

## JunoCam images at PJ60: Io

**John Rogers (BAA) (2024 June 30)**

*Perijove-60 was on 2024 April 9. The first part of this report, with Figures 1-3, was posted on May 3. Since then, Gerald Eichstädt has made map projections of the Io images, which are here assembled into preliminary global maps of the volcanic moon, for PJ60 and for all of Juno's recent flybys. Thus we present the most complete JunoCam map of Io, and show the dramatic effects of the huge eruption of the Nusku volcano, which occurred between PJ58 and PJ60.*

On all the even-numbered orbits for the rest of this year, Juno will fly past the southern hemisphere of Io about 4 hours before perijove, at ever-increasing distances. The PJ60 flyby, on 2024 April 9, was the first of these. Although the closest approach to Io was 16932 km (eleven times further than at PJ58), the resolution was good enough to reveal a wealth of detail. These views revealed more volcanic activity than JunoCam has hitherto seen, mainly in the southern hemisphere: four active plumes on the limb, changes since the Voyager and Galileo maps, and a spectacular new red ring around a far-southerly caldera.

The source volcanoes of the plumes have been identified by Jason Perry as Volund, Prometheus, Seth, and Mixcoatl [141°W, 46°S]\*. He notes that Seth [132°W, 5°S], source of the biggest and brightest plume, has been experiencing an intense eruption with a new flow field since late 2022. In contrast, Volund and Prometheus have been erupting since the Voyager 1 flyby in 1979, and both were also imaged at PJ55 (although the Volund plume was misidentified as Zamama in our PJ55 report). Jason Perry identifies the big red ring as a deposit from Nusku [4°W, 65°S], which must have undergone a very large eruption recently.

Figure 1 shows rough assemblies of raw images, brightened to show the plumes. Figure 2 (in opposite orientation) shows some of the best images with key features marked, including image 54 which was a long exposure to show the jove-lit dark side, revealing the red ring. Figure 3 aligns these with the NASA Voyager/Galileo south polar map. Although many apparent differences are presumably due to the differences in lighting and viewing angles, many others are real changes. Both may be apparent in Lerna Regio, which shows an apparent reversal in contrast, and was the site of a plume seen at PJ58. (This plume, at 290°W, 55°S, is now named Xihe according to the USGS.)

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Now we have produced global cylindrical maps from these images, for PJ60 (Figure 4) and for Juno's best four flybys (Figure 5), showing both the sunlit side (longitudes ~150 to 320/335) and the jove-lit dark side (longitudes ~320/335 to 80/90). Figure 5 combines the PJ60 map with the composite map posted in our PJ58 report, and is our first version of a full JunoCam map of Io. As Juno's orbit will pass further from Io in future, these will remain the best views of Io from JunoCam. The projections are preliminary and positions could be out by several degrees, as some adjustment was needed to align the various maps; the USGS Voyager/ Galileo map was used as reference.

Nevertheless, there is a dramatic real difference between the PJ58 map (in our PJ58 report, q.v.) and the PJ60 map (herein), on the jove-lit side. They reveal that the colossal eruption at Nusku took place between those two perijoves and eliminated most of the detail within its giant red ring! Pale deposits may have extended broadly outside it as well, causing the contrast reversal of Mbali and other volcanic centres just north of the ring, unless this is merely an effect of the different viewing angles. The diameter of the red ring is ~1100 km, which is typical for such rings around volcanoes such as Pele, Tvashtar or Surt, as seen during the Galileo mission. The red colour in the ring is almost certainly due to sulphur from the eruption.

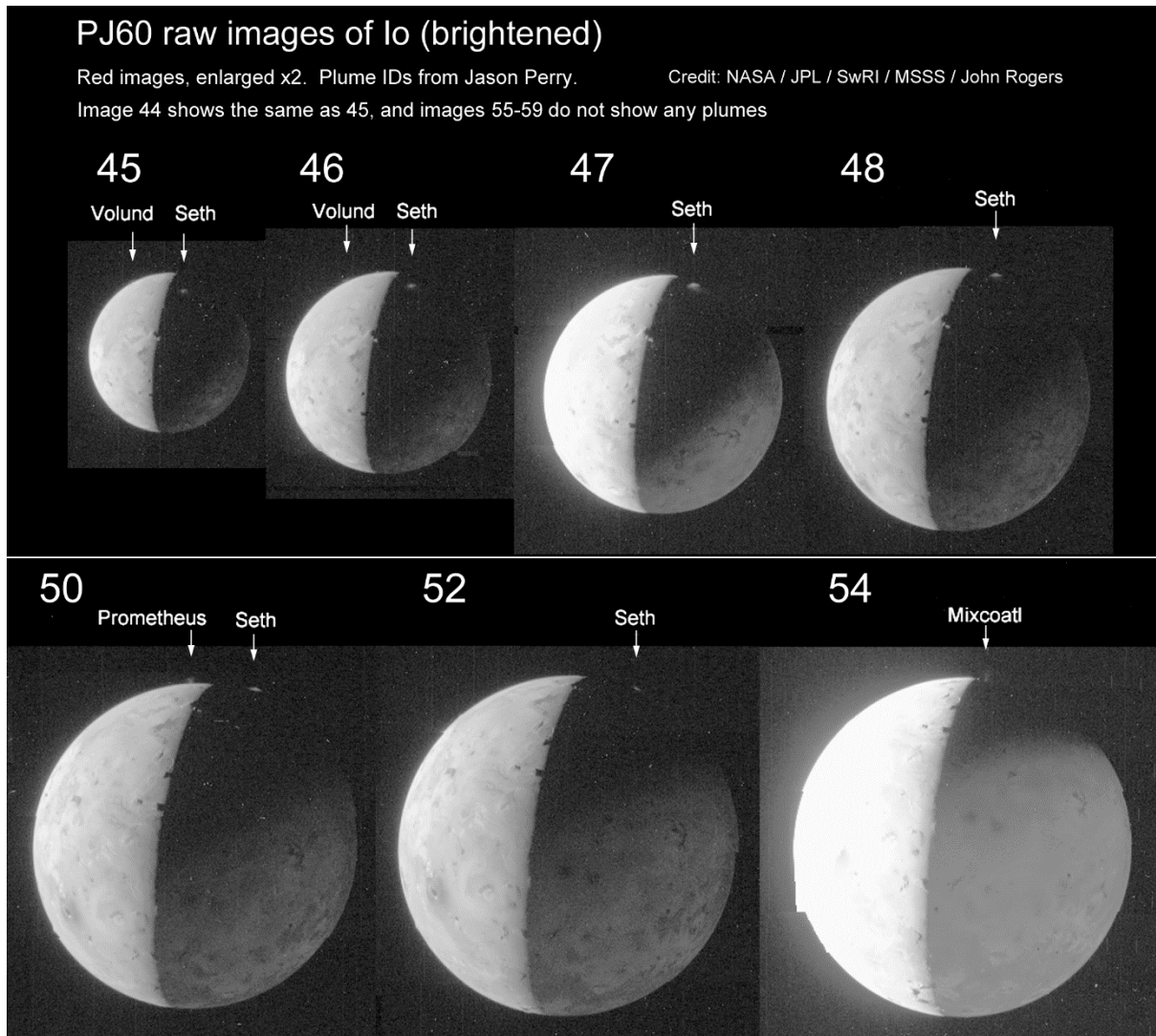
Nusku, which is named after an Assyrian fire god, was previously little-known. It has never been imaged at high resolution, but the dark spot at the centre of the ring is likely to include its caldera.

Tantalisingly, the PJ60 map shows a small red spot inside this dark spot. As it was imaged on the dark side, one might wonder whether this was still-glowing lava. However, this red spot is due to a single bright dot in image 54, much like other single-colour dots in these images, which are caused by random radiation hits. So its location is probably a coincidence.

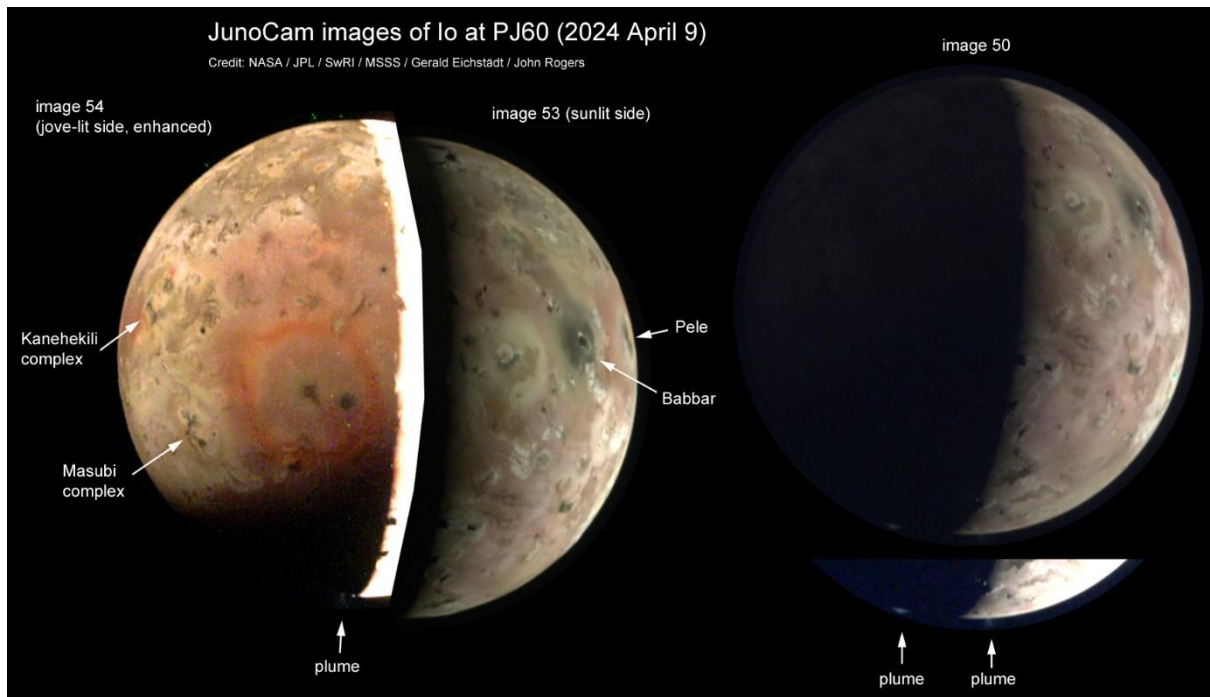
\*The latest list of features on Io, from the US Geological Survey, is at <https://planetarynames.wr.usgs.gov/Page/IO/target>

Volcanoes on Io are named according to gods of volcanoes, fire, lightning, or the Sun. Strictly speaking, the name alone represents an active volcanic plume; with suffix 'Patera' it denotes a caldera, and with suffix 'Fluctus' it denotes a lava flow field. For simplicity, we omit the suffixes in our accounts.

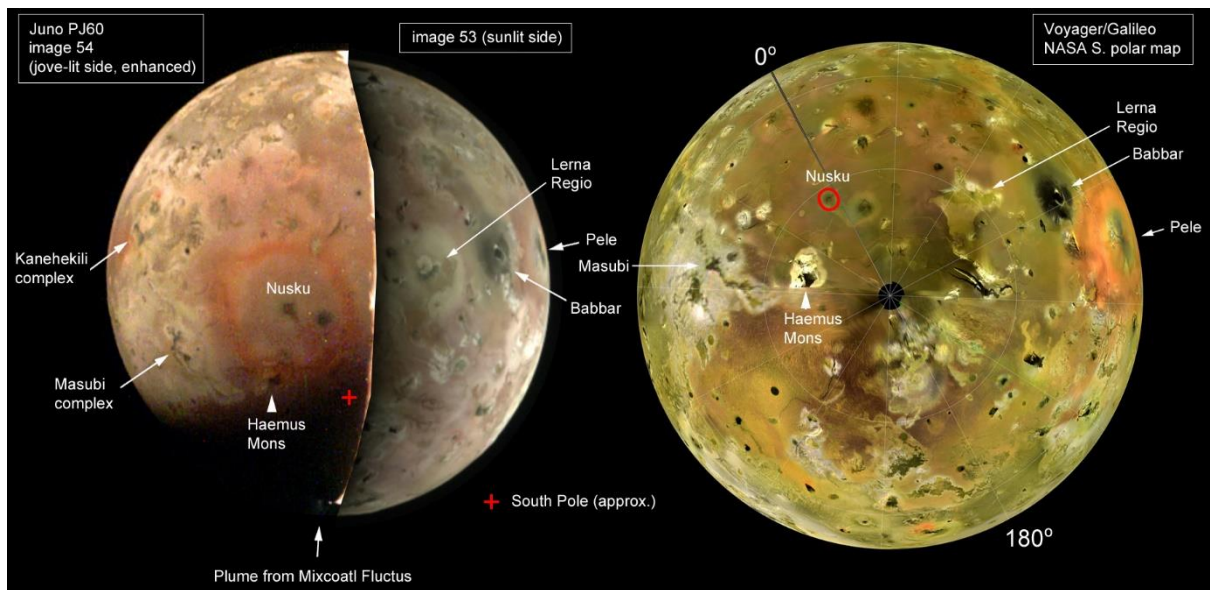
**Figure 1:**



**Figure 2:**

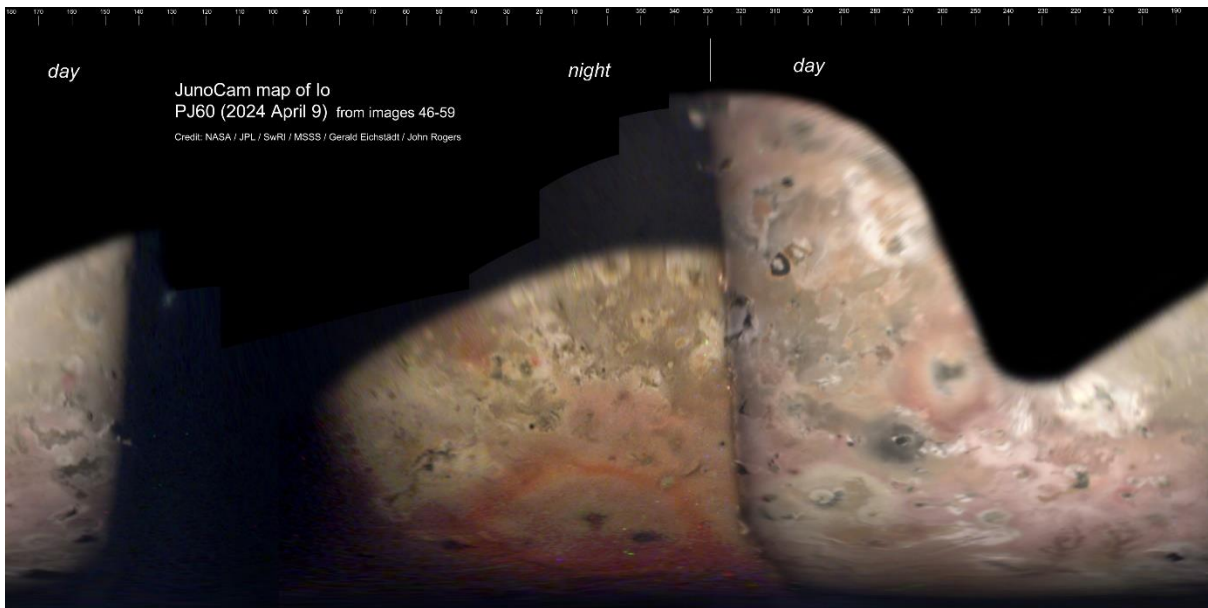


**Figure 3:**

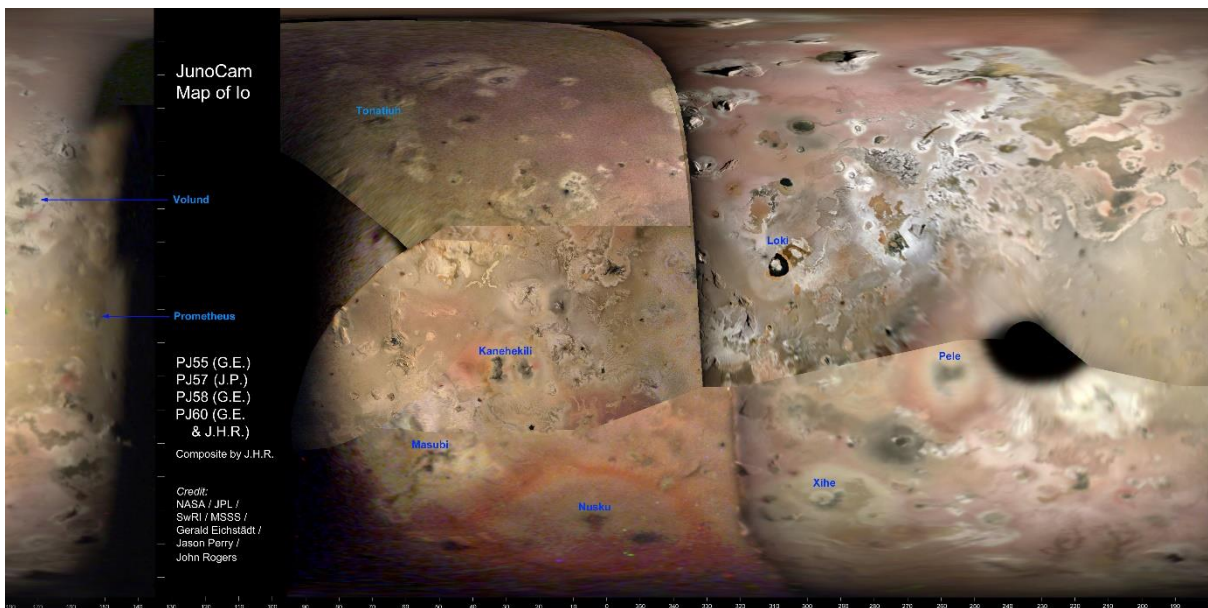




**Figure 4:**



**Figure 5:**



Volcanoes whose eruptions have been observed by JunoCam are named, as well as the famous volcanoes Pele and Loki. An unlabelled version of this map is in the attached ZIP file. For a map with other features labelled, see PJ58 Fig.2.