JunoCam at PJ45: What the images show
Part I: Europa

John Rogers (BAA) (2022 Oct.9)

Juno's perijove-45 (PJ45) occurred on 2022 Sep.29. Seven-and-a-half hours before the perijove, the spacecraft had its first close encounter with Europa, flying just 352 km above the moon's icy surface. As it receded, JunoCam was able to get four images, showing a side of the moon that was poorly covered by Voyager and Galileo imagery.

In addition, Juno's Stellar Reference Unit – a very sensitive camera used for start tracking, but also capable of detecting faint features like Jupiter's ring and jovian lightning – took a hi-res image of Europa's dark side illuminated by jove-shine, spanning ~150x200 km (Fig. 1).

Small copies of the four JunoCam images are shown in Figure 2. Figure 3 is a part of image 1, processed by Brian Swift, showing nice examples of a chaos area (brown, but not sunken) and a large pit.

The four images were projected into cylindrical maps by Gerald Eichstädt, and Figure 4 is a reduced-resolution composite of them, with some features labelled. (Gerald's original maps, as well as a larger-scale, unlabelled version of this one, are on the JunoCam web site in the 'Think Tank' pages.)
Impact features are rare: this map shows one large one (Callanish, which was viewed at high resolution by the Galileo orbiter), and possibly a small one (Midir, not yet viewed at hi-res).
The general texture of ridges and bands and chaos regions is ubiquitous on Europa, but much of this area has not previously been imaged so well. There are swathes of cycloidal bands, dark in the northern and southern latitudes, and bright in low latitudes, where they have a different orientation.
White arrows indicate features that Paul Schenk and colleagues have argued may be signs of global stresses due to polar wander (global rotation of the crust) as shown in Figure 5 [adapted from Schenk's 'Atlas of the Galilean Satellites'; see figure for references].
There are four parallel long troughs (plus a near-parallel line of depressions between two of them). Two of these were proposed by Schenk as arcuate troughs concentric to the disrupted region centred at 300°W, 10°N, due to stresses of polar wander, and the pattern is seen here to be continued further.
Corick Linea, a sinuous bright band, was proposed by Richard Greenberg as an antipodal twin of the great Agenor Linea, which is thought to be a convergence zone. This image shows a previously unstudied extension of it; but it is much narrower than Agenor, and trends north of the disrupted region rather than towards it, so its relevance is not so clear. Corick Linea runs across the chaos region in Figure 3, but in a somewhat disrupted manner, so the chaos may actually be younger.

Figures (small copies):

Figure 1. Close-up of the dark side of Europa from Juno's Stellar Reference Unit. *Credits*: NASA/JPL-Caltech/SwRI.

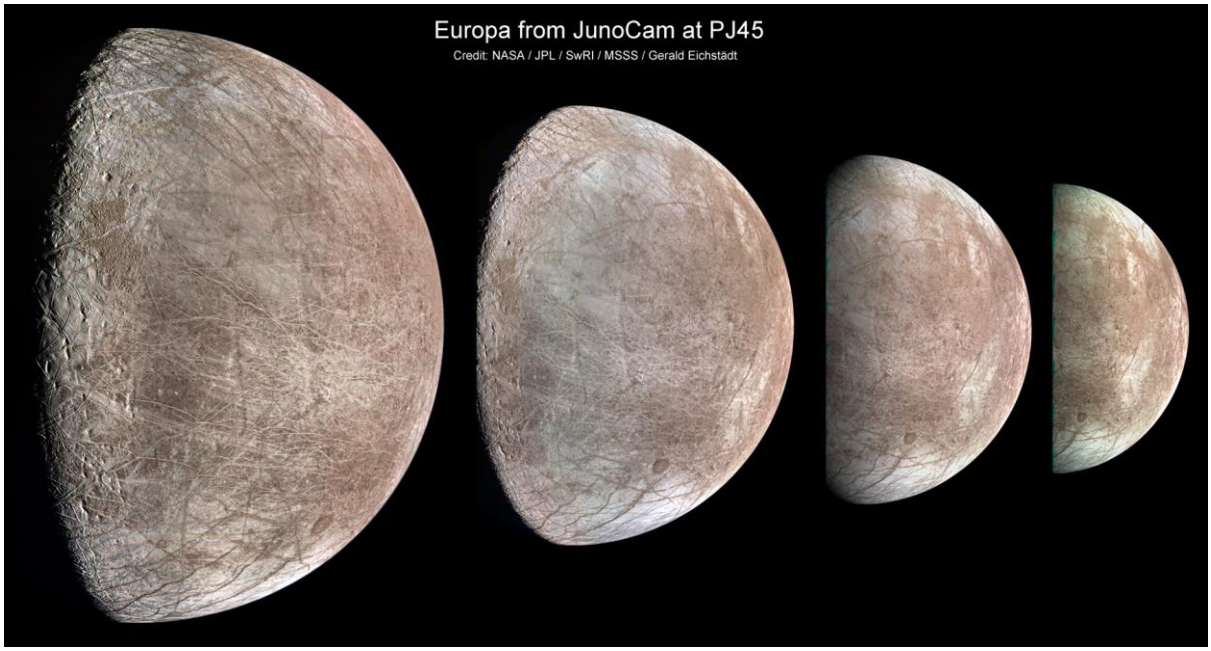

Figure 2

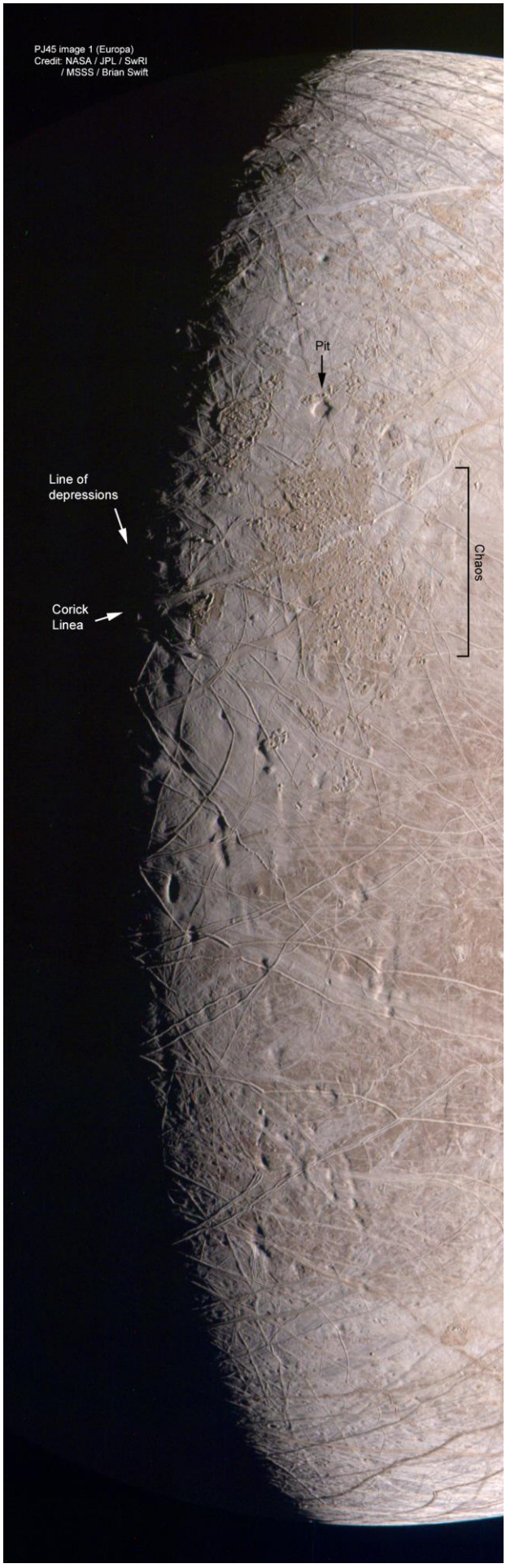
PJ45 image 1 (Europa)
Credit: NASA / JPL / SwRI
/ MSSS / Brian Swift
Pit
Line of
depressions
Corick
Linea
Chaos

Figure 3

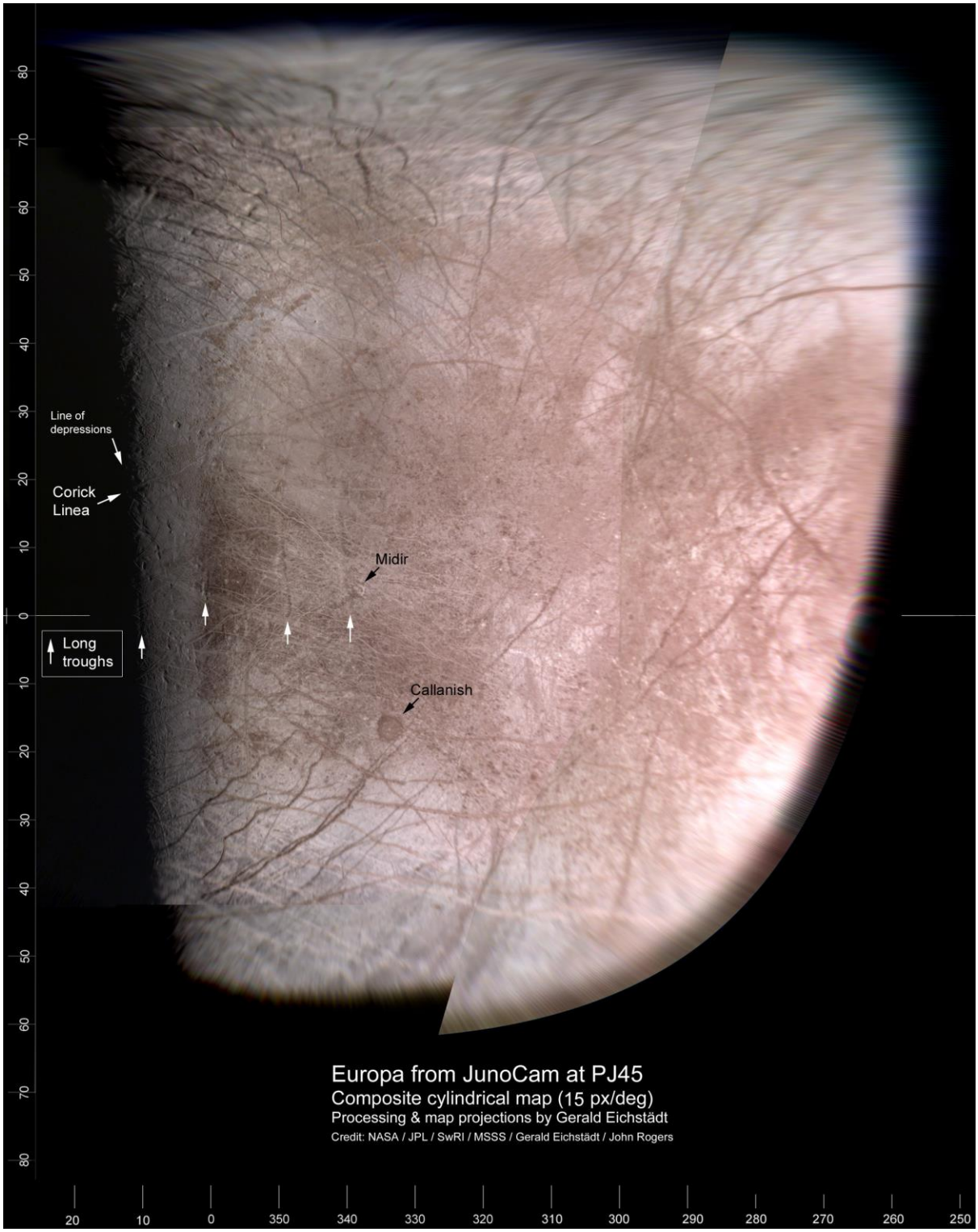
Line of depressions
Corick Linea
Midir
Long troughs
Callanish
Europa from JunoCam at PJ45
Composite cylindrical map (15 px/deg)
Processing & map projections by Gerald Eichstädt
Credit: NASA / JPL / SwRI / MSSS / Gerald Eichstädt / John Rogers
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
20
10
0
350
340
330
320
310
300
290
280
270
260
250

Figure 4

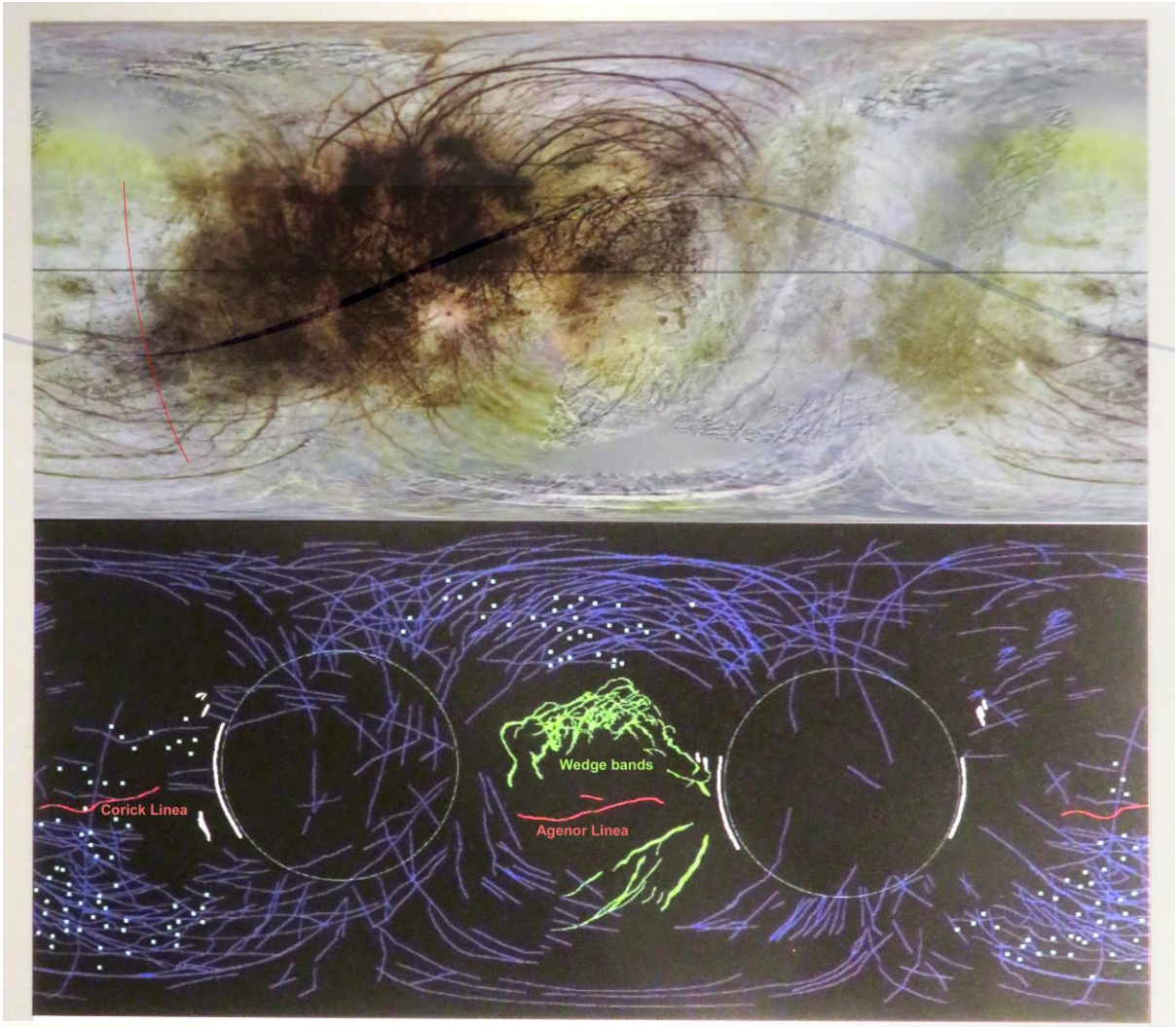

Figure 5.3.4 This "altered" global mosaic shows how Europa's geography might have looked before polar wander of the outer ice shell shifted its rotational orientation. Below the mosaic is a simplified map showing the major features of Europa. Compare this mosaic to Plate Je, the global map of Europa as we see it today. From this new perspective, a strong symmetry is now apparent either side of the paleo-equator (the dark line across center) despite major gaps in our mapping coverage. Very long arcuate lineations, mostly dark bands (blue in the map), form symmetric patterns that converge toward two opposite regions (large circles on the map) located on the paleo-equator. Small dark freckles (cyan) resolved as lenticulae are also common through this zone on both sides. The long bands also enclose a concentration of both shorter dark dilational bands (green) and the unusual bright bands Agenor and Corrick Linea (red) along the paleo-equator. This symmetric pattern fits very well with the stress patterns predicted if Europa's icy shell rotated almost 90°, shifting polar terrains to the equator. The author and colleagues Isamu Matsuyama and Francis Nimmo proposed this scenario in 2008, almost 30 years after *Voyager* first mapped Europa.

Curves added to the upper map show approximate positions of the present equator (grey) and the PJ45 terminator (red).

Adapted from: P. Schenk, *Atlas of the Galilean Satellites* p.39 (Cambridge Univ. Press, 2010).
Original ref: P. Schenk, I. Matsuyama & F. Nimmo (2008), Nature 453, 368. 'True polar wander on Europa from global-scale small-circle depressions'.
Also see: R. Greenberg (2004), Icarus 167, 313. 'The evil twin of Agenor: tectonic convergence on Europa'.

Figure 5