ASTR688R Paper Summary

A Summary of:

Observations and temperature of Io's Pele Patera from Cassini and Galileo spacecraft images, by Jani Radebaugh et al., (2003)

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Radebaugh et al., present two new data sets from the latest observations of Pele Patera by Cassini and Galileo. Pele Patera is a long lived, high thermal output volcano-tectonic depression on Jupiter's moon Io that is associated with a large, ~300 km high 'stealth' plume of SO_2. Its most active region is in the southern portion of the patera along a large rift, where a chain of hotspots has been observed.

In December of 2000, during its flyby of Jupiter, "Cassini obtained four sets of multiple-filter images of Io in Jupiter's shadow", monitoring for the first time the variability of Pele on the time scale of minutes, and obtained 61 km/pixel resolution images. From both Cassini and Galileo, Radebaugh et al. were able to obtain two-filter color temperatures of Pele Patera. From Cassini's observations of the variability of Pele, Radebaugh et al. measured a range of temperatures from 1260 to 1580 K (with 1 sigma error bars) with a median of 1300 K. The largest variability was during the first set of observations with an oscillation from 1300 ± 40 to 1500 ± 80 K, in the last 22 minutes of observations as Pele rotated out of view. Also, the overall intensity of Pele decreased with the rotation of Io by a factor of $[\cos(\text{emission angle})]^{1.6}$, while there was no decrease in temperature with rotation. Due to the decrease in intensity by a power of the cosine of the emission angle, Radebaugh et al. determine that the patera is not a perfectly flat radiator.

In October of 2001, "Galileo observed Io and obtained night side images of Pele through two filters" with 60 m/pixel resolution, coming to within 200 km of Io's surface. Galileo, having a high resolution, confirmed a chain of small hotspots along the southern rift of the patera with a large, more central hotspot within a relatively cool background of Pele. The temperatures of the hotspots and central region range from 1270 ± 100 to 1605 ± 220 K and the cool background temperature was <800 K.

From these observations Radebaugh et al. conclude that Pele Patera is an active lava lake, which has a cooled crust due to the cool background found and that the southern chain of hotspots is the crust breaking up against walls possibly confining the patera. The large central region may be exposed lava due to convection disrupting the cool surface. They also hypothesize that the increased temperature variability of Pele as Io rotates is due to lava fountains that are time variable and therefore appear more erratic as the emission angle increases. These fountains could be produced by the plume of SO_2 continually erupting near Pele. Lastly, Radebaugh et al. also speculate the lava at Pele Patera is basaltic but that limitations in determining the lava temperature cannot rule out ultramafic compositions.