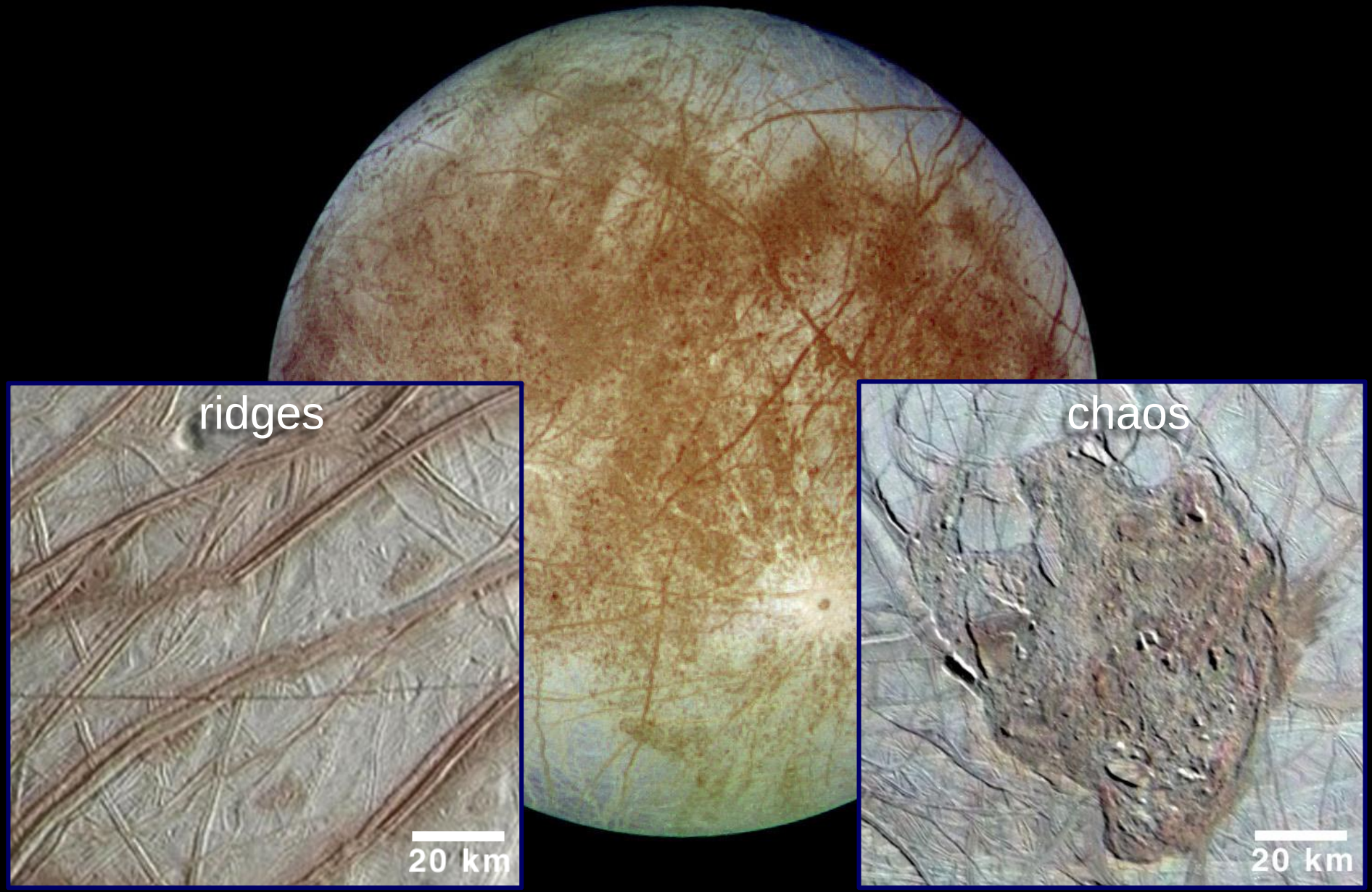


Europa & Impact Craters

Ganymede

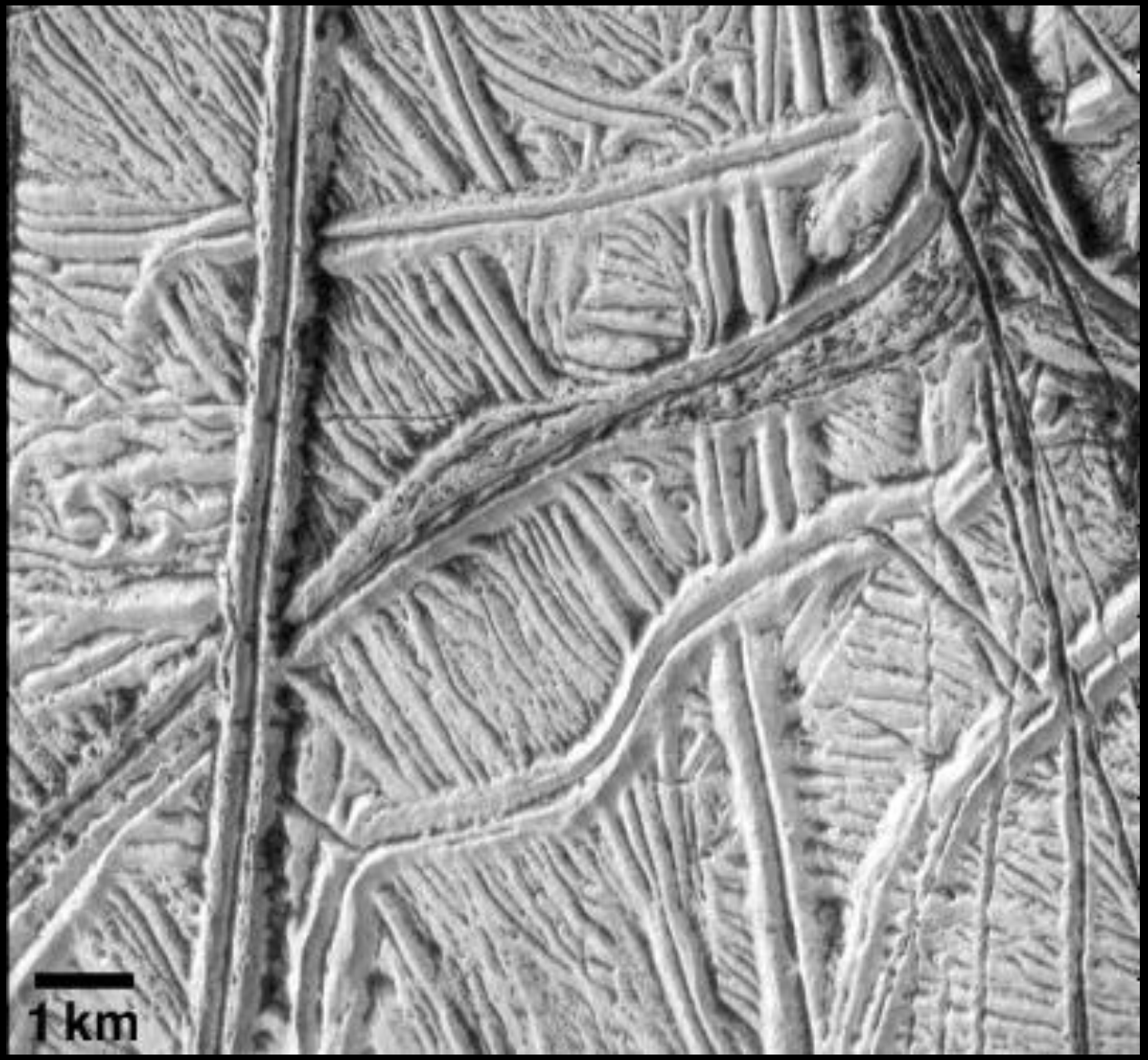
Europa

Europa's Surface



Ridges

Ridges

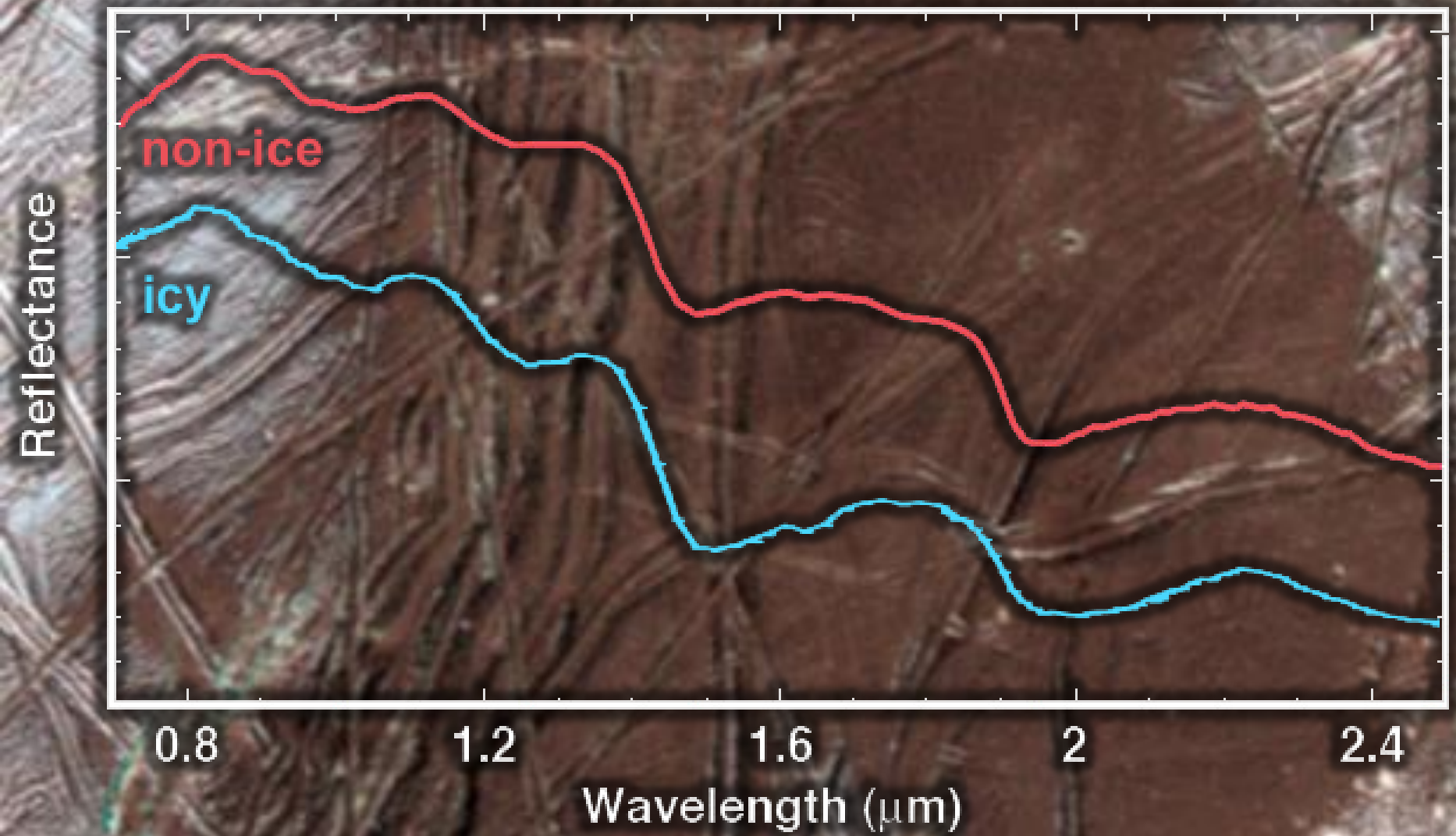


Argadnel Regio, Europa

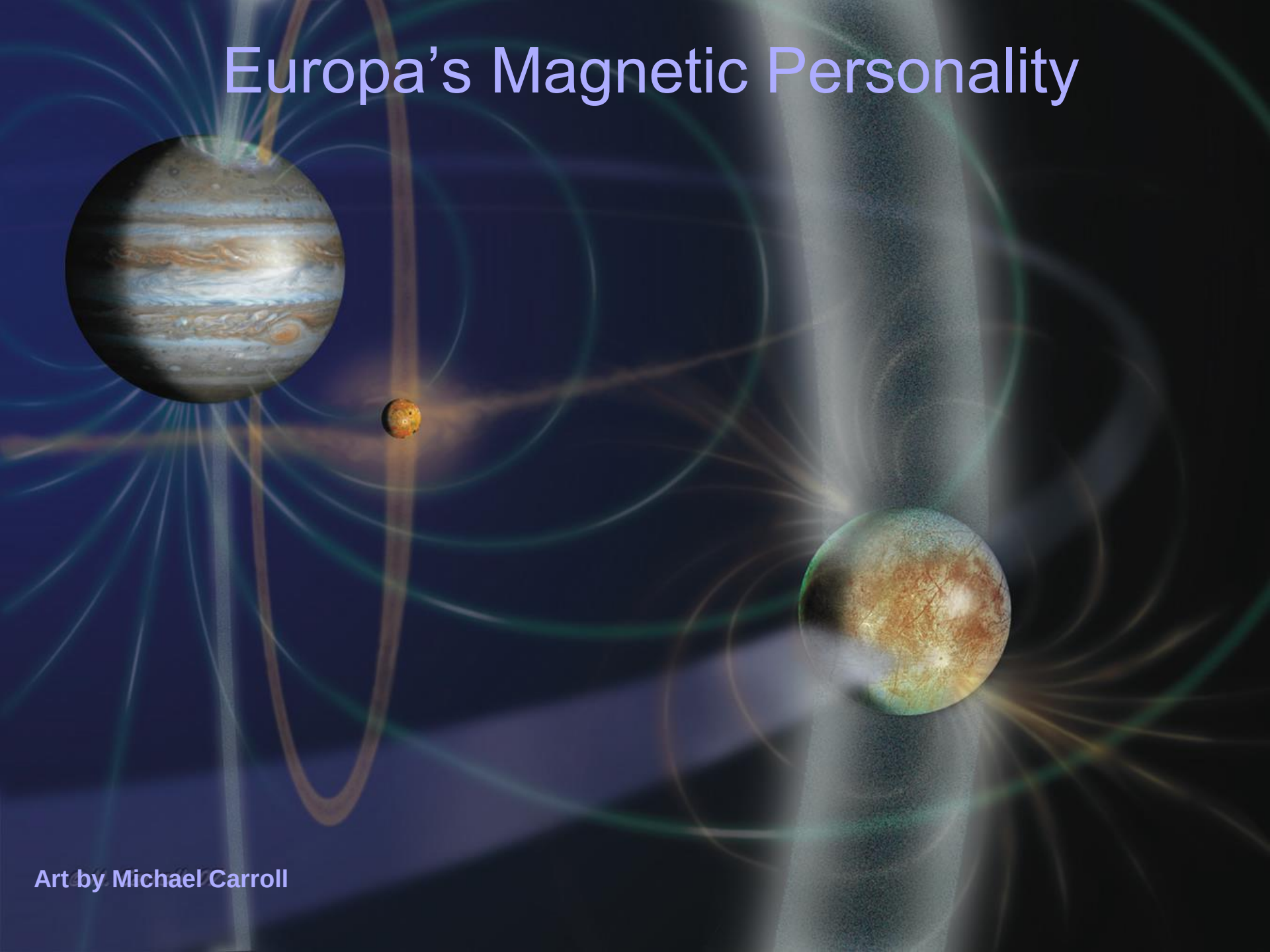
San Andreas Fault, Earth

Impacts

Dark Spots

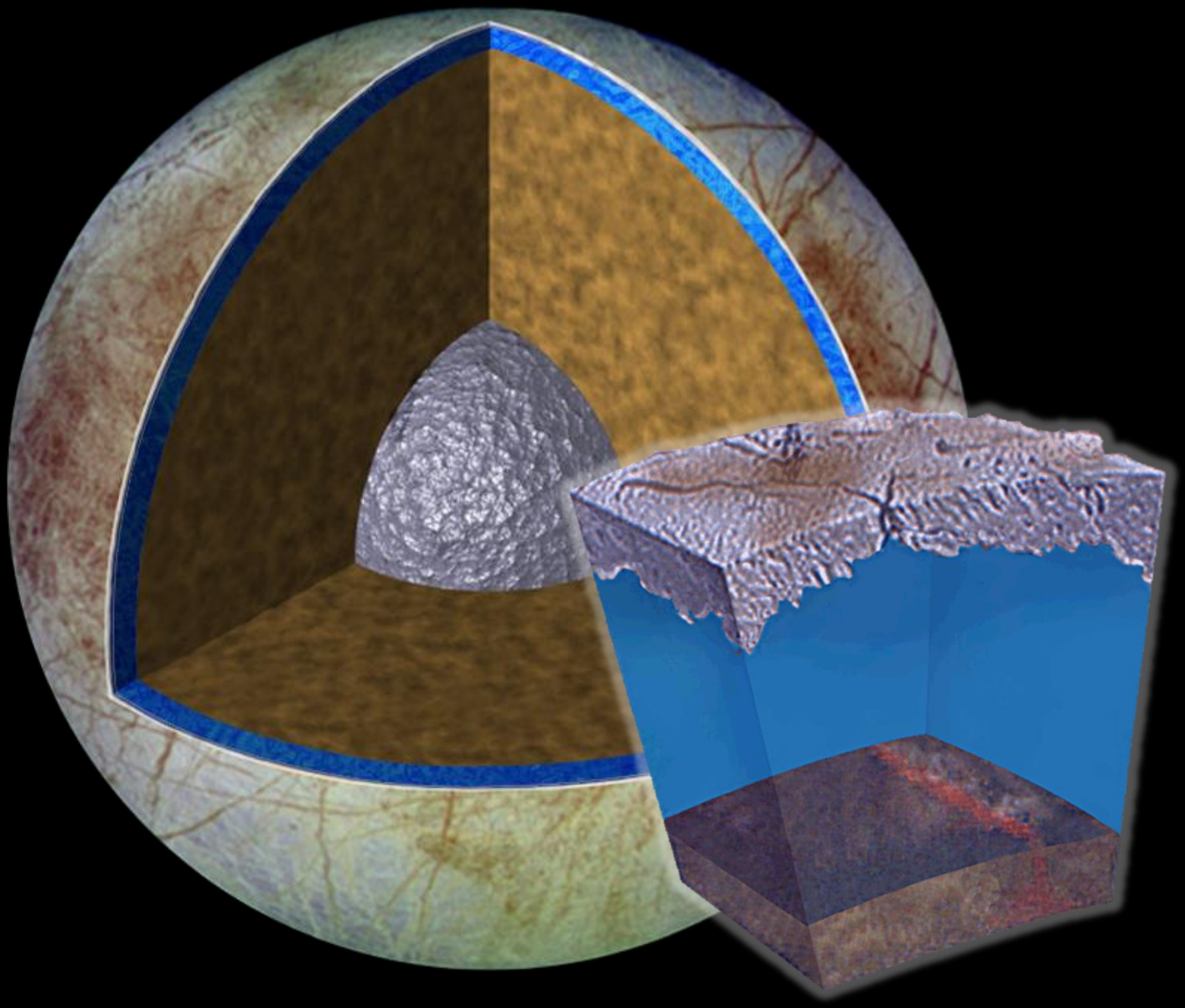


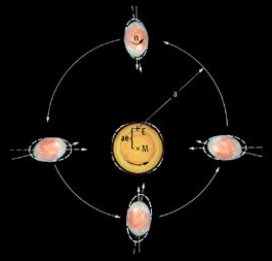
Europa’s Magnetic Personality



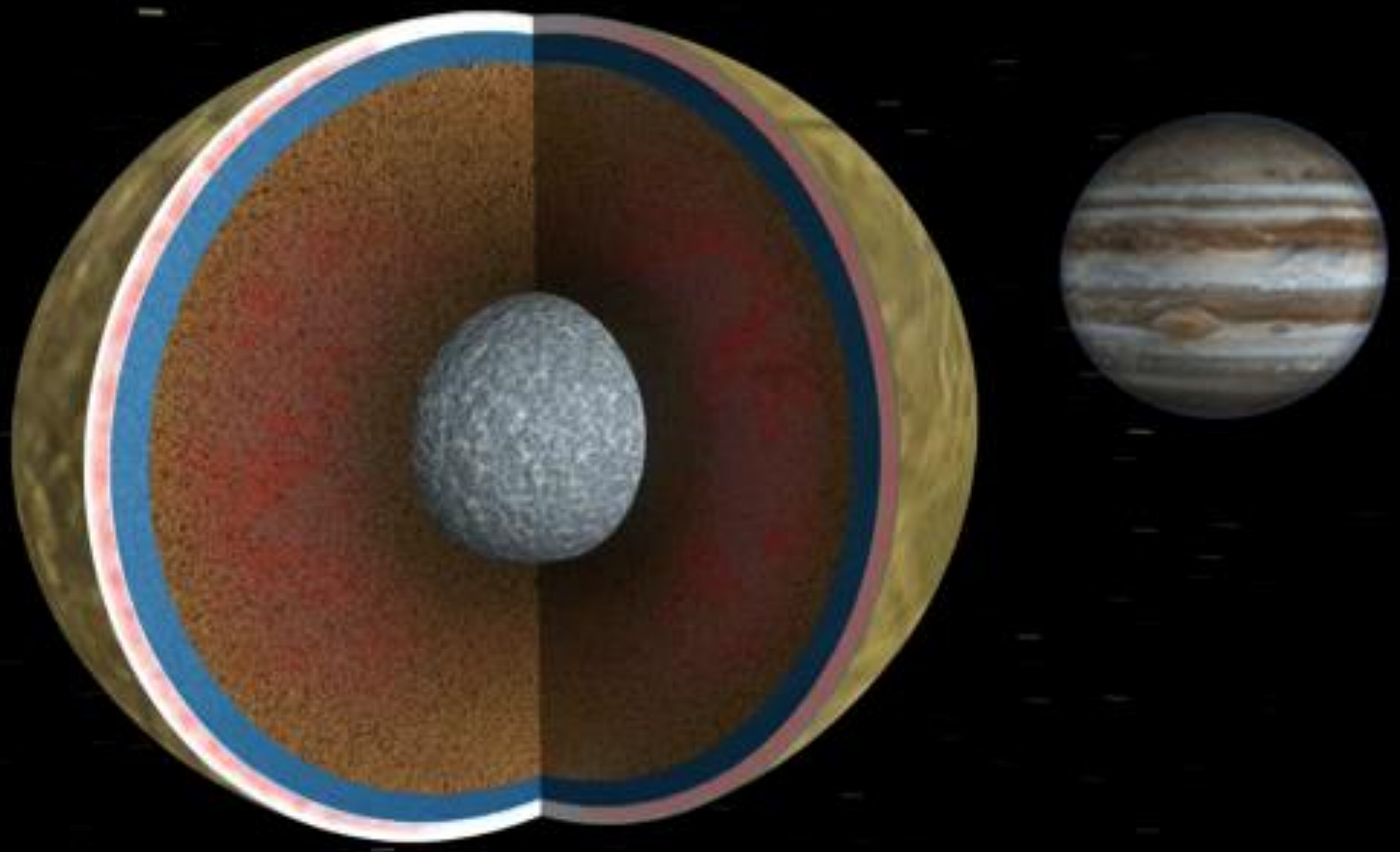
Art by Michael Carroll

Europa's Interior

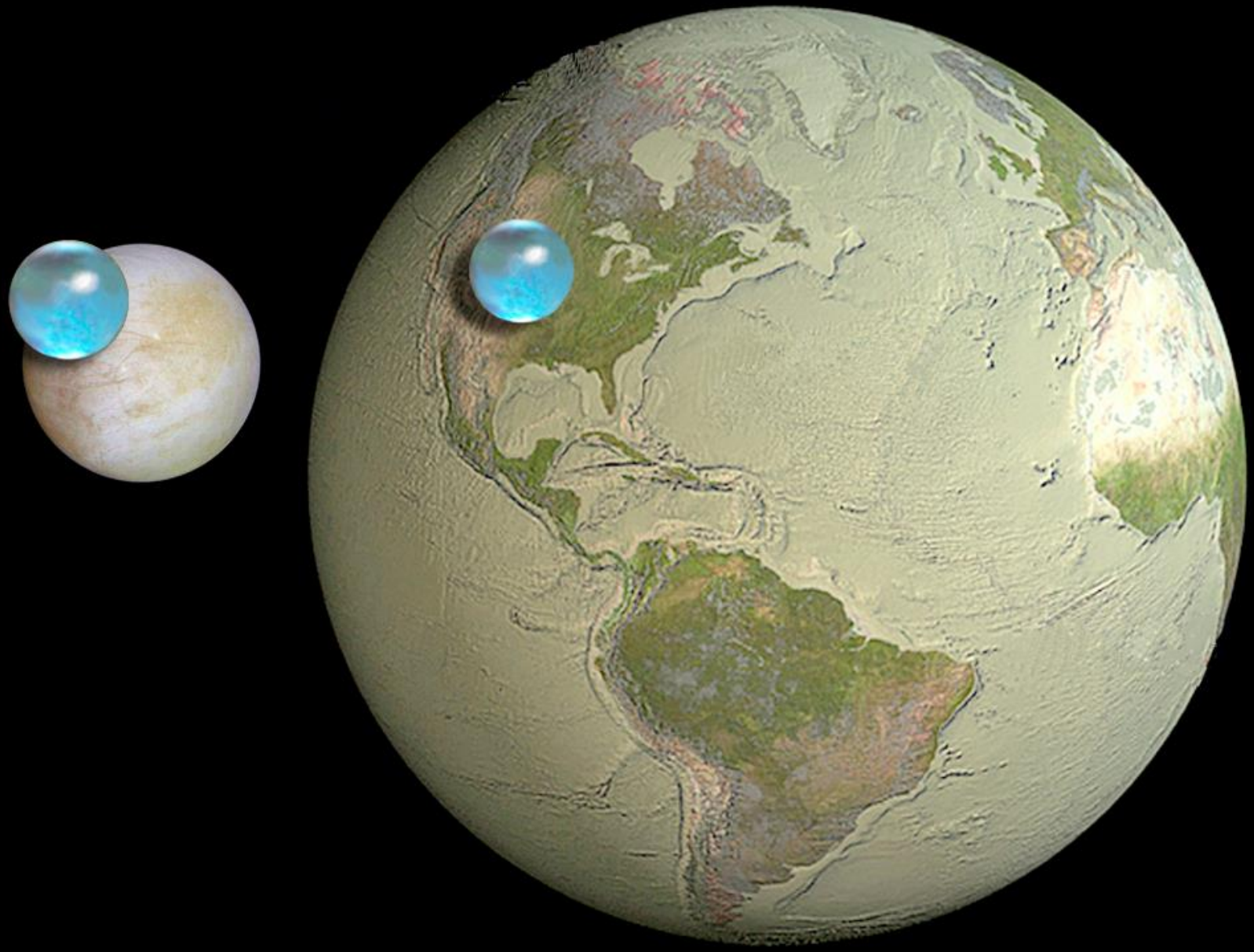




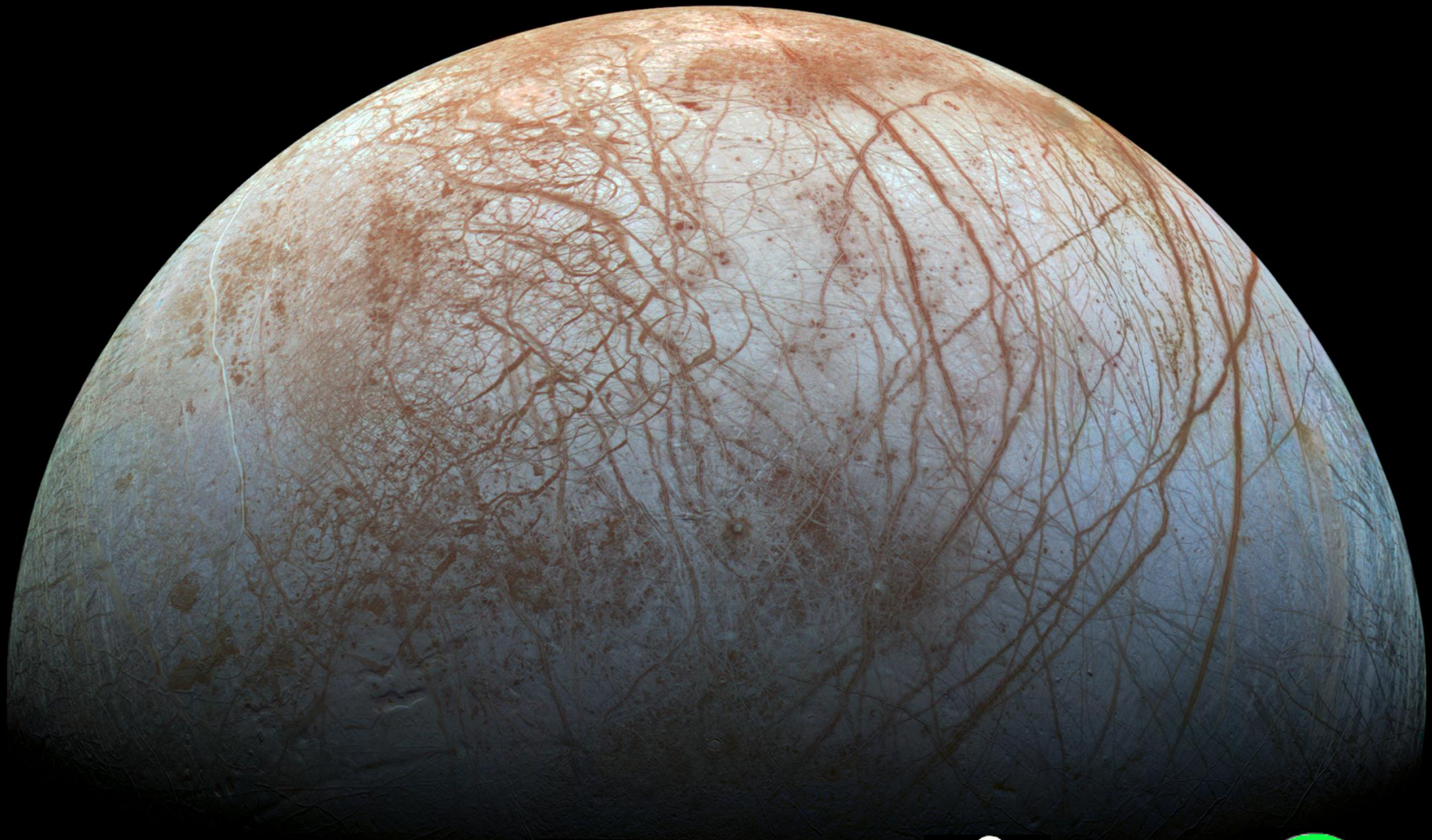
Tidal Flexing



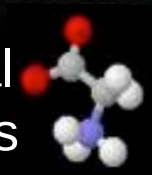
Europa: More Water Than Earth



The Planetary Ingredients for Life



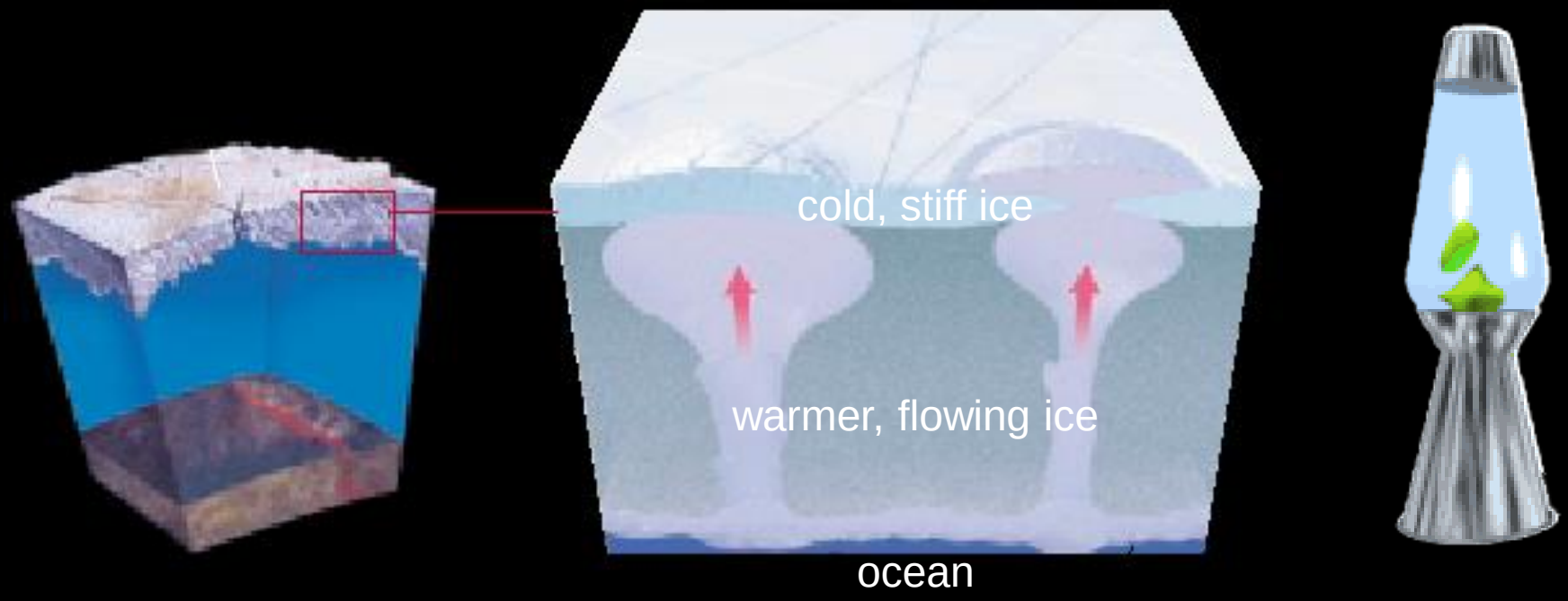
water

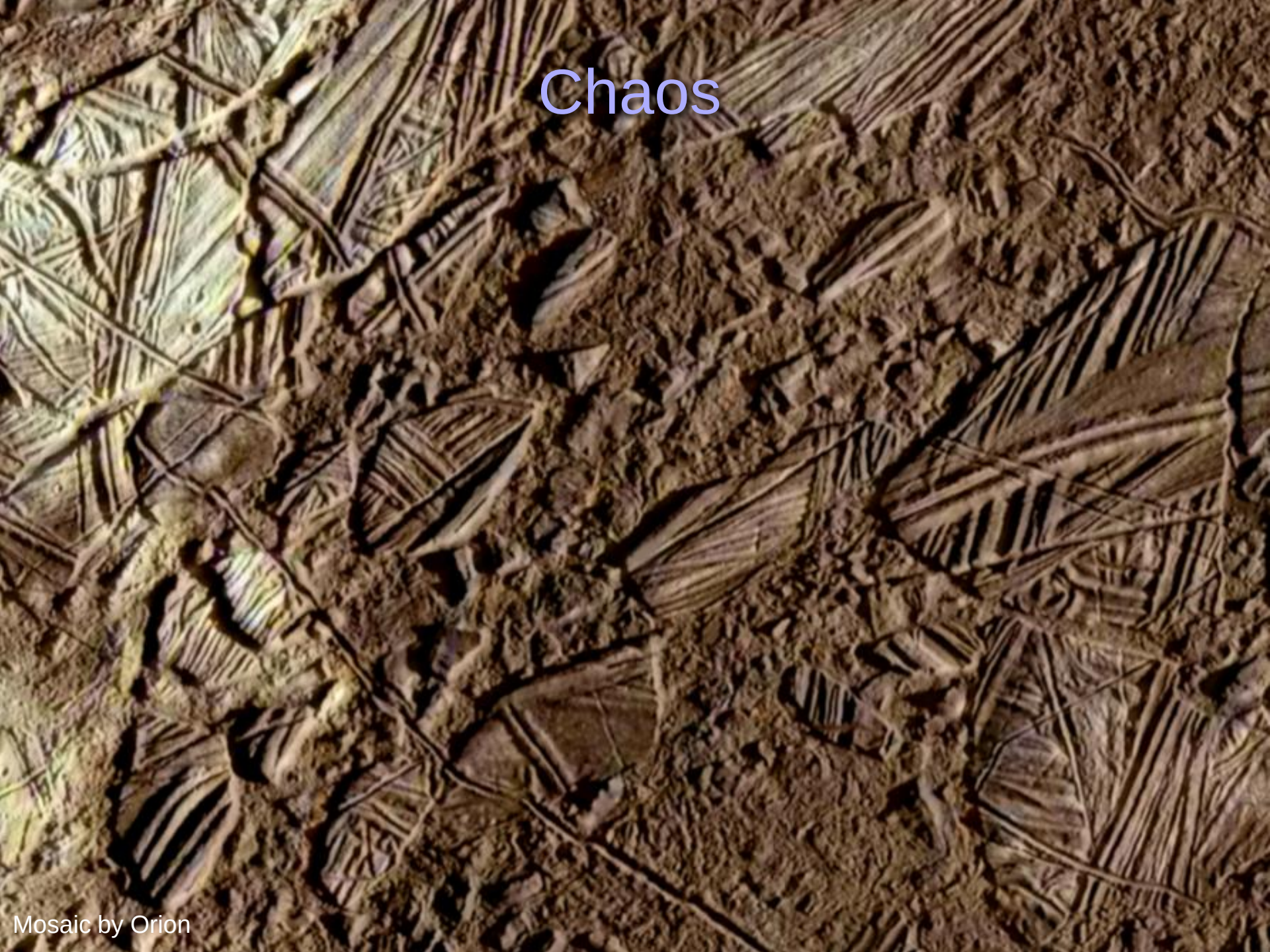
essential elements 

chemical energy

stability

Icy “Lava Lamp”




Chaos
Mosaic by Orion

Chaos

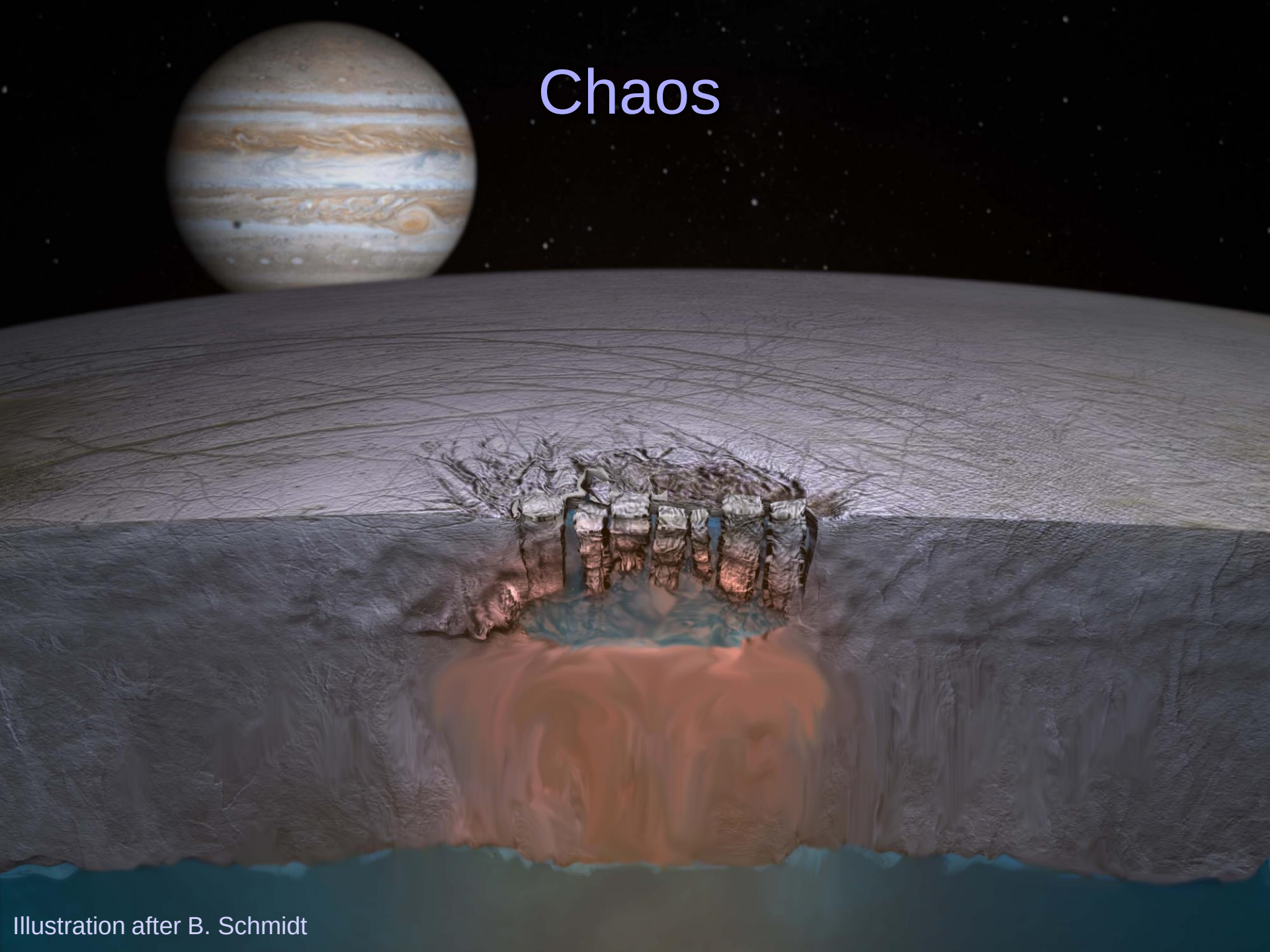
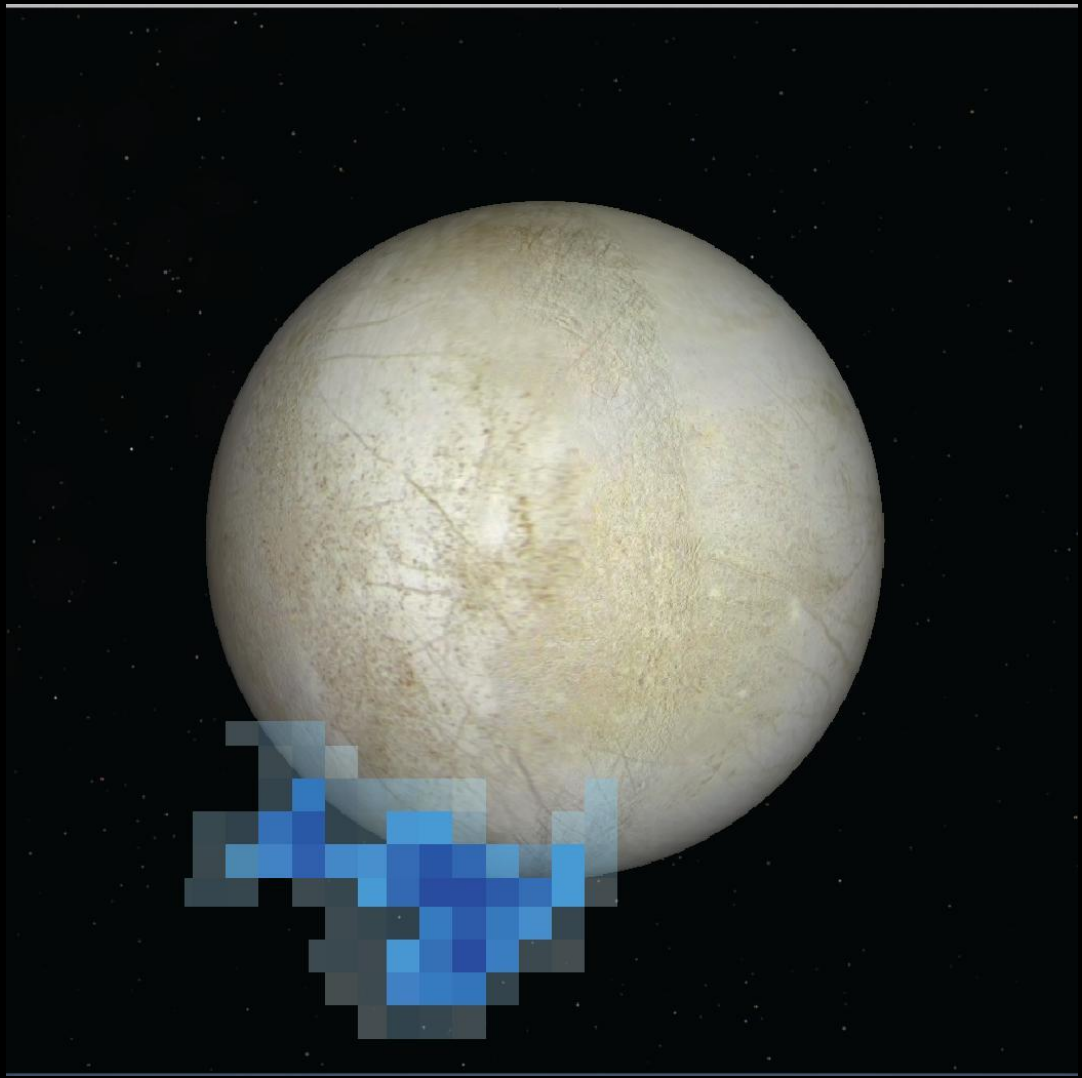
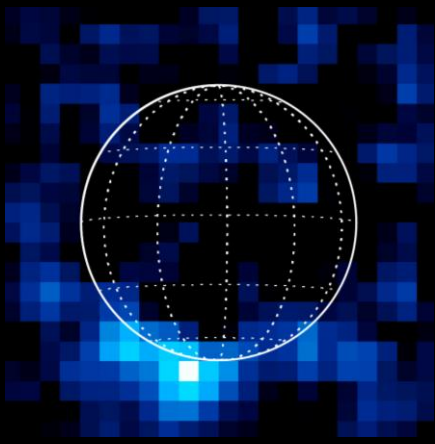


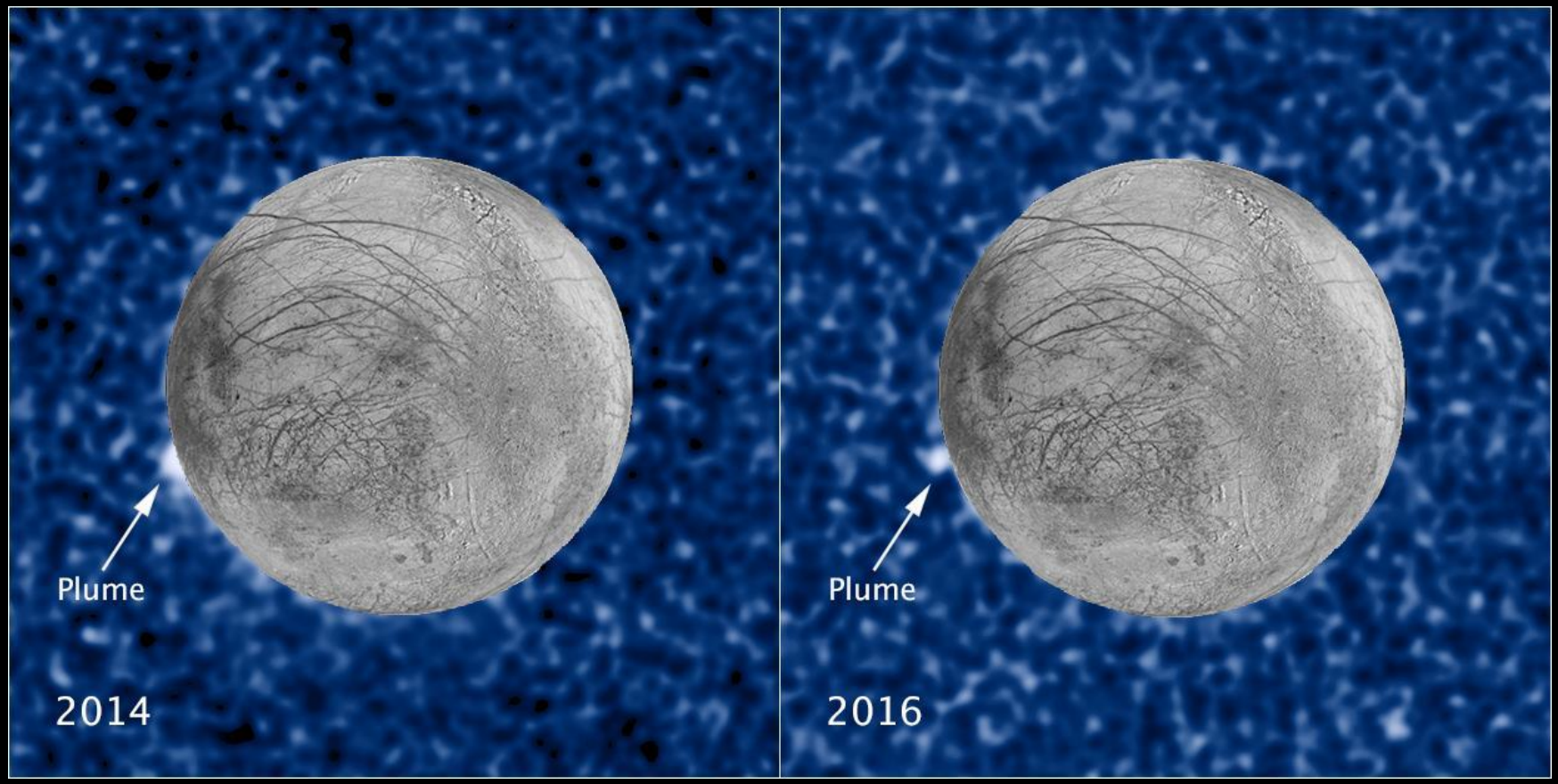
Illustration after B. Schmidt

Plumes?
2012 Hubble Water signs

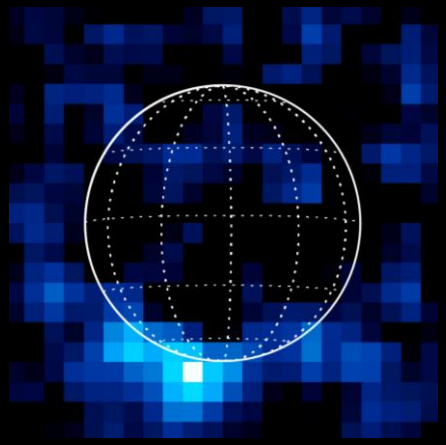


Plumes?
Signs from Hubble



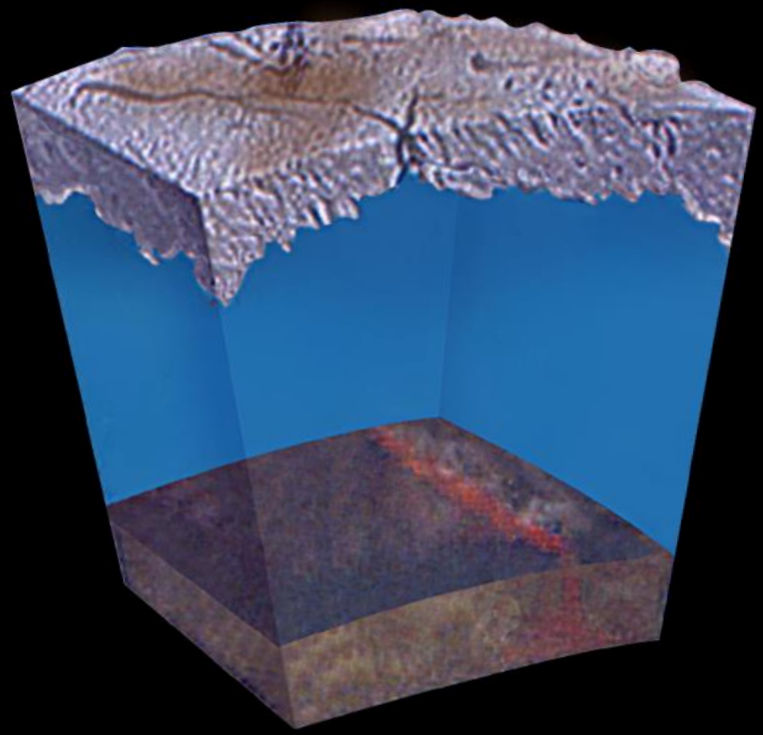


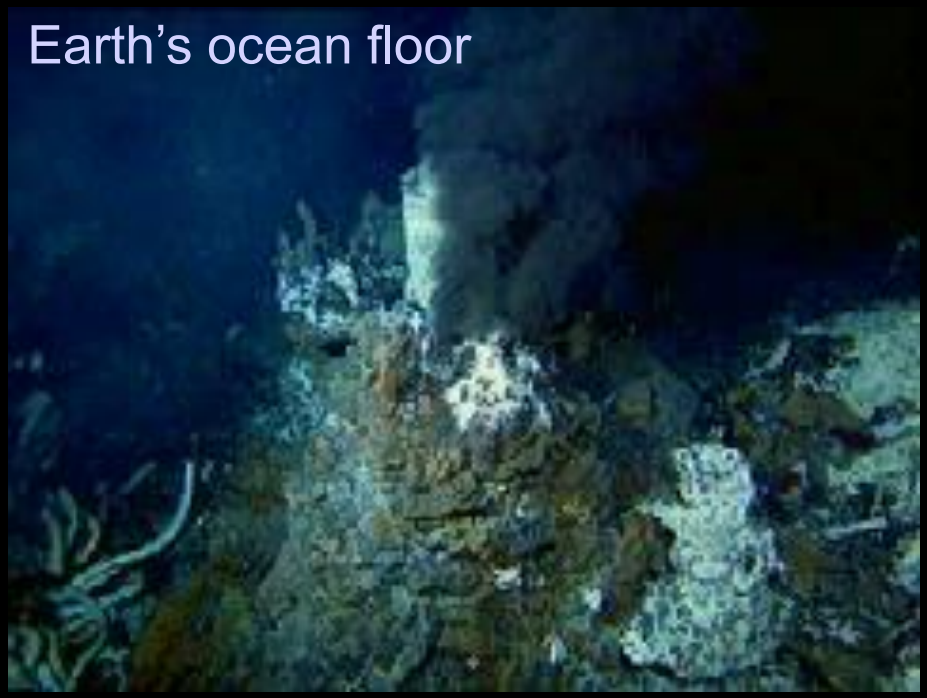
Plumes?



Ingredients for Life?

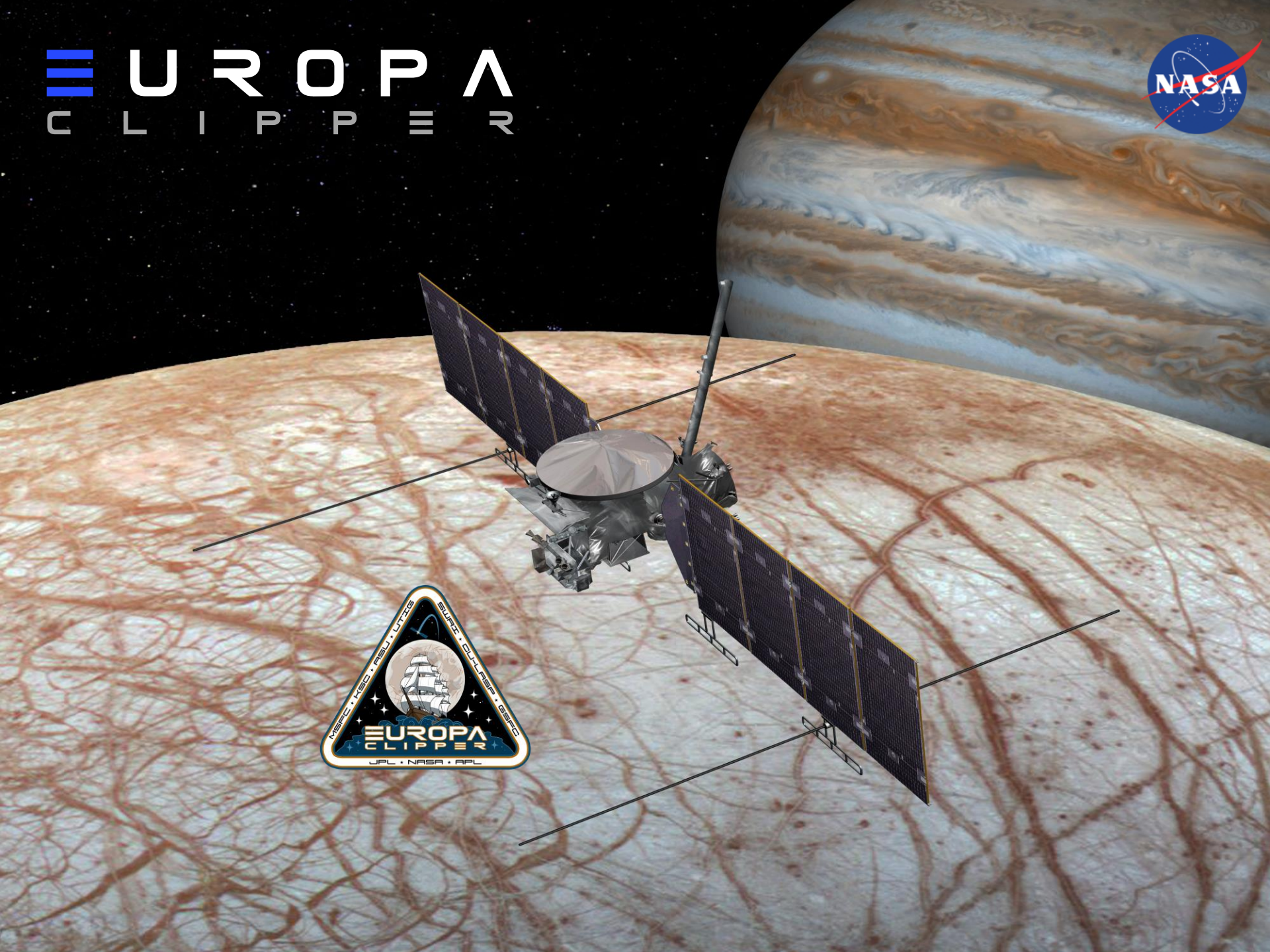
- Water: *Much more than all of Earth's oceans*
- Essential elements: *From formation and impacts*
- Chemical energy: *From above and below*
- Stability: *"Simmering" for 4 billion years*





Woods Hole Oceanographic Institution

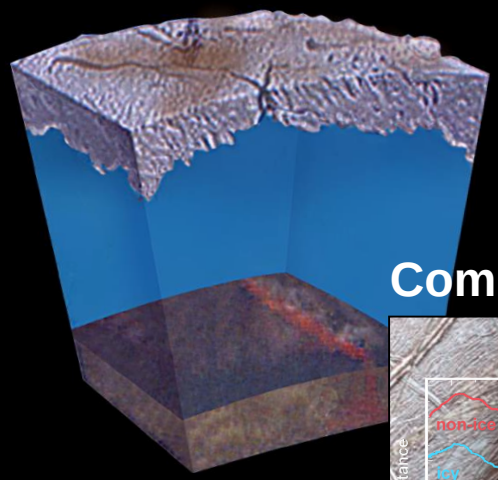
EUROPA CLIPPER



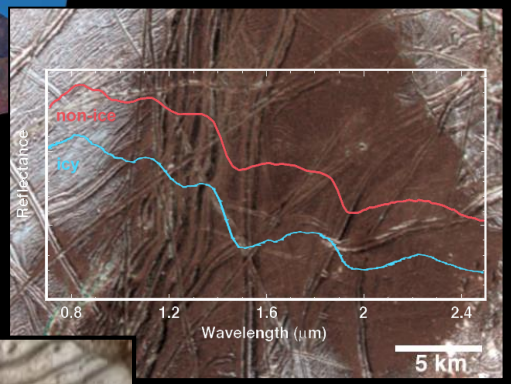
Europa Mission Science

Goal: Explore Europa to investigate its habitability

Ocean & Ice Shell

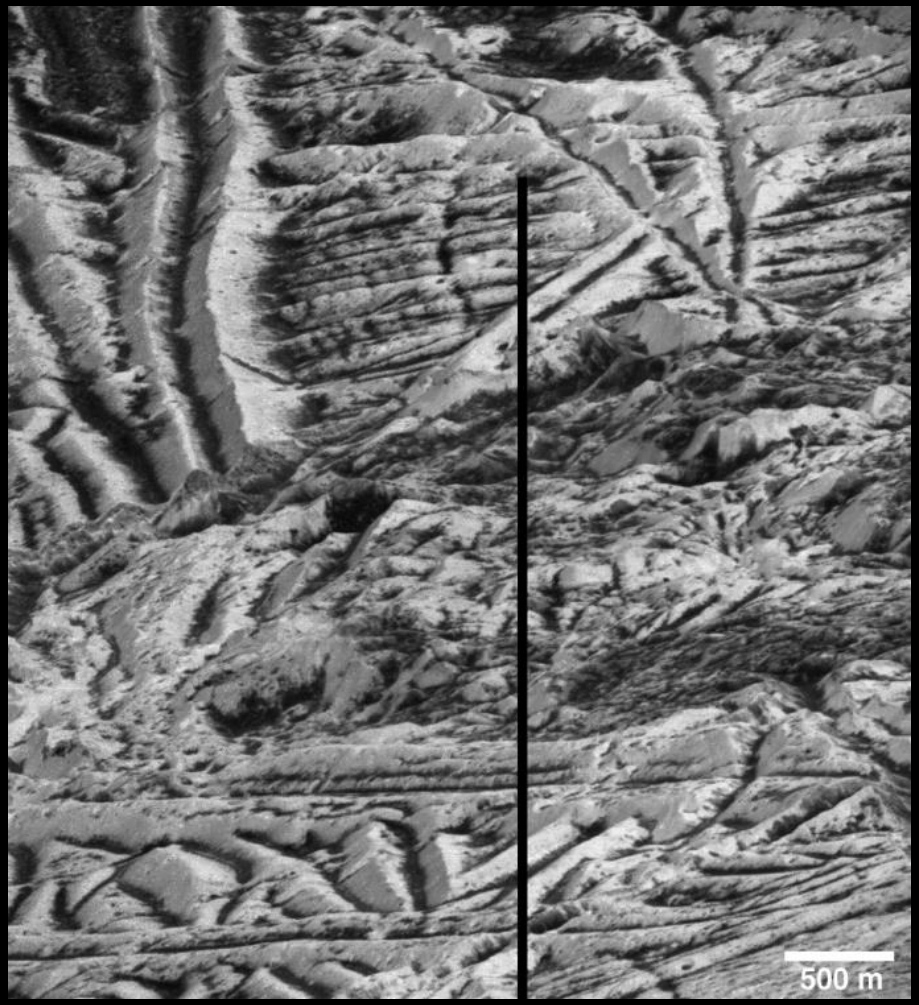


Composition

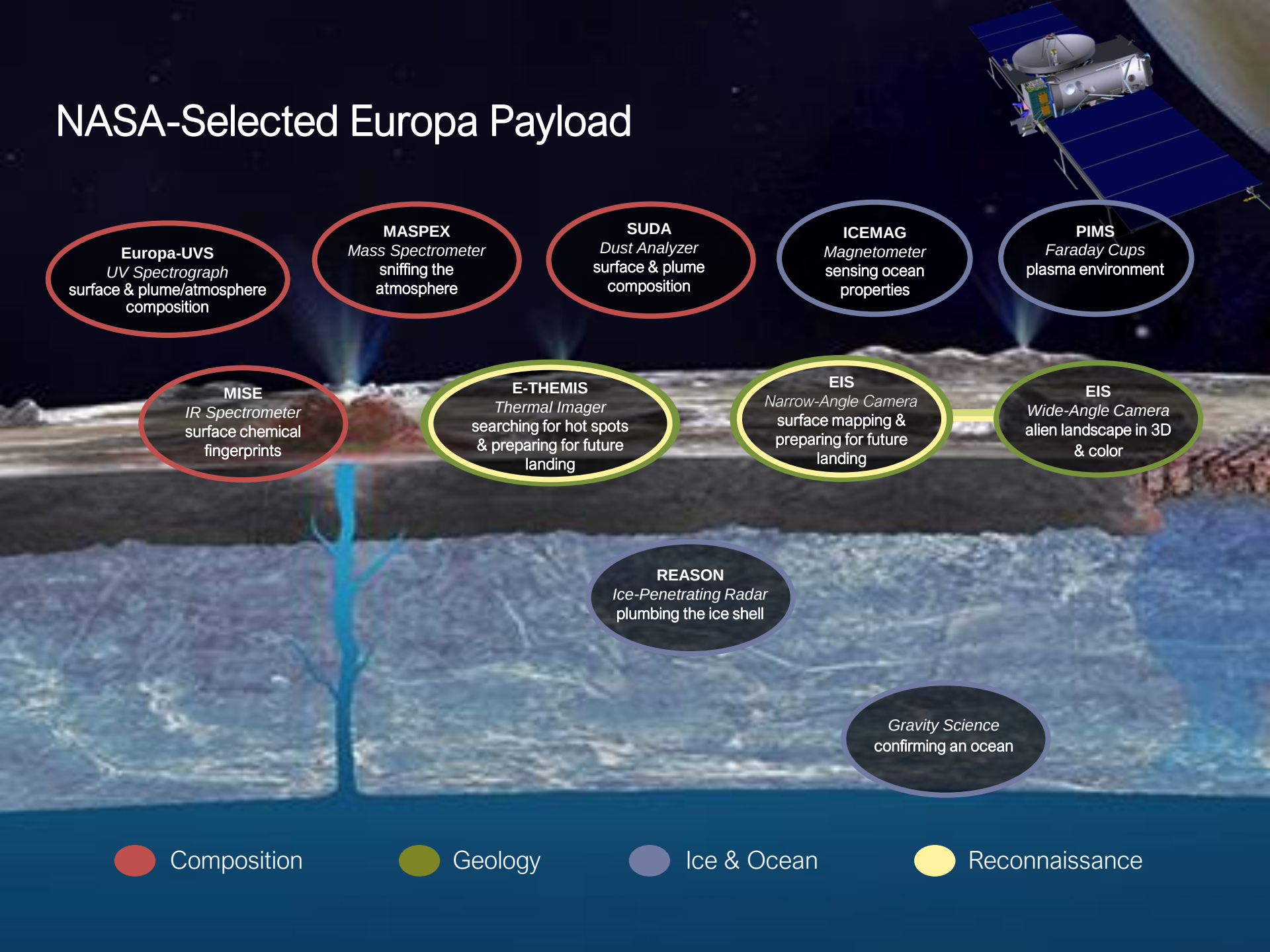


Geology

Reconnaissance

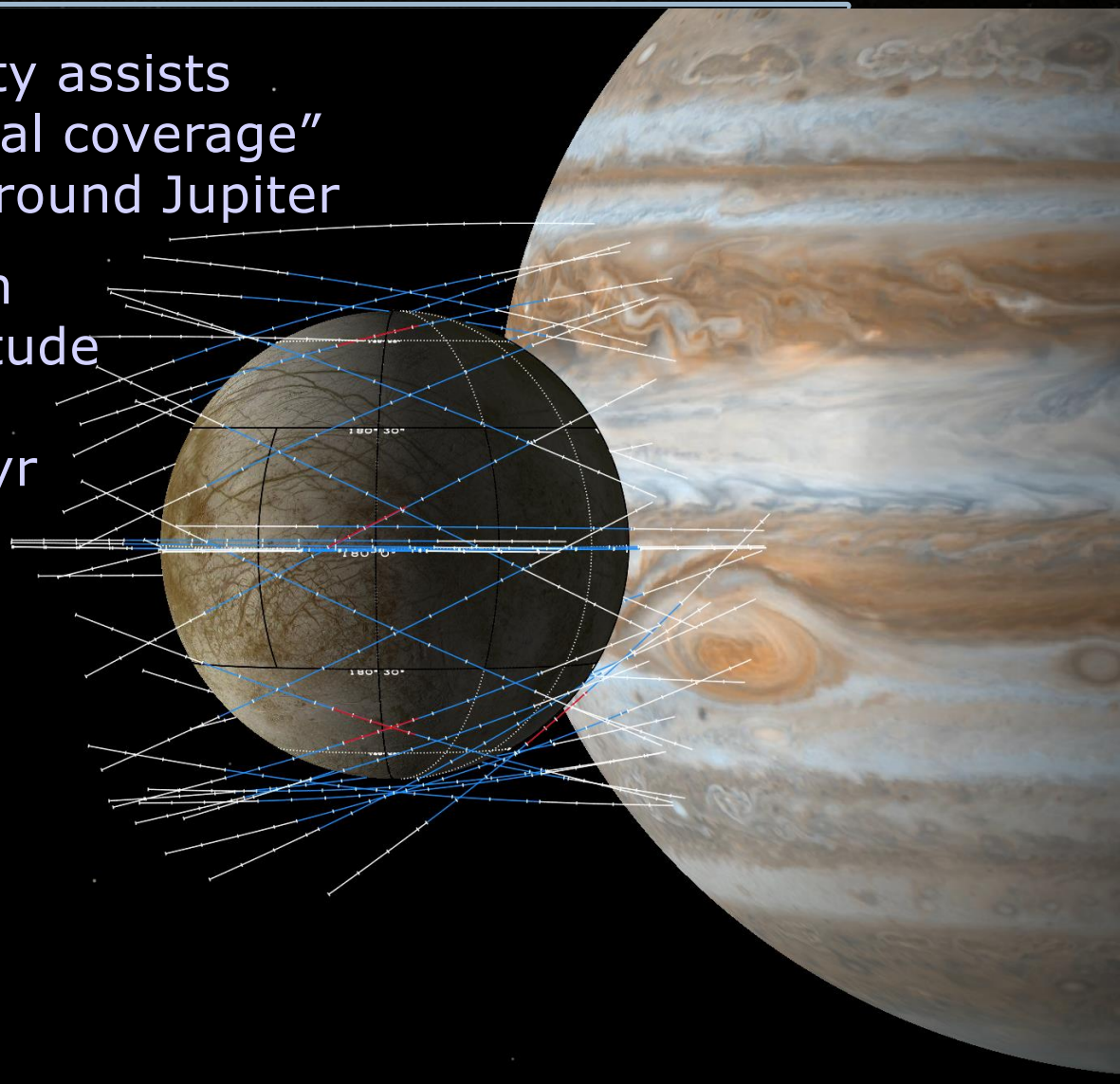


NASA-Selected Europa Payload



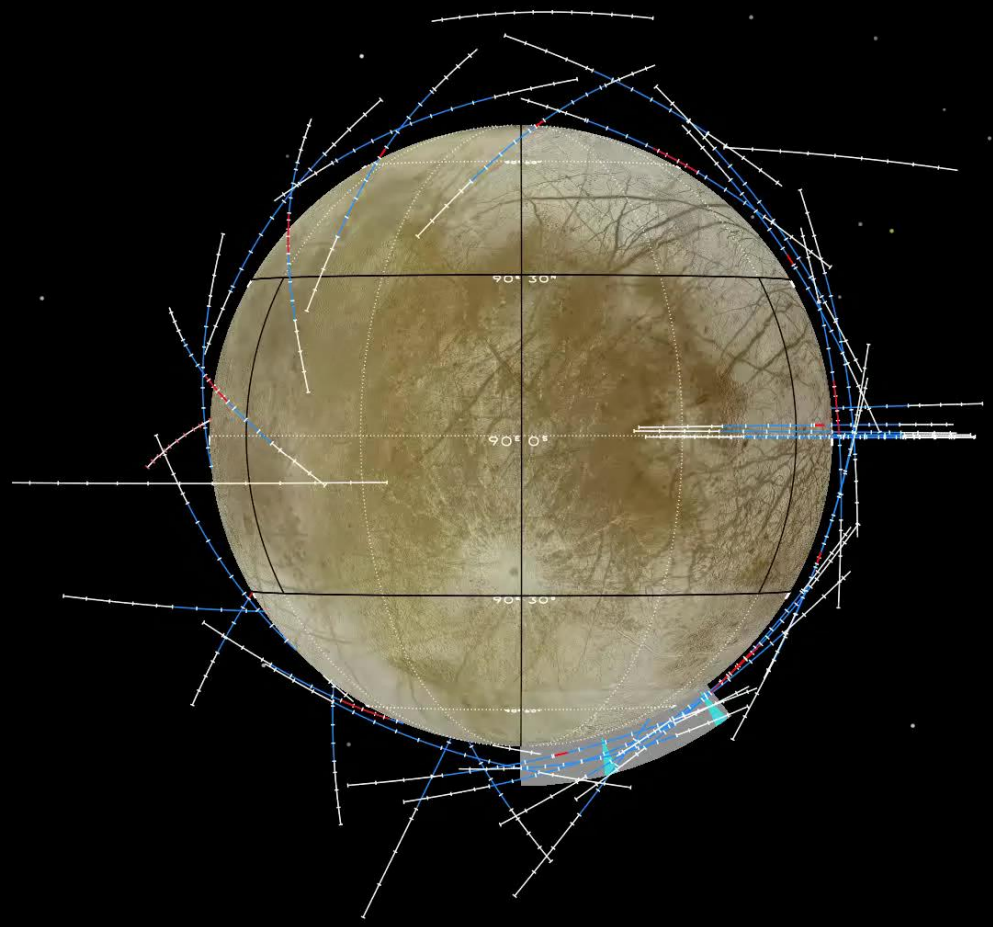
A Global Web of Fly-bys

- Multiple satellite gravity assists enables "global-regional coverage" of Europa from orbit around Jupiter
- Current mission design consists of 46 low-altitude flybys of Europa from Jupiter orbit over 3.5 yr
- Minimizes time in high radiation environment
- Simple repetitive operations

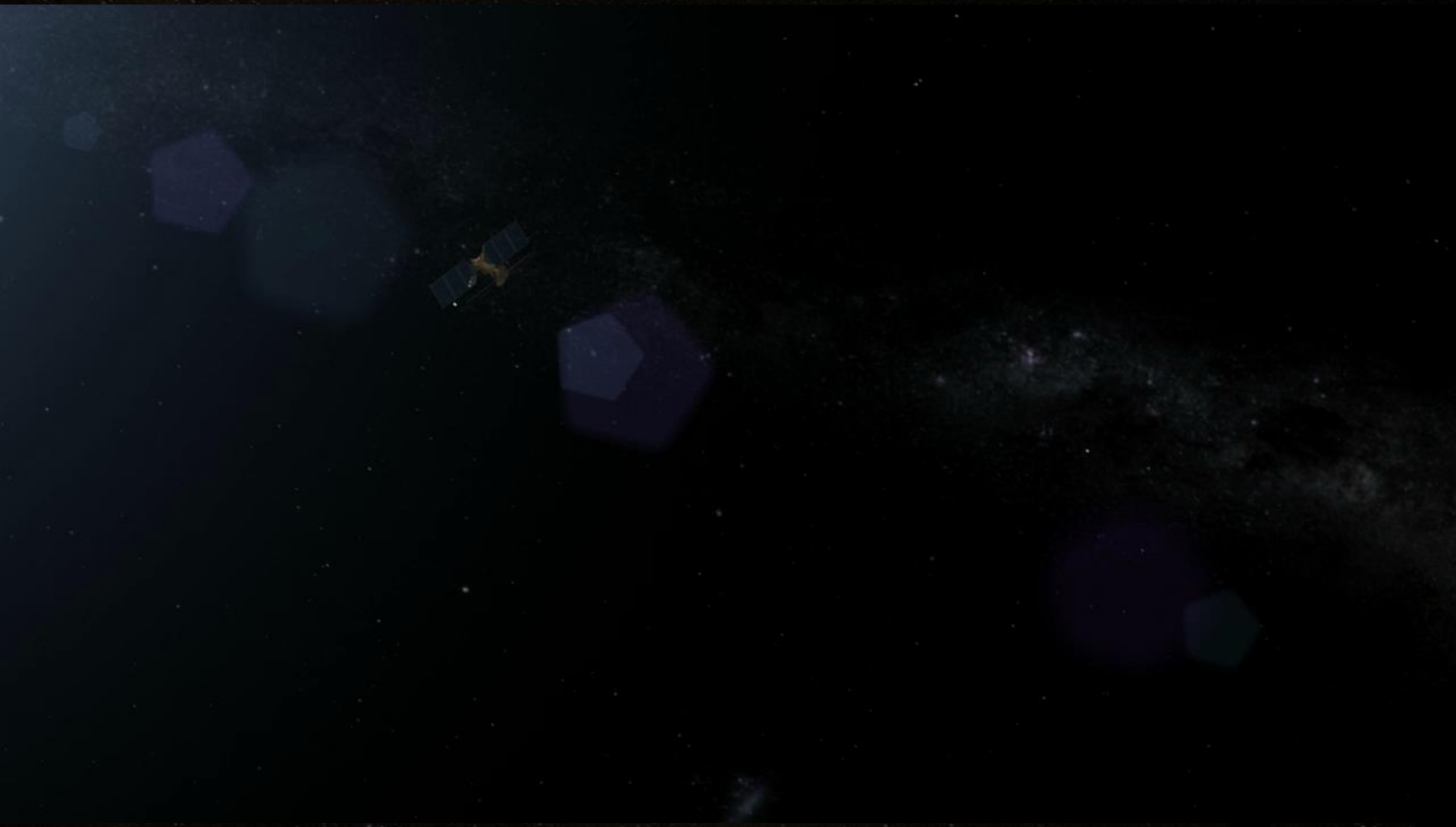


Coverage in Plumes Region

13F7-A21 Trajectory



Europa Mission Concept



Europa Lander?

Artist's Concept of a potential Europa lander

Pre-Decisional — For Planning and Discussion Only.

http://www.nasa.gov/europa

Thank you