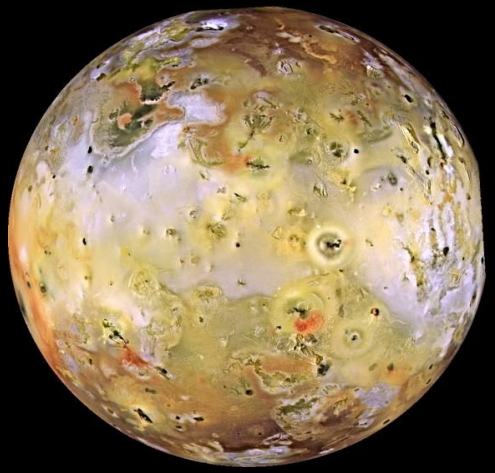
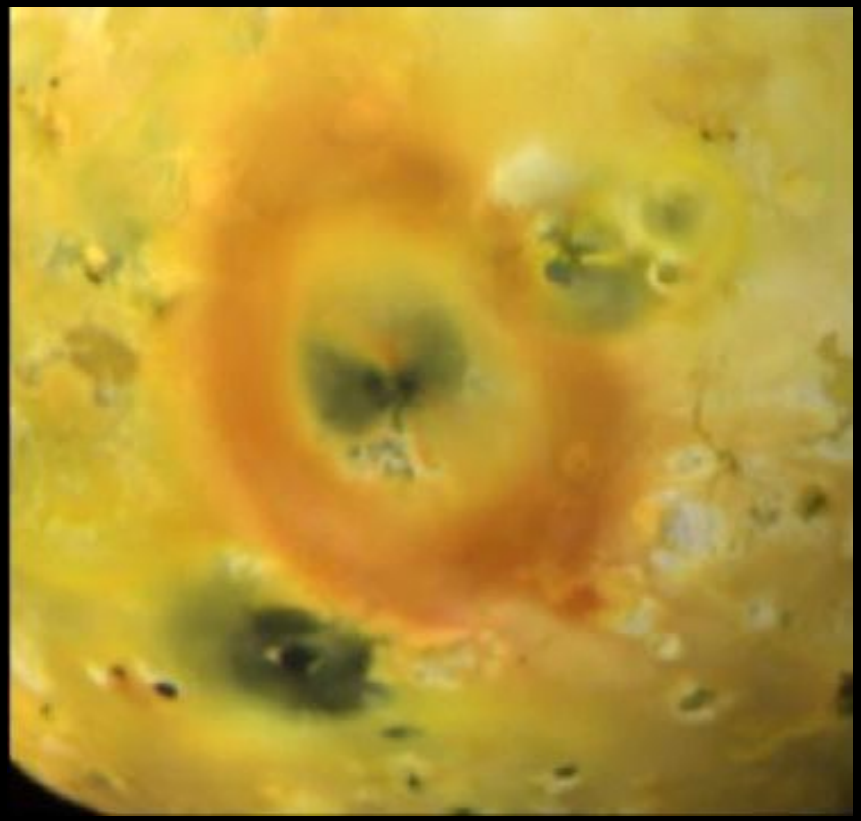
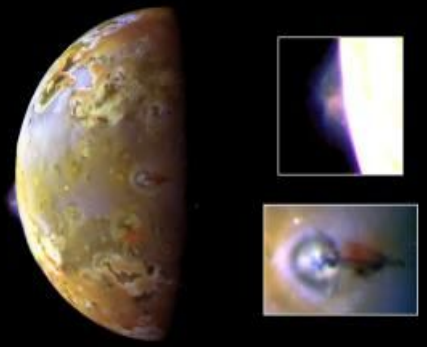
Determining the Eruption Style of Io's Pele Patera



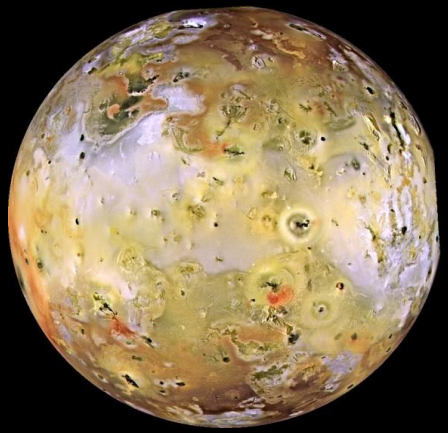




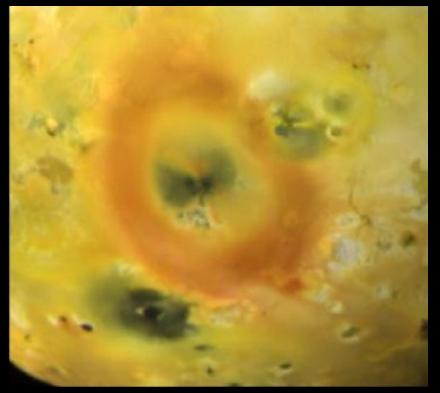
Misty La Vigne

TERPS Conference, Session 1

December 7, 2004



Outline

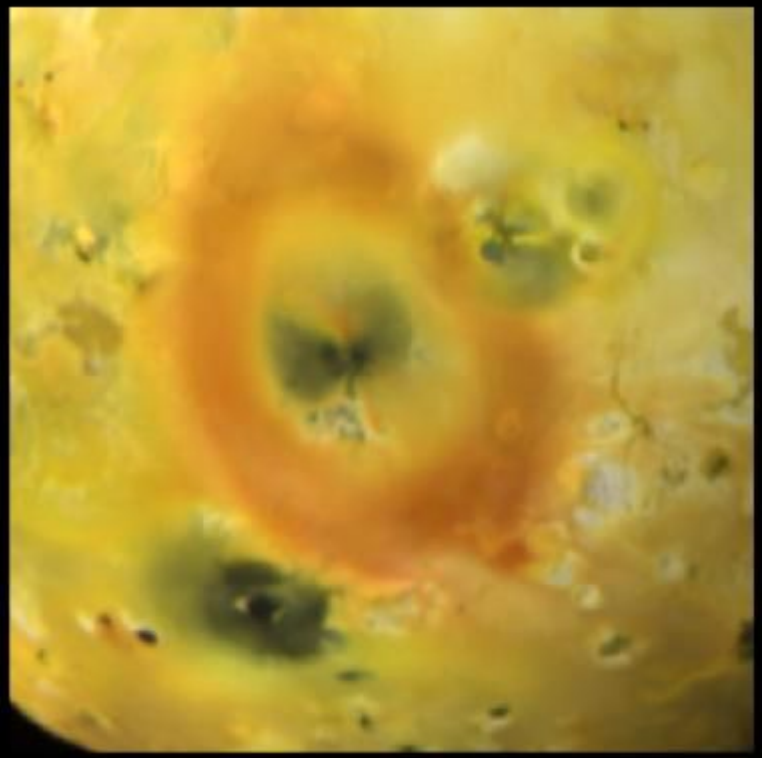


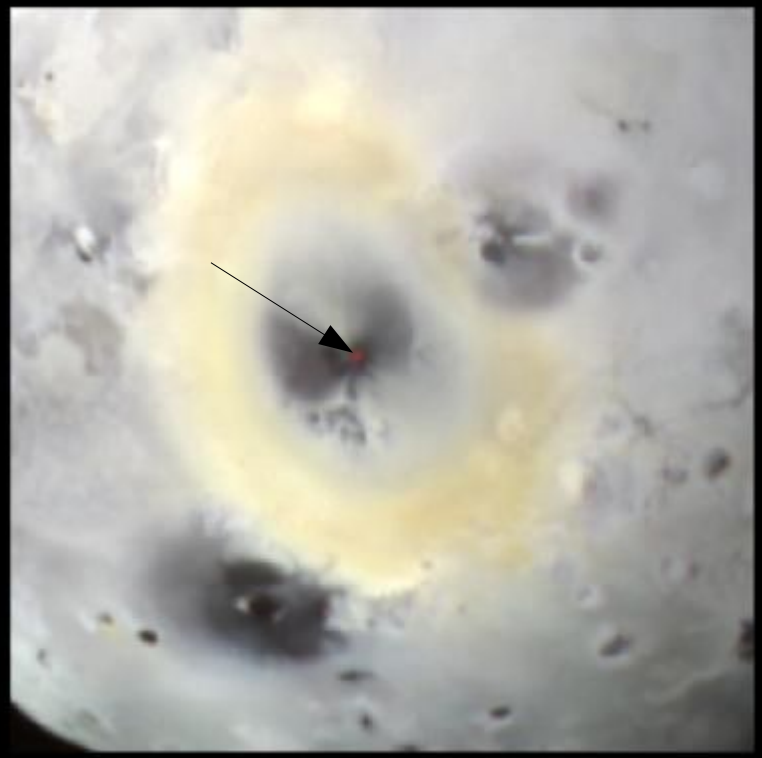
- Introduction:
  - So, you want to know what a patera is...
- Motivation for Observations
- Observations
  - Cassini
    - Flyby, eclipse watcher
  - Galileo
    - Nightside observations
- Conculsions

Introduction: Pele Patera

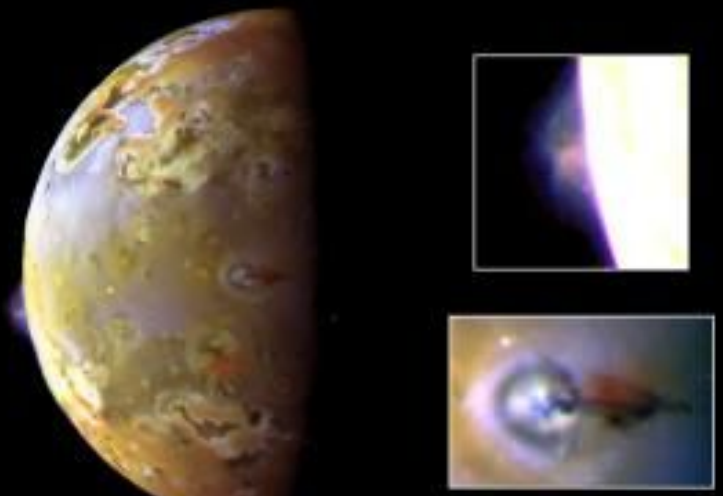
- A long lived, high thermal output, volcanotectonic depression.
- Named after the Hawaiian Goddess of Fire.

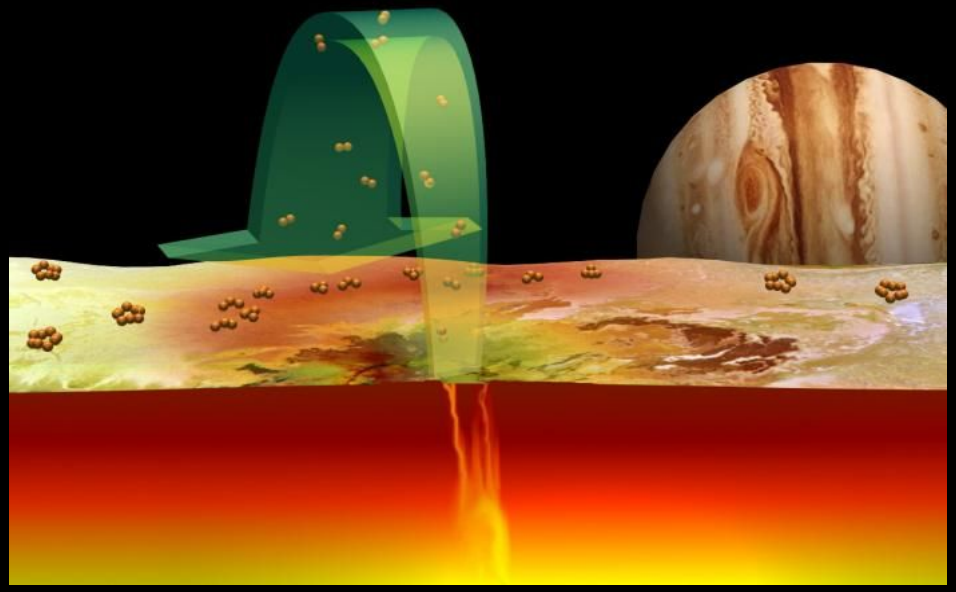
- It is surrounded by a diffuse, 1200 km diameter, red ring of S & SO_2 deposits.





Introduction: Pele Plume

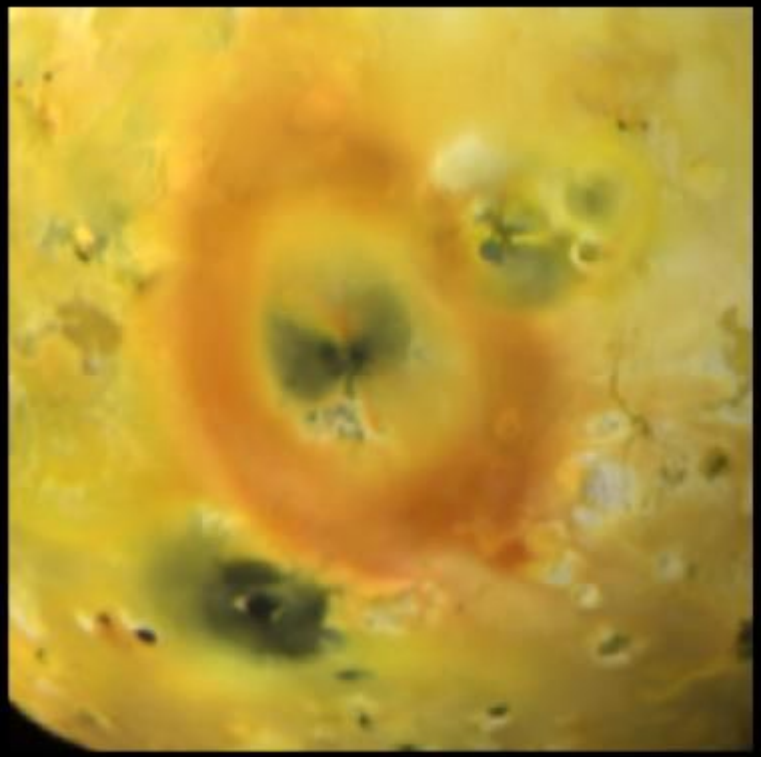


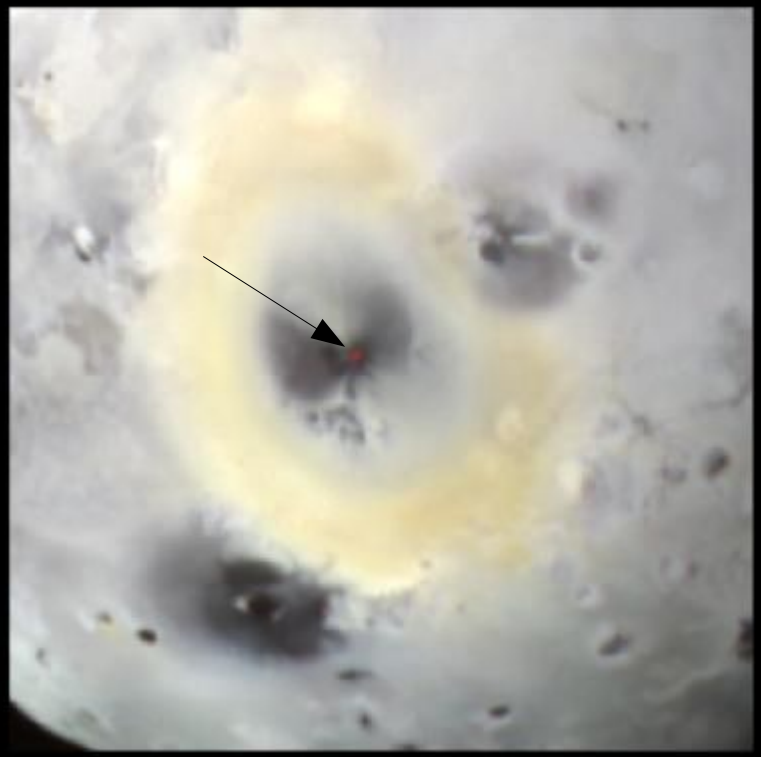


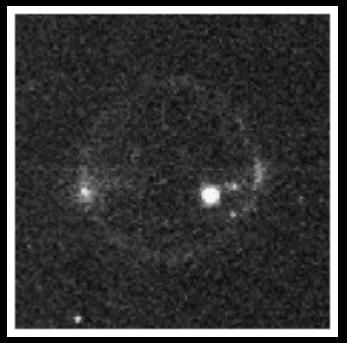
- The red ring is produced by a 300km high, continually erupting plume.
- S_2 is expelled from Io's interior by Pele.
- Molecules land on the frozen surface and combine to make S_3 , $S_4 \Rightarrow$ red
- Finally combine into $S_8 \Rightarrow$ pale yellow

Motivation for Cassini and Galileo Observations

- Need high resolution images and short timescale observations to determine the structure and eruption style of Pele Patera.

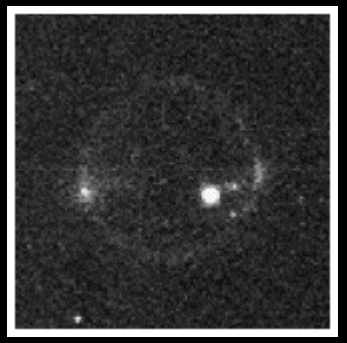






Cassini Flyby Eclipse Observations

- Obtained four sets of images of Io in Jupiter's shadow.
- Monitored, for the first time, the variability of Pele on a timescale of minutes.
- Measured a range of temperatures from 1260K to 1580K; variability increases with emission angle.
- The largest variability, during the first set of observations, was an oscillation from 1300K to 1500K in the last 22 minutes of observations.

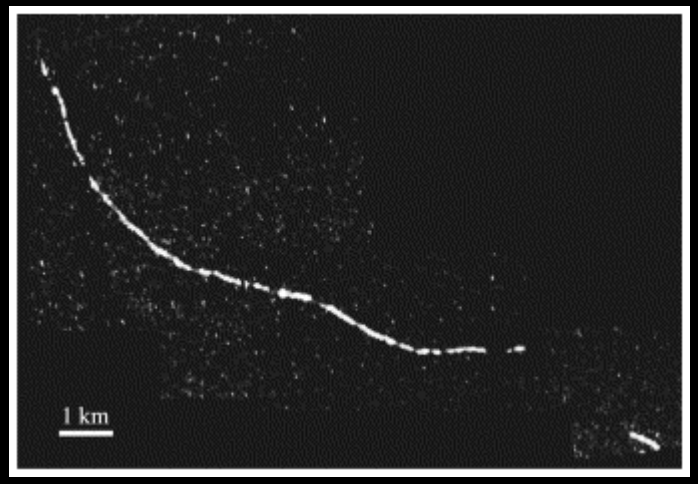


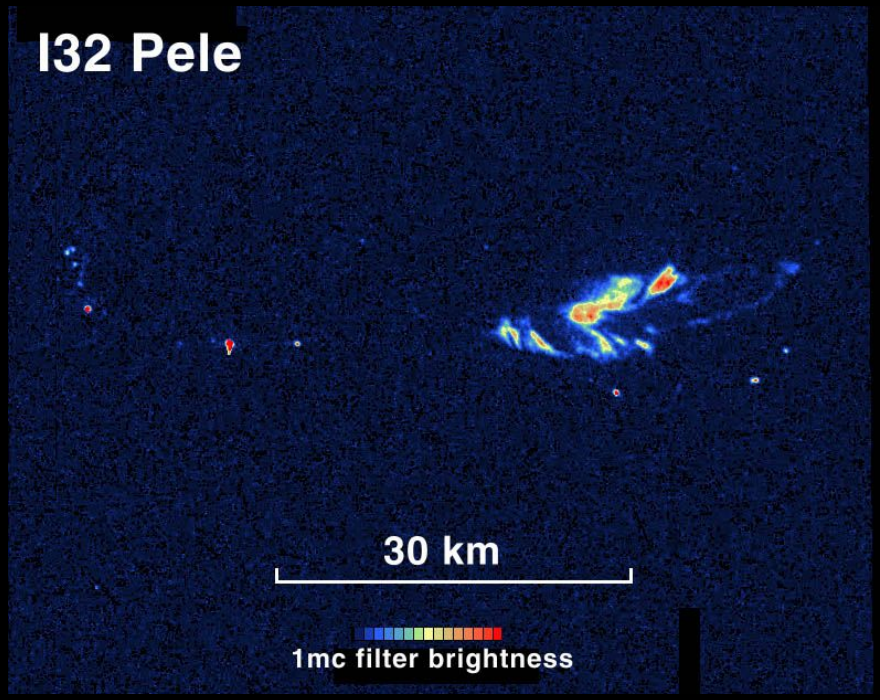
Cassini Flyby Eclipse Observations

- Cassini also measured the overall intensity of Pele.
- The intensity decreased more than expected, with the rotation of Io, if the patera were a flat radiator.

$\Rightarrow$ May indicate that there are walls surrounding the patera.

Galileo Night Side Observations

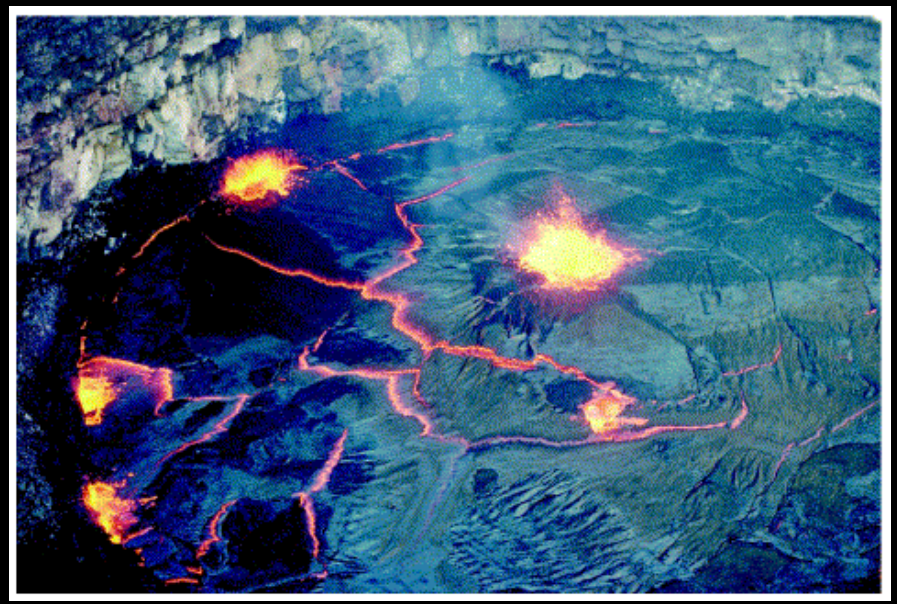




- 60 m/pixel resolution images, coming within 200km of Io's surface.
- Confirmed a chain of small hotspots along the southern rift of the patera.
- Observed a central hopspot within a relatively cool background.
- Hotspots and central region range from 1200K to 1650K, cool background < 800K

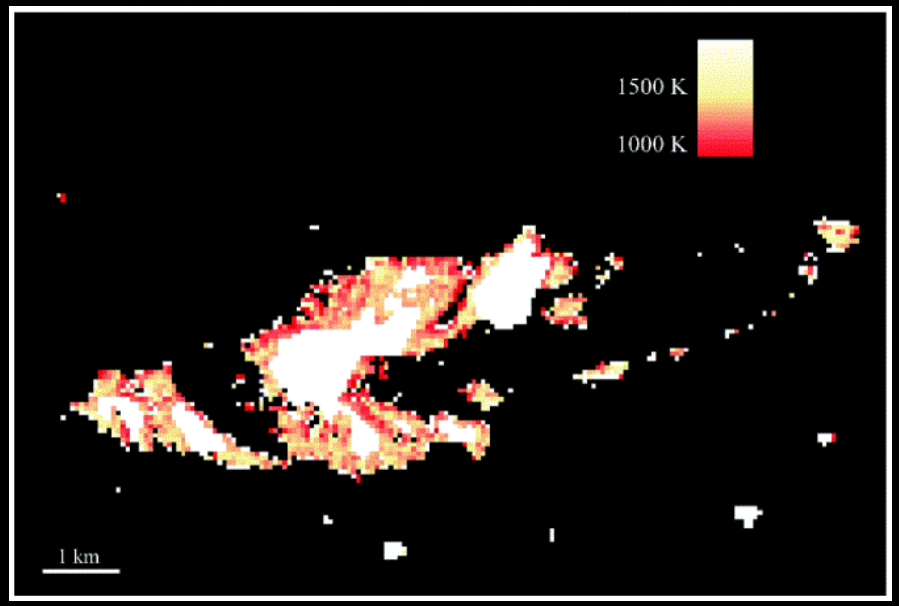
Conclusions form Observations: Pele Patera, Lava Lake

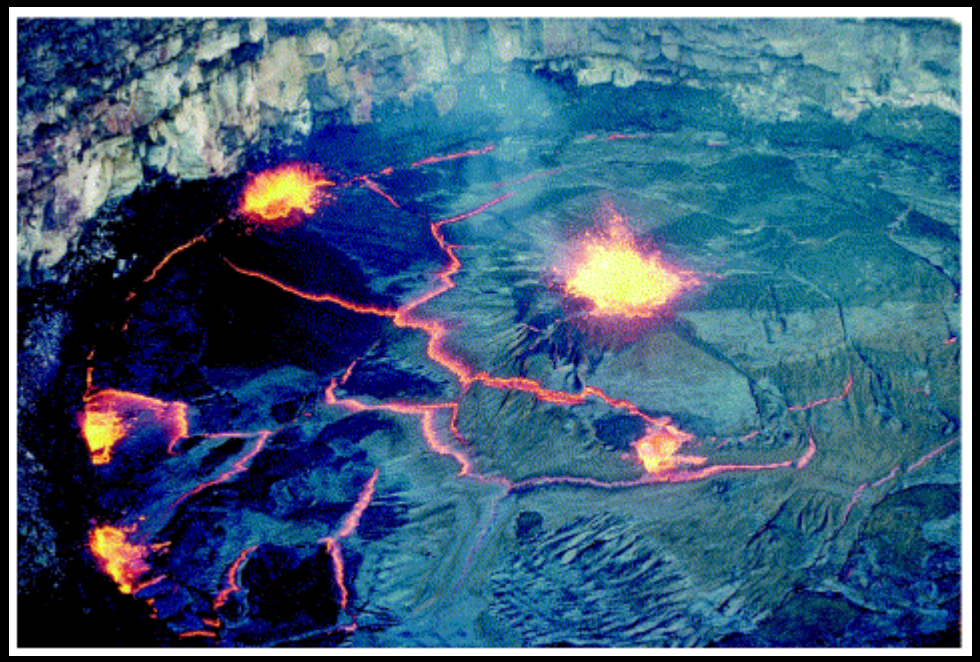
- The patera can be compared to an active lava lake....
  - Cool (< 800K) background = a cooled crust.
  - Southern chain of hotspots = crust breaking up along walls possibily confining the patera.



Erta Ale lava lake, Ethiopia

Pele Patera, Lava Lake





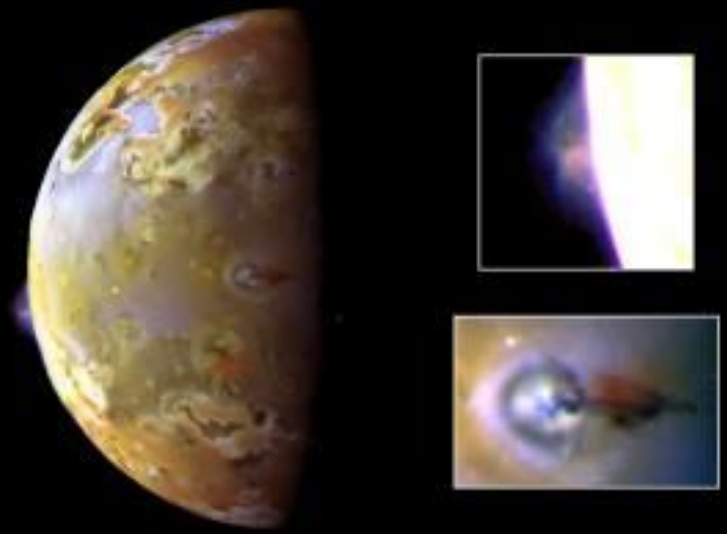
- High temperature, central region = exposed lava due to convection breaking up the crust.

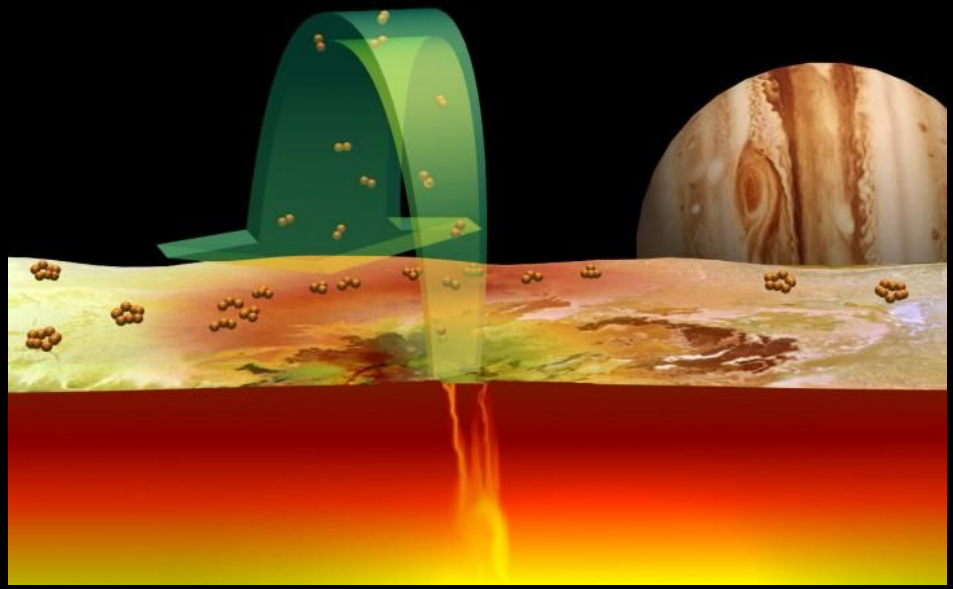
Pele Patera, Lava Lake

- The hot central region = an active lava fountain
- Lava fountains are variable with time
- Explain the increased temperature variability of Pele, as Io rotated away from Cassini.

Lava fountain at Erta Ale

Pele Patera, Lava Lake





- Lava fountains within Pele's patera may be produced by the continually erupting plume of S_2.

Conclusions

- From the high resoultion images of Galileo and the variability observations of Cassini, Pele Patera is thought to be...
  - an active lava lake
  - a cool crust
  - hotspots at the edge,which indicate possible surrounding walls
  - with variable lava fountains possibly produced by Pele's plume.

Refences

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