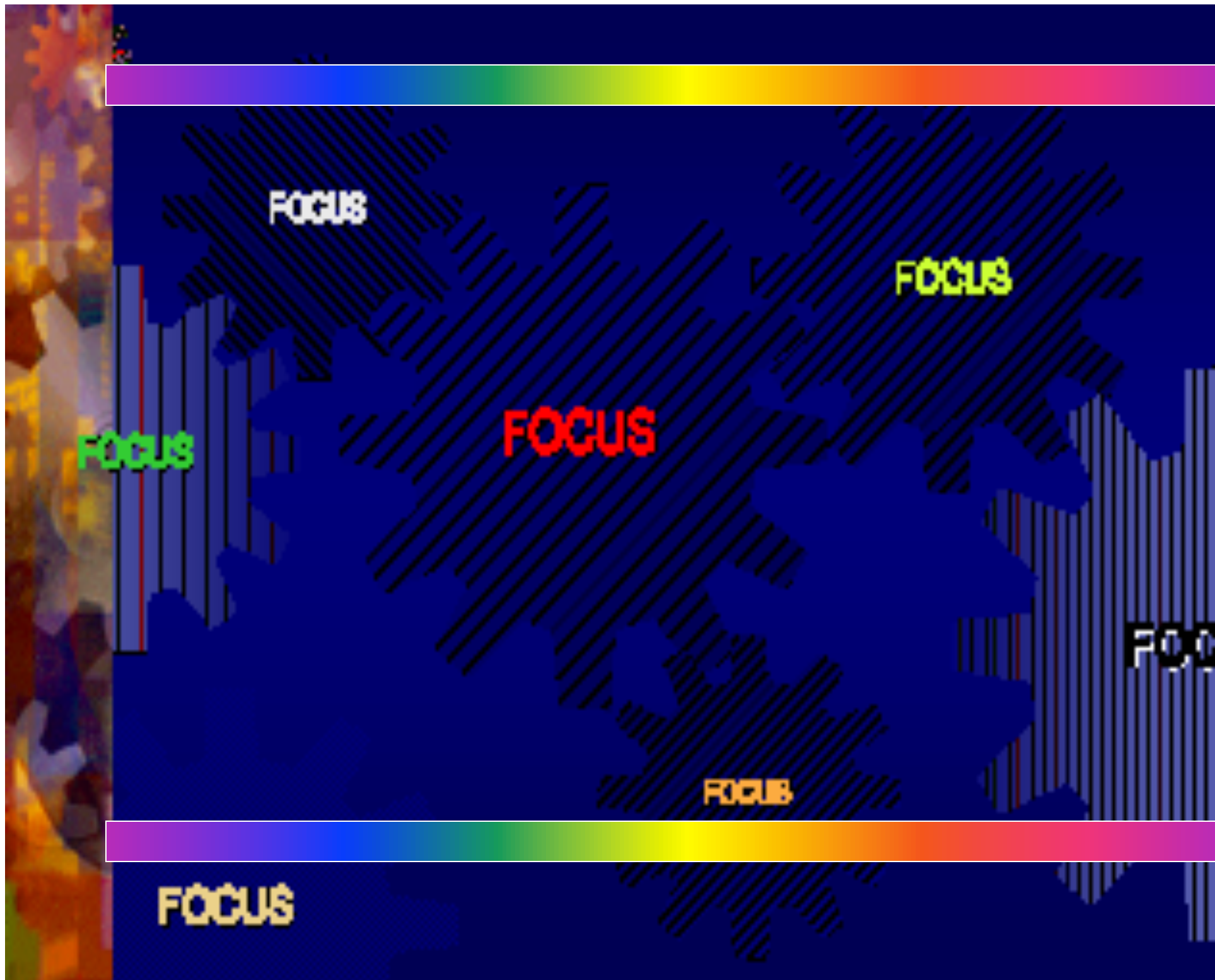




The Galileo Mission: Exploring the Jovian System

Torrence V. Johnson

Challenging the Paradigm: The Legacy of Galileo

November 19, 2009

Hameetman Auditorium – Cahill Building
California Institute of Technology



OBSERVAT. SIDEREAE

Ori.



Occ.

Stella occidentaliori maior, ambae tamen valde conspicuae, ac splendide: vtraque distabat à Ioue scrupulis primis duobus; tertia quoque Stellula apparecepit hora tertia prius minime conspicua, quae ex parte orientali Iouem ferè tangebatur, eratque admodum exigua. Omnes fuerunt in eadem recta, & secundum Eclipticæ longitudinem coordinatae.

Die decimatertia primum à me quatuor conspicuae fuerunt Stellulae in hac ad Iouem constitutione. Erant tres occidentales, & una orientalis; lineam proximè

Ori.



Occ.

rectam constituebant; media enim occidentalium paululum à recta Septentrionem versus deflectebat. Aberrat orientalis à Ioue minuta duo; reliquarum, & Iouis intercapedines erant singulae unius tantum minuti. Stellae omnes eandem praeseferbant magnitudinem; ac licet exiguae, lucidissimae tamen erant, ac fixis eiusdem magnitudinis longosplendidiore.

Die decimaquarta nubilosa fuit tempestas.

Die decimaquinta, hora noctis tertia in proximè depleta fuerunt habitudine quatuor Stellae ad Iouem;

Ori.



Occ.

occidentales omnes; ac in eadem proximè recta linea dispositae; quae enim tertia à Ioue numerabatur paululum

RECENS HABITAE 19

Iolum in boream attollebatur; propinquior Ioui erat omnium minima, reliquae consequenter maiores apparebant; intervalla inter Iouem, & tria consequentia Sydera erant aequalia omnia, ac duorum minorum; at occidentalius aberat à sibi propinquo minutis quatuor. Erant lucida valde, & nihil scintillantia, qualia semper tum ante, tum post apparuerunt. Verum hora septima tres solummodo aderant Stellae, in huius-

Ori.



Occ.

modi cum Ioue aspectu: Erant nempe in eadem recta ad vnguem, vicinior Ioui, erat admodum exigua, & ab illo remota per minuta prima tria, ad hac secunda distabat min: uno; tertia verò à secunda min: pri: 4. sec: 30. Post verò aliam horam duae Stellulae mediae adhuc viciniores erant; aberant enim min: si: vix 30. tantum.

Die decima sexta hora prima noctis, tres vidimus Stellae iuxta hunc ordinem dispositae. Duae Iouem

Ori.

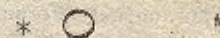


Occ.

intercipiebant ab eo per min: 0. sec: 40. hinc inde regione, tertia verò occidentalis à Ioue distabat min: 8. Ioui proximae non maiores, sed lucidiores apparebant remotiori.

Die decima septima hora ab occasu 2. min: 30. huiusmodi fuit configuratio. Stella una tantum orientalis à

Ori.



Occ.

Ioue

OBSERVAT. SIDEREAE

Ori.



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Ori.

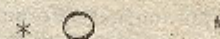


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Ori.



Occ.

Ioue

OBSERVAT. SIDEREAE

cum daturam. Depressiores insuper in Luna cernuntur magnae maculae, quam clariiores plagae; in illa enim tam crescente, quam decrecente semper in lucis tenebrarumque confinio, prominente hinc inde circa ipsas magnas maculas contermini parvis lucidioribus; veluti in describendis figuris observavimus; neque depressiores tantummodo sunt dictarum macularum termini, sed aequabiliores, nec rugis, aut asperitatibus interrupti. Lucidior vero pars maximè propè maculas eminet; adeo ut, & ante quadraturam primam, & in ipsa scilicet secunda circa maculam quandam, superiorem, borealem nempe Lunae plagam occupantem valde attollatur tam supra illam, quam infra ingentes quaedam eminentiae, veluti apposite praefecerunt delineationes.



Hæc

RECENS HABITAE



Hæc eadem macula ante secundam quadraturam nigrioribus quibusdam terminis circumvallata complitur: qui tanquam altissima montium iuga ex parte Soli aversa obscuriores apparent, quæ vero Solem respiciunt lucidiores extant; cuius oppositum in cavitatibus accidit, quarum pars Soli aversa splendoris apparet, obscura vero, ac vultrosa, quæ ex parte Solis sita est. Imminuta deinde luminosa superficie, cum primum tota scilicet dicta macula tenebris est obducta, clariora motuum dorsa eminenter tenebras scandunt. Hanc duplicem apparentiam sequentes figure commostrant.

C 2 Vnum

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en dum
s illumi-
, & col-
i autem
ia longè
ntur, vt
hè inuol-
eruatum
t, cuius
o præse-
lumino-
m quidē
obscuro
n fra me-
gere cæ-
ram præ-
facie re-
cuspides
signa

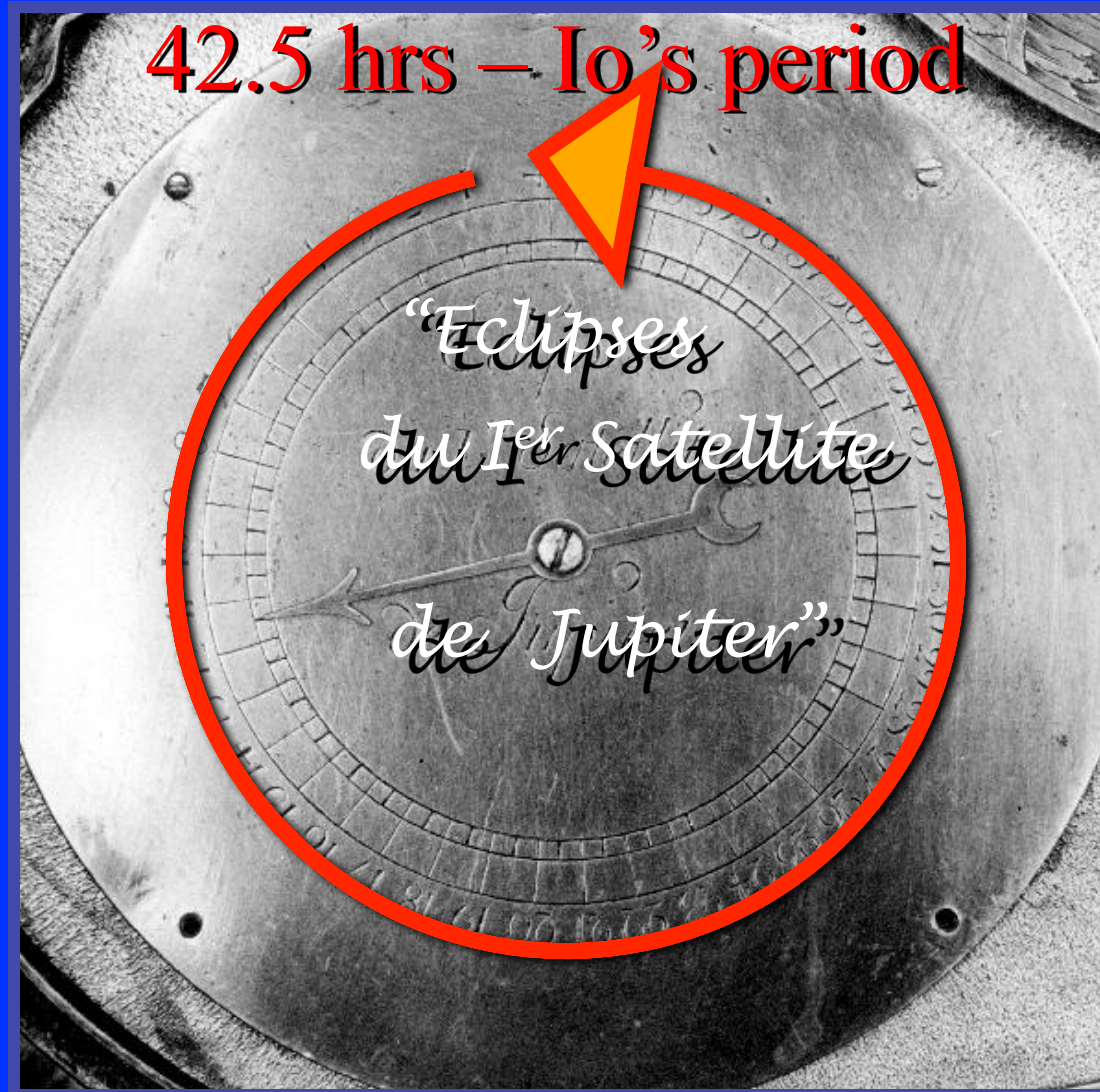
Solaris locum respicit, splendidior vero limbus nigri-
cantem maculam in parte Soli auersa, & Lunæ tene-
brosam plagam respiciente, circumdat. Hæc Lunaris
superficies, quæ maculis, instar Pauonis cauda cæru-
leis oculis, distinguitur, vitreis illis vasculis redditur
consimilis, quæ adhuc calentia in frigidam immissa
perfractam, vndosamq; superficiem acquirunt, ex quo
à vulgo Glaciales Cياتi nuncupantur. Verum magnæ
eiusdem Lunæ maculæ consimili modo interruptæ, at-
que lacunis, & eminentijs confertæ minimè cernuntur;
sed magis æquabiles, & vniformes; solummodo enim

some brighter little places. Thus, if anyone wanted to resuscitate the old
opinion of the Pythagoreans that the Moon is, as it were, another Earth, its
brighter part would represent the land surface while its darker part would
more appropriately represent the water surface. Indeed, for me there has
never been any doubt that when the terrestrial globe, bathed in sunlight, is
observed from a distance, the land surface will present itself brighter to the
view and the water surface darker.



7.19. Cigoli, *Assumption of the Virgin* (1612). Pauline Chapel, Santa Maria Maggiore, Rome.
Courtesy of Miles Chappell, Williamsburg, Virginia.

Planisphere (Paris, 1745-1749)

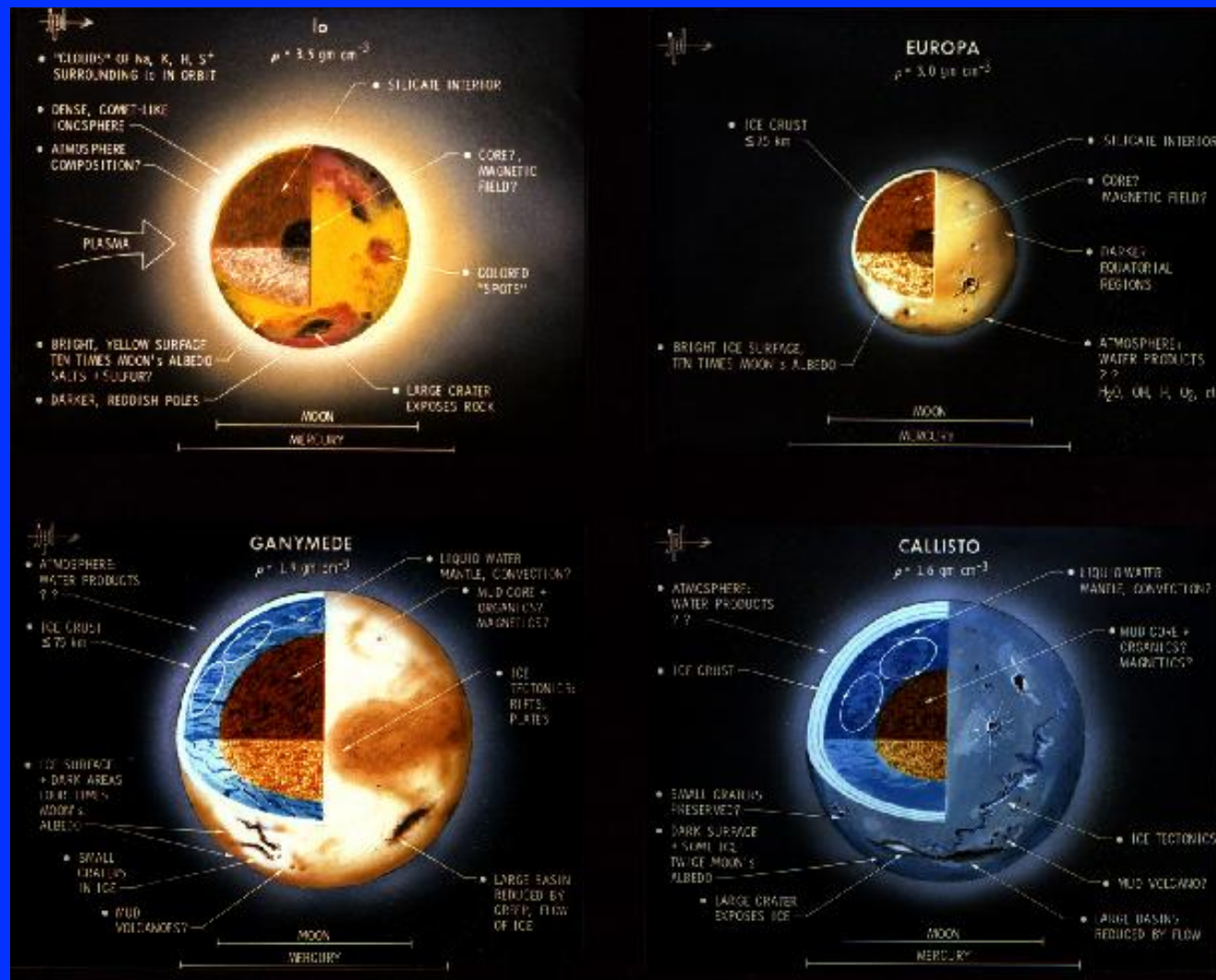


es in the
unnel Ports



Courtesy Getty Museum

Satellite Models: 1977



Voyager: “Family Portrait”

1979





660-26

A Science Rationale For Jupiter Orbiter Probe 1981/1982 Mission

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California 91103

Ames Research Center
Moffett Field, California 94035

August 1976

National Aeronautics and Space Administration

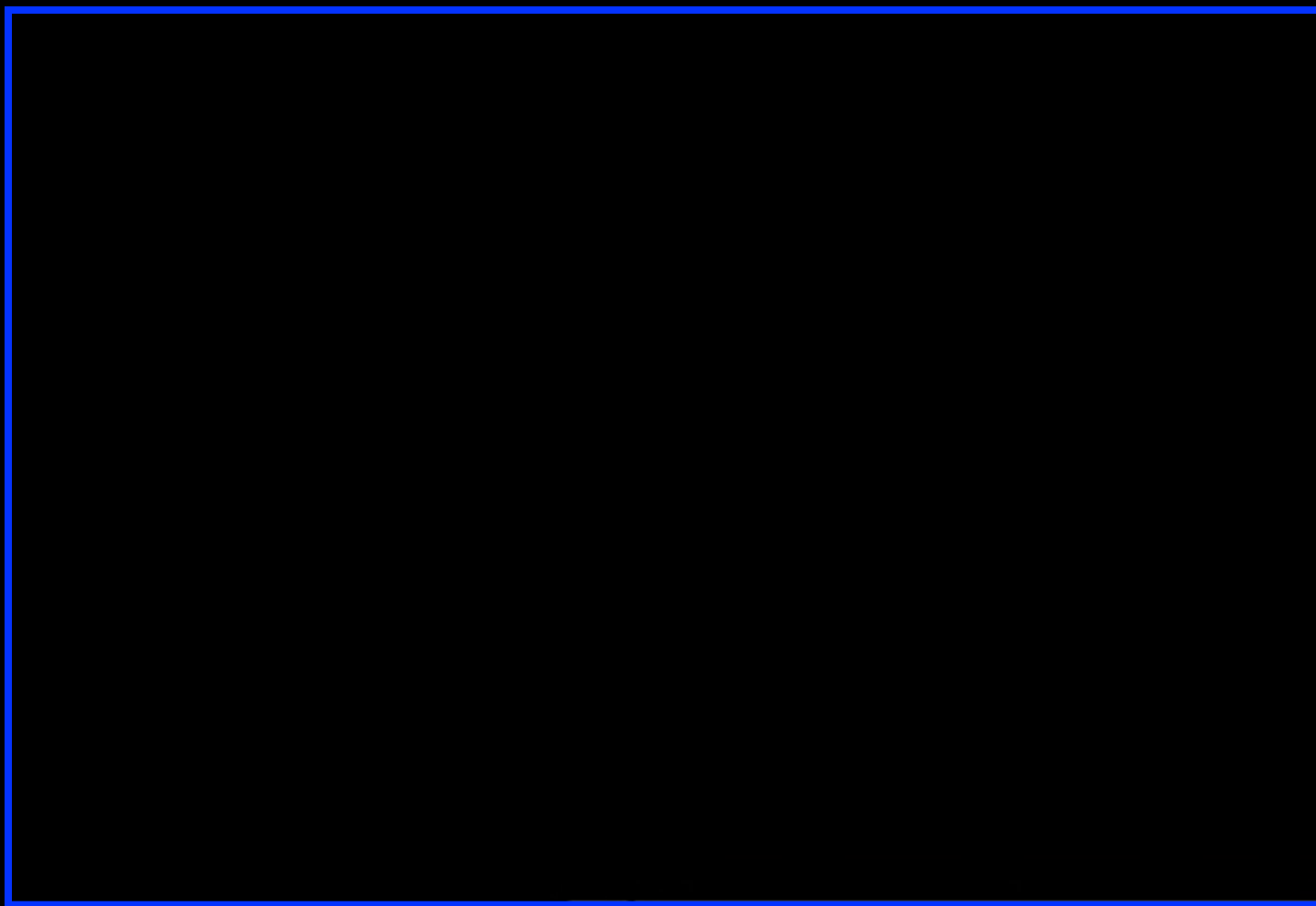
PREFACE

The Jupiter Orbiter with Probe Science Working Group (JOPSWG) was formed in January 1976. The objectives of the group were to assess the science priorities for Jupiter exploration as developed by the Committee on Planetary and Lunar Exploration (COMPLEX), to recommend a typical payload for both Orbiter and Probe, and to recommend a mission and spacecraft concept which would be consistent with fiscal constraints. The group was asked to develop a mission which would be exciting and saleable as well as one which would be scientifically sound.

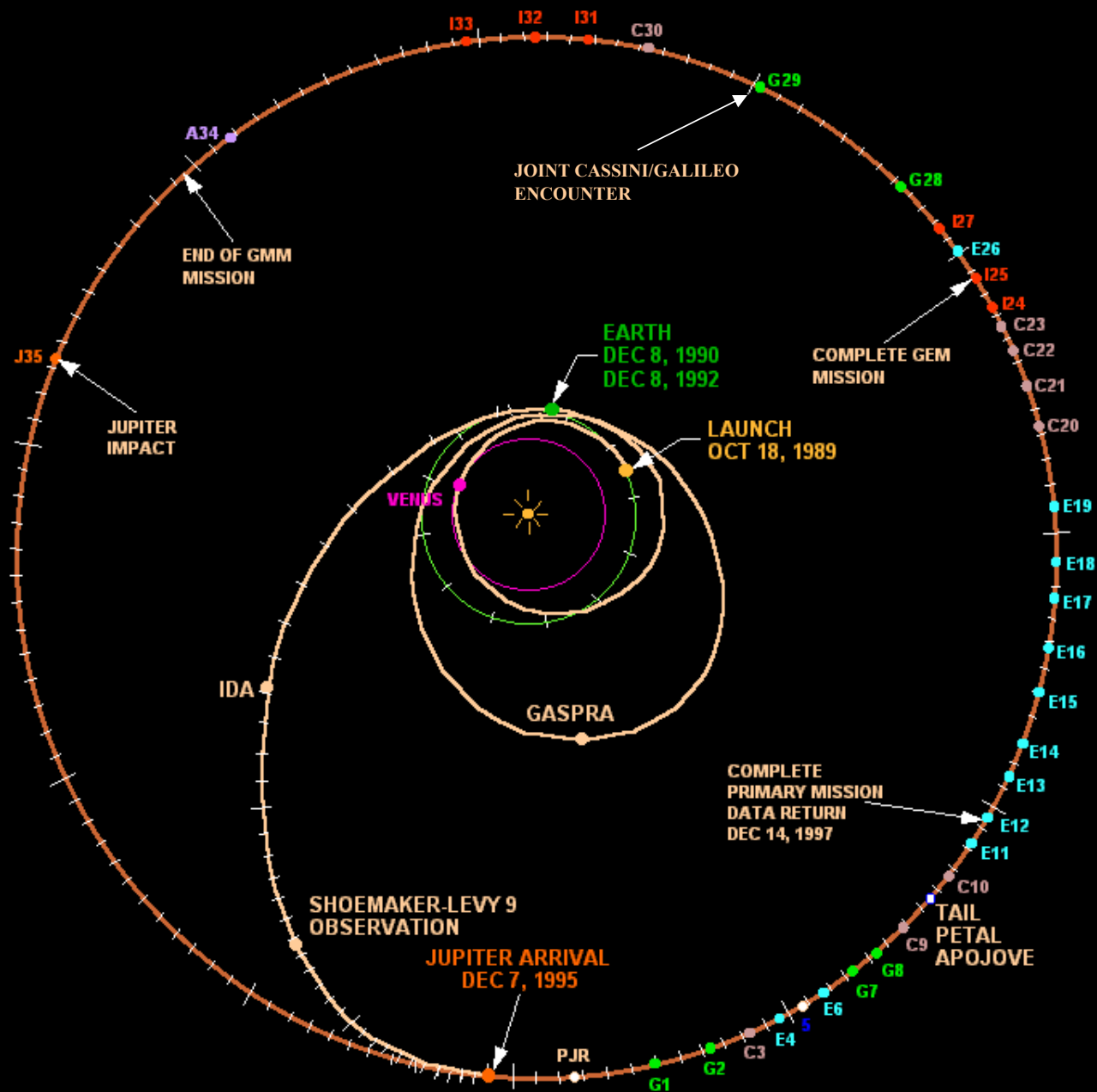
This science rationale is presented as background material for proposers. The JOPSWG also transmitted to NASA a specific set of recommendations and conclusions as part of its final report. The members of the JOPSWG are given below:

<u>Member</u>	<u>Affiliation</u>
Dr. James A. Van Allen (Chairman)	University of Iowa
Dr. Donald M. Hunten (Vice-Chairman)	Kitt Peak National Observatory
Dr. James R. Arnold	Revelle College
Dr. Ian Axford	Max Planck Institute, Federal Republic of Germany
Dr. Michael J. S. Belton	Kitt Peak National Observatory
Dr. Lawrence Colin	NASA/Ames Research Center
Dr. Samuel Gulkis	Jet Propulsion Laboratory
Dr. William B. Hubbard	University of Arizona
Dr. Torrence V. Johnson	Jet Propulsion Laboratory
Dr. Charles F. Kennel	University of California at Los Angeles
Dr. Konrad Mauersberger	University of Minnesota
Dr. Norman F. Ness	NASA/Goddard Space Flight Center
Dr. James B. Pollack	NASA/Ames Research Center
Dr. U. von Zahn	Physikalisches Institut der Universität Boon, Federal Republic of Germany
Dr. James W. Warwick	University of Colorado
Dr. John H. Wolfe	NASA/Ames Research Center

October 18, 1989
Kennedy Space Center



Galileo's Historic Tour Through the Solar System

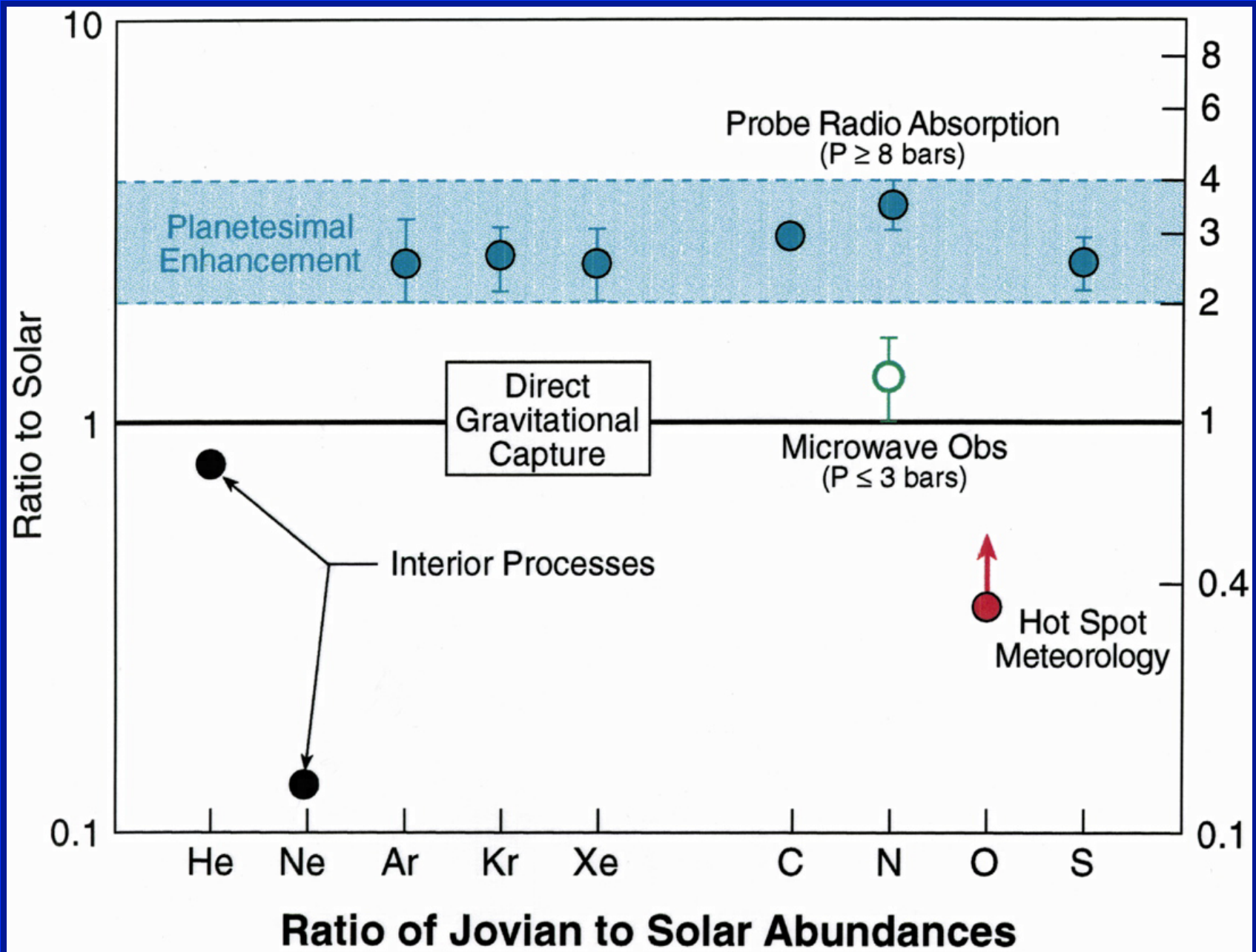


Galileo: Earth and Moon 1992

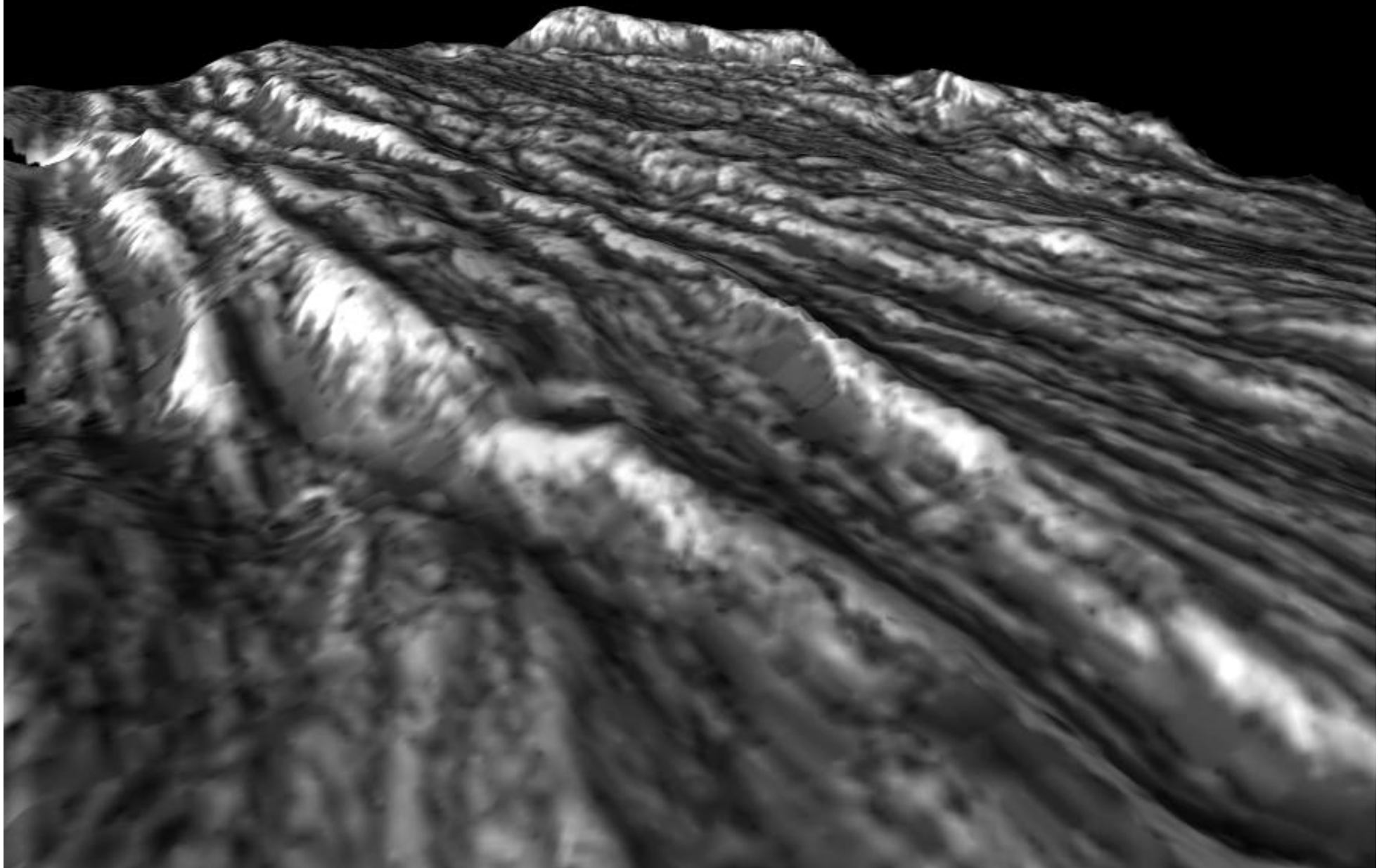


Jupiter
7 December 1995





Ganymede: Uruk Sulcus



Ganymede 1, July 1996

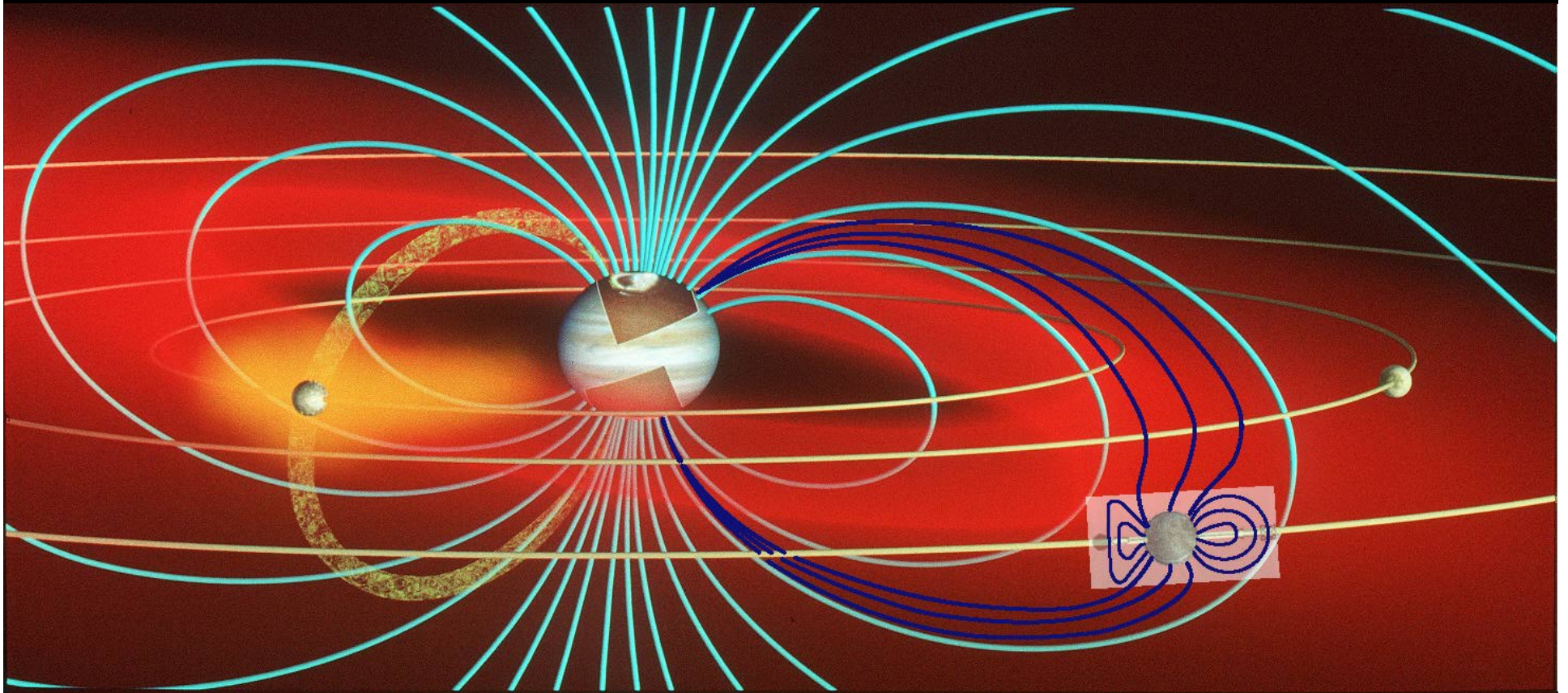
Jupiter's Moon Ganymede

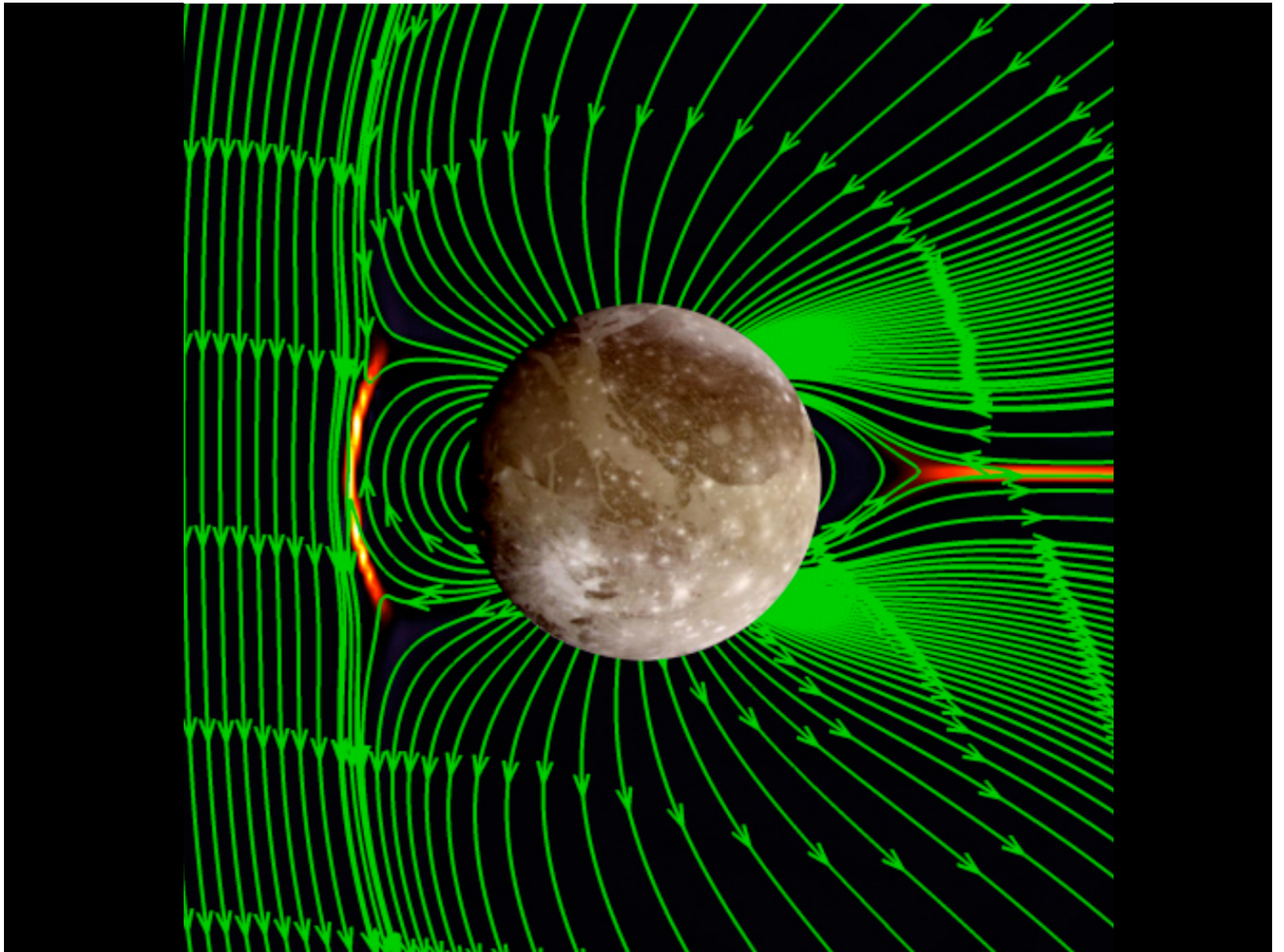
Magnetic Data and Radio Noise

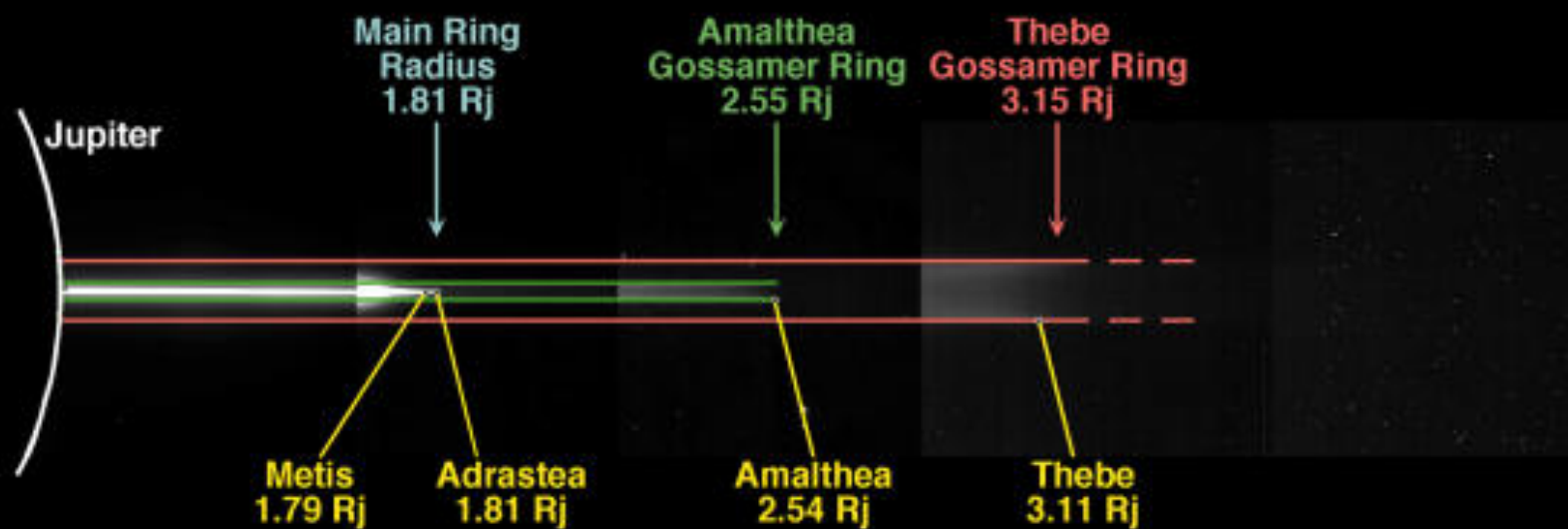
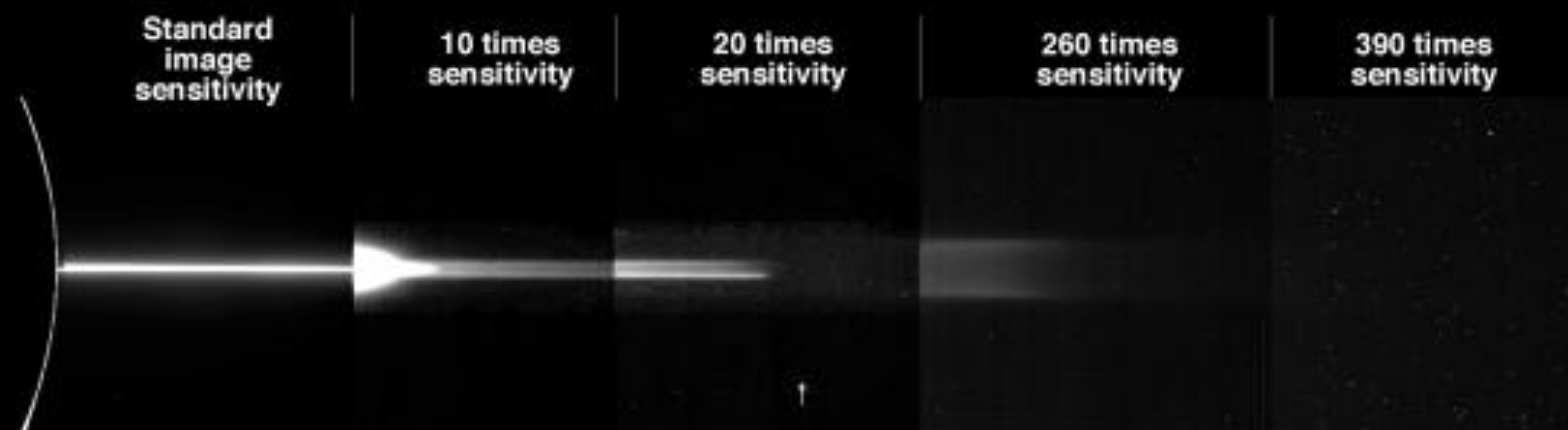
Magnetic Field Model

Internal Structure derived from
gravity data

Ganymede: A Moon with Magnetism

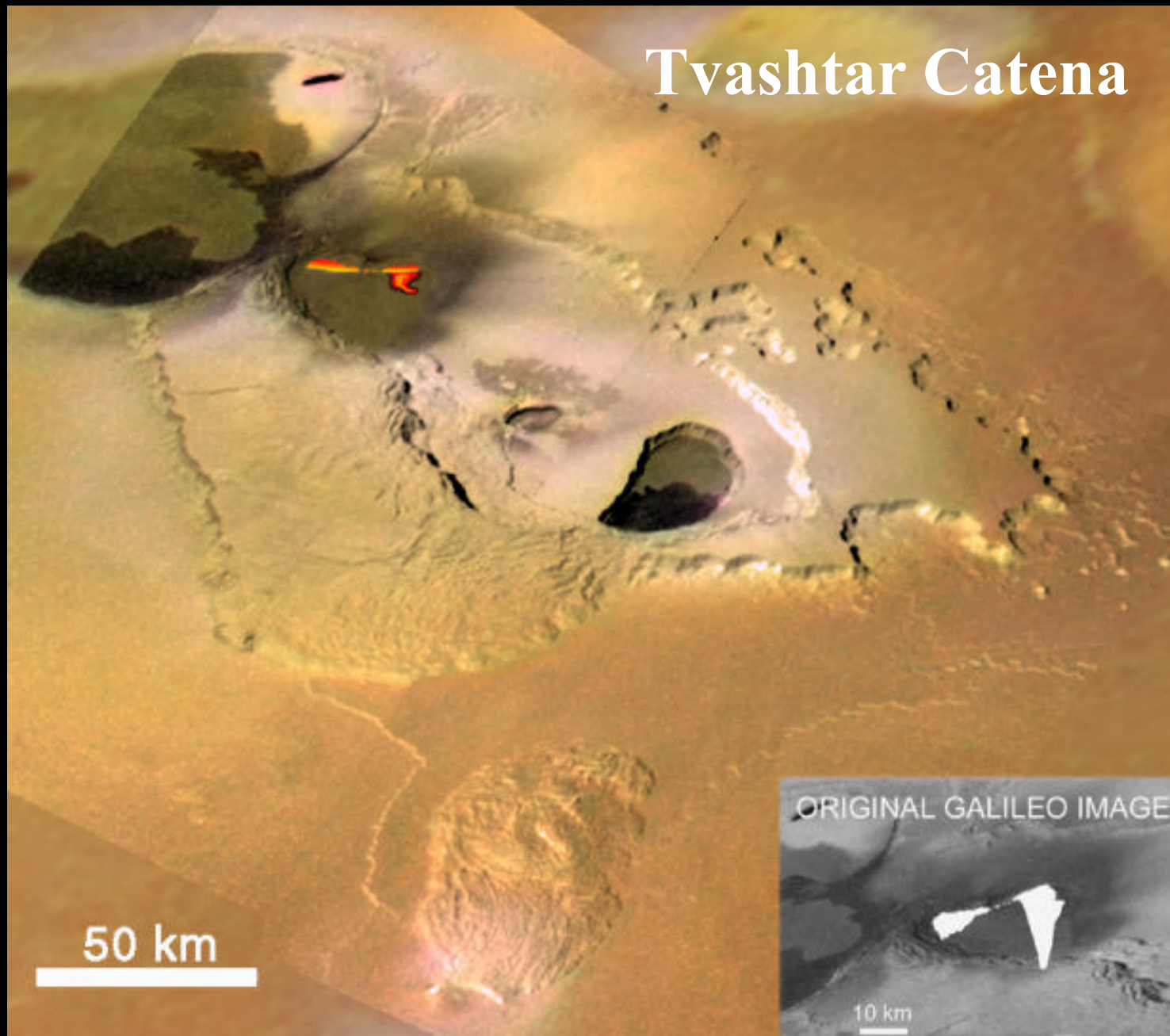






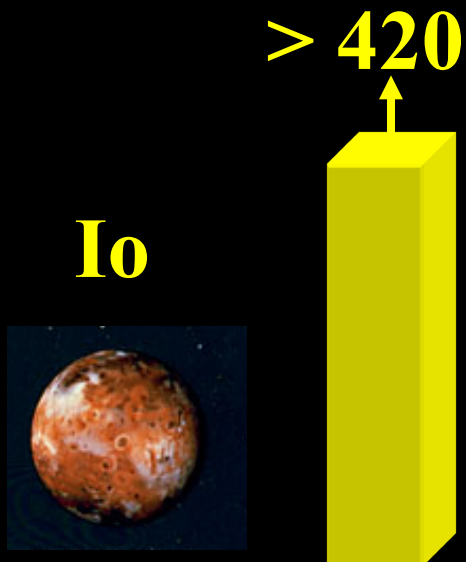
● = Earth for scale

Tvashtar Catena



Magma Generation, km^3/yr

Earth

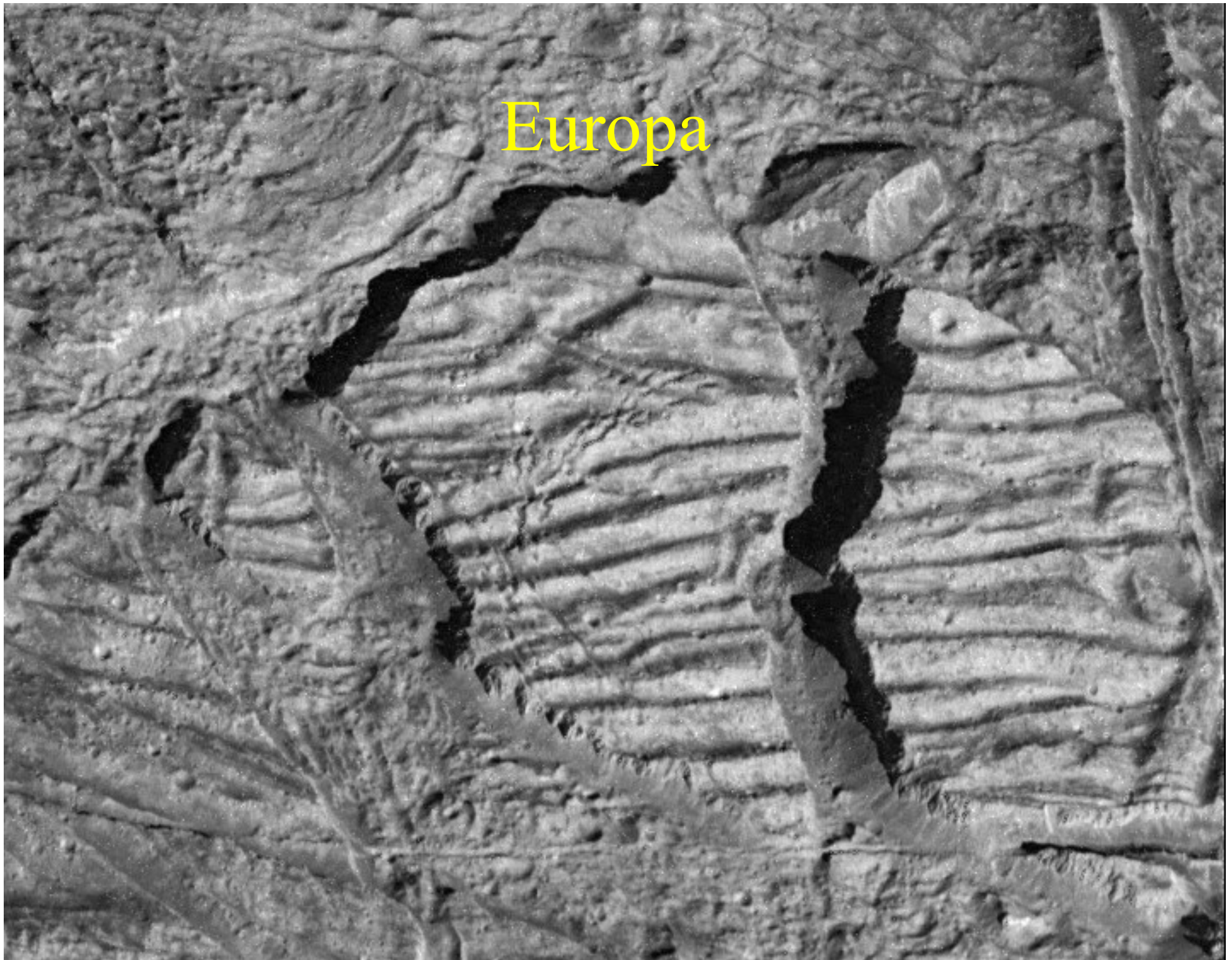


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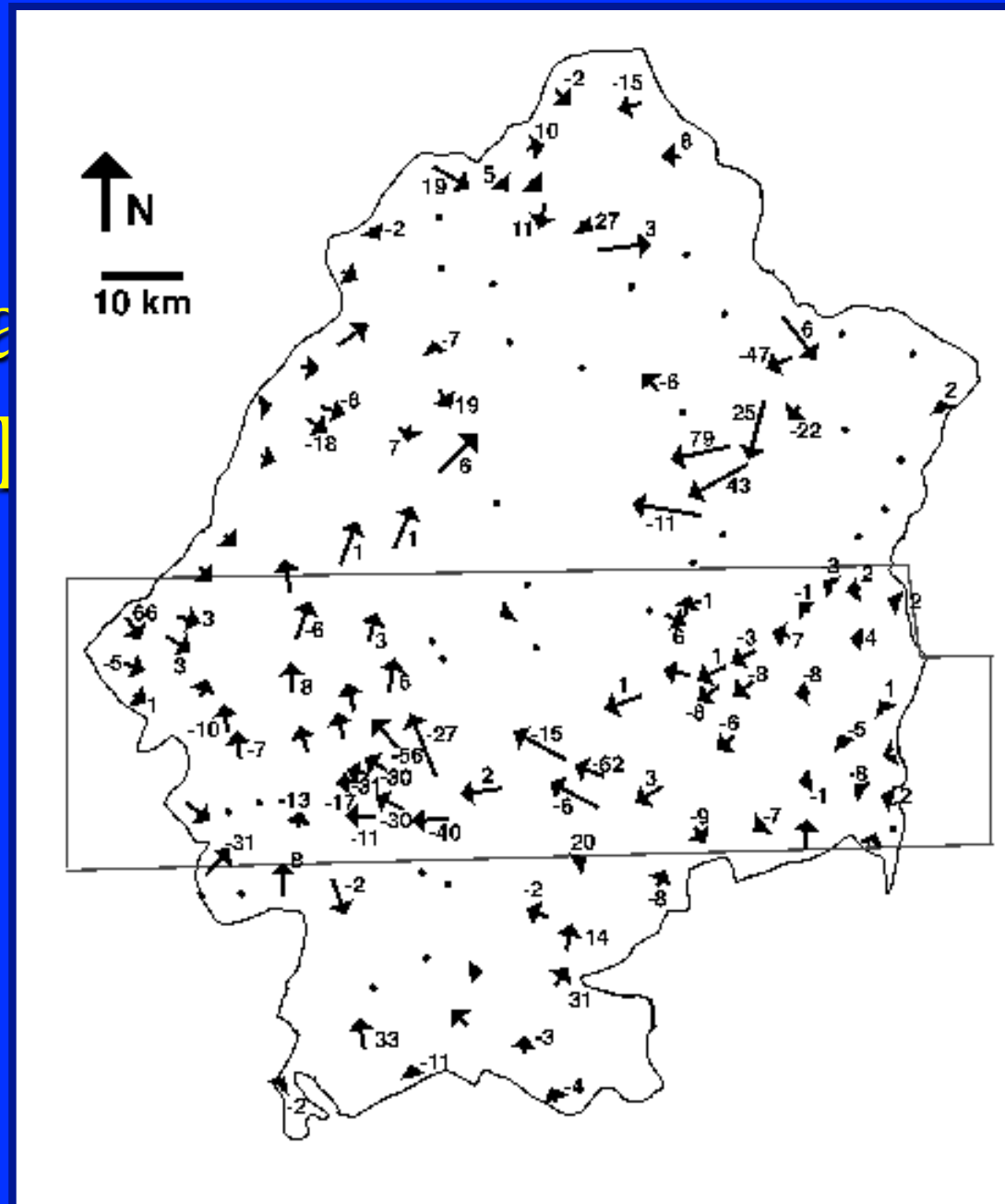
A small blue 3D bar representing magma generation for Earth.

Europa



Cona

N.



uropa:
le

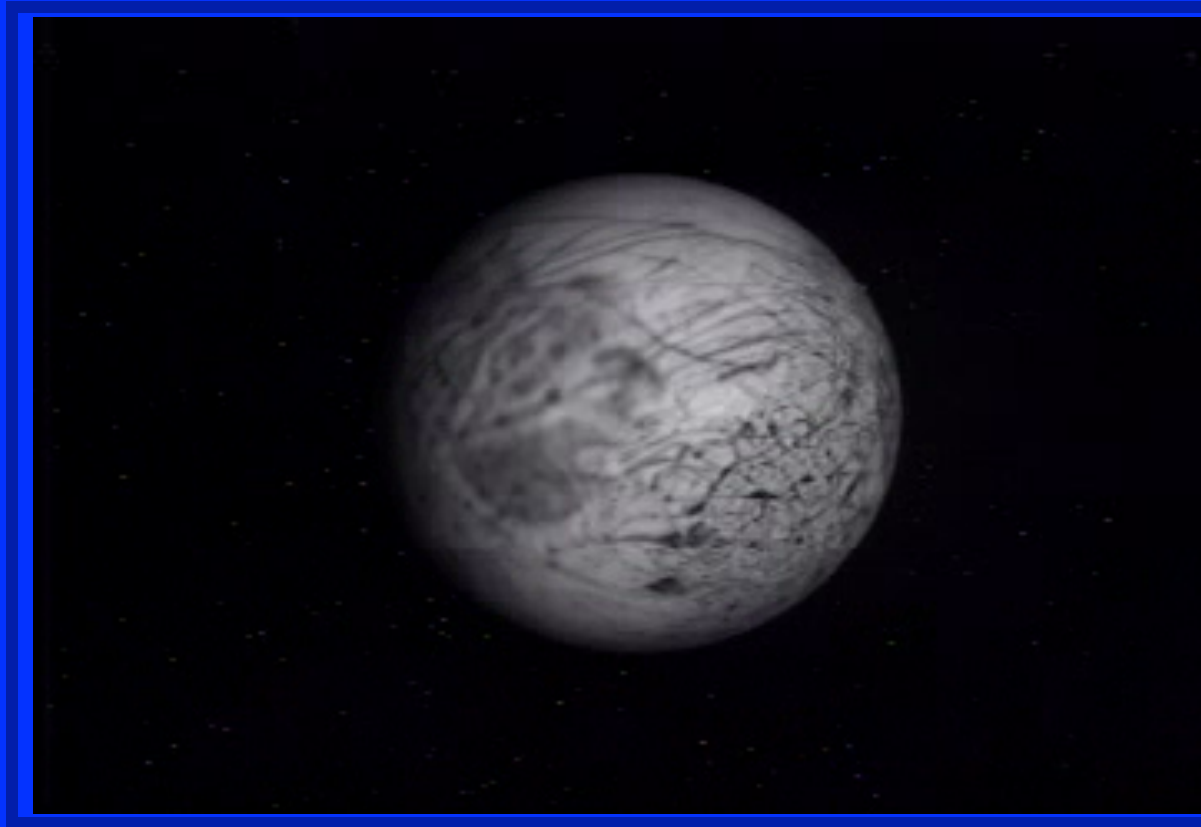
1998

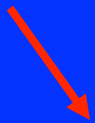


Magnetic Signatures of Oceans

- Galileo's magnetometer experiment (M. Kivelson, PI) finds evidence that the icy moons – Europa, Ganymede, and Callisto - act like global scale electrically conducting spheres
- Required conductivity $\gg$ ice, rock, ionospheres, etc
- Salty seawater is $\sim$ right

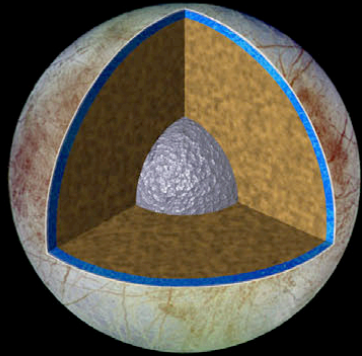
Magnetic Induction Model



 Jupiter's field: 10.7 hr period

 Electrical currents in outer shell create 'counter' field

Kivelson *et al.*; Khurana *et al.*



Europa

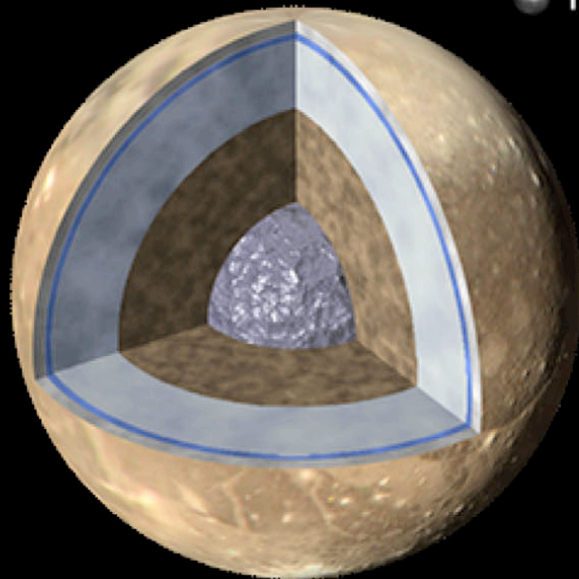
- ice
- water
- rock
- metal



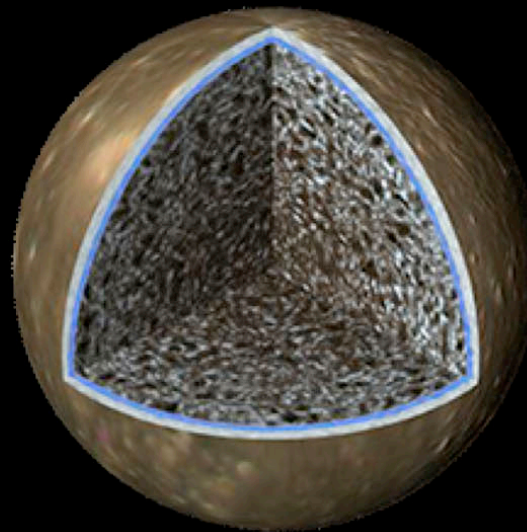
Earth



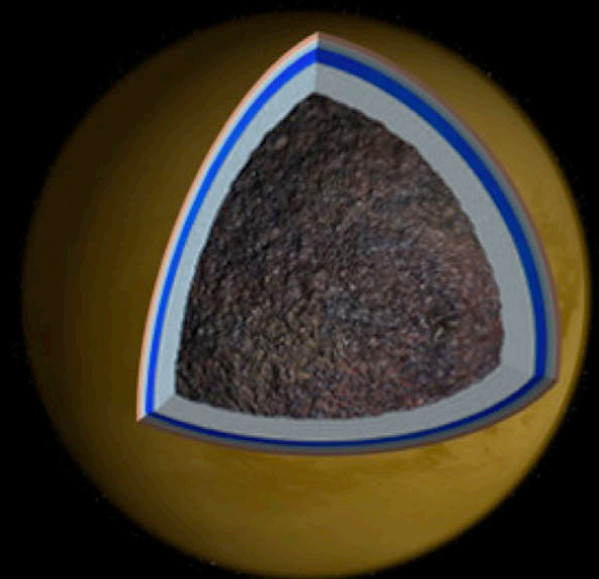
Enceladus



Ganymede



Callisto



Titan

