Determining the Eruption Style of Io's Pele Patera

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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.

⇒ 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 hotspot 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 possibly 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 resolution 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


• http://solarsystem.jpl.gov/planets
• http://solarsystem.jpl.gov/missions
• http://www.solarviews.com/eng/iopele.htm
• http://educeth.ch/stromboli/perm/erta/lava-en.html