NEW HORIZONS OBSERVATIONS OF IO'S VOLCANISM. J. R. Spencer[1], S. A. Stern[2], J. Moore[3], R. M. C. Lopes[4], K. Retherford[5], O. Abramov[5], M. Showalter[6], A. F. Cheng[2], H. A. Weaver[7], D. C. Reuter[8], A. Lunsford[8], C. Olkin[5], H. Throop[5], K. L. Jessup[5], [1]Southwest Research Institute, 1050 Walnut St., Suite 300, Boulder, CO (spencer@boulder.swri.edu), [2]NASA Headquarters, [3]NASA Ames Research Center, [4]Jet Propulsion Laboratory, [5]Southwest Research Institute, [6]SETI Institute, [7]Applied Physics Laboratory, [8]NASA Goddard Spaceflight Center.

Introduction: The New Horizons spacecraft flew past Jupiter on February 28th 2007 en route to its primary destination, the Pluto system. In addition to obtaining a gravity assist from Jupiter and taking calibration data, the spacecraft was able to conduct an extensive series of observations of the Jupiter system. Because New Horizons' closest approach distance to Jupiter, 2.3 million km, was about four times closer that that of Cassini, its data rate was much greater than that of Galileo, and it carried a suite of instruments with unique capabilities, the spacecraft was able to provide much new information about the Jupiter system.

A prime target for New Horizons was Io, which was observed with multiple instruments in 39 separate sets of observations. The observations were designed to inventory changes in Io's surface and plume activity since the last Galileo images in 2001, measure high-temperature thermal emission from Io's hot spots to constrain surface temperatures, and to study Io's auroral emissions in sunlight and Jupiter eclipse.

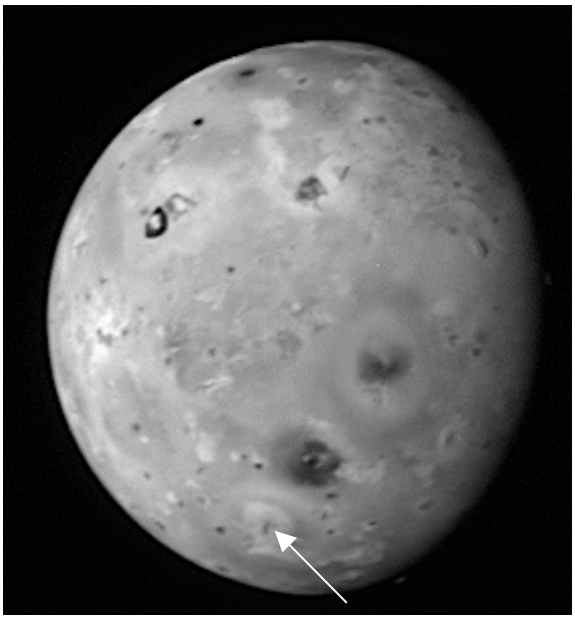

Figure 1 *LORRI image of the Jupiter-facing hemisphere of Io showing pyroclastic deposts from a new eruption at Lerna Regio (arrowed). Image taken on February 27th 2007.*

Surface Changes: New Horizons imaged all of Io's surface using its panchromatic Long-Range Reconnaisance Imager (LORRI) [1] with a resolution between 12 and 20 km/pixel, and also imaged the night side in four colors with the Multicolor Visible Imaging Camera (MVIC) [2] at a resolution of about 50 km/pixel. Many local surface changes were apparent in the more than five years since the last Galileo observations [3]. The most striking was a new 400-km diameter ring of pyroclastic deposits (Fig. 1) from a previously unknown volcanic center at Lerna Regio, near 60 S, 280 W. The 1300 km diameter pyroclastic ring from the Tvashtar volcano, centered near 60 N, 130 W, which formed towards the end of the Galileo mission, was still present.

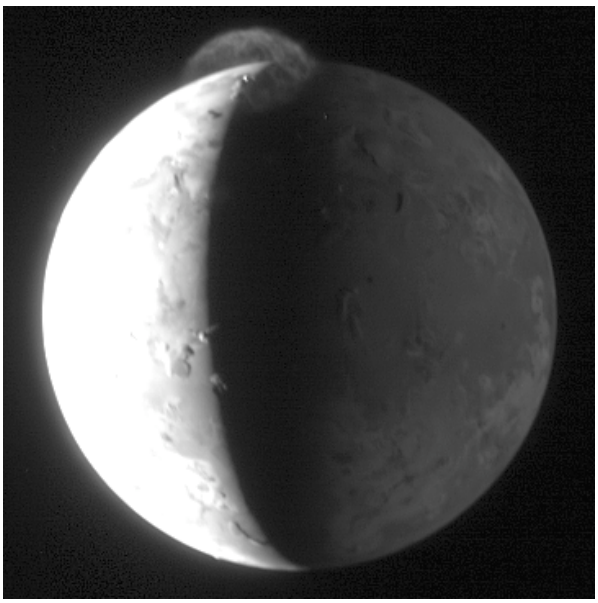

Figure 2 *The Tvashtar plume and central hot spot (near the terminator), observed by LORRI on February 28 2007. The night side of Io is illuminated by Jupiter.*

Plumes: New Horizons observed many active volcanic plumes on Io. Some, such as Prometheus and Masubi, have been active since the 1979 Voyager flybys, but several new plumes were also detected, including one from the Lerna Regio eruption. By far the most striking plume was from the Tvashtar volcano. A large, Pele-type [4] plume was seen by the Cassini spacecraft in 2000, at low spatial resolution at ultravio-

let wavelengths, but Galileo saw only the plume deposits, not the plume itself, due to its limited temporal coverage of Io. The New Horizons-era plume was first imaged by the Hubble Space Telescope on February 14th 2007, and was then seen in almost all New Horizons observations between February 24th and March 3rd 2007. The plume height (about 330 km) was roughly constant through the encounter. The plume showed complex filamentary structure (Fig. 2) similar to that first seen by Voyager 1 in the Pele plume, which had similar size and shape, though the structure was seen much more clearly in the New Horizons images. This structure varied dramatically on short timescales, revealing the motion of the plume particles in images taken a few minutes apart.

Hot Spots: Thermal emission from numerous volcanic hot spots was seen on Io's night side and during Jupiter eclipse, using LORRI, MVIC, and New Horizons' 1.2 – 2.5 micron Linear Etalon Imaging Spectral Array (LEISA) [2]. The Tvashtar hot spot was by far the brightest and could be seen even in daylight near the terminator by LORRI (Fig. 2). Combined thermal emission measurements of Tvashtar from 0.6 to 2.5 microns will provide valuable constraints on eruption temperatures. Another bright hot spot, near 20 N, 230 W, is from a previously-unknown volcano and showed no surface changes since Galileo observations in daytime images, possibly indicating that this is a relatively recent eruption.

Implications for Future Exploration: The New Horizons observations of Io, particularly those of the Tvashtar eruption which was unlike anything observed by Galileo during six years in Jupiter orbit, highlight the importance of good temporal coverage - something that Galileo was unable to provide - in exploring the full range of phenomena that Io can exhibit. It is likely that even more dramatic phenomena occur occasionally and have been missed by all spacecraft observations so far. Future Jupiter missions which place a high priority on good temporal coverage of Io (even at moderate spatial resolution) will generate major discoveries that will greatly increase our understanding of this remarkable world.

References: [1] Cheng, A., et al. (2007) *Space Science Reviews,* in press. [2] Reuter, D. C. et al. (2007) *Space Science Reviews,* in press. [3] Geissler, P. E. et al. (2004) *Icarus, 169,* 29-641. [4] McEwen, A. S. and L. Soderblom (1983) *Icarus, 55,* 191-217.