GROUND-BASED OBSERVATIONS OF IO IN SUPPORT OF THE NEW HORIZONS FLYBY. J. A. Rathbun[1] and J. R. Spencer[2], [1]University of Redlands (1200 East Colton Ave., Redlands CA 92373, USA *jullie_rathbun@redlands.edu*), [2]Southwest Research Institute (1050 Walnut St., Suite 400, Boulder, CO 80302, USA).

Introduction: Io is the most volcanically active body in the solar system, often with hundreds of volcanoes active at one time. This activity has been observed using ground-based telescopes for approximately three decades (Spener et al., 1990).

The New Horizons spacecraft flew by Jupiter on February 28, 2007 and took many observations of Io on its way through the system. In order to help put those observations in temporal context, we began observing Io from the Infrared Telescope Facility (IRTF) in Hawaii during August 2006. Because of solar conjunction, we were unable to observe Io from October through December. We resumed observations in early January 2007 and continued through June 2007 with the highest concentration of observations nearest the flyby.

Observations: Our observations took place on 21 nights and can be generally classified into three types: sunlit imaging, eclipse imaging, and occultation light-curves. The sunlit images can be taken at almost any time, giving broad longitude coverage, and were obtained at 2.2, 3.5, and 4.8 microns. The eclipse images can only be taken of the Jupiter-facing hemisphere and were also obtained at 2.2, 3.5, and 4.8 microns. The occultation light-curves are obtained while Io is in eclipse and at 3.5 microns. They can be used to measure the brightness and location of individual volcanoes on the Jupiter-facing hemisphere.

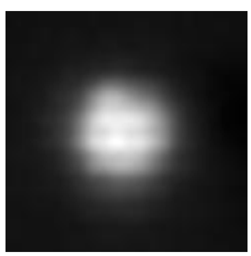

Figure 3: 3.5 micron image of Io from January 18, 2007 using the shift-and-add technique. Tvashtar was at the upper left near the limb when this image was taken, consistent with the apparent hot spot in the image.

Sunlit images: At the mid-infrared wavelengths used for our observations, reflected sunlight swamps out all but the brightest eruptions in our relatively low-resolution images. We employed a shift-and-add technique to increase the resolution of the images. We obtained many short exposure images (0.06 s) at 3.5 microns to lessen the effects of atmospheric blurring. We then chose the best images, shifted their positions to line up and added them together. Of the 7 sunlit shift-and-add images obtained, 3 showed evidence of a hotspot (Fig. 1), all with a location consistent with Tvashtar, which was the brightest hotspot seen by New Horizons during its flyby. The observations of Tvashtar were taken January 18th, January 23rd, and January 27th, 2007.

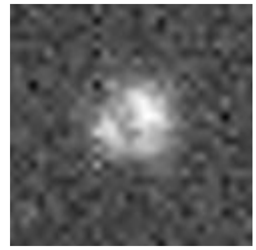

Figure 1: 3.5 micron observation of Io in eclipse from August 15, 2006.

Eclipse images: Observing Io in eclipse eliminates the contribution of reflected sunlight, but only the Jupiter-facing hemisphere can be viewed. We observed Io in eclipse on 8 nights. Seeing (and, therefore, resolution) varies over the nights, but on some nights at least three distinct volcanoes can be discriminated (figure 2).

Occultation light-curves: As Io disappears behind or reappears from behind Jupiter, individual volcanoes are revealed one at a time (figure 3). Generally the brightest volcano observed in a light-curve has been Loki (Rathbun et al., 2002) at an occultation phase near 0.8. We determined that Loki's brightness at each occultation event was very faint (< 20 GW/micron/str). The occultation data taken closest to the New Horizons flyby (2/20/2007) show no other obvious discrete hotspots, suggesting minimal and broadly distributed volcanic activity on the Jupiter facing hemisphere during the flyby. At least 3 other

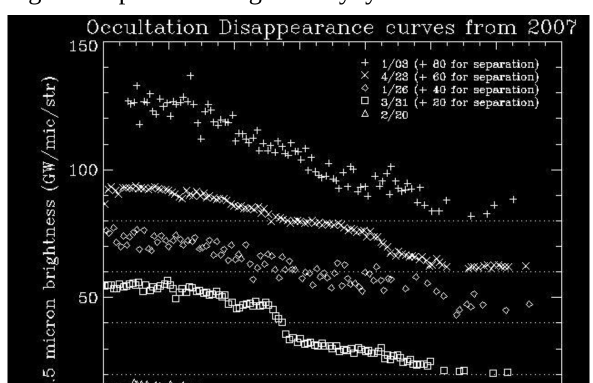

Figure 2: Occultation disappearance light-curves from 2007. Steps in the curve indicate a volcano disappearing behind Jupiter. Occultation Phase is defined to be zero when Io first touches Jupiter's limb, and 1.0 when Io has completely disappeared.

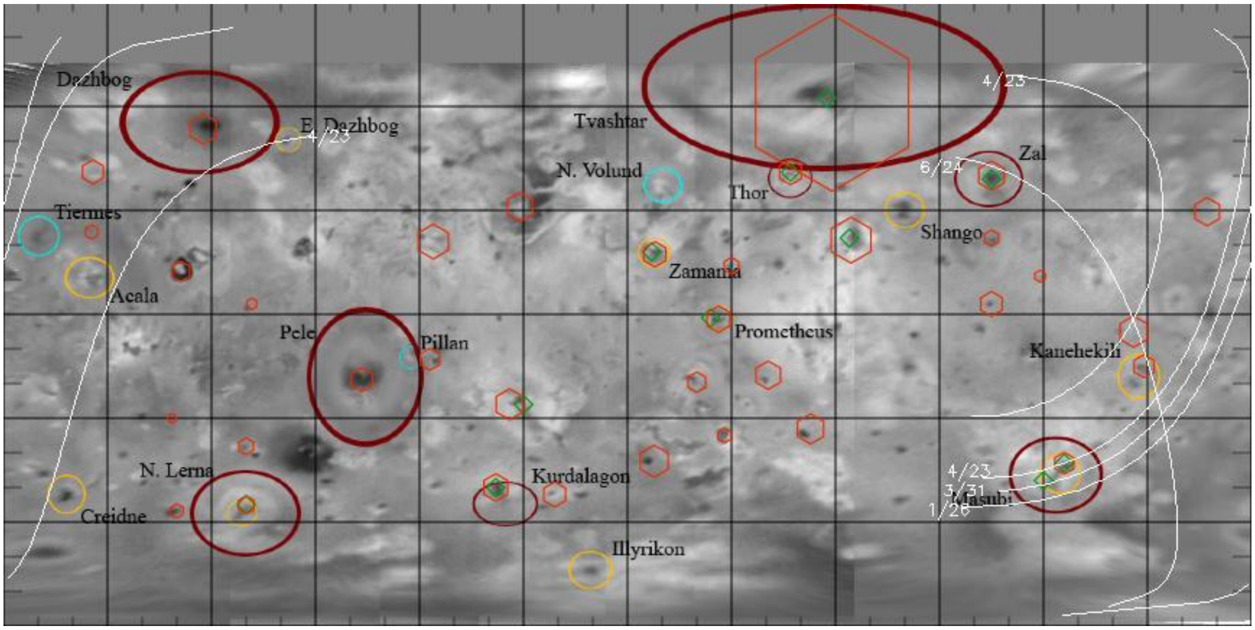

Figure 4: Simple cylindrical projection of Io showing locations of Jupiter's limb during bright events observed in the occultation curves as well as summarizing New Horizons observations. The dates of the occultation curves are marked next to the accompanying line.

hotspots were observed in the 5 occultations observed in early 2007. From the time at which the hotspot is observed, we can determine a line on Io, on which the hotspot must lie. Figure 4 shows the locations of Jupiter's limb on Io at these times overlaid on an image of Io summarizing the New Horizons observations (Spencer et al., 2007). In the background images, orange hexagons indicate locations of hotspots detected by the LEISA instrument. Based on the intersection of the occultation lines with these New Horizons detections, we likely saw activity at the volcanoes Masubi, Kanehekili, and Dazhbog.

Discussion: We observed Tvashtar in every sunlit observation where it would be visible, suggesting that it was continuously active for more than a month prior to the New Horizons flyby. In the eclipse images and occultation curves, we observed at least four hotspots, likely located at the volcanoes Dazhbog, Kanehekili, Loki, and Masubi. We will measure the brightness of each of these volcanoes and determine if it varies with time or if any variation is due to viewing geometry and can thus be used to constrain eruption type. We will also compare our measured brightnesses to those measured by the New Horizons spacecraft.

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