E u R O p A

Mission Concept Overview

6 July 2016

L. Alberto Cangahuala
Europa Mission System Manager
Jet Propulsion Laboratory,
California Institute of Technology

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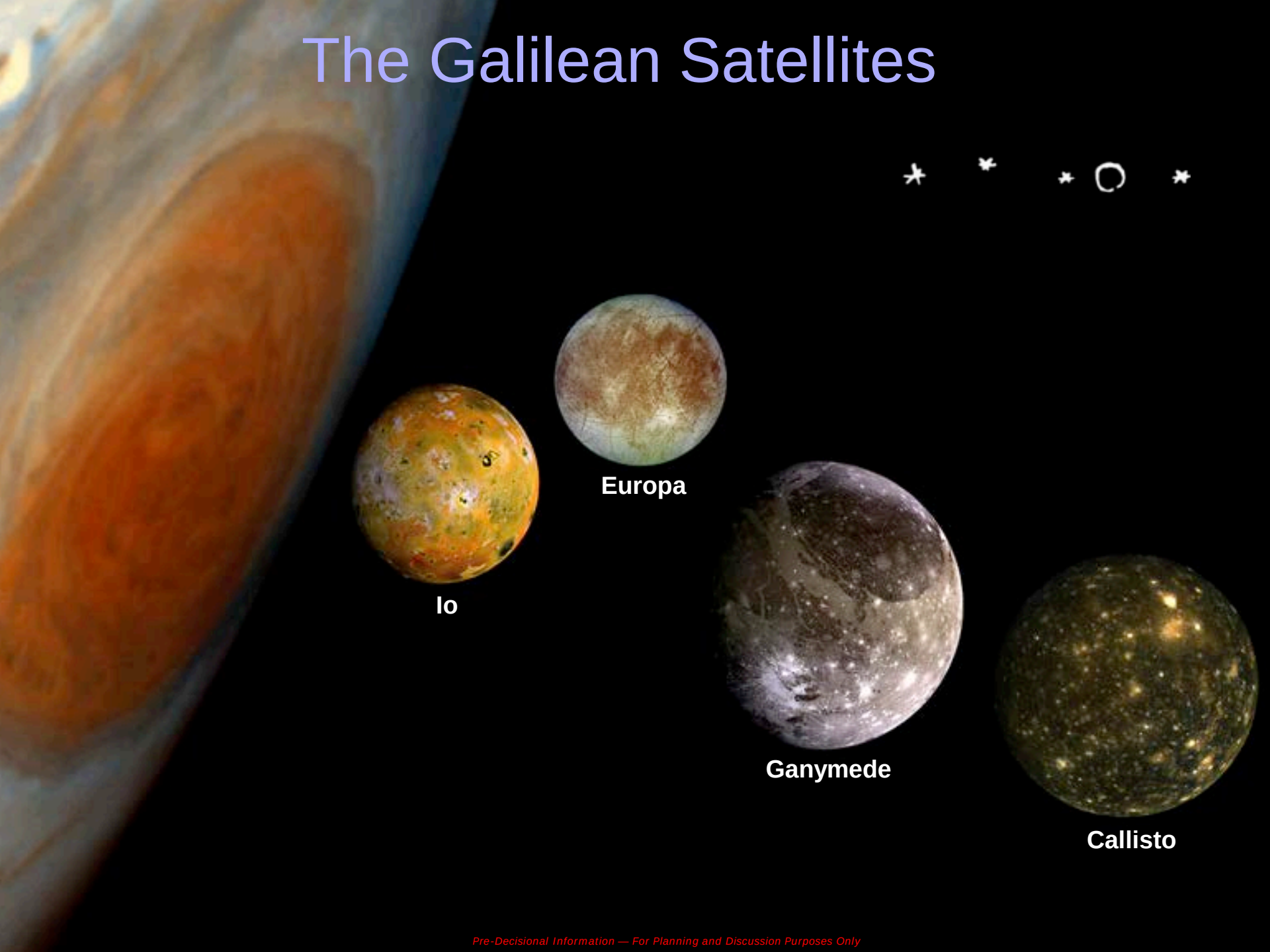
The Galilean Satellites



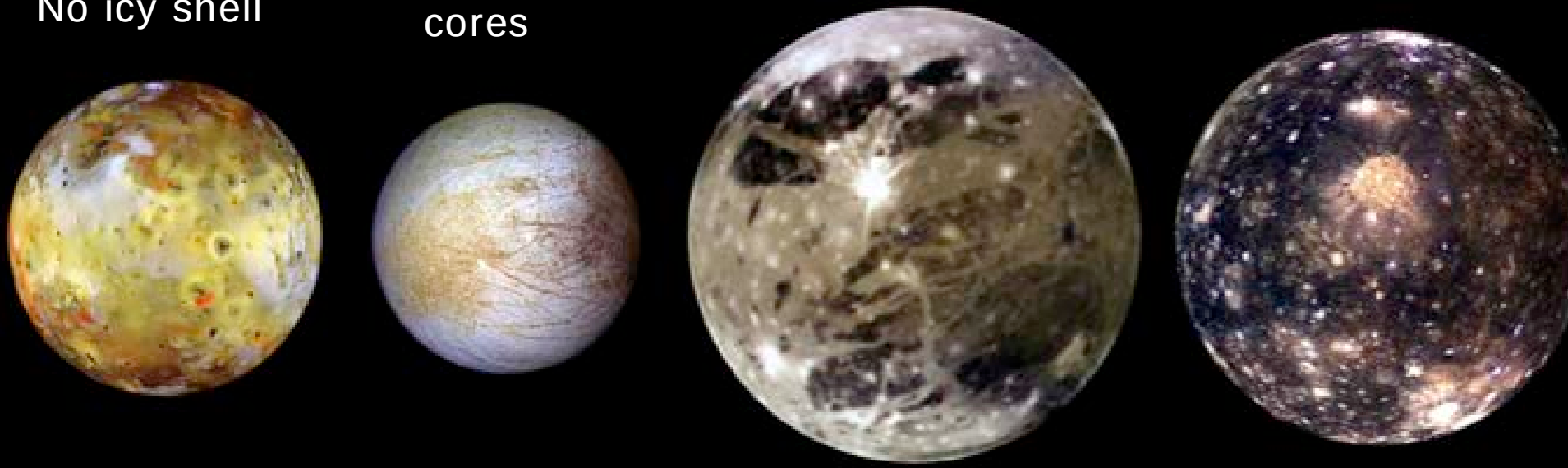
Pre-Decisional Information — For Planning and Discussion Purposes Only

Jupiter's Galilean Satellites

Galileo discovered four moons around Jupiter in January 1610

Volcanic World
No icy shell

Icy Worlds – ice shells on top of Oceans with rocky cores



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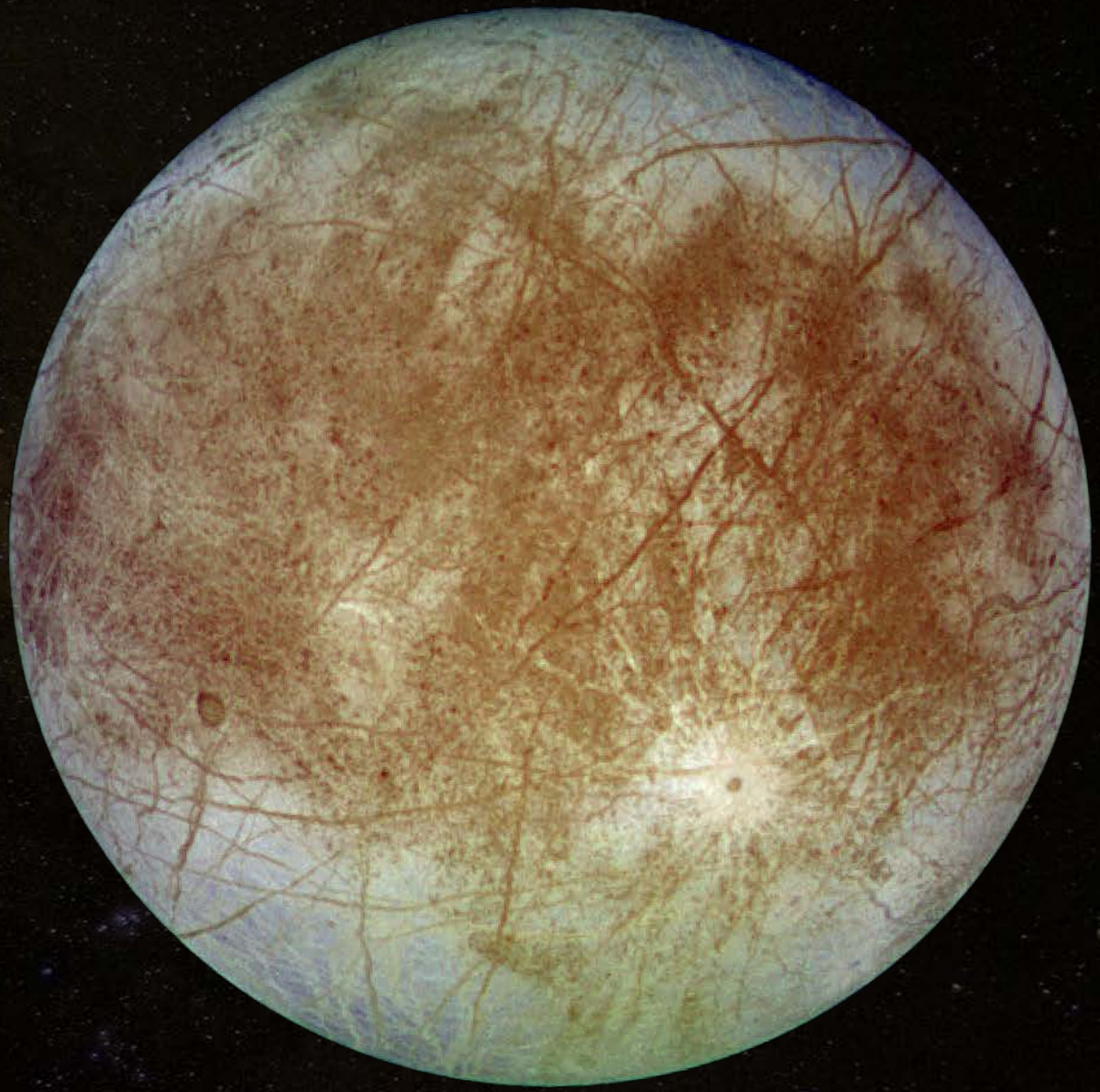
Europa



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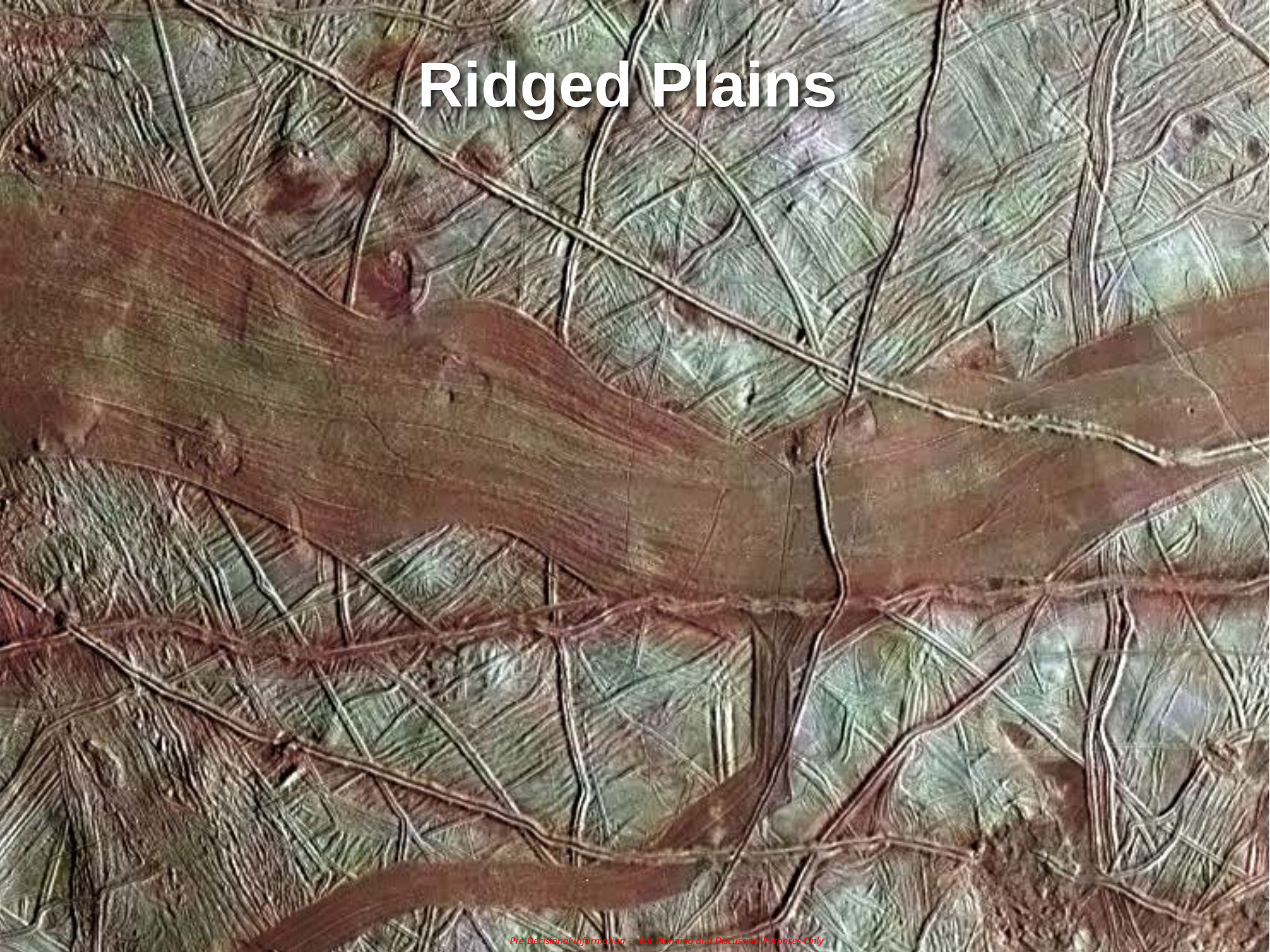
Ridged Plains



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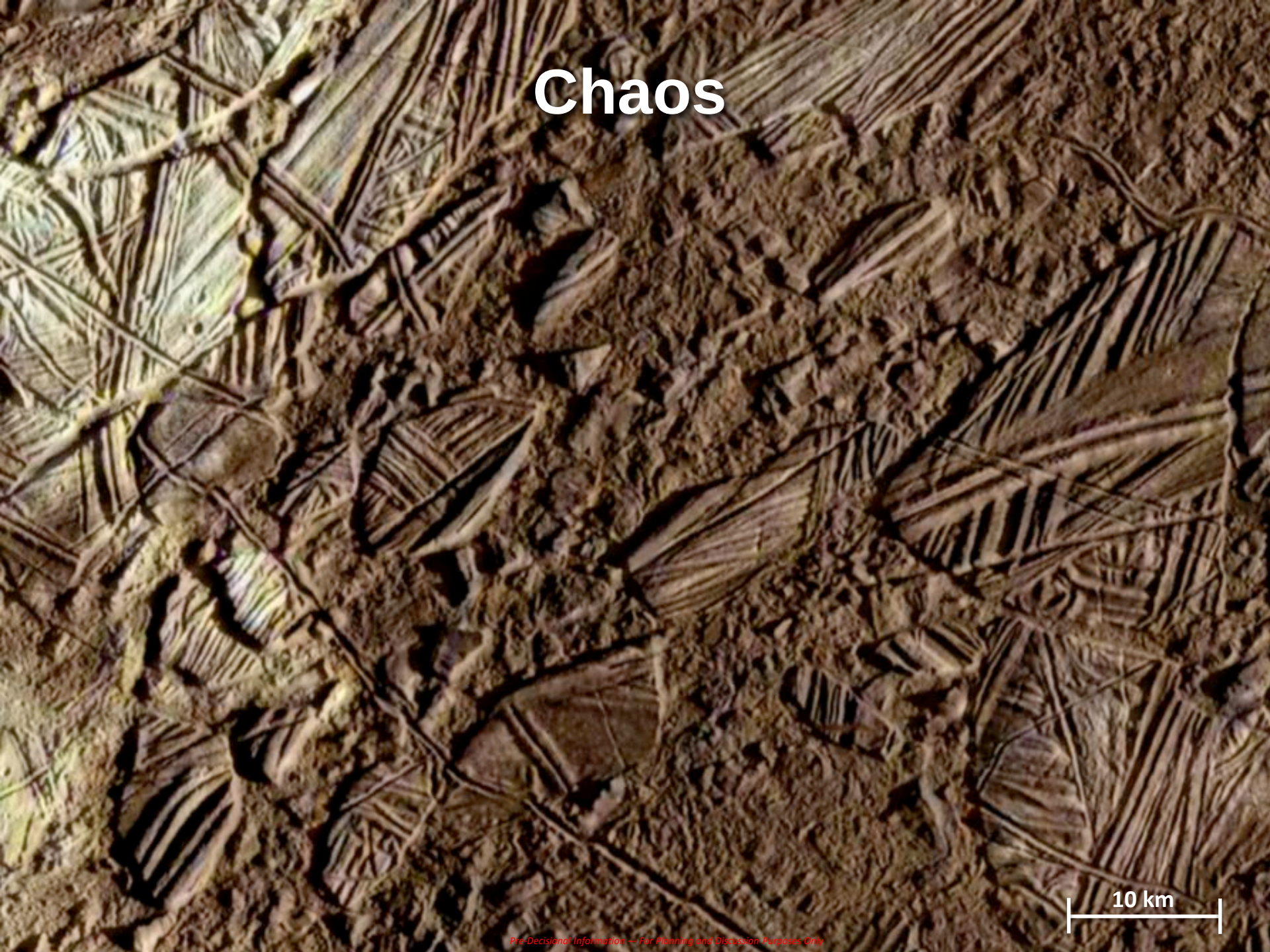

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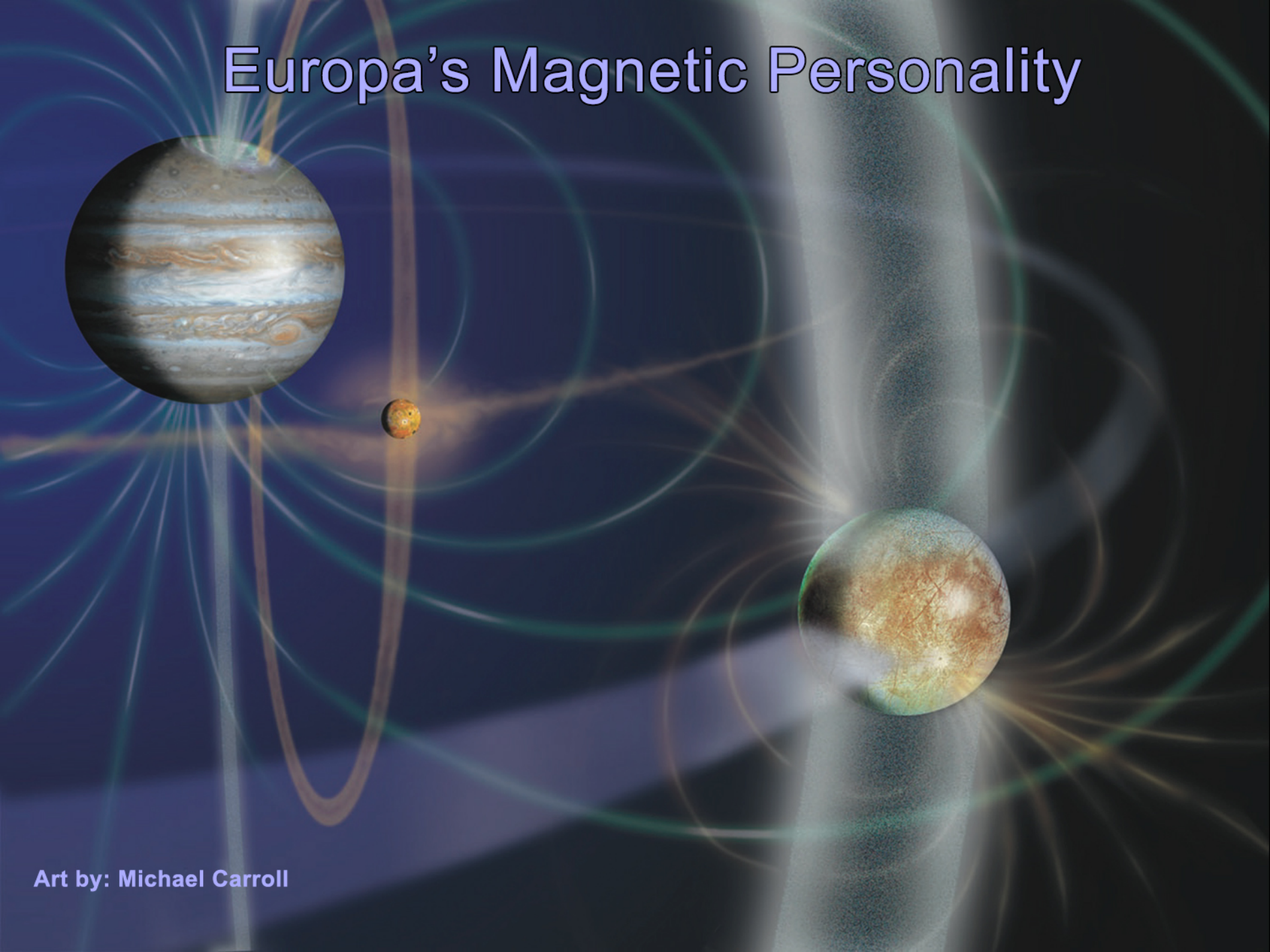
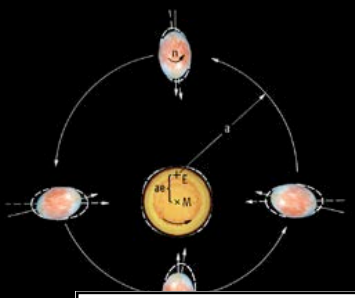
Europa's Magnetic Personality



Art by: Michael Carroll

Europa's Induced Magnetic Field

[*animation by E. Sturm using JPL's Jupiter Environment Tool*]



Tidal Flexing → Tidal Heating

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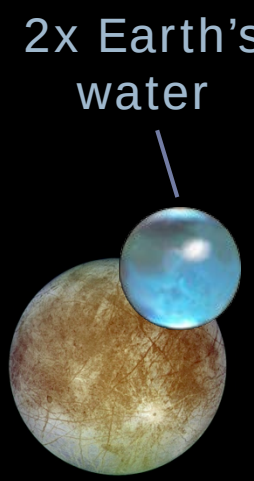
Water World

Earth: Known life

Mars: Past conditions for life



Europa: Present conditions for life?

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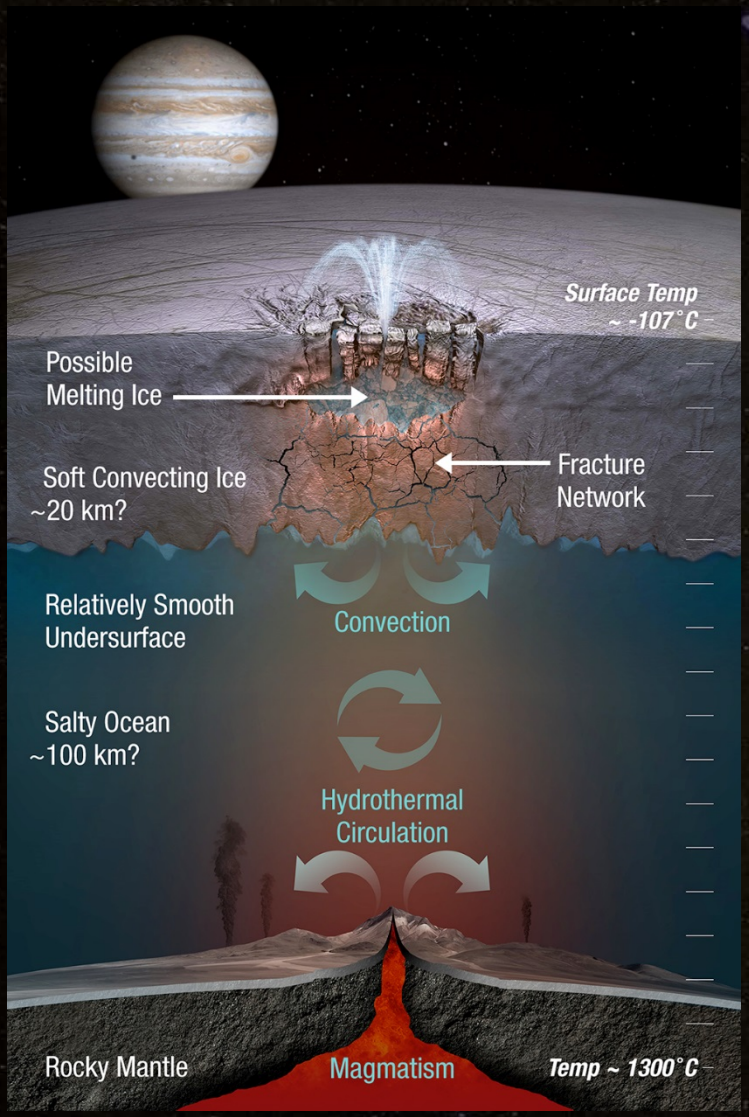
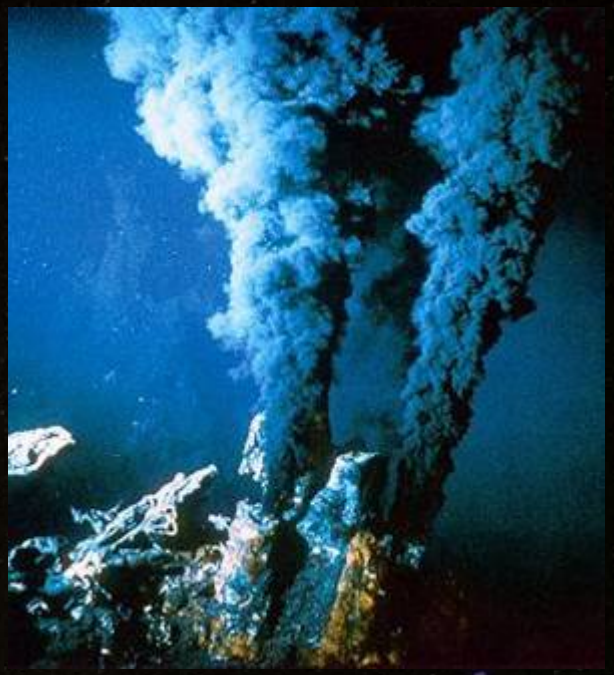
Habitability: Ingredients for Life





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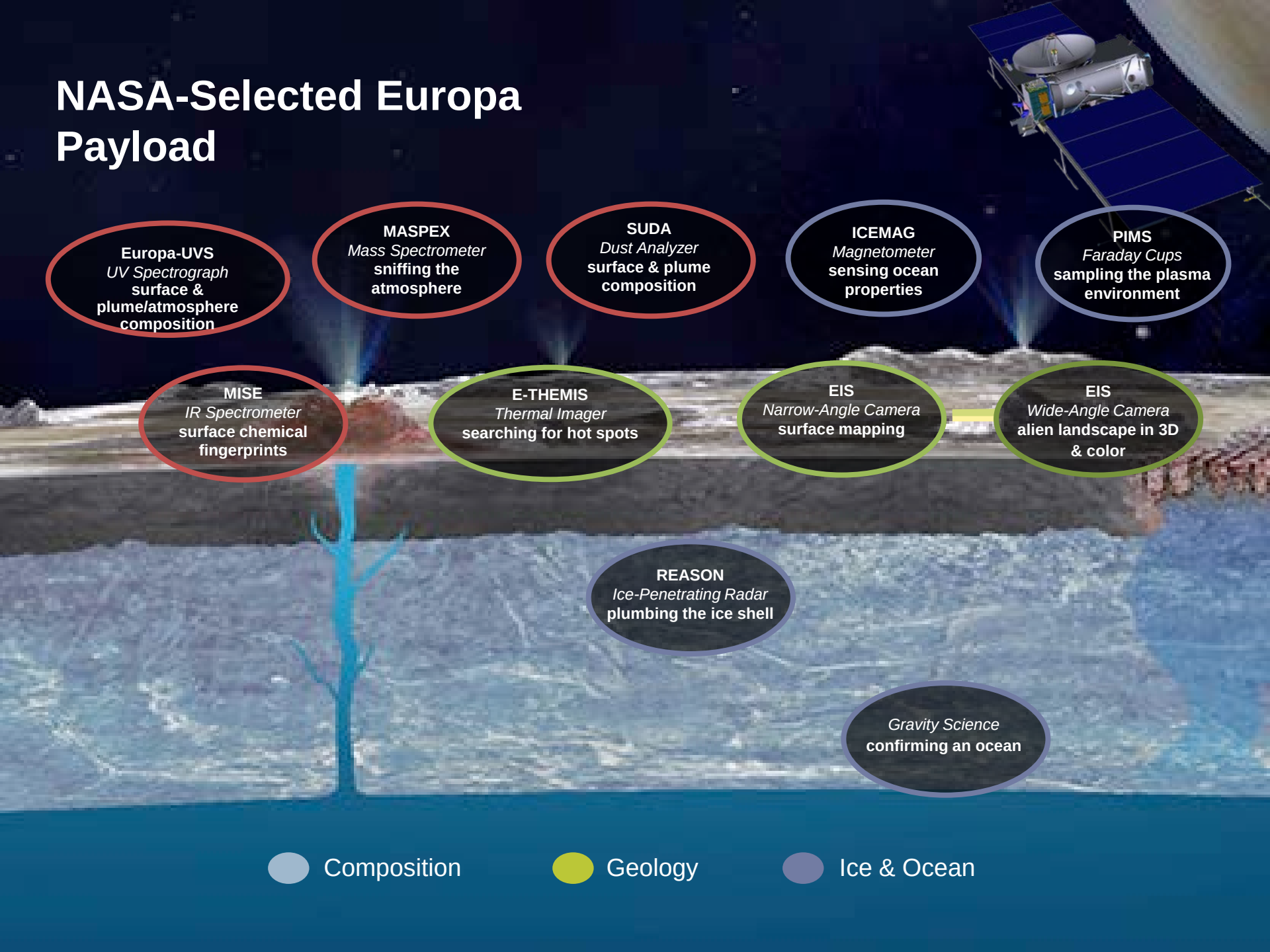
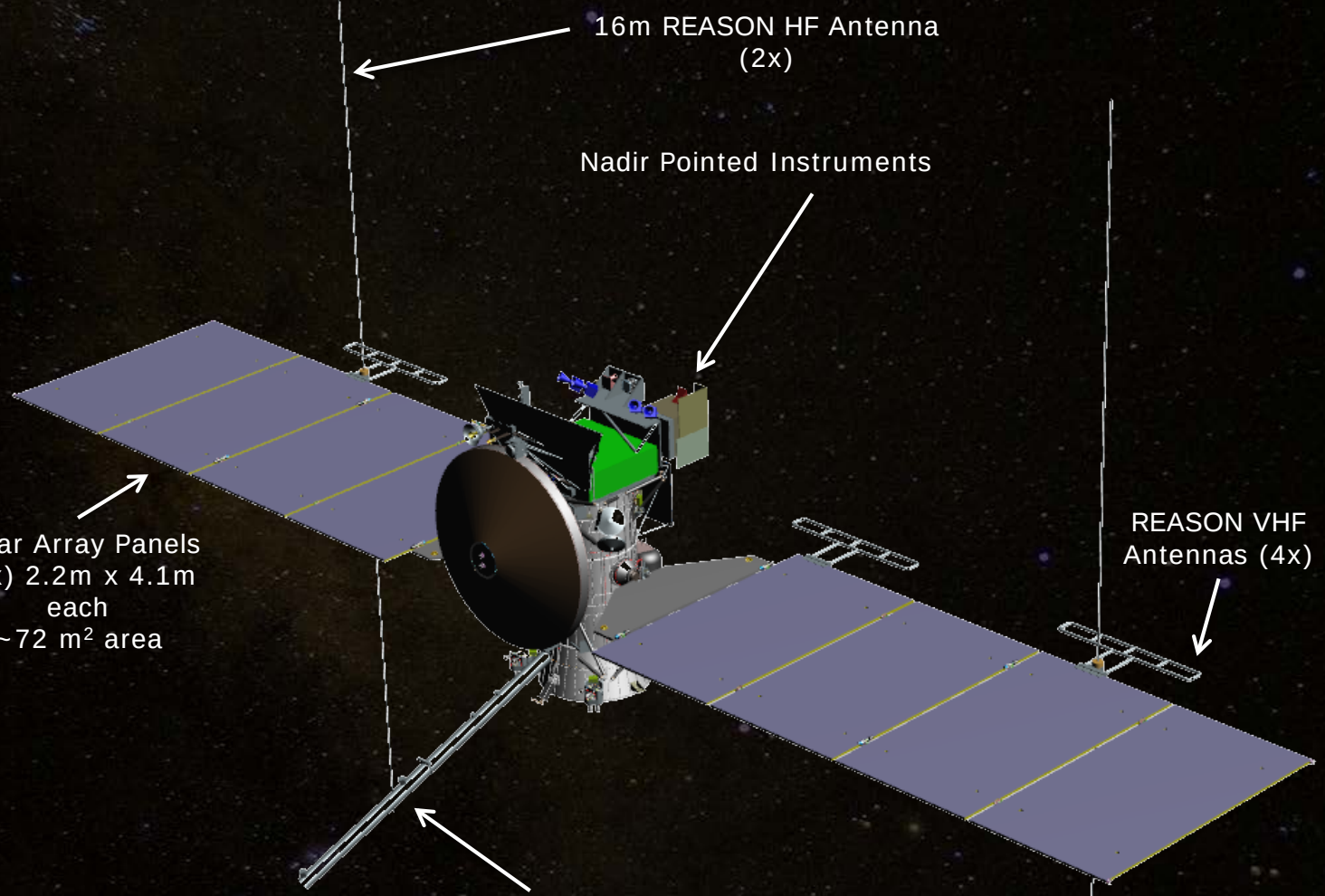
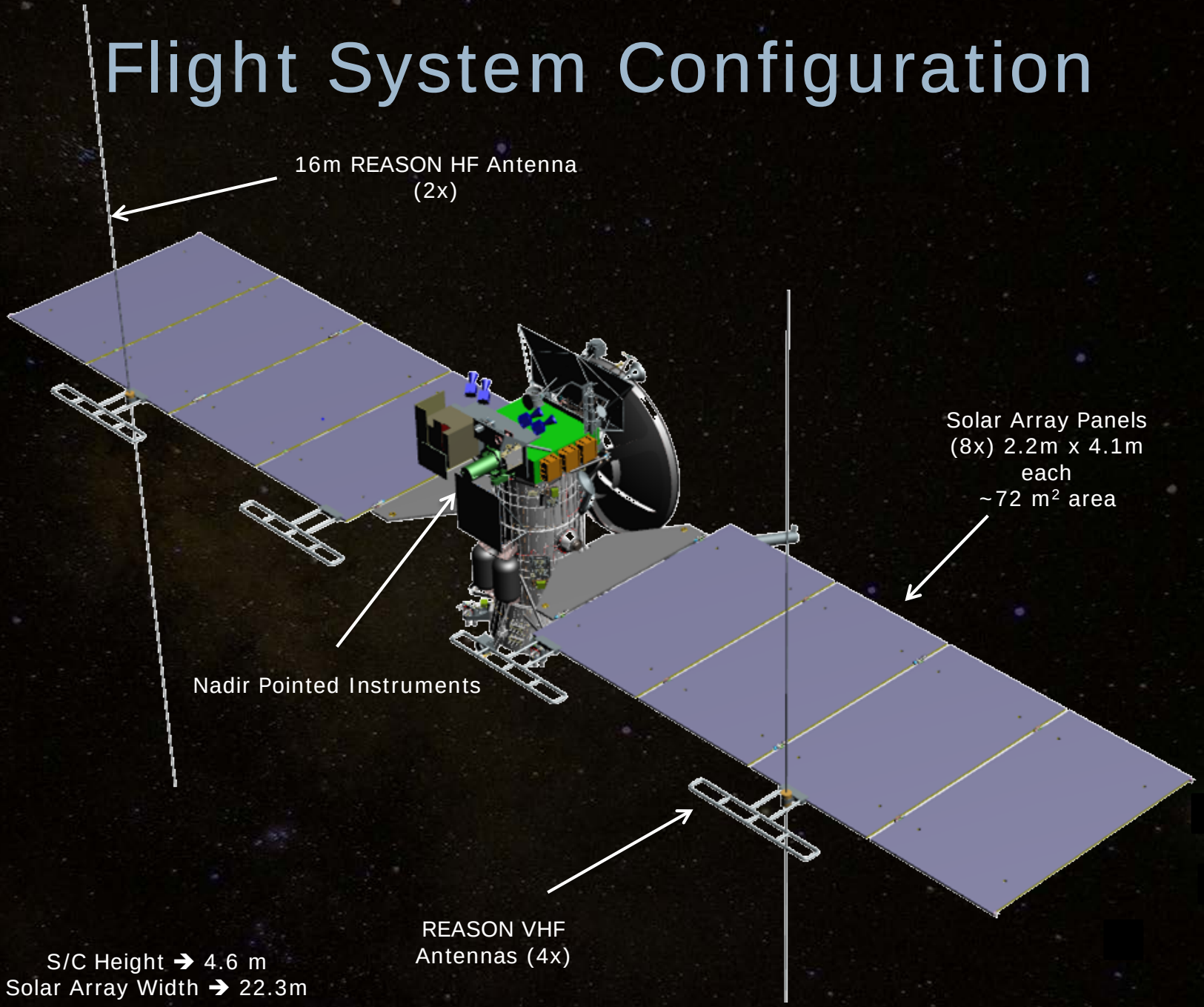

NASA-Selected Europa Payload
Europa-UVS
UV Spectrograph
surface & plume/atmosphere composition
MASPEX
Mass Spectrometer
sniffing the atmosphere
SUDA
Dust Analyzer
surface & plume composition
ICEMAG
Magnetometer
sensing ocean properties
PIMS
Faraday Cups
sampling the plasma environment
MISE
IR Spectrometer
surface chemical fingerprints
E-THEMIS
Thermal Imager
searching for hot spots
EIS
Narrow-Angle Camera
surface mapping
EIS
Wide-Angle Camera
alien landscape in 3D & color
REASON
Ice-Penetrating Radar
plumbing the ice shell
Gravity Science
confirming an ocean
Composition
Geology
Ice & Ocean

Flight System Configuration



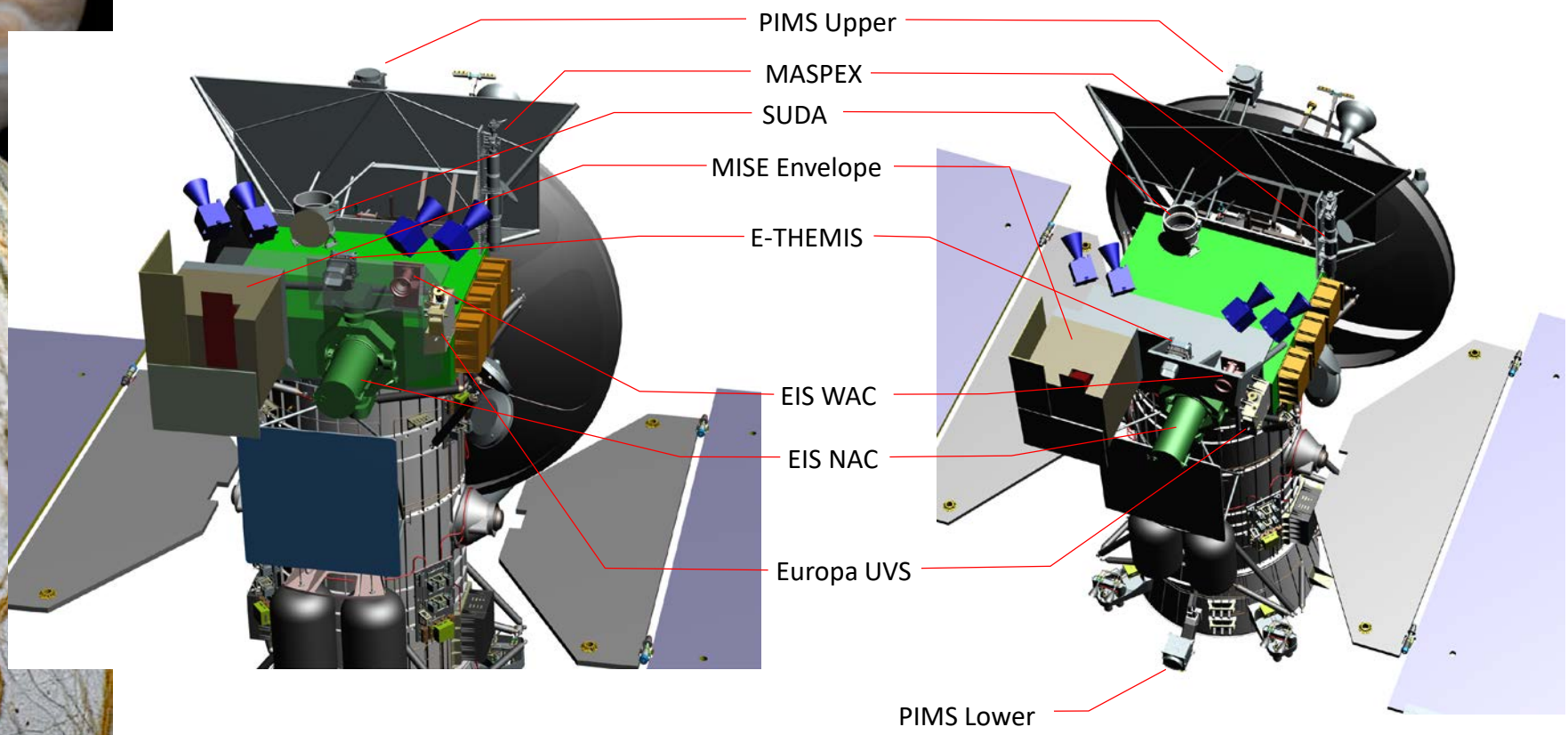
S/C Height ➔ 4.6 m
Solar Array Width ➔ 22.3m

Flight System Configuration

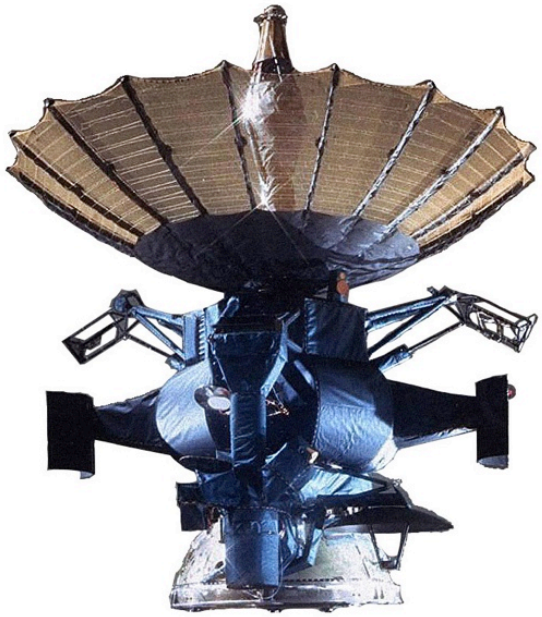


S/C Height ➔ 4.6 m
Solar Array Width ➔ 22.3m

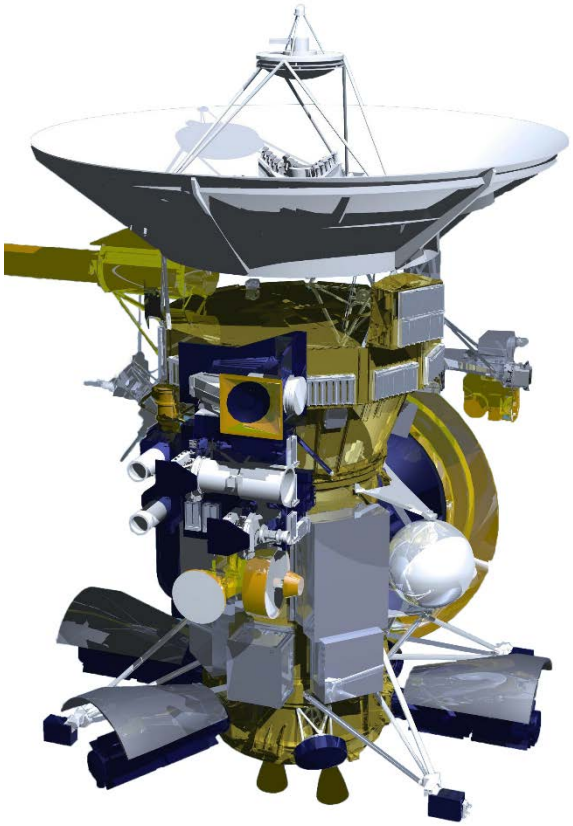
Instrument Details



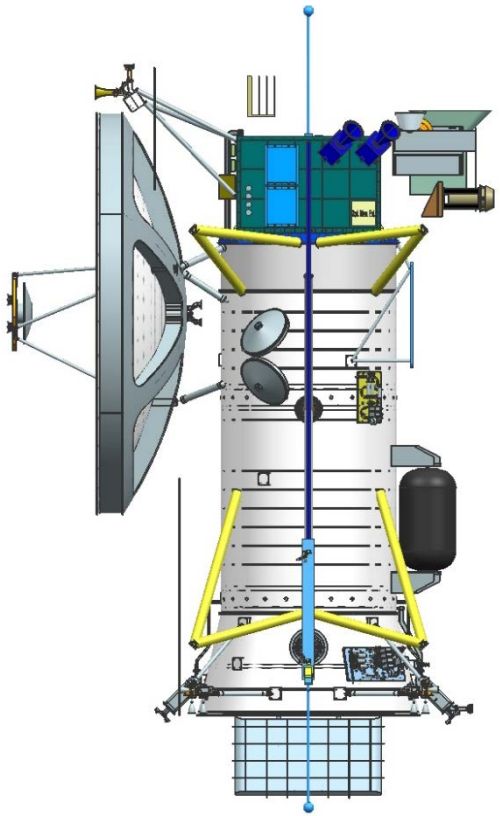
Outer Planet S/C



Galileo
Launch Mass: 2,562 kg



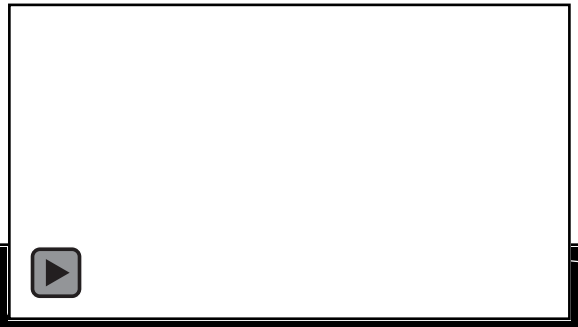
Cassini
Launch Mass: 5,655 kg



Europa Multi-Flyby
***Launch Mass: 4,915kg**

*-Atlas V-551 mass limit

Jovian Tour Concept



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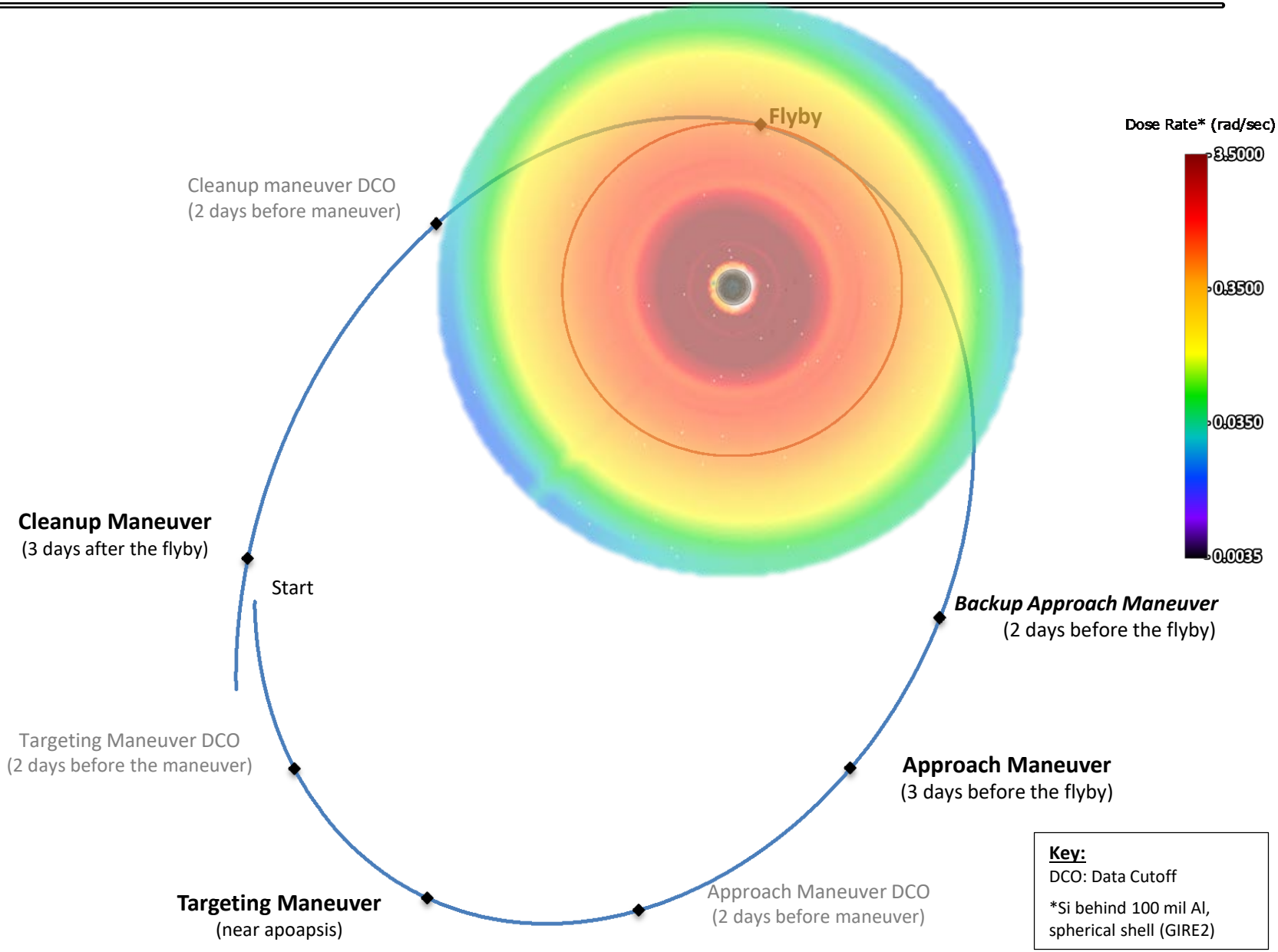
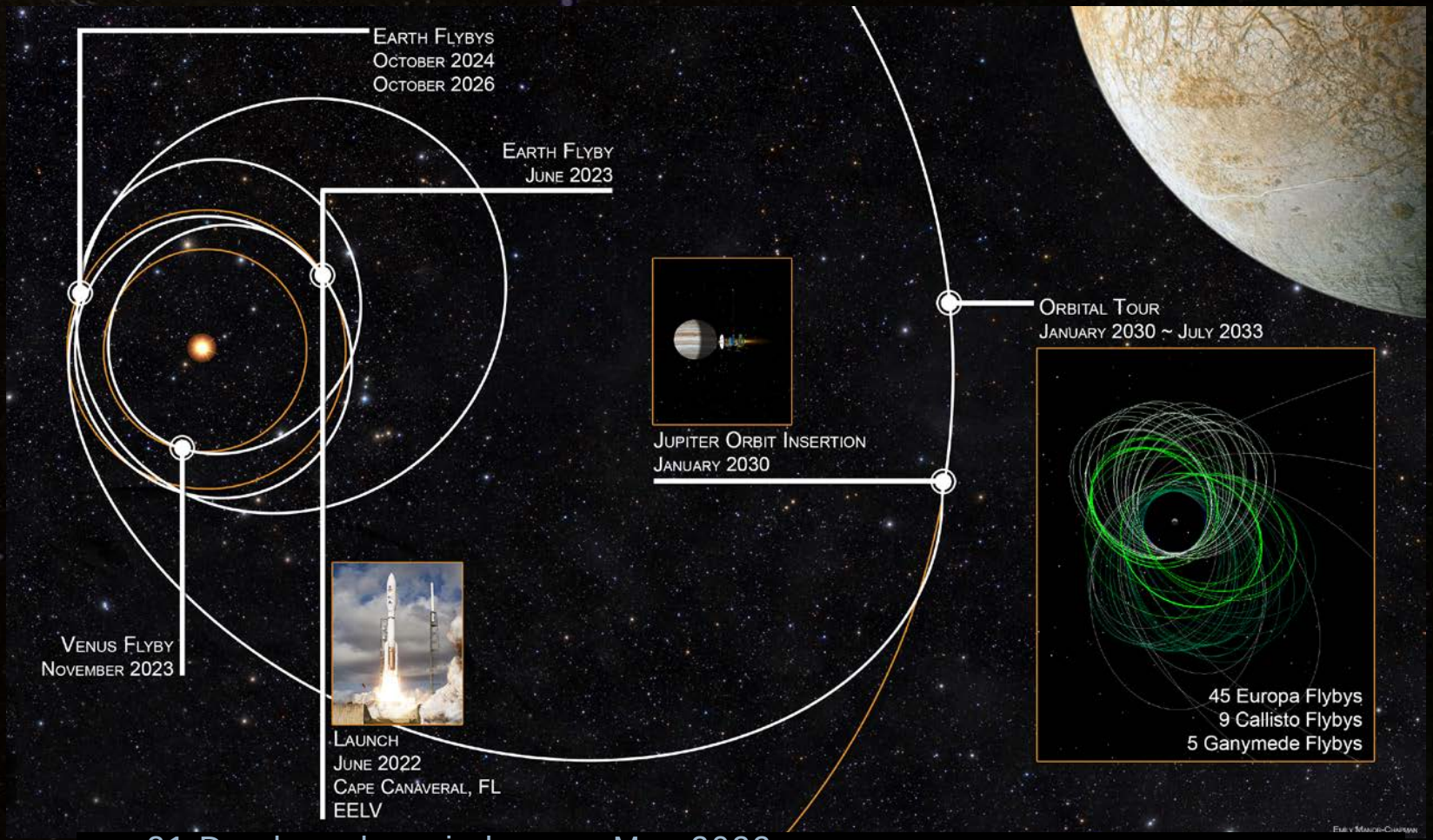
Europa Pedal- Jovian Orbit



EVEEGA Interplanetary Trajectory

EELV – (ATLAS/Delta-IV/Falcon)



- 21 Day launch period opens May 2022
- Earth/Venus/Earth/Earth Gravity Assist
- Arrive Jovian System January, 2030 (7.5 Years)

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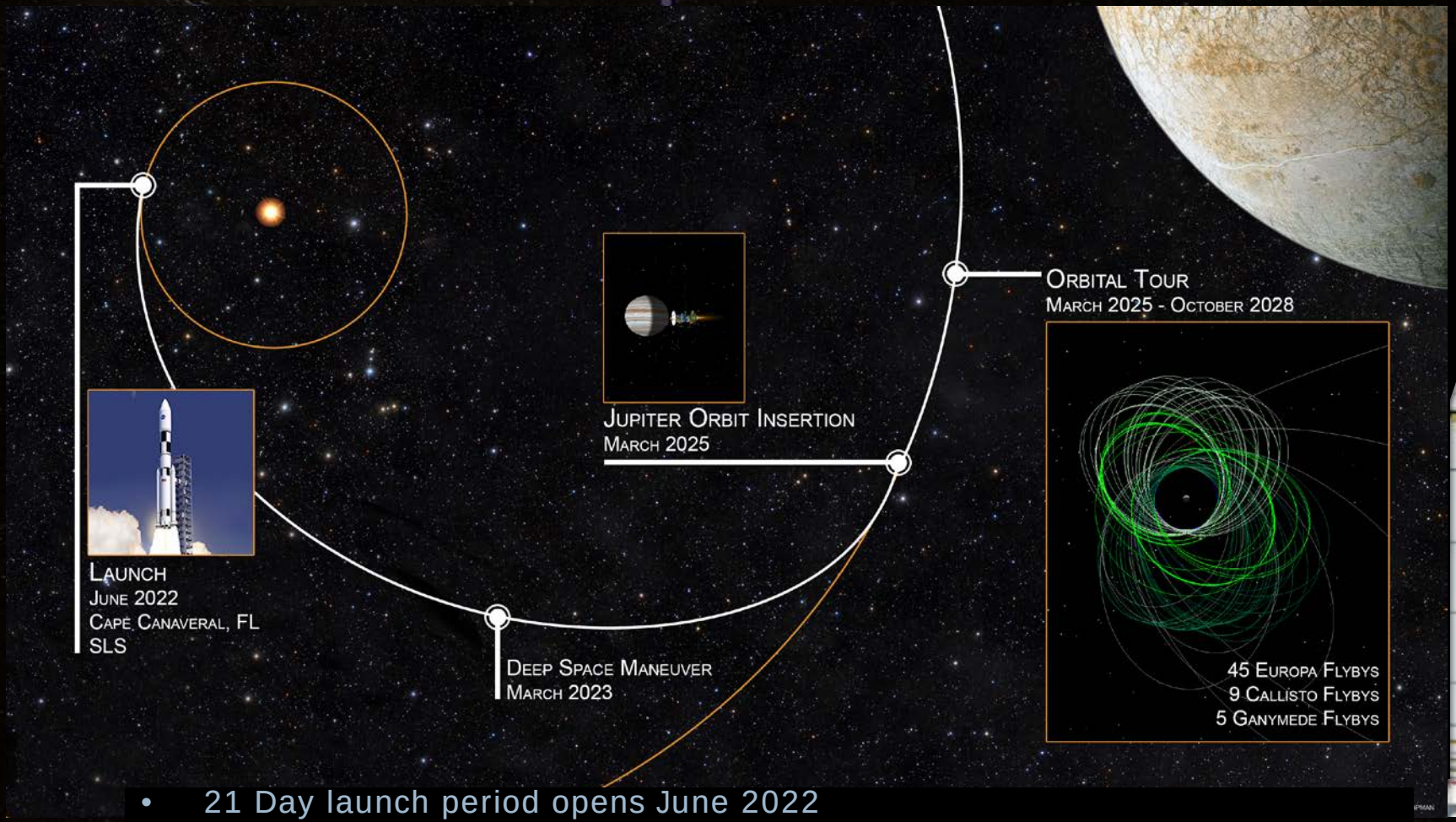
Direct-to-Jupiter Trajectory & Jovian Tour
SLS Launch Option



- 21 Day launch period opens June 2022
- Arrive Jovian System March, 2025 (2.7 Years)
- Tour after Jupiter orbit insertion is the same for both vehicles
- The project will maintain dual launch capability through CDR

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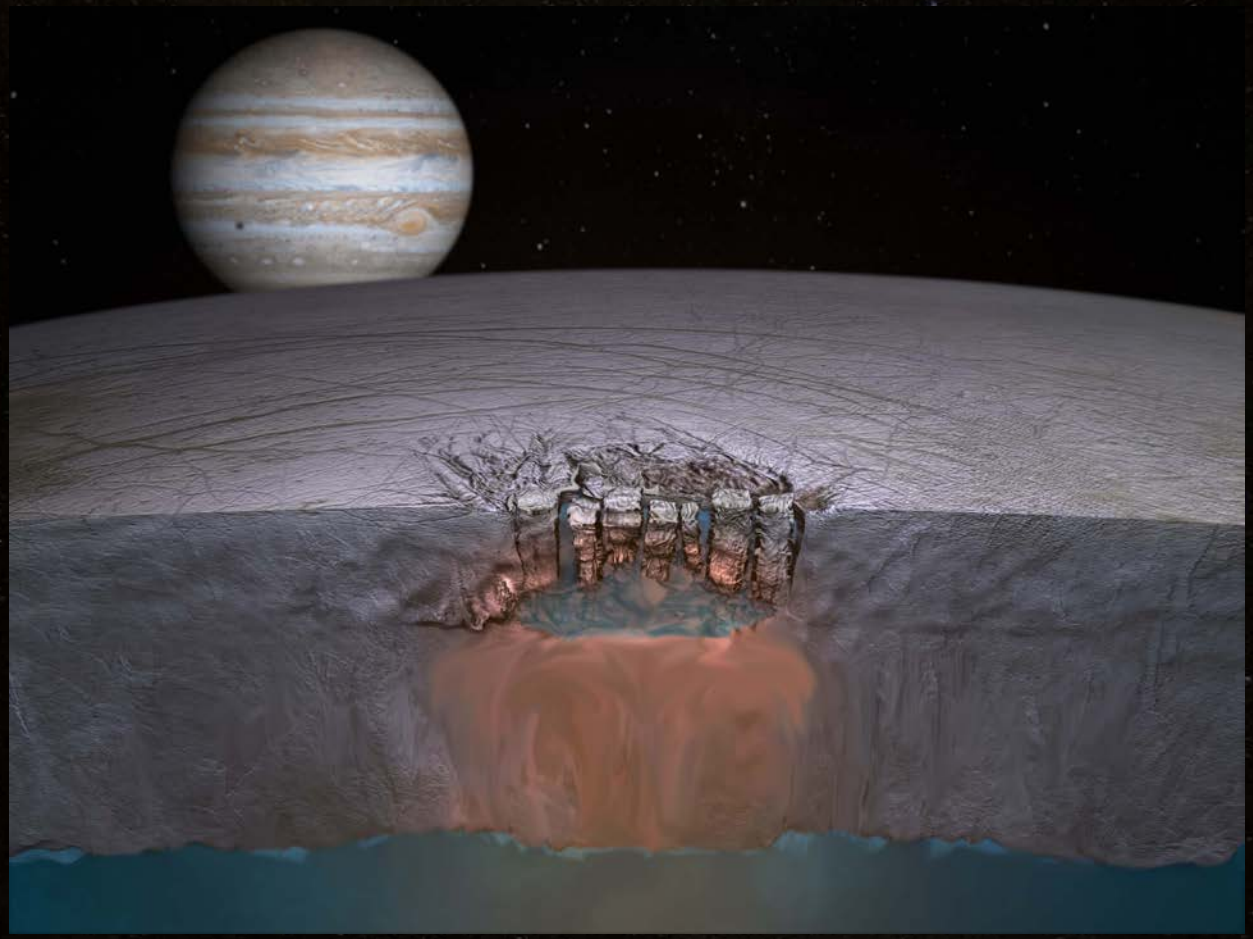
Plumes?



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Present Coverage in Potential Plume Region

13F7-A21 Trajectory

- **Above 1,000 km → 2**
- 250 km to 750 km → 6
- 80 **km to 100 km → 9**
- 50 km → 18
- **25 km → 10**

Spacecraft Trajectory

- $25 \text{ km} \leq r_{alt} \leq 50 \text{ km}$
- $50 \text{ km} < r_{alt} \leq 400 \text{ km}$
- $400 \text{ km} < r_{alt} \leq 1000 \text{ km}$
- $1000 \text{ km} < r_{alt} \leq 4000 \text{ km}$

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Habitability: Ingredients for Life

Water: √

- Probable saltwater ocean, implied by surface geology and magnetic field
- Possible lakes within the ice shell, produced by local melting

Chemistry: √

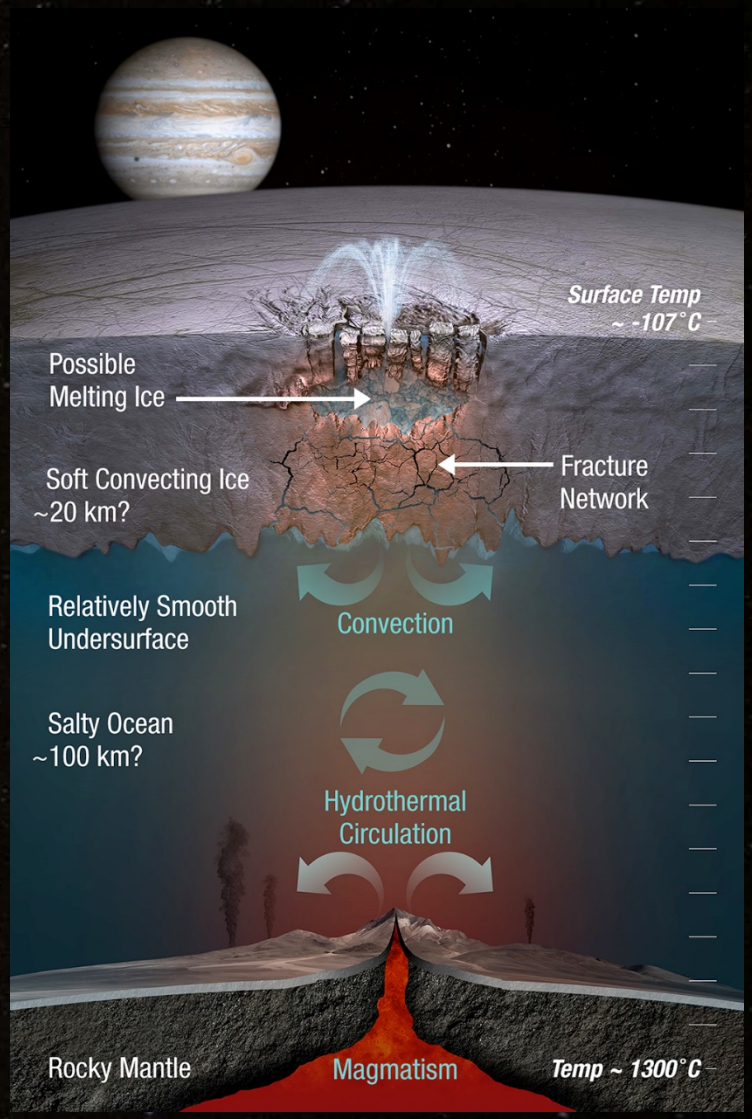
- Ocean in direct contact with mantle rock, promoting chemical leaching
- Dark red surface materials contain salts, probably from the ocean

Energy: √

- Chemical energy could sustain life
- Surface irradiation creates oxidants
- Mantle rock-water reactions could create reductants

- Geological activity "stirs the pot"

A Europa mission would verify key* habitability *hypotheses



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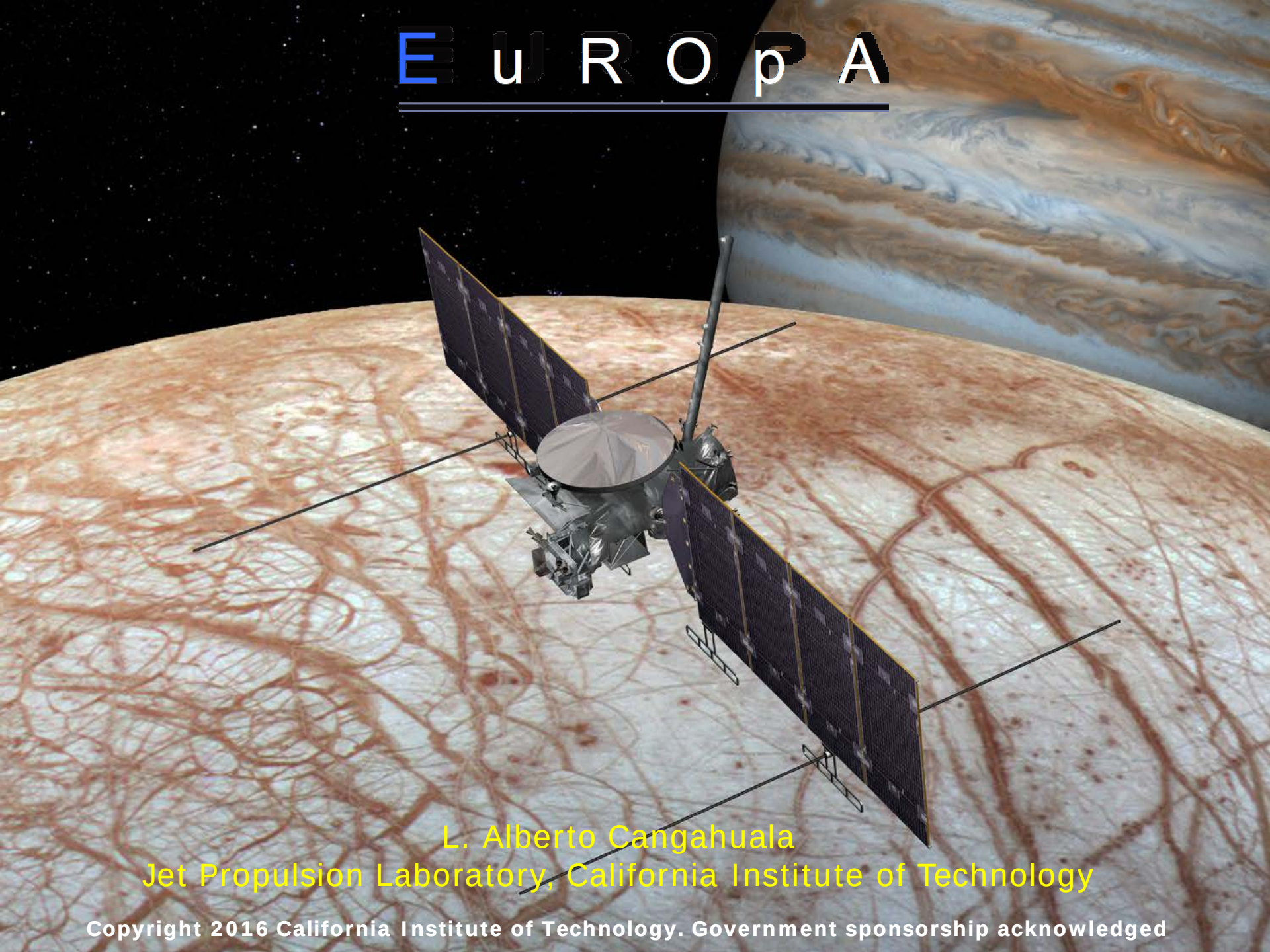
EuROPA



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Backup

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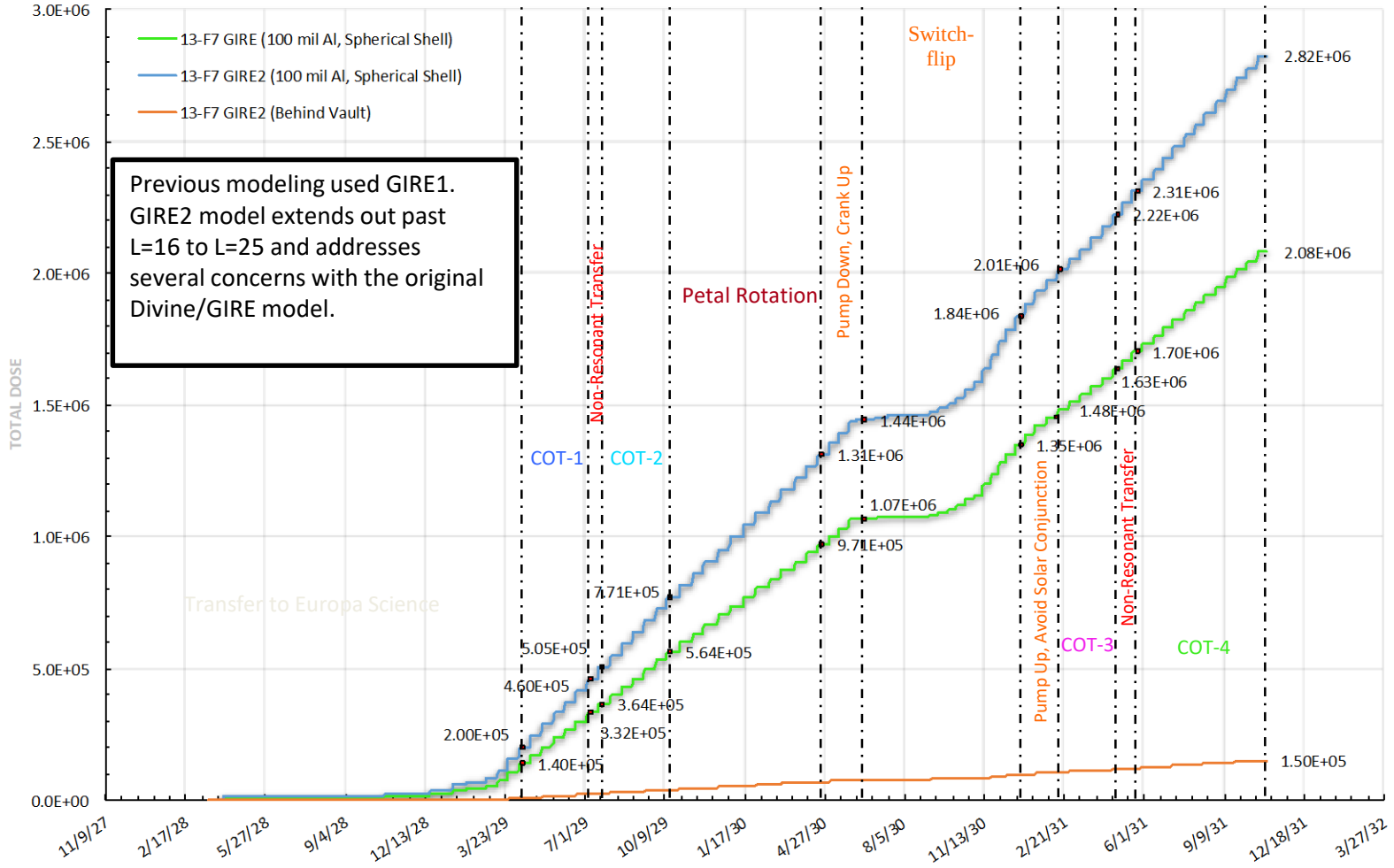
Radiation Modeling: GIRE2



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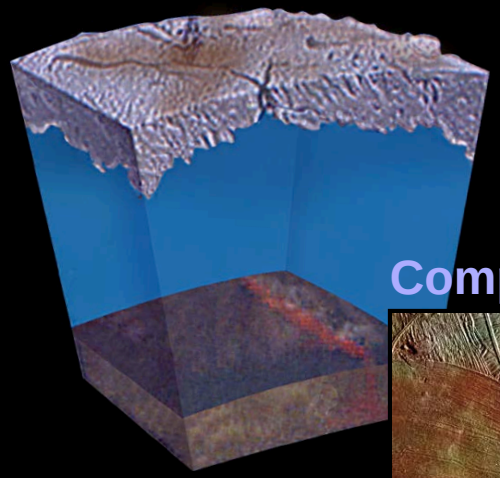
Europa Mission Science

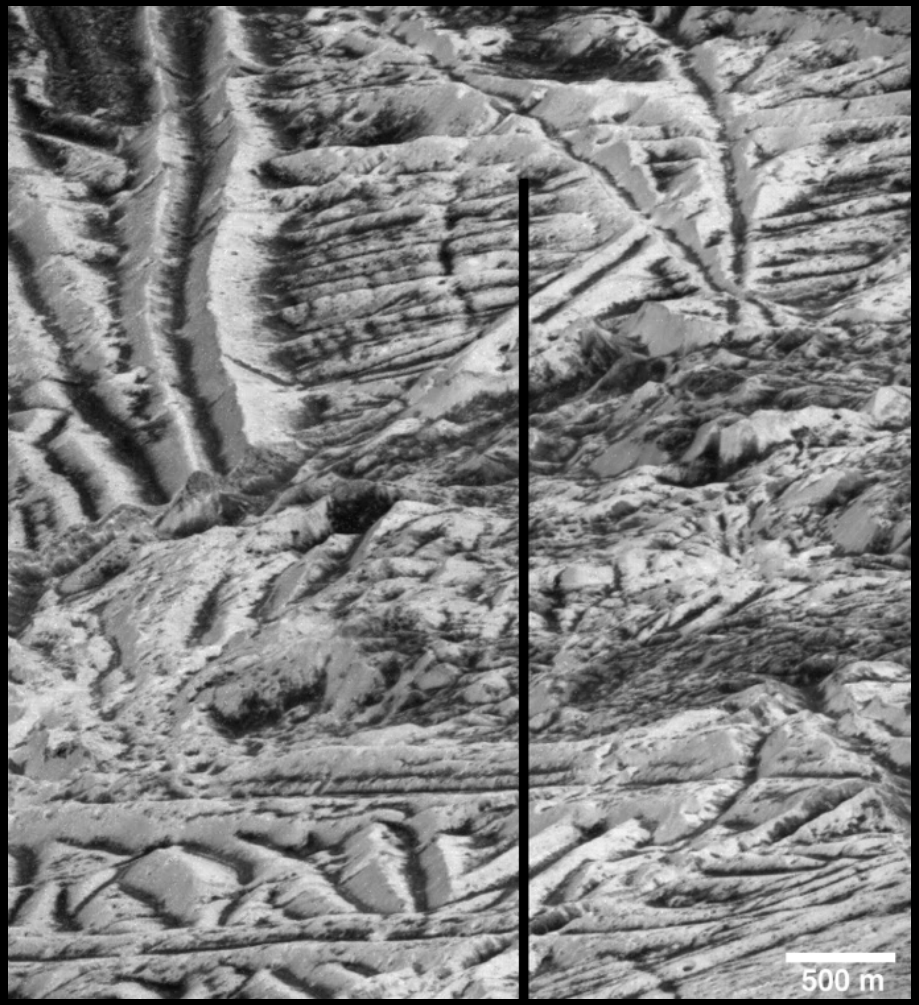
Ocean & Ice Shell



Composition

Geology

Reconnaissance



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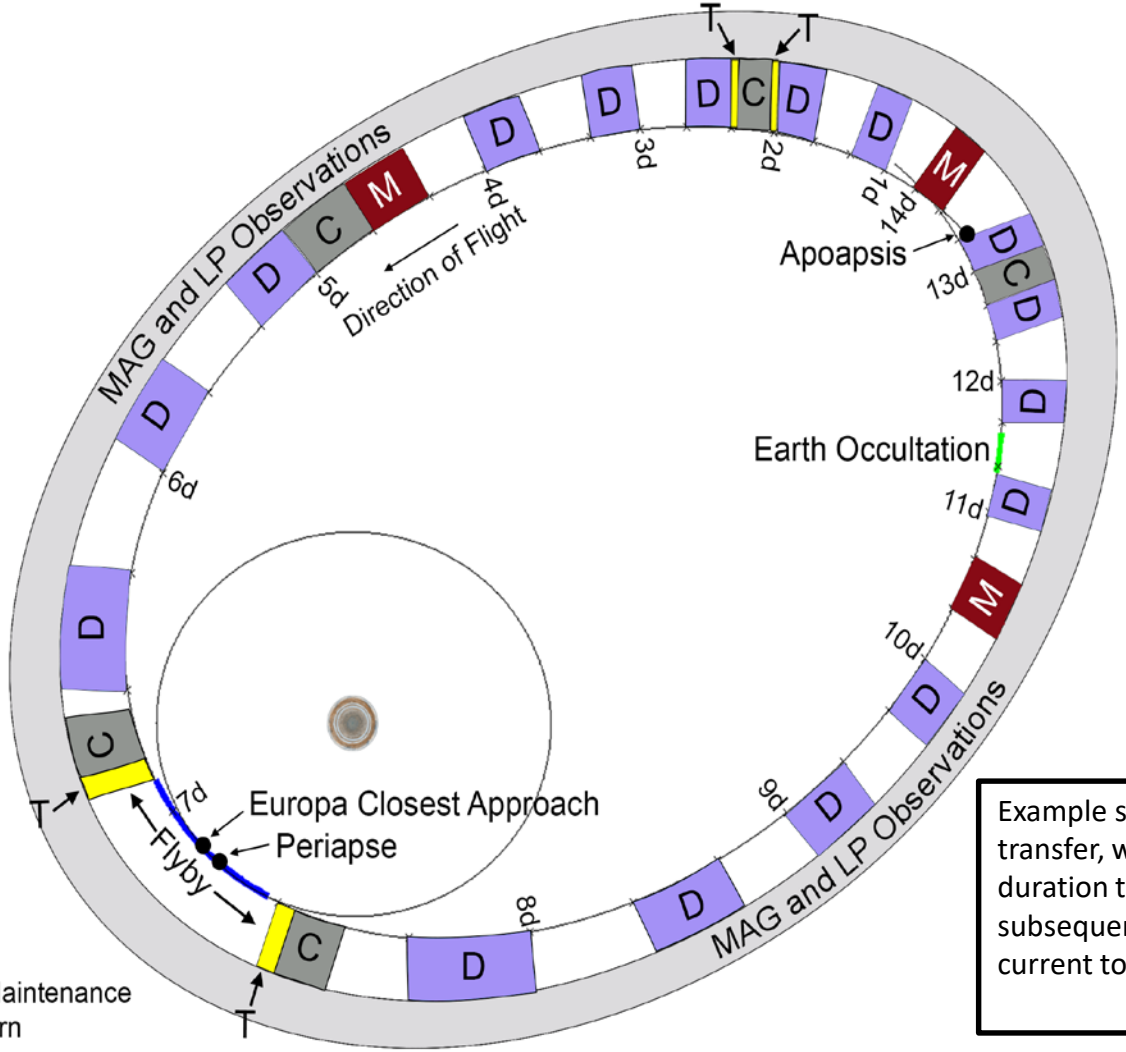
“Orbit-in-the-Life” of Europa Clipper



KEY
x = 8 hour ticks
D = DSN Track
M = Manuver
C = Calibration/ Maintenance
T = Spacecraft Turn

Example shown for a 14-day transfer, which is the shortest duration transfer between subsequent Europa flybys for the current tour (13F7).

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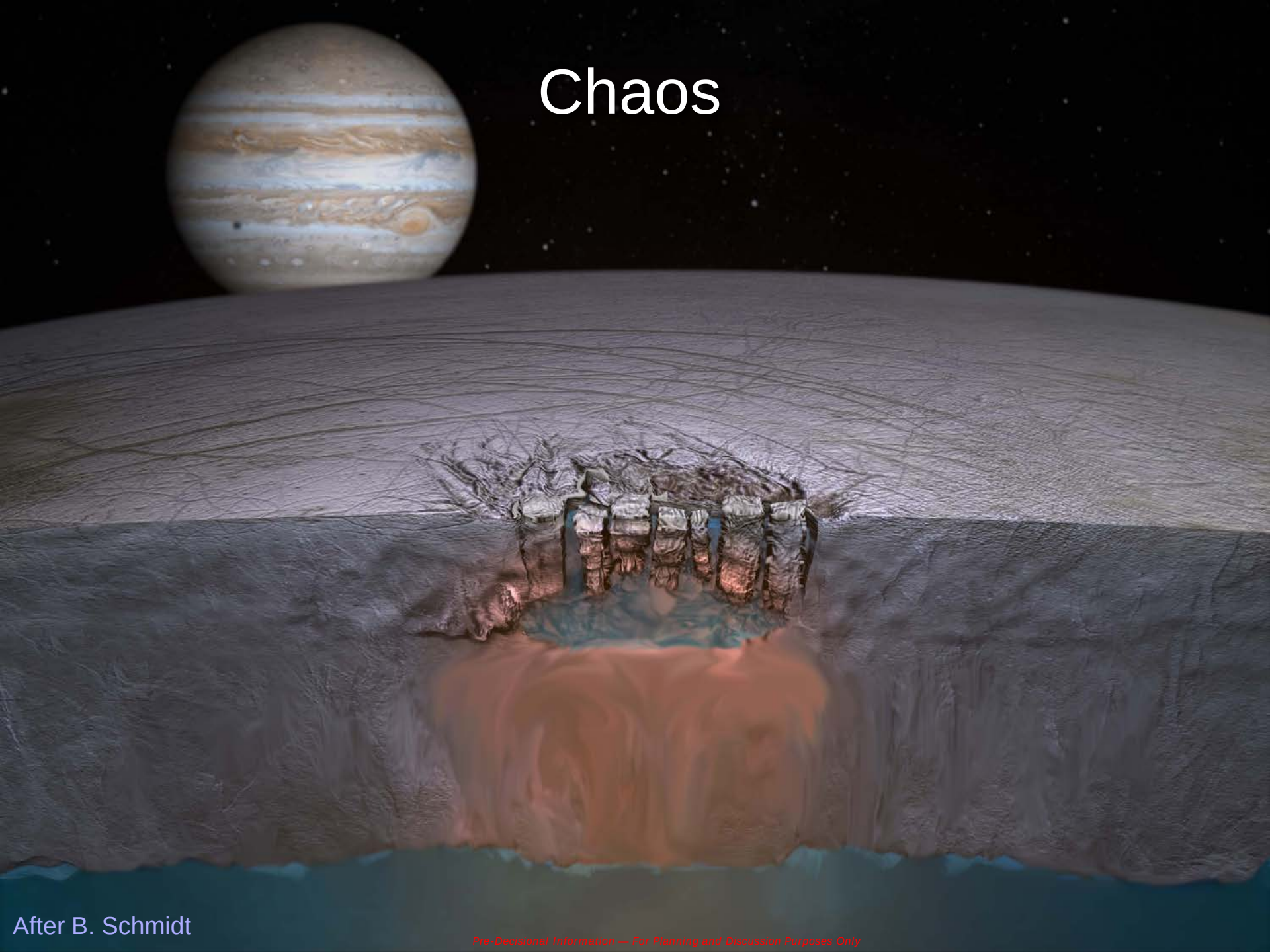
Chaos



After B. Schmidt

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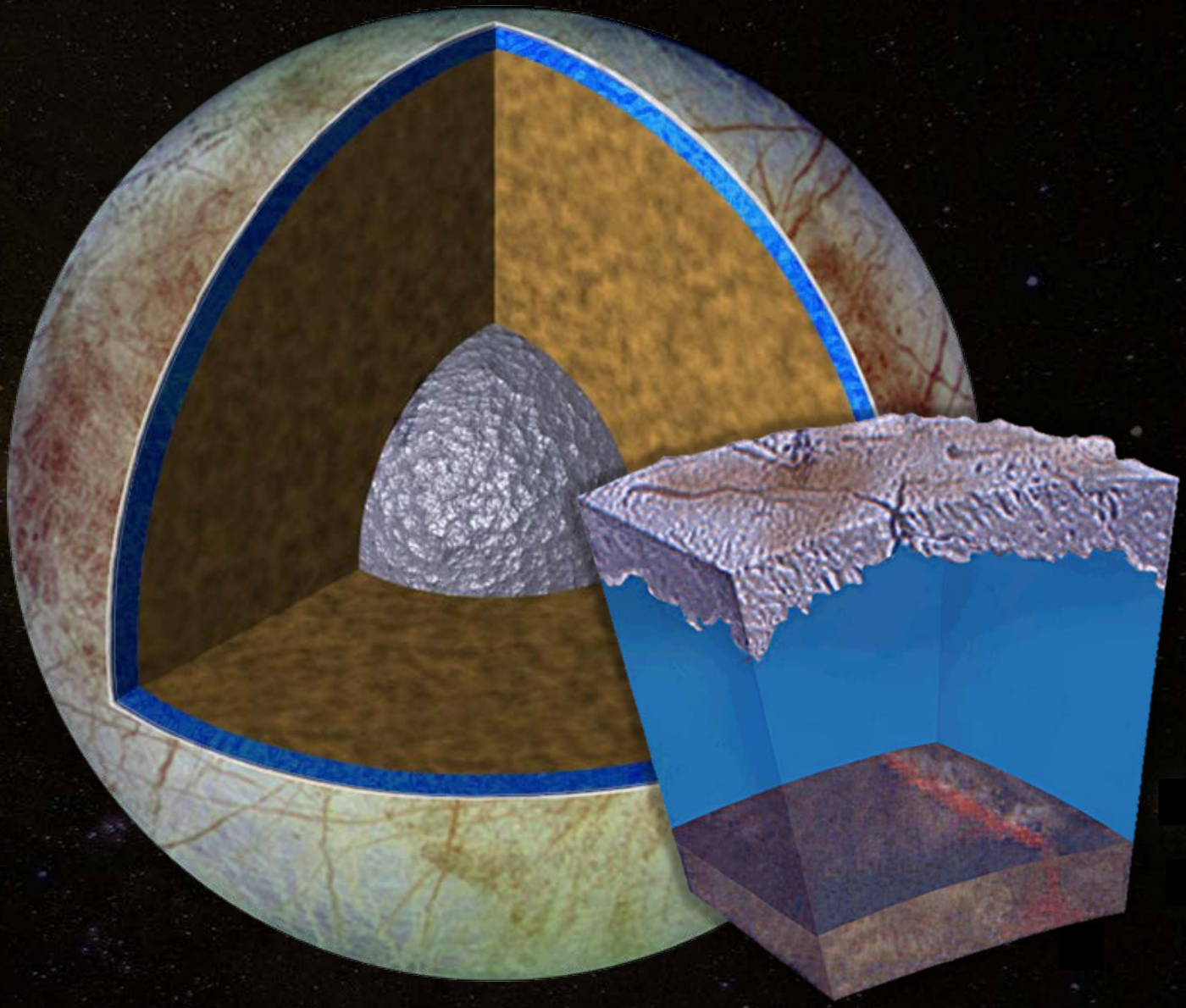
Europa's Interior



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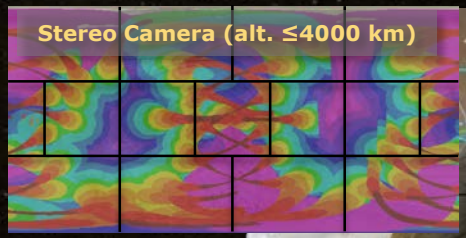
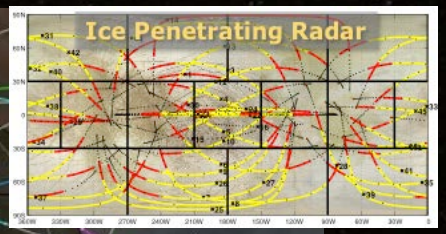
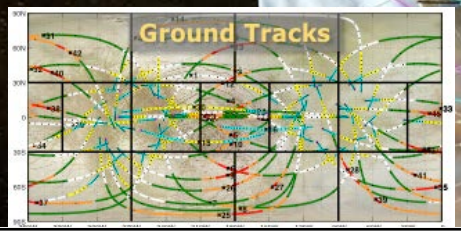
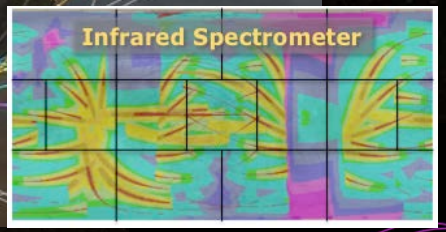
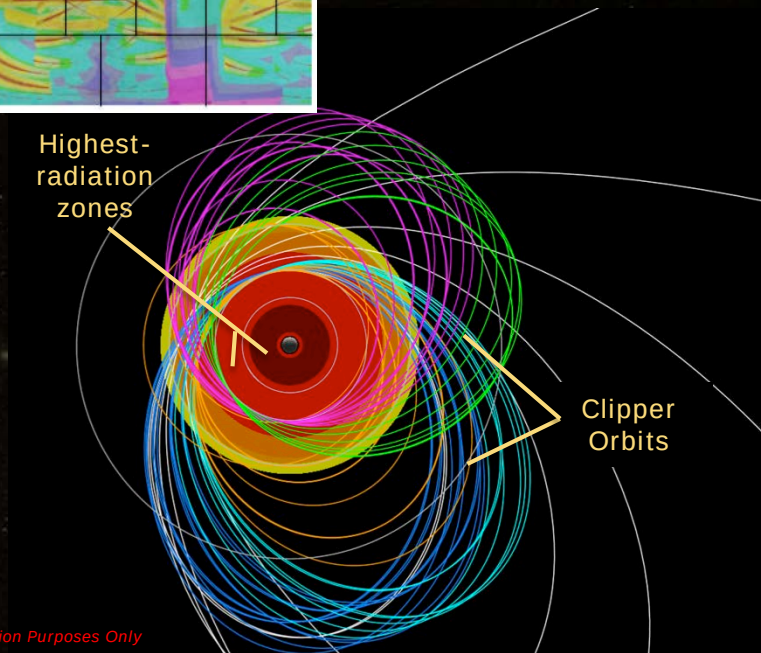
Innovative Mission Concept











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