

## Lava Lakes in Io's Paterae

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New Galileo images and Galileo and Cassini temperature data lend credence to previous proposals that some of the paterae on Io contain lava lakes, similar in some ways to those observed on Earth. Galileo's October 2001 I32 flyby produced spectacular new high resolution observations of Io's paterae, their margins, and floors. Images reveal where lavas have filled Emakong Patera and overtopped its margins. Landslides from the peaks of Tohil Mons are not present on the adjacent floor of a dark patera, perhaps because they have slumped into a molten lava pit. Dark lavas have filled and drained back from colorful Tupan Patera, leaving a ring of material on its walls. This patera also shows evidence of interaction between molten sulfur and silicate lavas, a relationship observed at the terrestrial Poas Volcano (Francis et al., 1980, *Nature* 283, 754-756; Oppenheimer and Stevenson, 1990, *La Recherche* 21,1088-1090). The extremely uniformly dark materials in many other paterae could also be lava lakes.

Pele Volcano on Io, in particular, has previously been considered a lava lake based on several characteristics (Davies et al., 2001, *JGR* 106,33,079-33,103). Recent analyses of eclipse images of Pele from Cassini reveal average temperatures of 1375 K, with variations on short (~10 minute) timescales, consistent with active fountaining in a lava lake. Similar oscillations around high temperatures over these time scales are seen in terrestrial lava lakes, such as at Kupaianaha (Flynn et al., *GRL*, 19,6461-6476, 1993) and Erta Ale (see Figure 1; Bessard, Caillet and others, in progress). Nightside high resolution (60 m/pixel) images from Galileo I32 reveal a region of overturning and convection, with some areas reaching in excess of 1800 K, verifying very high-temperature components identified in high-resolution NIMS data (Lopes et al., 2001, *JGR*, 106, 33,053-33,078). This region is ringed with small hotspots, comparable to locations of breakup and fountaining at the margins of many terrestrial lava lakes.

The presence of giant lava lakes within these large paterae (up to 200 km diameter) has implications for the transfer of internal heat to the surface, as the paterae require direct links to comparably large, well supplied magma chambers (Harris et al., 1999, *JGR*, 104, 7117-7136) in order to maintain their vigorous activity over the observed timescales of tens of years. In addition, if much of Io's heat flow is restricted to these large lava lakes, then Io's resurfacing may be extremely spatially confined.



Figure 1. Erta Ale lava lake, Ethiopia