

Appendix 1: Io's hot spots

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Detections of plumes and hot spots by *Galileo*, *Voyager*, HST, and ground-based observations.

Notes and sources

- (N) NICMOS hot spots detected by Goguen *et al.* (1998).
- (D) Hot spots detected by C. Dumas *et al.* in 1997 and/or 1998 (pers. commun.).
- Keck are hot spots detected by de Pater *et al.* (2004) and Marchis *et al.* (2001) from the Keck telescope using Adaptive Optics.
- (V, G, C) indicate *Voyager*, *Galileo*, or *Cassini* detection. Other ground-based hot spots detected by Spencer *et al.* (1997a).
- *Galileo* PPR detections from Spencer *et al.* (2000) and Rathbun *et al.* (2004).
- *Galileo* SSI detections of hot spots, plumes, and surface changes from McEwen *et al.* (1998, 2000), Geissler *et al.* (1999, 2004), Kezthelyi *et al.* (2001), and Turtle *et al.* (2004).
- *Galileo* NIMS detections prior to orbit C30 from Lopes-Gautier *et al.* (1997, 1999, 2000), Lopes *et al.* (2001, 2004), and Williams *et al.* (2004).
- Locations of surface features are approximate center of caldera or feature.

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Table A.1. Active volcanic centers on Io.

Volcanic center	Location of candidate surface feature, if known	Detected by <i>Galileo</i> SSI?	Detected by <i>Galileo</i> NIMS?	Detected by <i>Galileo</i> PPR?	Detected by <i>Voyager</i> IRIS?	Detected from ground or HST NICMOS?	Plume detected? (<i>Galileo</i> = G <i>Voyager</i> = V <i>Cassini</i> = C)	Surface change detected?	Notes
Ruwa Patera	0.5N, 2.7W	Yes	No	No	No	9812A?	No	No	Faint hot spot detected by SSI in several orbits
Nusku Patera	64.4S, 4.9W	No	No	No	Yes?	Keck (12/2001)	No	No	Detected from Keck (<i>de Pater et al.</i> , 2004)
Mbali Patera	31.4S, 6.8W	No	No	No	Yes		No	No	Red deposits
Unnamed (Keck "N")		No	No	No	No	1±1S, 9±1W	No	No	<i>de Pater et al.</i> (2004). Possibly part of Karei Complex
Unnamed (Keck "S")	11S, 11W	Yes (11S, 11W)	No	No	No	15±1S, 10±1W	No	No	Detected by SSI in C21 and from Keck (12/2001, <i>de Pater et al.</i> , 2004)
Unnamed	2.8S, 13.3W	Yes	No	No	No		No	No	Detected by SSI in several orbits
Unnamed (Keck "U")		No	No	No	No	31±1N, 14±1W	No	No	Detected from Keck (12/2001; <i>de Pater et al.</i> , 2004)
Unnamed	11.5S, 14W	Yes	No	No	No	9606C? 9906A?	No	No	Detected by SSI in several orbits
Karei Patera	2N, 16W	Yes	No	No	No	9608A? 9812A?	No	No	Detected by SSI in G8
Unnamed	6S, 19W	Yes	No	No	No		No	No	Detected by SSI in several orbits
Unnamed	1N, 21W	Yes	No	No	No		No	No	Detected by SSI in several orbits
Unnamed	1S, 23W	Yes	No	No	No		No	No	Detected by SSI in several orbits
Unnamed	5N, 23W	Yes	No	No	No		No	No	Detected by SSI in G8
Uta Patera	35.3S, 24.5W	No	No	No	Yes?	9606C? NICMOS 15? Keck (12/2001)	No	No	Very low albedo Repeated ground-based detections (07/1998 and 12/2001 from Keck, also detected by C. Dumas)
Unnamed	9S, 27W	Maybe	7±3S, 34±3W	No	No		No	No	Faint hot spot in SSI G8, C10, and E15. Detected by NIMS in C30
Unnamed	16.5S, 27.9W	Yes	No	No	No	9606C?	No	No	Detected by SSI in several orbits
Unnamed (N. Polar)	69N, 30W	No	No	No	No	9610A?	No	Yes	N. Polar changes seen by SSI, unclear if location consistent with ground-detected hot spot. Error on ground-observed hot spot ~15 degrees
Kanehekili N and S	16S, 38W	14.5S, 33.4W 17.2S, 35.5W	12±10S, 34±4W	No	No	Numerous ground-based detections N5, Keck (12/2001)	G	Yes	Detected numerous times from the ground and by NIMS. Two active areas (N and S) detected by SSI.

Unnamed (Keck "W")		No	No	No	No	46±1N, 41±3W	No	No	Detected from Keck (12/2001, de Pater <i>et al.</i> , 2004)
Janus Patera	3S, 42.5W	Yes	2±3S, 39±3W	No	No	9606A?, N2, D, Keck (12/2001)	No	No	Detected several times from the ground (including by Keck on 12/2001). Detected by NIMS and SSI in several orbits. NIMS C30 data suggests two hot spots, second at 7±3S, 34±3W
Unnamed (Keck "V")		No	No	No	No	34±1N, 51±4W	No	No	Detected from Keck (12/2001, de Pater <i>et al.</i> , 2004)
Unnamed	11N, 59W	Yes	No	No	No	990930B?	No	No	Detected by SSI in one orbit (C10)
Masubi	48S, 60W	Yes	45±2S, 56±2W	No	No	9808A?, Keck (12/2001)	V, G	Yes	New plume deposits, hot spot detected by SSI and NIMS in E11, I31. Hot spot detected by J. Spencer on 98/08/29 (faded by 98/08/31). Detected from Keck on 12/2001
Unnamed	60±15N, 60±15W	No	No	No	No	002A, NICMOS 14?	No	No	Detected by J. Spencer and R. Howell at 60±15N, 60±15W
Shamshu	9.8S, 63.6W	No	10±4S, 67±4W	No	No		No	No	
Unnamed (NIMS C30A, "Tejeto")	48.9S, 69.4W	No	49±1S, 68±1W	No	No	9808A? 9509A?	No	No	Possible site of outburst detected on 99/08/02 by R. Howell. Detected by NIMS in orbit C30, I31, I32
Zal Patera	40.5N, 74.9W	Yes	37±3N, 78±3W	No	No		No	Yes	Bright red deposits. Detected by SSI and NIMS in several orbits, including NIMS in I31 and I32
Tawhaki	3.1N, 75.1W	Yes	3±3N, 76±3W	No	No	9908A?	No	No	Detected during several orbits by SSI and NIMS, including by NIMS in I31. Possible site of outburst detected on 99/08/02 by R. Howell. Hot spot detected by NIMS before outburst (C21)
Unnamed		No	37±3S, 79±3W	No	No	Yes?	No	No	Detected by NIMS in E11 and I31
Hi'iaka Patera	3.1S, 79.8W	No	1±4S, 76±4W	No	No	Yes	No	Yes	Detected multiple times from the ground and by NIMS. Plume deposits detected by SSI in 1996/1997

(continued)

Table A.1. Active volcanic centers on Io (*cont.*).

Volcanic center	Location of candidate surface feature, if known	Detected by <i>Galileo</i> SSI?	Detected by <i>Galileo</i> NIMS?	Detected by <i>Galileo</i> PPR?	Detected by <i>Voyager</i> IRIS?	Detected from ground or HST NICMOS?	Plume detected? (<i>Galileo</i> = G <i>Voyager</i> = V <i>Cassini</i> = C)	Surface change detected?	Notes
Estan Patera (NIMS I31F and I31M)	24.6N, 86.2W	No	21±2N, 87±2W and 20±1N, 81±1W	No	No		No	No	Detected by NIMS in I31, I32
Unnamed (NIMS I32J)	18.6S, 87.5W	No	19±1S, 87±1W	No	No		No	No	Detected by NIMS in I32. Possibly same as Poliahu hot spot
Ekhi	28.3S, 87.6W	Yes	No	No	No		No	No	Detected by SSI in one orbit (G8)
Gish Bar Patera	15.6N, 89.1W	Yes	16±4N, 89±5W	No	No	9908A?	No	No	Detected by NIMS during several orbits, including I31, I32. Possible site of outburst detected on 99/08/02 by R. Howell. Detected by Keck on 12/2001
Unnamed (NIMS I31E, Aluna Patera)	43.9N, 90.7W	Yes	44±2N, 91±2W	No	No		No	No	Detected by SSI in E15 and by NIMS in I31, I32
Unnamed	37.3S, 91.9W	No	No	No	No	39.6±5.7S, 91.2±5.5W	No	No	Detected by Keck (Marchis <i>et al.</i> , 2003)
Unnamed (NIMS I32K)	5.8N, 96.7W	No	7±1N, 95±1W	No	No		No	No	Detected by NIMS in I32
Sigurd Patera	5.9S, 97.4W	No	5±4S, 100±4W	No	No	990930I?, 991124F?	No	No	Detected by NIMS in several orbits, including I31
Itzamna	15.2S, 97.7W	No	15±3S, 97±3W	No	No	990930I?	No	No	Detected by NIMS in C10, I31, I32
Arusha Patera	39S, 100.7W	No	39±2S, 100±2W	No	No	9503A?	No	No	Possible site of outburst detected by J. Spencer in March 1995. Hot spot detected by NIMS in I31, I32
Catha Patera	53.6S, 100.9W	No	53±1S, 105±1W	No	No		No	Yes	Detected by NIMS in C30, I31, I32
Monan Patera	20.3N, 103.8W	Yes	20±1N, 103±1W	No	No		No	Yes?	Detected by NIMS in several orbits, including I31, I32. Detected by SSI in E15. Plume possibly detected by SSI in E4. SSI images suggest 3 main active areas

Unnamed ("Ah Peku Patera")	10.3N, 106.3W	Yes	9±1N, 105±1W	No	No	No	No	No	Detected by SSI in orbit E15, by NIMS in 132
Unnamed (NIMS 131D)	Possibly part of Monan Patera complex	No	20±2N, 106±2W	No	No	No	No	No	Detected by NIMS in 131, near Monan
Altjirra Patera	34.3S, 108.4W	No	35±2S, 108±2W	No	Yes-same as Malik?		No	Yes	Bright red deposits. Detected by NIMS in several orbits, including 131, 132
Unnamed (NIMS 132G)	47.1S, 108.1W	No	48±2S, 109±2W	No	No	No	No	No	Detected by NIMS in orbit 132
Unnamed (NIMS 132F)	69.1S, 108.3W	No	69±2S, 109±2W	No	No	No	No	No	Detected by NIMS in orbit 132
Unnamed (NIMS C30B)	24N, 109W	No	24±1N, 109±1W	No	No	No	No	No	Detected by NIMS in orbit C30
Unnamed (NIMS 127E, NW of Amirani)	31.1N, 115.9W	No	31±0.5N, 117±0.5W	No	No	No	No	No	Detected by NIMS in 127, 131, 132
Amirani	23.2N, 116.3W (location of caldera)	Yes	27±4N, 112±4W (very extended)	No	Yes	Yes	V, G	Yes	Bright red deposits. NIMS detects thermal emission along whole flow. Persistent hot spot detected by NIMS and SSI in several orbits, including NIMS in 131, 132. Detected from Keck in 12/2001
Unnamed (NIMS 131J, in Tvashtar Catena)	59.5N, 117.9W	No	59±1N, 117±1W	No	No	No	No	No	Detected by NIMS in 131. Activity in SW corner of caldera located to the SE of Tvashtar lava fountain site
Dusurra	37.1N, 118.5W	No	39±7N, 125±7W	No	No	No	No	No	Detected by NIMS in orbits C21, I25, I27, I31, I32
Unnamed (NIMS 132M)	40N, 118.6W	No	37±2N, 118±2W	No	No	No	No	No	Detected by NIMS in 131 (fainter), 132
Emakong	3S, 120W	No	3±1S, 119±1W	No	No	No	No	No	Detected by NIMS in orbits I25, I27, I32

(continued)

Table A.1. Active volcanic centers on Io (*cont.*).

Volcanic center	Location of candidate surface feature, if known	Detected by <i>Galileo</i> SSI?	Detected by <i>Galileo</i> NIMS?	Detected by <i>Galileo</i> PPR?	Detected by <i>Voyager</i> IRIS?	Detected from ground or HST NICMOS?	Plume detected? (<i>Galileo</i> = G <i>Voyager</i> = V <i>Cassini</i> = C)	Surface change detected?	Notes
Tvashtar Catena (Lava fountain site)	61.5N, 120.2W, 62N, 123W	Yes	62±1N, 123±1W	No	No	9911A	No	Yes	Detected by NIMS in I25, I27, G29, I31, I32. Detected by SSI in I25 and G7. Lava fountain seen in I25. Possible site of 990930A and of outbursts in 11/13/00 and 12/16/00
Unnamed (NIMS I31K, in Tvashtar Catena)	60.5N, 120.4W	No	61±1N, 120±1W	No	No	No	No	No	Detected by NIMS in orbit I31 (I31K). Small caldera SE of Tvashtar lava fountain site
Maui Patera	16.2N, 123.8W	No	16.5±1N, 124±1W	No	Yes-same as Amirani?	No	V	Yes?	<i>Voyager</i> plume site was at the end of Amirani flow. Hot spot detected by NIMS in several orbits prior to I27, I31, and I32, but position uncertain
Unnamed (NIMS I31L, NE Tvashtar Catena)	67N, 125W	No	67±1N, 125±1W	No	No	No	No	No	Small caldera to the north-east of Tvashtar, detected by NIMS in I31
Tvashtar Catena (Flow site)	64.8N, 126W	Yes	65±1N, 126±1W	No	No	Yes?	G	Yes	Hot spot detected by SSI in orbits G7, I27. Hot spot detected by NIMS in orbits I27, I31, I32. Plume detected by Cassini 12/200000-01/2001. Hot regions seen in dolphin-shaped flow in caldera
Unnamed (NIMS I31H)	11S, 128W	No	11±1S, 127±1W	No	No	No	No	No	Detected by NIMS in orbits I31, I32
Malik Patera	34S, 129W	No	34±2S, 128±2W	No	Yes	No	No	No	Bright red deposits. Hot spot detected by NIMS in several orbits, including I31, I32
Unnamed (NIMS I27B, "Maju Patera")	19.5N, 131.1W	No	20±1N, 130±1W	No	No	No	No	No	Detected by NIMS in I27, I31, I32
Unnamed (NIMS I31A, "Thor")	39N, 131–135W	No	38±1N, 131±1W, 39±1N, 135±1W	No	No	0108A, Keck 12/20	G	Yes	Large outburst. Hot spot detected by NIMS in I31, I32. Active flow detected by NIMS in I31, I32. Large plume detected by SSI in I31 and I32

Yaw Patera (NIMS Camaxtli C)	9.3N, 132W	No	9.5±1N, 132±1W	No	No	No	No	No	Detected by NIMS in I25, I27, I32
Unnamed (S Seth Patera, NIMS I25B)	2S, 133W	No	5±1S, 132±1W	No	No	99I124D?	No	No	Detected by NIMS in I25, I27, C30, I31, I32. Seth Patera is at 2S, 133W
Tien Mu Patera (NIMS Camaxtli east)	12N, 133.9W	No	12±1N, 134±1W	No	No	No	No	No	Detected by NIMS in I24, I27, I31, I32
Camaxtli Patera	15N, 136.4W	Yes	14.5±1N, 136±1W	No	No	No	No	No	Detected in E15 by NIMS, SSI. Detected by NIMS in I24, I27, I32
Unnamed (NIMS I31B)	35.2N, 137.2W	No	35±1N, 137±1W	No	No	No	No	No	Detected by NIMS in I31 and I32, probably related to I31A
Ruaumoko Patera (NIMS Camaxtli West)	14.5N, 139.3W	No	15±1N, 139±1W	No	No	No	No	No	Detected by NIMS in I24 and I27
Unnamed ("Chors Fluctus", NIMS I32H and I)	45S, 140W	No	45±1S, 139±1W	No	No	No	No	No	Detected by NIMS in I32
Tupan Patera	19S, 141W	No	17±1S, 141±1W	No	No	No	No	No	Bright red deposits. Persistent hot spot detected by NIMS in several orbits, including I31, I32. High-resolution NIMS and SSI observations in I32
Unnamed (N. Polar)	66N, 144W	Yes	No	No	No	No	No	No	Detected by SSI in orbit G7
Unnamed (NIMS I24A, near Surya)	22N, 145.6W	No	22±1N, 145±1W	No	No	No	No	No	Detected by NIMS in I24, I27, I31, I32
Cuchi Patera (NIMS I25A)	0.6N, 145.8W	No	2±1S, 144±1W	No	No	No	No	No	Detected by NIMS in I25, I32
Unnamed (NIMS I32C, "Thor Fluctus")	26S, 147W	No	26±1S, 147±1W	No	No	No	No	No	Detected by NIMS in I31 (faint), I32
Arinna Fluctus	32N, 147W	No	30±1N, 147±1W	No	No	No	No	Yes	Extensive, bright red deposits. Detected by NIMS in several orbits, including I31, I32

(continued)

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Volcanic center	Location of candidate surface feature, if known	Detected by <i>Galileo</i> SSI?	Detected by <i>Galileo</i> NIMS?	Detected by <i>Galileo</i> PPR?	Detected by <i>Voyager</i> IRIS?	Detected from ground or HST NICMOS?	Plume detected? (<i>Galileo</i> = G <i>Voyager</i> = V <i>Cassini</i> = C)	Surface change detected?	Notes
Sobo Fluctus (NIMS I24B)	14N, 150W	No	14±1N, 150±1W	No	No	No	No	No	Detected by NIMS in I24, I27, and I32. Possibly two hot spots detected in I32
Surya (NIMS I27A)	21.3N, 150.9W	No	22±1N, 152±1W	No	No	No	No	Yes	Detected by NIMS in I27. Surface change detected by SSI
Shamash Patera	35S, 152W	No	34±1S, 153±1W 36±1S, 151±1W	No	Yes-same as Malik?	No	No	No	Detected by NIMS in several orbits, including I32, when NIMS detected thermal emission from patera and flow (I31I)
Prometheus Patera	0.5N, 153W	Yes	1±3S, 155±3W	No	No	No	V, G	Yes	Bright red deposits. Volcanic activity along flow. Persistent hot spot detected by NIMS and SSI in several orbits, including I31, I32. Plume moved between <i>Voyager</i> and <i>Galileo</i>
Chaac	11.8N, 157.2W	No	10N, 157W	No	No	No	No	No	Bright green deposits on caldera floor. Hot spot detected by NIMS in I25 and I27
Radegast Patera	28S, 160W	No	27± 0.5S, 160±0.5W	No	No	No	No	No	Detected by NIMS in I32 – small caldera near Tohil
Culann Patera	19.9S, 161.5W	Yes	18±3S, 163±3W	No	No	No	G	Yes	Bright red deposits. Persistent plume and hot spot. Hot spot detected by NIMS in several orbits, including I32, and by SSI in E11
Tsui Goab Fluctus (NIMS I27D)	0.0, 163.3W	No	0, 164W	No	No	No	No	No	Detected by NIMS in I27 (I27D), I31, I32
Unnamed (NIMS I32E)	65.9S, 168.6W	No	68±1S, 166±1W	No	No	No	No	No	Detected by NIMS in orbits C30 (faint), I32

Michabo Patera (NIMS I31G)	3N. 168.8W	No	2±2S. 169±2W	No	No	No	No	No	Detected by NIMS in orbit I31
Zamama	18N. 174W	Yes	17±2N. 172±2W	No	No	Keck 12/01	G	Yes	Bright red deposits. Detected from Keck 12/2001. Persistent hot spot detected by NIMS and SSI in several orbits, including I32
Unnamed (NIMS I32D)	42S. 175W	No	45±2S. 172±2W	No	No	No	No	No	Detected by NIMS in orbit I32
Aidne Patera	2S. 178W	No	2±3S. 178±3W	No	No	No	No	Yes	Detected by NIMS in several orbits, including I27
Volund	25N. 184.3W	Yes	25±3N. 174±3W	No	Yes	No	V	Yes	Detected by NIMS and SSI. Prometheus-type plume and lava flow
Donar Fluctus	24.3N. 186.2W	Yes	No	No	No	No	No	No	Detected by SSI in E11
Haokah	20.7S. 187W	No	19±3S. 185±3W	No	No	No	No	No	Bright green deposit in SSI images. Hot spot detected by NIMS in E11, E14
Unnamed	28.1N. 192W	Yes	No	No	No	No	No	No	Detected by SSI in G1 and by NIMS in I24
Fo Patera	40.9N. 192.6W	Yes	39±3N. 191±3W	No	No	No	No	Yes	Detected by NIMS and SSI in several orbits
Sethlaus Patera	52S. 194W	No	50±3S. 195±3W	No	No	No	No	No	Red deposits. Hot spot detected by NIMS in several orbits
Unnamed	32N. 199W	No	Yes	No	No	No	No	No	Detected by NIMS in I24
Rata Patera	35.2S. 199.2W	Yes	35±3S. 199±3W	Yes	No	No	No	No	Red deposits. Detected by NIMS in several orbits, by SSI in E11, by PPR in I25, I27, I31, I32
Gabija	51S. 203W	No	52±3S. 204±3W	Yes	No	No	No	No	Hot spot detected by NIMS in E14, I24. Detected by PPR in I25, I27, I31, I32
Lei-Kung Fluctus	38N. 204W	Yes	37±3N. 206±3W	Yes (north and south Lei-Kung)	No	No	No	No	Bright red deposits. Detected by SSI and NIMS in several orbits and by PPR in I27, I31, I32
Unnamed	55S. 206W	No	No	Yes	No	No	No	No	Detected by PPR in I25, I27, I31, I32
Isum Patera-N&S	28N. 209W	32.9N, 204.7W, 30.3N, 206.8W	31±3N. 207±3W	Yes	Yes	9510A?	No	No	Bright red deposits. SSI detected two hot spots, Keck 12/2001. Activity detected by NIMS in several orbits, including I31. Detected by PPR in I27, I31, I32

(continued)

Table A.1. Active volcanic centers on Io (*cont.*).

Volcanic center	Location of candidate surface feature, if known	Detected by <i>Galileo</i> SSI?	Detected by <i>Galileo</i> NIMS?	Detected by <i>Galileo</i> PPR?	Detected by <i>Voyager</i> IRIS?	Detected from ground or HST NICMOS?	Plume detected? (<i>Galileo</i> = G <i>Voyager</i> = V <i>Cassini</i> = C)	Surface change detected?	Notes
Marduk	28.4S, 209.9W	Yes	27±2S, 211±2W	Yes	Yes	No	V, G	Yes	Bright red deposits. Detected by NIMS and SSI in several orbits, by PPR in I25, I27, I31, I32
Unnamed	65N, 215W	No	No	No	No	No	No	No	Detected by PPR in I25. Possible Lei-Kung source
Ot	0.9S, 217W	No	2±3S, 218±3W	Yes	No	No	No	No	Detected by NIMS in several orbits including I24. Detected by PPR in I25, I27, I31, I32
Unnamed	10.1S, 217.3W	Yes	No	No	No	No	No	No	Detected by SSI in E11
Mulungu Patera	17.2N, 217.5W	Yes	17±3N, 219±3W	Yes (with Susanoo)	No	9510A?	No	No	Detected by NIMS in several orbits, by SSI in G1. Detected by PPR in I25, I27, I31, I32
Kurdalagon Patera	50S, 218.4W	No	47±3S, 219±3W	Yes	No	No	No	No	Red deposits. Detected by NIMS and PPR in several orbits
Susanoo	22.3N, 219.3W	No	21±3N, 222±3W	Yes (with Mulungu)	No	9510A?	No	No	Hot spot detected by NIMS in E14 and I24. Detected by PPR in I25, I27, I31, I32
Unnamed (NIMS I32A)	31N, 222W	No	28±2N, 227±2W	No	No	No	No	No	Detected by NIMS in I32
Unnamed	24S, 224W	No	No	Yes	No	No	No	No	Detected by PPR in I25, I27, I31, I32
Wayland Patera	32.2S, 225.5W	No	33±2S, 223±2W	Yes	No	No	No	No	Hot spot detected by NIMS in E14. Detected by PPR in I25, I27, I31, I32. Detected by <i>Cassini</i> ISS on 01/01/01
Unnamed	4S, 233W	No	No	Yes	No	No	No	No	Detected by PPR in I27, I31, I32
Unnamed	28S, 233W	No	No	Yes	No	No	No	No	Detected by PPR in I25, I27, I31, I32
Reiden Patera	13S, 236W	Yes	11±2S, 234±2W	Yes	No	No	No	No	Detected by SSI in G1, by NIMS in I24 and I32, by PPR in I25, I27, I31, I32
Unnamed	49S, 236W	No	No	Yes	No	No	No	No	Detected by PPR in I25, I27, I31, I32
Girru	22.6N, 239.3W	Yes	22±3N, 238±3W	Yes	No	No	No	No	Detected by NIMS in several orbits, by SSI in E11. Detected by PPR in I27, I31, I32

Llew	12.1N, 241.8W	No	10±2N, 240±2W	Yes	No	No	No	No	Detected by NIMS in I32. Detected by PPR in I27, I31, I32
Unnamed Pillan Patera	35.6S, 242.5W 12S, 244W	Yes	No 13±3S, 244±3W	No	No	No	No	No	Detected by SSI in E11
		9.5S, 242.7W, 11.5S, 242.2W		Yes	No	Keck 12/2001	G	Yes	Major eruption in 1997. Plume detected by SSI and HST. Persistent hot spot detected by NIMS since 1996 (G2). Caldera, fissure vent, lava flows identified by SSI
Chors Patera	68.5N, 249.9W	No	No	Yes	No	No	No	No	Detected by PPR in I27, I31, I32
Pyerun Patera	55.4S, 251.1W	No	No	No	yes-same as Mithra?	No	No	No	<i>Voyager 1</i> detection
Pele	18.4S, 255.7W	Yes	20±3S, 255±3W	Yes	Yes	No	V, G	Yes	Large, bright red deposits. Plume detected also by HST. Very persistent hot spot detected by NIMS, SSI, and PPR numerous times
Unnamed	37N, 261W	No	No	Yes	No	No	No	No	Detected by PPR in I27, I31, I32
Unnamed	53N, 264W	No	No	Yes	No	No	No	No	Detected by PPR in I27, I31, I32
Svarog Patera	48S, 265.5W	Yes	42±5S, 269±5W	Yes	Yes	Keck, 12/2001	No	No	Detected by NIMS, SSI, and PPR in several orbits
Shakuru Patera	23.1N, 266W	No	No	Yes	Yes-same as Daedalus?	No	No	No	Very low albedo. Detected by PPR in I27, I31, I32
Mithra Patera	58.6S, 266.7W	54.3S, 268.6W	No	Yes	Yes-same as Pyerun?	No	No	No	Red deposits. SSI detected hot spot north of patera. Detected by PPR in I25, I27, I31, I32
Babbar Patera	39.4S, 271.8W	No	37±4S, 283±8W	Yes	Yes	No	No	No	Detected by NIMS in several orbits, by PPR in I25, I27, I31, I32
Daedalus Patera	19N, 274.4W	No	18±3N, 273±3W	Yes	Yes	990929E?, 991030C?, 991125A?, 980905B?, 0112G?	No	Yes	Red deposits. Detected numerous times from ground. Detected as a hot spot by PPR in I25, I27, I31, I32
Unnamed	7S, 277W	No	No	Yes	No	No	No	No	Detected by PPR in I27, I31, I32
Unnamed	13S, 278W	No	No	Yes	No	No	No	No	Detected by PPR in I27, I31, I32
Atar Patera	31N, 278W	No	No	Yes	No	No	No	No	Detected by PPR in I27, I31, I32
Unnamed	49.9N, 278.6	No	No	No	No	Yes, Keck12/2001	No	No	Observed by Keck on 12/2001
Viracocha Patera	61.4S, 281W	No	No	No	Yes	No	No	No	Detected by <i>Voyager</i>

(continued)

Table A.1. Active volcanic centers on Io (*cont.*).

Volcanic center	Location of candidate surface feature, if known	Detected by <i>Galileo</i> SSI?	Detected by <i>Galileo</i> NIMS?	Detected by <i>Galileo</i> PPR?	Detected by <i>Voyager</i> IRIS?	Detected from ground or HST NICMOS?	Plume detected? (<i>Galileo</i> = G <i>Voyager</i> = V <i>Cassini</i> = C)	Surface change detected?	Notes
Ulgen Patera	40.4S, 287.7W	No	41±9S, 291±9W	Yes	Yes	N6?, D?, Keck (12/2001)	No	No	Very low albedo, detected by NIMS in C22. Detected by Keck 12/2001.
Hephaestus Patera	1.9N, 290.1W	No	No	Yes	No	Keck	No	No	Detected by PPR in I25, I27, I31, I32. Detected By PPR in I27, I31, I32. Detected from Keck on 12/2001
Lerna Regio	62S, 292W	No	No	Yes	No	No	No	No	Detected by PPR in I25, I27, I31, I32
Vivasvant Patera	75.1N, 295W	No	No	Yes	No	No	No	No	Detected by <i>Galileo</i> PPR in I27, I31, I32
Gibil Patera	15S, 295W	No	No	Yes	No	No	No	No	Detected by PPR in I27, I31, I32
Dazhbog Patera	54.3N, 301.1W	No	No	Yes	No	N13, Keck 12/2001	No	Yes	Detected by NICMOS (66.4±8 N, 310.6±14W). Red plume deposits observed by SSI in I31, I32. Hot spot detected by PPR in I25, I27, I31, I32
Rarog	41.4S, 304.9W	No	No	Yes	No	44±1S, 302±2W (Unnamed Keck "J")	No	No	Detected from Keck (12/2001; de Pater <i>et al.</i> , 2003). Large patera. Detected by PPR in I25, I27, I31, I32
Sengen Patera	32.5S, 304W	No	No	Yes	No	9506J?, N6?, D?, Keck (12/2001)	No	Yes	Detected by PPR in I25, I27, I31, I32
Unnamed (Keck "M")		No	No	No	No	61±2S, 305±2W	No	No	Detected from Keck (12/2001, de Pater <i>et al.</i> , 2003)
Mihr Patera	16.2S, 305.7W	Yes	No	Yes	No	Keck (12/2001)	No	No	Detected by SSI in orbits C9, E11. Detected by PPR in I27, I31, I32
Amaterasu Patera	36.3N, 306.2W	No	40±4N, 309±4W	Yes	Yes	Maybe	No	Yes	Detected by NIMS in several orbits, by PPR in I25, I27, I31, I32
Loki Patera	12.7N, 308.8W	Yes	9±7N, 309±7W	Yes	Yes	Numerous ground-based observations, NI	V	Yes	Detected multiple times from ground and by NIMS. Two plumes observed to the north of caldera by <i>Voyager</i> . Hot regions in caldera observed by NIMS and PPR at high resolution (I24, I27, I31 (PPR only), I32)

Aten Patera	48.2S, 310.5W	No	No	Yes	Yes	N9, D?	No	Yes	Pele-type plume deposits, reddish.
Kinich Ahau	50.4N, 311W	No	No	No	No	N11	No	No	Detected by PPR in I25, I27, I31, I32
Heno Patera	57S, 311W	No	No	Yes	No	No	No	No	Detected by NICMOS (50.3±5N, 318.8±8W)
Mazda Catena	9.4S, 314.9W	No	No	Yes	Yes	9606H?N7?, D?	No	No	Detected by PPR in I25, I27, I31, I32
Nemea	78S, 320W	No	No	No	Yes	No	No	No	Red deposits. Detected by PPR in I27, I31, I32
Manua Patera	35.2N, 321.6W	Yes	No	No	No	06/1997?	No	No	Detected by SSI in orbit E6 and by UH AO on 06/97
Argos Planum	47S, 322W	No	No	Yes	No	No	No	No	Detected by PPR in I25, I27, I31, I32
Tol-Ava Patera	2N, 322W	No	No	Yes	No	No	No	No	Detected by PPR in I27, I31, I32
Ra Patera	8.3S, 325.2W	No	No	Yes	No	No	G	Yes	Major brightening and surface change observed by HST between 3/1994 and 3/1995 (Spencer <i>et al.</i> , 1997). Plume detected by SSI in orbit G1, E4.
Unnamed (Keck "L")	Possibly Fuchi or Manua?	No	No	No	No	34±1N, 326±1W	No	No	Detected by PPR in I25, I27, I31, I32
Unnamed	40.5S, 326.3W	Yes	36±9S, 324±9W	No	No	9606G?	No?	No	Detected from Keck (12/2001; de Pater <i>et al.</i> , 2003)
Fuchi Patera	28.3N, 327.7W	Yes	No	Yes	No	9606G?, N4, D, Keck 12/2001	No	No	Detected by NIMS in C22. NIMS hot spot could also be from feature at 40.5S, 326.3W
Huo Shen Patera	15S, 329W	No	No	Yes	No	No	No	Yes	Red deposits, hot spot detected by SSI in several orbits. Detected by PPR in I27, I31, I32
Dongo Patera	16.6N, 332W	Yes	No	No	No	No	No	No	HST changes (Spencer <i>et al.</i> , 1997). Detected by PPR in I27, I31, I32
Acala Fluctus	11N, 337W	Yes	No	Yes	Yes	N3, D	G	Yes	Detected by SSI in orbits C9, E11
Surt	44.9N, 337.1W	No	No	No	No	9606E?, N12, 0102A, Keck 12/2001	No	Yes	Detected by SSI in E14, PPR in I27, I31, I32
Creidne Patera	52.4S, 343.2W	No	No	No	Yes	N8?	No	Yes	Pele-type plume deposits observed by <i>Voyager 2</i> . Outbursts observed on 02/2001
									Tentative identification of hot spot location

(continued)

Table A.1. Active volcanic centers on Io (*cont.*).

Volcanic center	Location of candidate surface feature, if known	Detected by <i>Galileo</i> SSI?	Detected by <i>Galileo</i> NIMS?	Detected by <i>Galileo</i> PPR?	Detected by <i>Voyager</i> IRIS?	Detected from ground or HST NICMOS?	Plume detected? (<i>Galileo</i> = G <i>Voyager</i> = V <i>Cassini</i> = C)	Surface change detected?	Notes
Unnamed	3.1N, 350.4W	Yes	No	No	No	No	No	No	Detected by SSI in several orbits
Tiermes Patera	22.2N, 350.4W	No	No	Yes	No	9507A	No	No	Detected by PPR in I25, I27, I31, I32
Euboea Fluctus	45S, 352W	No	No	No	No	9606F?, N8?, D?, Keck 12/2001	No	Yes	Pele-type plume deposits, bright red
Unnamed (Keck "R")	Possibly Mama Patera at 10.6S, 356.5W	No	No	No	No	7±1S, 353±3W	No	No	Detected from Keck (12/2001, de Pater et al., 2004)
Unnamed Fjorgynn Fluctus	4.8N, 356.1W	Yes	No	No	No	No	No	No	Detected by SSI in several orbits
	12N, 358W	Maybe (16.0N, 3.8W)	No	No	No	9606D?, N10. D, Keck "N" (9±1N, 1±1W)	No	Yes	Possibly detected by SSI in orbit E15. Detected from Keck (12/2001; de Pater et al., 2004)

Table A.2. Identification of possibly active volcanic centers.

Volcanic center	Location of candidate surface feature, if known	Galileo SSI?NIMS Tentative detection?	Ground-observed? HST NICMOS?	Surface change?	Notes
Unnamed	15.3N, 4.7W	No	9606D?	No	
Cataquil Patera	23.5S, 18.2W	No	9906A?	No	Tentative identification of ground-observed hot spot
Ukko Patera	32N, 20W	No	9508A?	Yes	Surface changes indicate activity
Unnamed	19.4N, 23.3W	No	0011A?	No	Tentative identification of ground-observed hot spot
Unnamed	13.5S, 23.9W	SSI	9606C?	No	Faint spot in SSI G8, E15 images
Lei-Zi Fluctus	14N, 45W	No	No	Yes	New plume deposits detected by SSI in orbit C9
NIMS I32		NIMS at 39±1N, 69±1W	No	No	Possibly detected by NIMS in I32, very faint
Wabasso Patera	55N, 73.8W	No	0011B?	No	Dark patera. May be same hot spot as above
“Poliahu”	19.4S, 81.8W	No	Yes	No	Reported at 22±5S, 79±5W by Goguen <i>et al.</i> (1988) as very bright eruption in 1986. Same as I32J?
Shango	31.7N, 99.7W	Yes	No	No	Faint spot in SSI eclipse image
NIMS C30	53S, 148W	NIMS	No	No	Possibly detected by NIMS in C30, very faint
Unnamed	25.7S, 168.2W	SSI at 22S, 168W	No	No	Faint spot detected by SSI in E11
Namarrkun	10.1N, 175.7W	SSI	No	No	Identification based on SSI data
Kami-Nari Patera	8S, 234W		No	Yes	Pillan-type plume deposits detected by SSI in C21, I24
NIMS I32		NIMS at 23±3N, 248±3W	No	No	Possibly detected by NIMS in I32, very faint
Unnamed	38S, 291W	No	No	No	Low albedo and bright red materials
Khalla Patera	5.7N, 303.4W	No	Yes	No	Probably site of hot spots observed by University of Hawaii AO 06/1997
Unnamed	2S, 352W	Yes	Yes?	No	Faint spot in SSI G8 eclipse image. Possibly same as hot spot detected by C. Dumas on 6/3/98 at 6±3S, 358±3W and by Keck (Keck “R”)

Appendix 2: Ionian mountains identified to date

Elizabeth P. Turtle, Windy L. Jaeger, and Paul M. Schenk

List of the 135 Ionian mountains positively identified to date, documenting locations, heights, geomorphic classification (tectonic or volcanic), and proximity to paterae (compiled by re-examining and attempting to minimize discrepancies between the lists published in Schenk *et al.*, 2001, and Jaeger, 2005). The geographic positions of adjacent paterae are also noted.

Table A.3. Ionian mountains.

Feature name	Mountain position		Height (km)	Tectonic/volcanic (T/V)	Number of paterae in contact with mountain	Patera(e) position(s) (latitude (°), longitude (°))
	Latitude (°)	Longitude (°West)				
	38.2	2.8	4.2	T		
	30.4	7.3	4.8	T	0	
	86.0	8.0	6.1			
	36.6	10.1	8.2	T	1	34.9, 11.9
	-12.5	14.7	9.5	T	0	
	31.2	24.7	6.1			
	-24.0	25.0	6.5	T	1	-21.8, 24.3
	-35.4	25.7	3.0	T		
	-84.9	28.9	1.6			
	-10.4	29.1	3.8	T	1	-13.5, 23.9
Ethiopia Planum	-44.1	30.0	3.0-4.5	T	0	
	35.0	30.1	>8.0	T		
	30.1	31.8	3.9	T	1 (or 2)	29.4, 22.3 (31.5, 34.6)
	-27.2	33.8	3.5-5.0	T		
Pan Mensa	-50.2	34.4	5.0	T	1 (or 2)	-47.5, 37.8 (-51.9, 32.2)
	70.0	36.0	10.7	T		
	-87.4	36.4	1.0-2.9			
	38.7	40.5	3.5	T	0	
	18.3	43.5	5.9	T	0	
	-25.4	43.7	3.5-5.5	T		
	-65.0	43.8			0	
	12.8	46.2	3.9	T		
Haemus Montes	-69.7	47.7	8.4-10.8	T	1	-68.5, 58.2
	69.9	50.6	3.8	T		
	-11.9	55.8			0	
	42.0	57.0	11.2	T	0	

	22.9	59.5	1.8			
	-15.8	60.8	>5.1	T	0	
	63.3	60.9				
	47.8	62.7			0	
	-6.7	63.1	>2.9	T	1	-9.8, 63.6
Mongibello Mons	22.6	66.6	8.6	T	0	
	15.5	67.2	>1.5		0	
	-25.6	68.9				
	39.3	69.8	1.4		0	
Shamshu Mons	-11.3	71.7	2.9	T	0	
Zal Montes	33.8	72.2	7.4	T	1	40.5, 74.9
Hi'iaka Montes	-7.4	78.7	4.3	T	1	-3.1, 79.8
Zal Montes	40.5	79.6	2.5	T	1	40.5, 74.9
Hi'iaka Montes	-9.4	81.6	4.5	T	0	
Hi'iaka Montes	-2.1	82.3	11.1	T	2	-3.1, 79.8; -6.3, 84.1
	25.0	83.3	6.2-6.4	T	0	
	14.2	84.7	3.1-4.0	T	0	
	17.6	86.8	2.4	T	1	15.7, 89.8
Gish Bar Mons	18.9	87.2	9.7-11.0	T	2	21.2, 86.9; 15.6, 89.1
	33.4	91.9			0	
	39.3	93.7	8.2	T	1	38.7, 24.9
Skythia Mons	25.7	98.8	5.5-6.0	T	0	
Monan Mons	15.4	104.0	6.5	T	2	20.3, 103.8; 10.3, 106.3
	-20.4	107.8	4.5	T	0	
	-10.3	113.2	6.0-6.5	T	0	
Tvashtar Mensae	62.1	116.6	2.0	T	1	61.5, 120.2
	54.2	120.0	3.0	T	0	
Telegonus Mensae	-63.8	120.9	2.7-4.0	T	0	
Capaneus Mensa	-16.5	121.1	9.2-9.5	T	0	
Tvashtar Mensae	58.8	122.4	6.0-6.6	T	2	61.5, 120.2; 64.8, 126.0
	-13.0	124.2	5.0	T	0	
	-26.3	124.5	3.9-6.0	T	0	
	45.6	125.9	5.0-7.2	T	1	47.9, 123.5

(continued)

Table A.3. Ionian mountains (*cont.*).

Feature name	Mountain position		Height (km)	Tectonic/volcanic (T/V)	Number of paterae in contact with mountain	Patera(e) position(s) (latitude (°), longitude (°))
	Latitude (°)	Longitude (°West)				
Euxine Mons	26.5	126.2	6.0–7.7	T	2	25.6, 124.3; 23.3, 125.1
	14.5	127.2	3.0–3.3	T	1	16.3, 126.1
	–42.5	129.7	3.2–4.5	T	1	–41.6, 137.5
Seth Mons	–10.3	134.0	7.0–7.5	T	0	
	–19.4	148.6	2.0	T	1	–18.7, 150.7
	–37.0	148.7	>3.0	T	1	–35.0, 152.0
	–64.2	157.2	1.7		0	
	28.9	159.5	3.0	T	2	27.5, 157.9; 31.6, 159.1
	–68.2	159.5	1.9–4.8		0	
Tohil Mons	–28.9	160.3	9.0–9.4	T	3	–35, 152; –27, 158; –28, 160
	–60.8	161.6	1.1–2.2			
	47.0	162.0	2.2–5.5	T	0	
Thomagata	25.2	165.5		V	1	25.2, 165.5
	–23.9	171.9	3.9–4.0	T	0	
	16.8	173.7	1.5	V	1	16.8, 173.7
	18.7	174.4	1.5	V	0	
	64.5	174.8	3.5	T		
	–77.7	179.0	2.7	T		
Dorian Montes	20.7	188.7	2.4–5.5	T	0	
	–21.5	193.0	8.5–9.2	T	2	–23.0, 193.9; –20, 194
	59.2	195.5	8.6–11.0	T	1	59.4, 198.6
	–73.1	196.8	7.0–7.3	T		
	73.8	200.5	7.0	T		
Rata Mons	–52.0	200.9	1.7		1	–51, 203
	–35.7	201.3	7.0–8.1	T	1	–35.2, 199.2

Dorian Montes	-26.8	201.8	7.7	T	0	
	-57.1	203.9	1.8		1	-55, 207
	53.0	206.8	9.0	T	0	
	-35.1	210.3	4.5	T	1	-36, 208
	9.2	212.7	>3.3	T	0	
Ot Mons	4.1	215.5	3.6	T	0	
	-27.2	236.0			0	
Ionian Mons	8.6	236.1	12.7	T	0	
Caucasus Mons	-32.2	238.0	10.6	T	0	
Crimea Mons	-75.0	243.4	3.7	T	1	-74.7, 246
Pillan Mons	-7.9	245.5	5.0-5.3	T	0	
	-29.9	245.6	2.0	V	1	-29.9, 245.6
Nemea Planum	-64.8	248.2	2.8-6.0	T	2	-67.2, 242.6; -62.6, 244.4
	-69.9	248.7	1.9		0	
Nile Montes	50.2	249.2	9.0	T	0	
Nile Montes	57.5	253.4	6.5	T	0	
Danube Planum	-21.5	257.6	3.4-5.5	T	2	-18.4, 255.7; -25.2, 257.7
Egypt Mons	-40.2	258.9	10.0	T	0	
	7.8	262.0	4.0	T	0	
Boösaule Montes	-2.2	263.9	7.0	T	0	
	23.6	269.0	7.0-7.2	T	1	23.1, 266
Boösaule Montes	-2.8	269.2	8.5	T	0	
Boösaule Montes	-9.6	272.3	17.5-18.2	T	0	
Silpium Mons	-51.8	273.4	5.5	T	0	
	-31.3	273.6	4.6	T	0	
	-5.4	279.1	4.0	T	1	-6.5, 276.1
	9.2	279.3	4.0	T	0	
	37.8	283.4			0	
	7.0	284.5	4.5	T	0	
Ulgen Montes	-39.1	284.7	4.0-6.0	T	0	
	75.0	287.0	4.2-8.4	T		
	-23.3	295.2	3.9-6.7	T	0	
	-36.3	299.1	3.7	T	0	

(continued)

Table A.3. Ionian mountains (*cont.*).

Feature name	Mountain position		Height (km)	Tectonic/volcanic (T/V)	Number of paterae in contact with mountain	Patera(e) position(s) (latitude (°), longitude (°))
	Latitude (°)	Longitude (°West)				
Iynx Mensa	-62.1	304.0	4.5	T	0	
	-44.6	310.1	>1.7		0	
Argos Planum	-47.7	318.3	3.2	T	1	-48.6; 320.1
Carancho Montes	-5.0	318.7	8.1–8.5	T	1	1.9, 322.4
	71.0	320.8	5.4			
	60.5	324.0	4.9	T	0	
	14.8	331.7	4.9– >6.0	T	0	
Iopolis Planum	-34.9	333.1	4.1–4.5	T	0	
	43.7	334.7			1	45.0, 337.1
Euboea Montes	-48.0	336.2	10.3–13.4	T	0	
	56.0	337.0	9.6	T	0	
	1.5	341.2	7.0	T	3	-0.1, 340; 0.7, 341; 0.7, 344
	-24.7	345.1	2.5	T	1 (or 2)	-22.2, 345.4 (-26.6, 343.3)
	1.6	346.9	4.5	T	0	
Euboea Montes	-51.4	348.6	2.5	T	1	-52.4, 343.2
Apis Tholus	-10.9	348.7		V	1	-10.9, 348.7
Inachus Tholus	-15.8	348.8	1.8	V	1	-15.8, 348.8
Echo Mensa	-79.9	355.7	0.7–3.0		0	
Possible mountains	22.4	151.6	>0.8		1	21.1, 151.6
	20.3	157.3	>~0.9		1	19.4, 158.8
	13.4	160.7			2	11.3; 155.8; 11.8, 157.2
	-1.7	183.7	>~0.7		0	
	4.6	185.8	>~0.8		1	6.3, 187.6

Note: Values for longitude increase to the west.

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