Joint Europlanet/ISSI Workshop 2008

Moons of the outer solar system: exchange processes involving the interiors SC1.3

Related to the science cases:

Dating planetary surfaces	**SC 1.1**
Surface material composition	**SC 1.4**
Terrestrial analogues (but not for Mars)	**SC 1.6**
Enceladus	**SC 1.7**

Joint ISSI/Europlanet Workshop 2008

Project leaders

Blanc M. (ISSI/Europlanet)

Grasset O. (N2 Europlanet)

Organizing Committee:

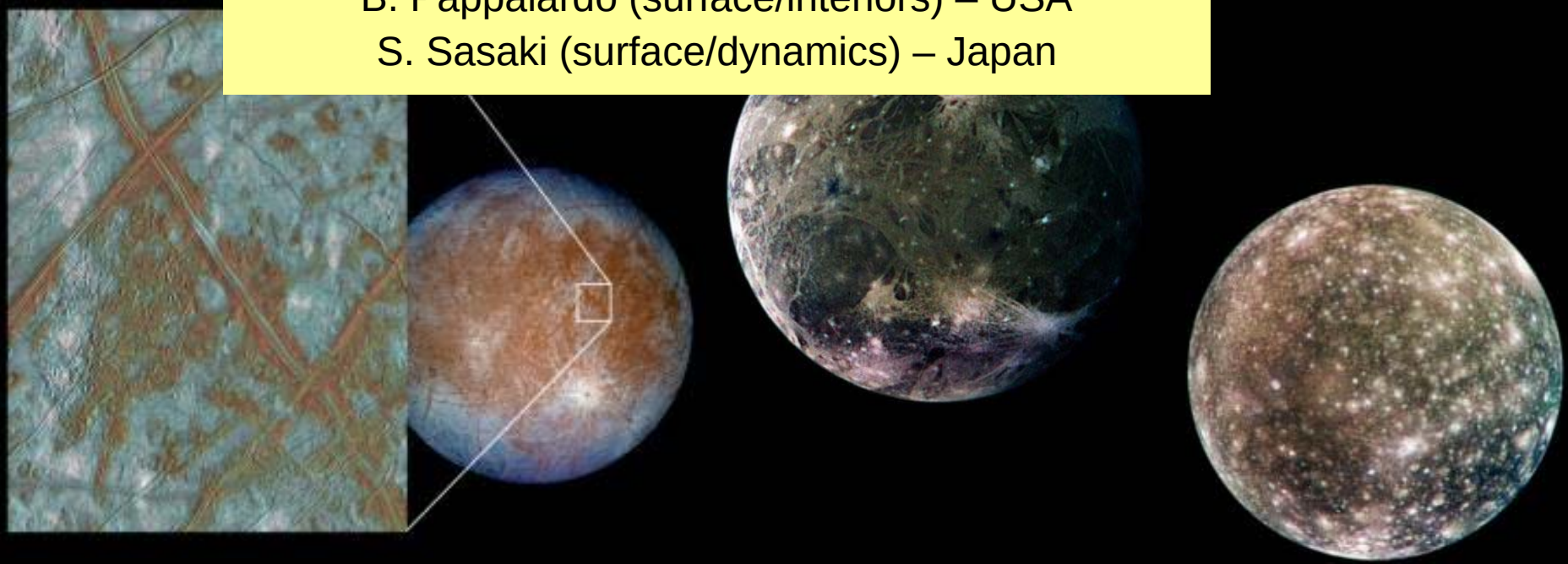
A. Coustenis (Surface/atmospheres) – France

H. Hussman (interiors) – Germany

D. Turrini (Origins) – Italy

B. Pappalardo (surface/interiors) – USA

S. Sasaki (surface/dynamics) – Japan



WS General themes

- Surface compositions: Interpretation of mapping spectrometer data
- Past and present dynamics of icy surfaces: erosion, tectonism and cryovolcanism
- Internal processes: dynamics of icy mantles
- Physics and chemistry of ices: experimental constraints on hydrates, clathrates and organics
- Earth analogs: a tool for understanding surface/ internal features
- Origin/composition of the moons

I. Science objectives of the workshop SC1.3: Exchange processes

Topics to be addressed

- Differentiation of icy moons
- Thermal evolution of icy mantles
- Heat sources
- Dating of icy moons surfaces (SC 1.1 – SC 1.4)
- Origin and evolution of the moons
- Experimental constraints on internal structures: state of the art
- Cryovolcanic activity in the outer system (Enceladus,Triton,Titan,…)
- Tectonics on icy moons (SC 1.6)
- Cryosphere/atmosphere exchanges on Titan
- Enceladus: a new active world (SC 1.4 - SC 1.7)
- The resurfacing of Europa (SC 1.4)
- New discoveries on Pluto/Charon and the TNO

General organisation

- Duration: 4 ½ days
- Organisation (classical)
  - Start: Monday Morning
  - End: Friday afternoon (final discussion for the book preparation)
  - Break: Wednesday afternoon
  - Mix of plenary sessions and splinters (preparation of multi-author chapters)
- Book
  - An integrated book is suggested

Schedule

January 2008

First meeting at ISSI

July 2008

Final list of attendees

First circular + call for abstracts

September 2008

Collection of abstracts

Preparation of the programme

Second circular

17 – 21 November 2008

2nd ISSI/Europlanet Workshop

May 2009

Final delivery of the manuscript

July 2009

Publication of the integrated book

List of participants (finalized before mid-July)

Blanc M.
Coll P.
Coradini A.
Coustenis A.
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Johnson T.
Kargel J.
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Koffman W.
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Lorenz R.
Lunine J.
McCord T.
Mosqueira I.
Owen T.
Pappalardo R.
Prokter L.
Raulin F.
Saur J./ Khurana
Schmidt J.
Sotin C.
Tobie G.
Tokano T.
Turrini D.
Van Hoolst T.
Wagner R.

Workshop organisation (from the first meeting in Bern)

DATA/FACTS:

- Surface composition of the moons
- Surface characteristics – topography/morphology
- Surface and atmosphere characteristics –specific bodies
- Physical constraints
- Physics and chemistry of ices and organics

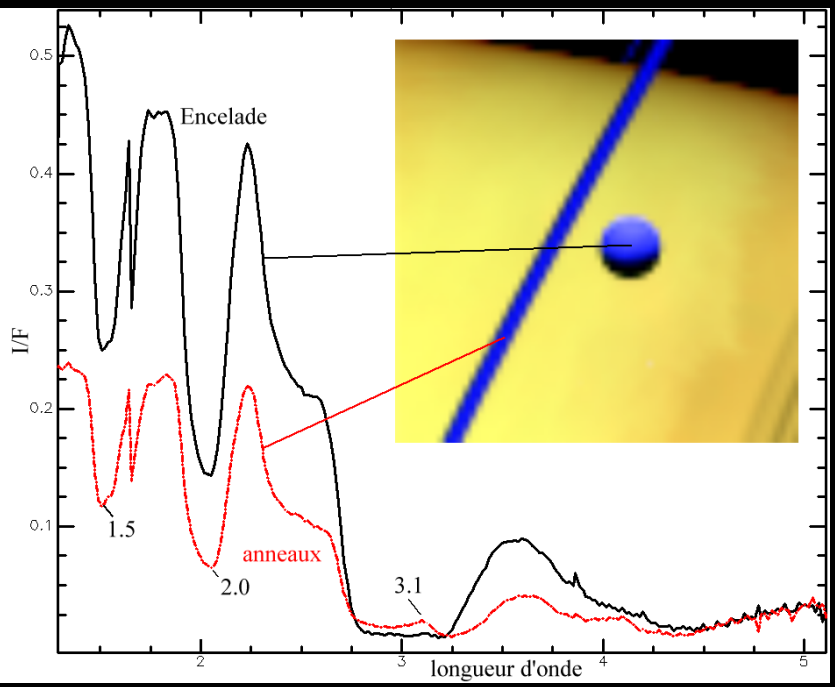
ANALYSIS:

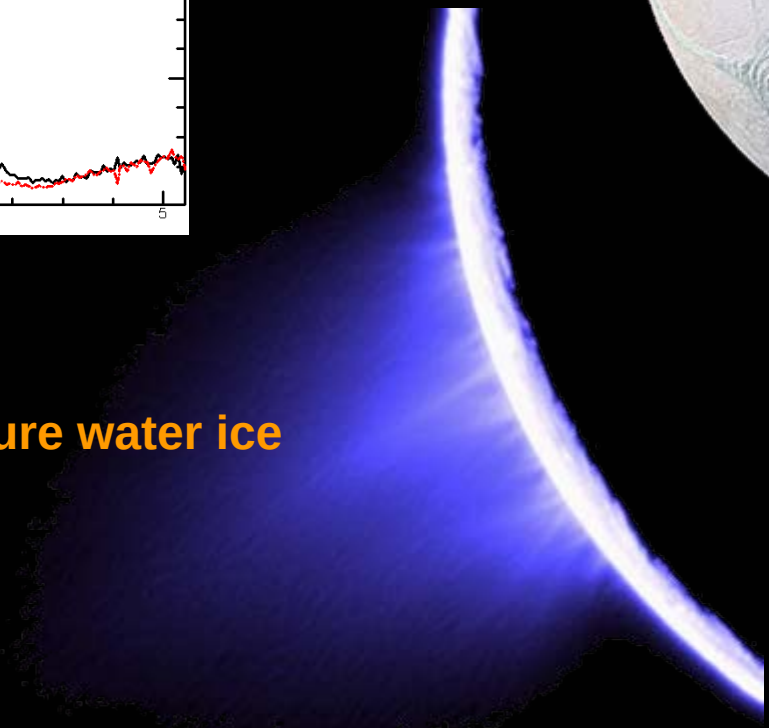
- Past and present dynamics of icy surfaces
- Internal processes: energy sources and dynamics
- External processes: interactions with the atmosphere and the space environment

IMPLICATIONS:

- Exobiology, habitability and planetary protection
- Evolution of the moons

1. Surface compositions: Interpretation of mapping spectrometer data (SC 1.4)

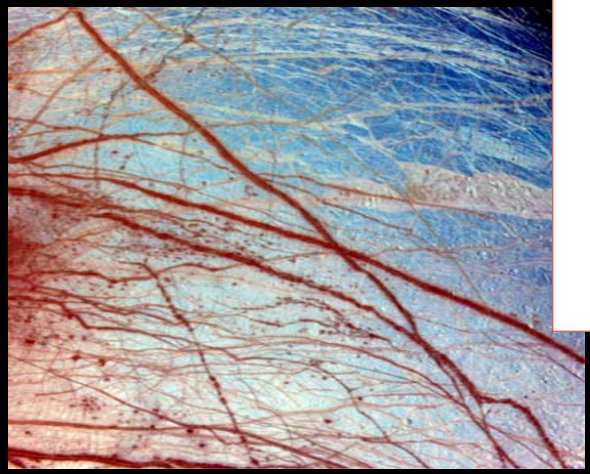


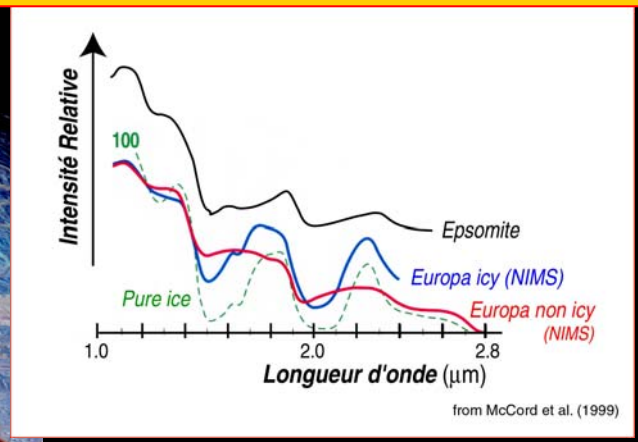


Direct determination of pure water ice

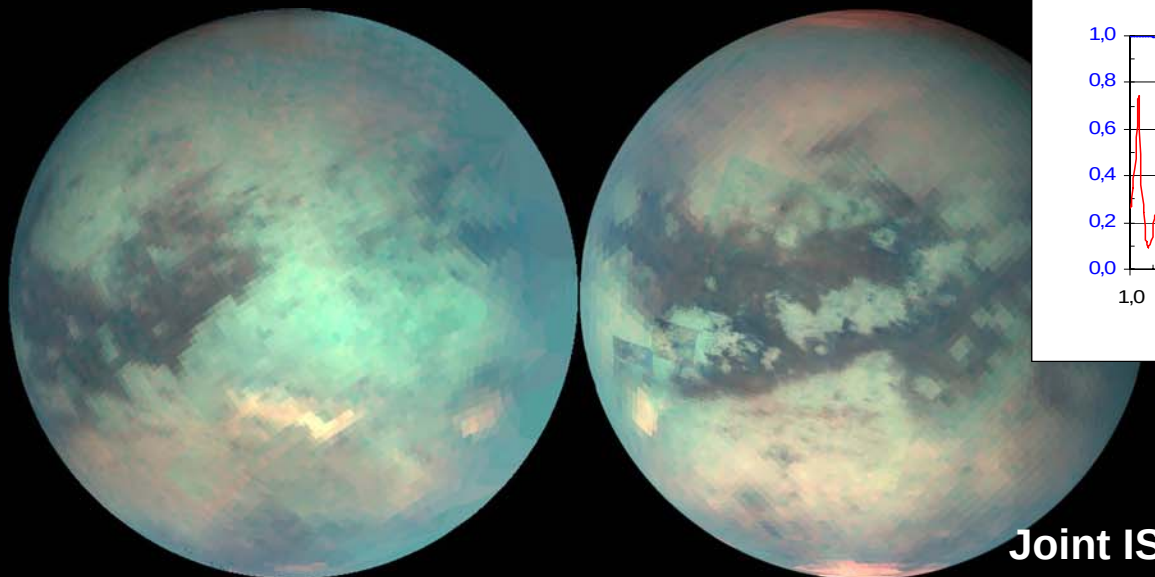
1. Surface compositions: Interpretation of mapping spectrometer data (SC 1.4)

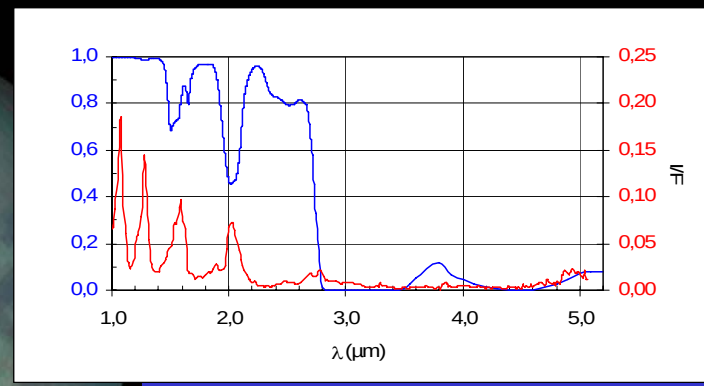
Europa: what are the “red” ices in faults?





Titan: Links between IR spectra and composition; a clue is still missing

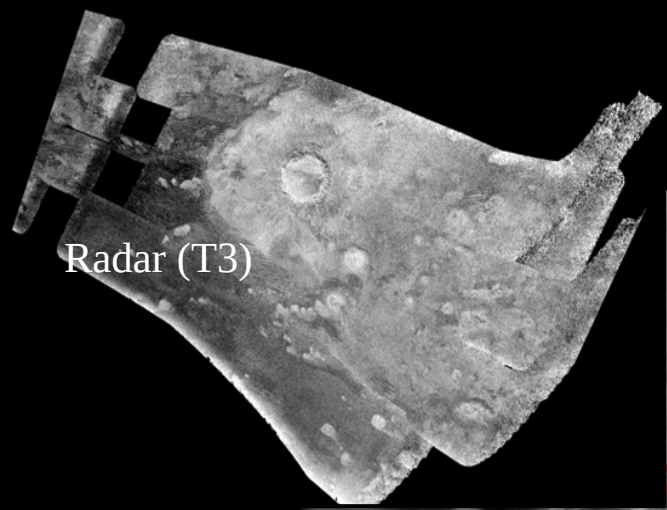


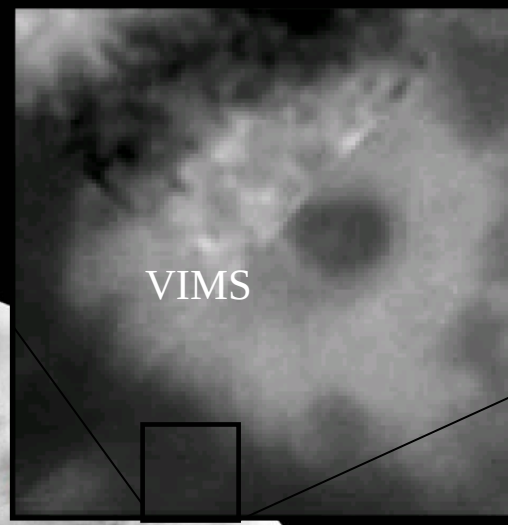


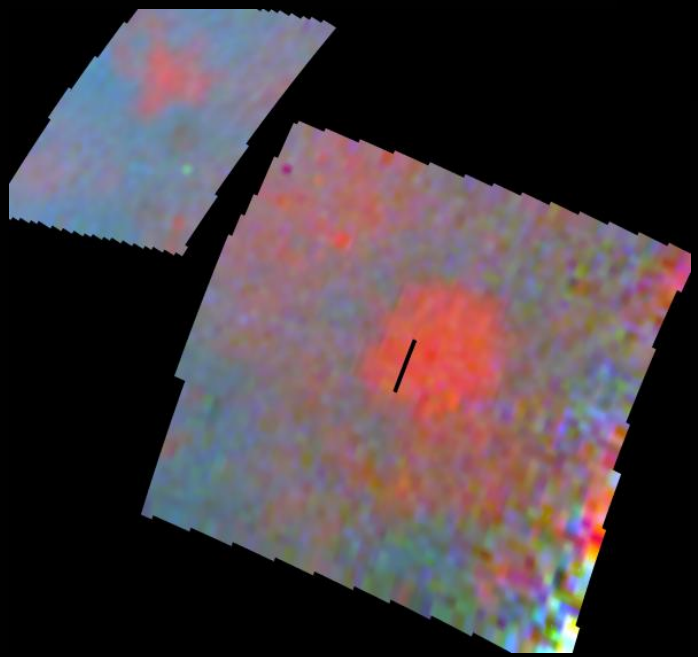
1. Surface compositions and datations (Sc1.1: Dating planetary surfaces)

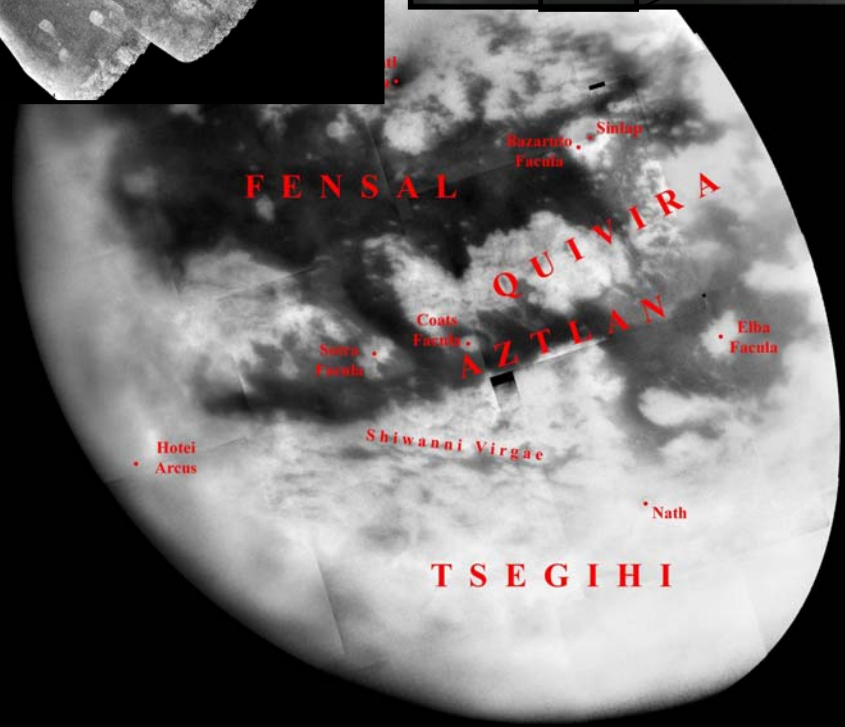
Sinlap

- observed twice by VIMS at T5 (April 2005) and T13 (April 2006) with a medium resolution (14 to 17 km/pixels)



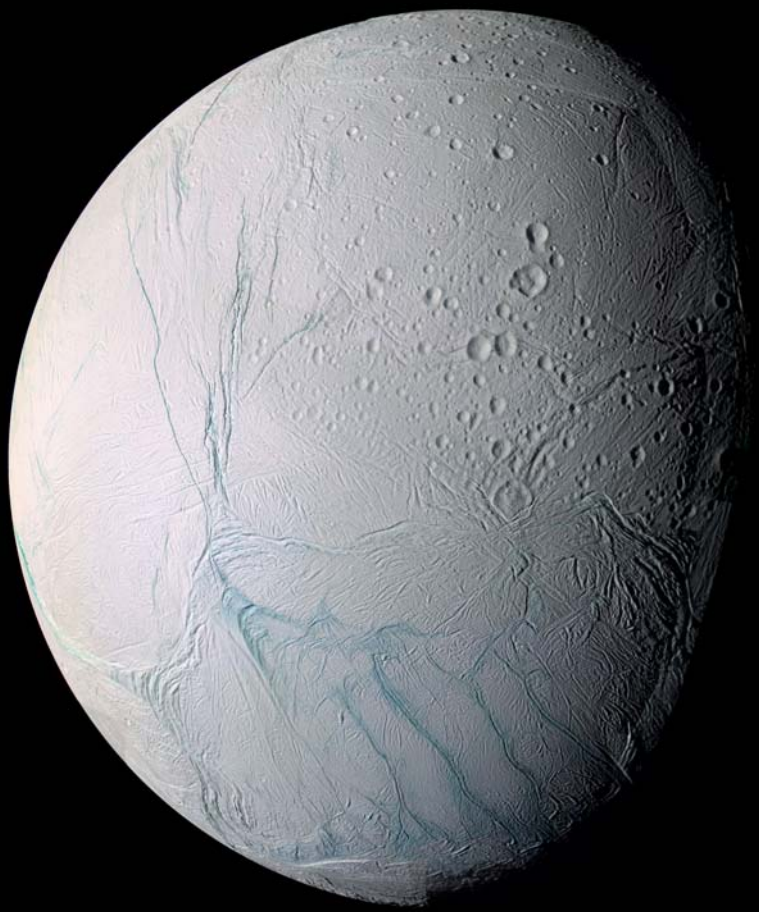


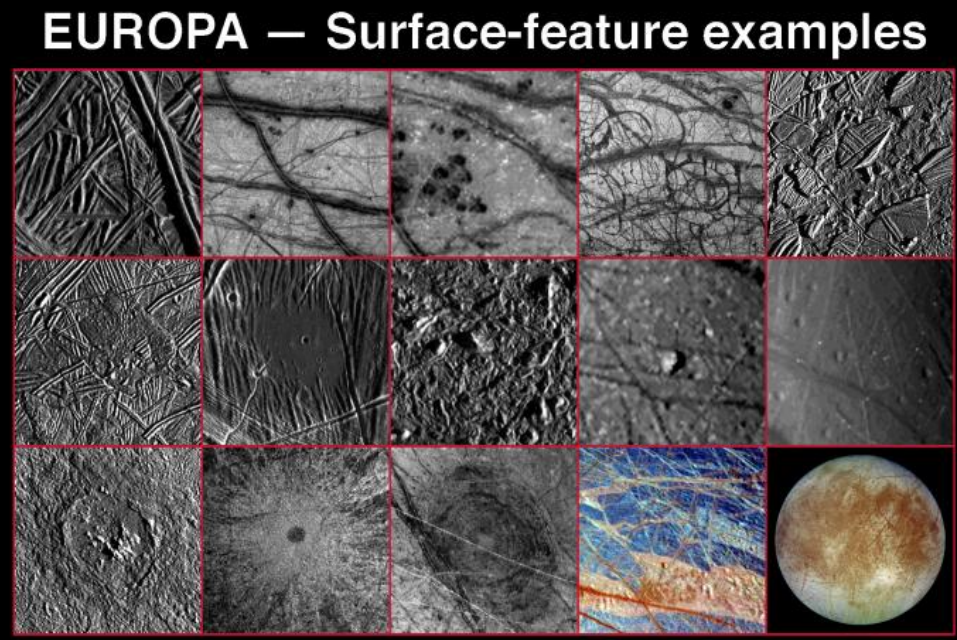




Callisto's southern hemisphere (NIMS)

2. Past and present dynamics of icy surfaces: erosion, tectonism and cryovolcanism





Enceladus (SC 1.7):

a present volcanic and tectonic activity

I. Science objectives

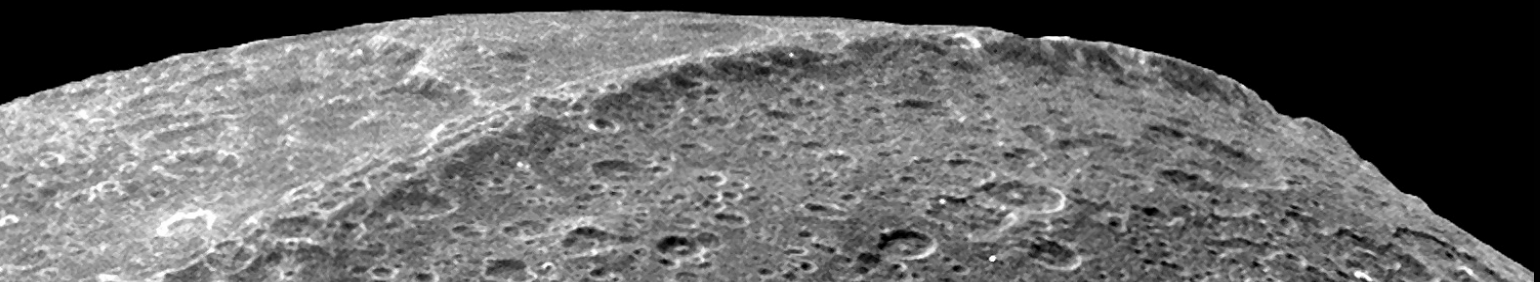
2. Past and present dynamics of icy surfaces: erosion, tectonism and cryovolcanism

Dione *canyons*

Hyperion

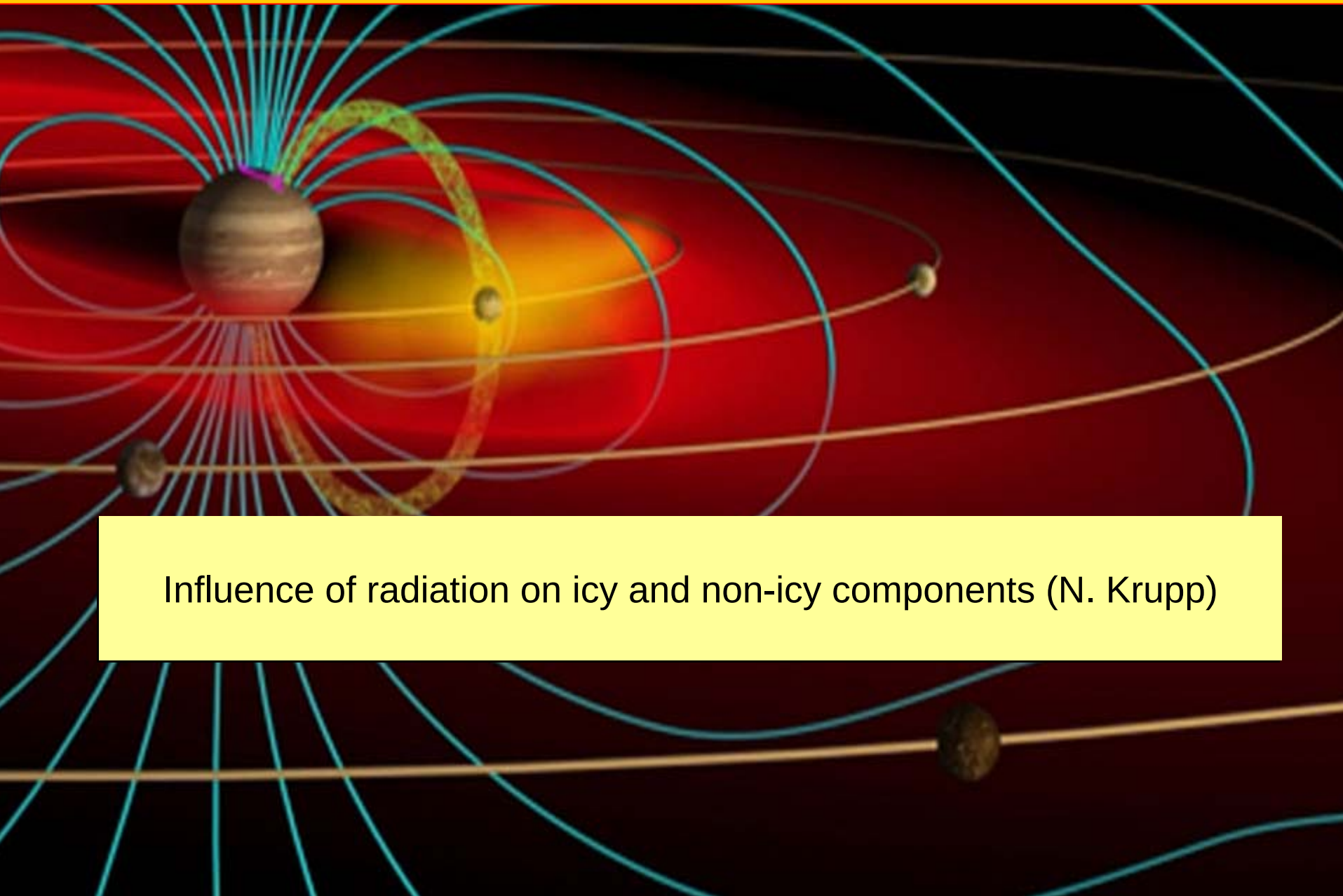
High resolution images of small bodies…

Equatorial bulge on ***Japet***



I. Science objectives

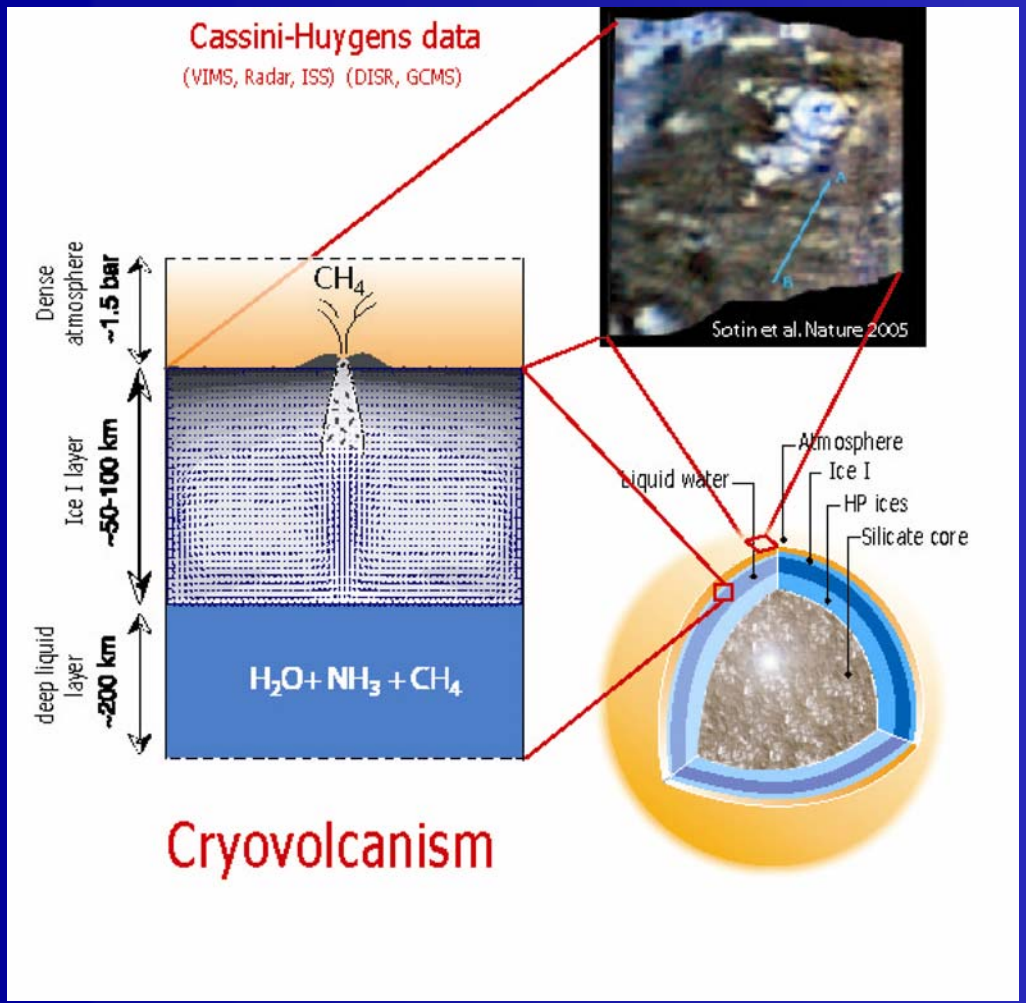
2. Past and present dynamics of icy surfaces: erosion, tectonism and cryovolcanism



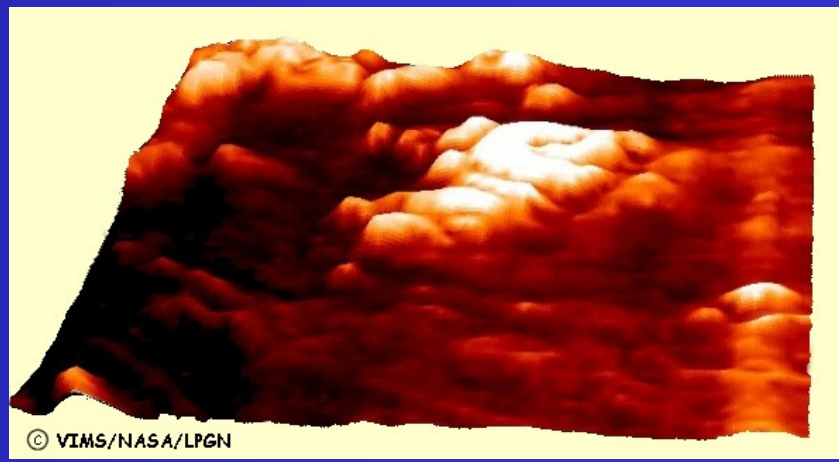
Influence of radiation on icy and non-icy components (N. Krupp)

3. Internal processes: dynamics of icy mantles

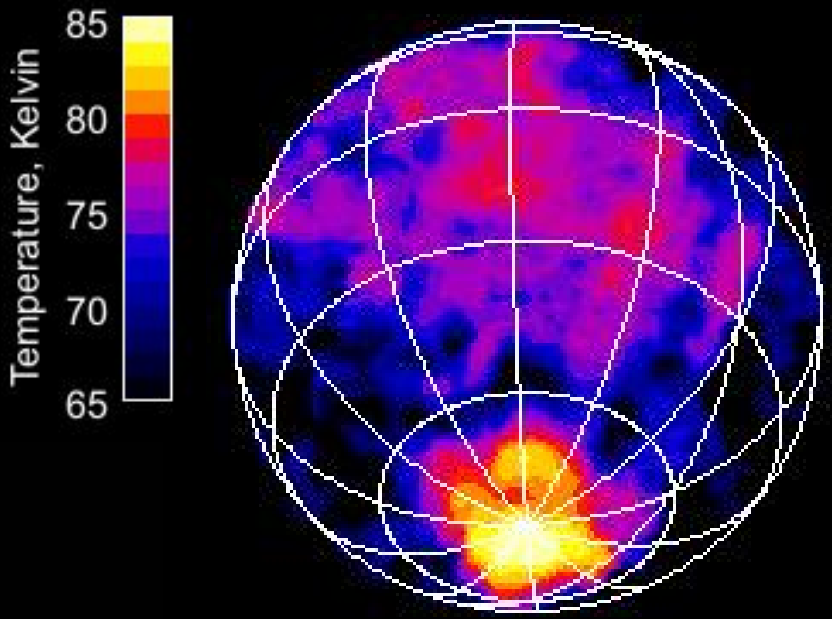
Titan's cryovolcanism as an example



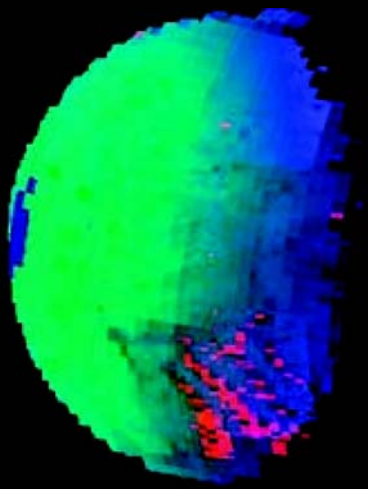
Tortola Facula: a volcano detected on Titan?



3. Internal processes: dynamics of icy mantles (SC 1.7)



ISS *(Porco et al. 2006)*



VIMS *(Brown et al. 2006)*

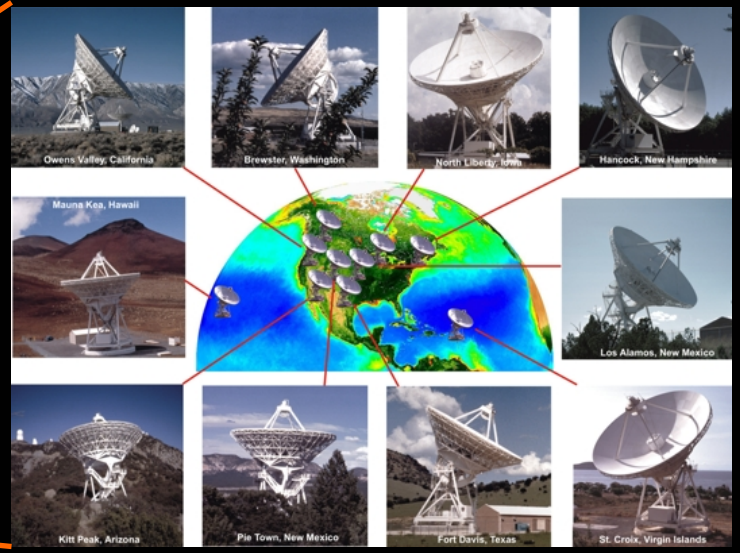
Pure ice + organics along the « tiger stripes »

Tiger stripes

Active deformation in relation with hot spots

3. Internal processes: dynamics of icy mantles

« Radio tracking » - a powerful tool for measuring the degree of differentiation



DEEP SPACE NETWORK

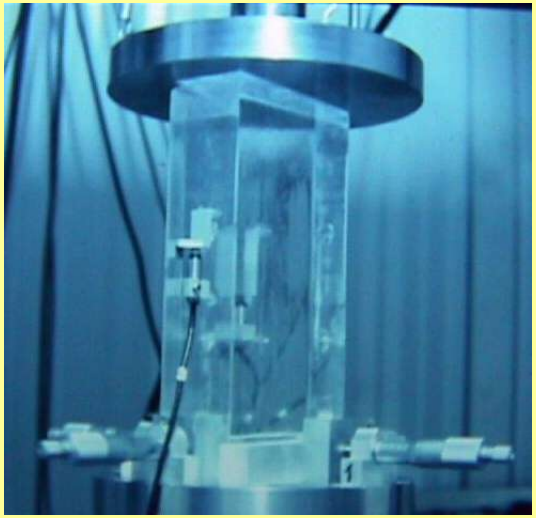
Radio-tracking → Gravitationnal coefficients (monopôle + quadripôle)

Inertial moments C/Ma^2

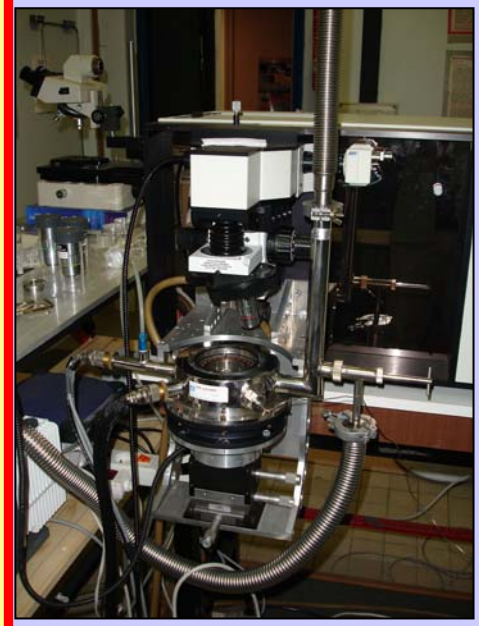
What has been done and what will be achieved on future missions?

4. Physics/chemistry of ices: experimental constraints on hydrates, clathrates and organics

Rheological properties: **Dynamics**

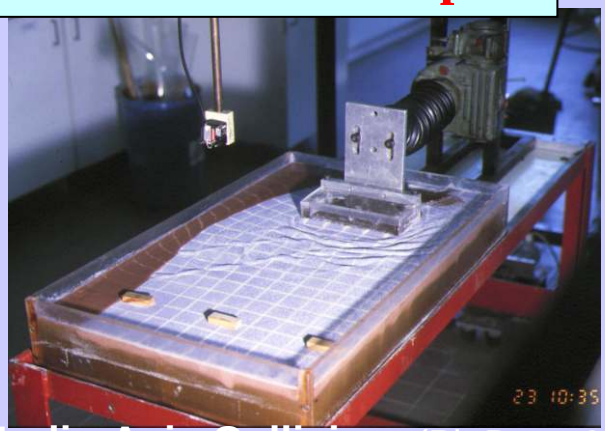


Crystal deformation under pressure



Phase diagrams, EOS and thermodynamics: **Dynamics, Structure**

Physical modeling **Tectonism/Volcanism/Impact**



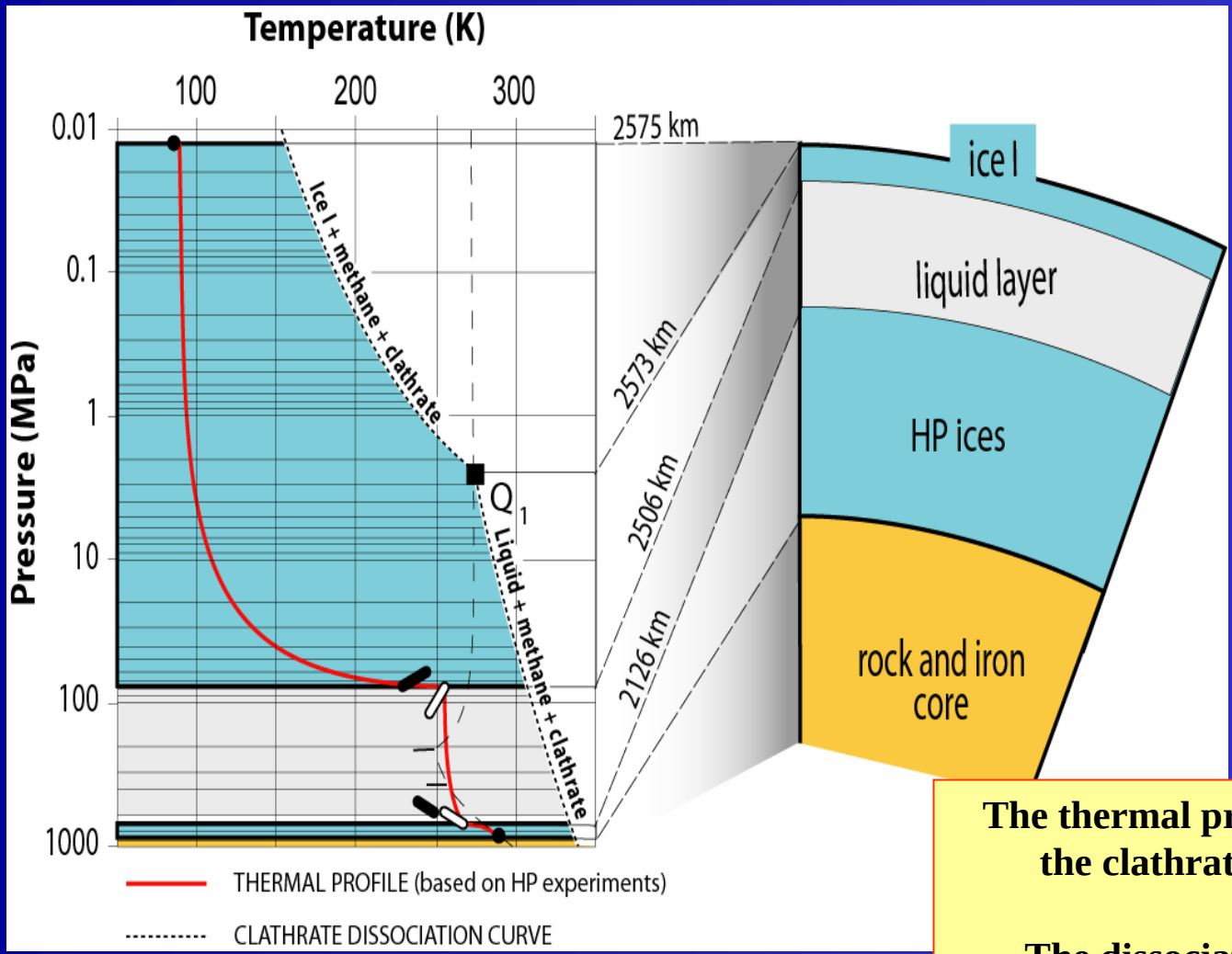
India-Asia Collision. (Ph Davy & P

Spectral signatures:**Surf./Int. composition**

LP Grenoble-France

4. Physics/chemistry of ices: experimental constraints on hydrates, clathrates and organics

Titan: how do methane clathrates dissociate through the icy crust?



The thermal profile seems to be below the clathrate dissociation curve

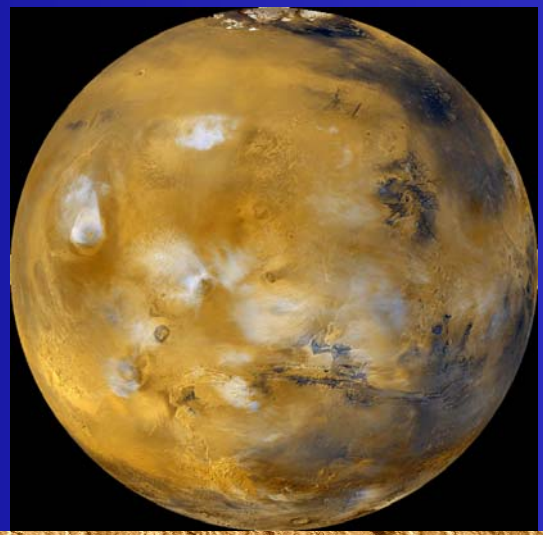
BUT

The dissociation curve is not well constrained (lack of experimental data)

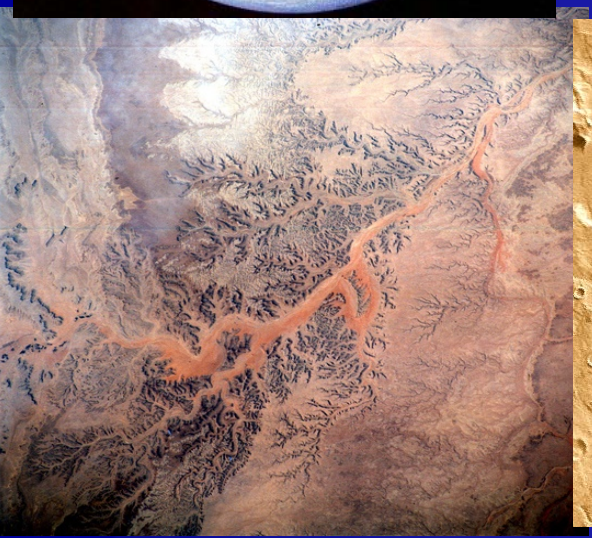
5. Earth analogs: a tool for understanding surface/ internal features (SC 1.6)

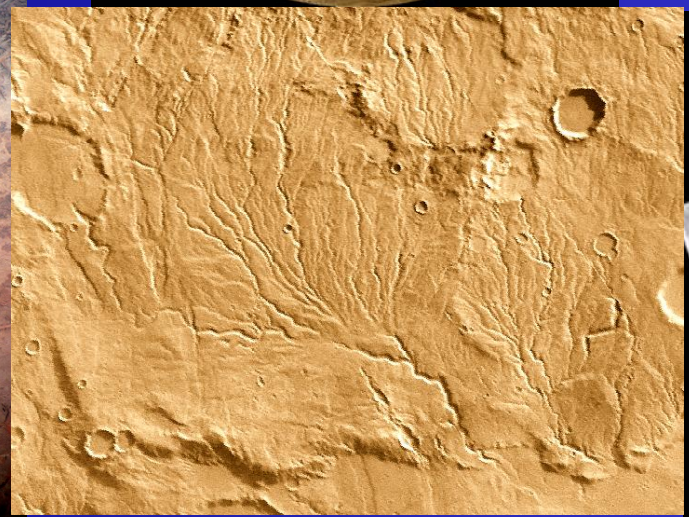
EARTH

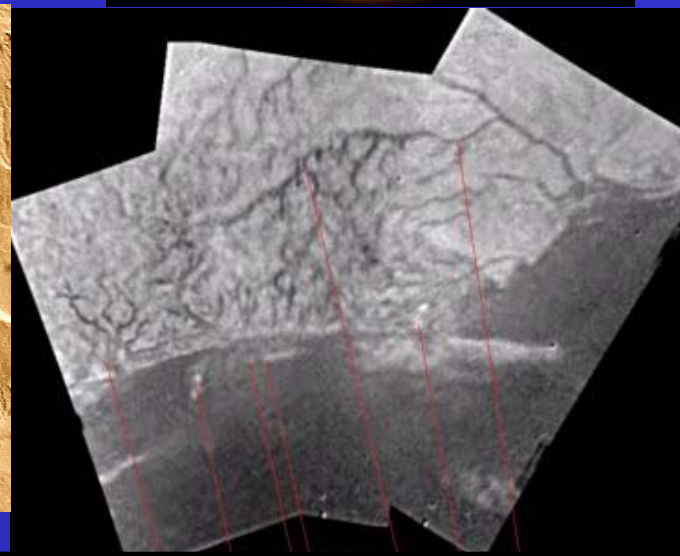
MARS



TITAN







Several planets – same features…

6. Origin of the moons – main questions (slide from F. Tosi)

Formation and evolution of the satellites' system: bulk composition and gradients in the same satellite and among satellites (Europa, Ganymede, Callisto) to characterize the primordial nebula.

Surface, subsurface and atmosphere characterization. Current composition is the result of several processes having different timescales: primordial nebula material, thermal processes, interaction with radiation and magnetic field particles, dust and impactors. The study of all these effects is necessary to unveil the mechanism of the origins of the Jovian system.

Timeliness and relevance to space science

- Cassini/Huygens mission
  - interpretation of remote sensing and in situ data
  - atmosphere/interior exchanges on Titan
  - Cryovolcanic activities on Enceladus
  - Comparing the evolution of saturnian moons
- New Horizons
  - Preparation of data interpretation on Pluto/Charon
  - Preparation of data interpretation of TNO
- Rosetta :
  - The link between comets and icy worlds
- Future mission to the moons (Europa, Titan, Enceladus, …):
- Discovery of icy exoplanets: CoRoT, Kepler , Darwin/TPF
  - How to distinguish between Earth-like and icy planets
  - Spectral signatures of habitable planets