Ian, I read your essay on the lunar list server, in particular your brief comments about the lunar impact history. I agree with your comment that it would be valuable to date younger mare surfaces in the age range of 1-3 Gyr. But, I argue not just to fill in details of what some suppose to be a constant flux over the past ~3500 Myr, but also because such data may reveal spikes in this flux curve. Of course, doing this requires not only age dateable basalts, but also that they derive from documented surfaces of sufficiently large area that crater densities can be determined for them. There is one crater whose age may fall in the time interval of 1 to 3 Gyr. This is Autolycus, for which the data were presented in a paper by Graham Ryder and myself (Geology 19, p.143, 1991). Of course association of the age with the crater is indirect, and probably not as strong as for Copernicus.

Concerning possible spikes in the flux curve, several workers have made this suggestion (e.g., Levine et al., GRL 32, L15201, 2005). The attached PPT file shows the lunar flux curve and the data that define it. Note that Copernicus and Autolycus plot slightly above the curve defined by a few recent (<100 Myr) craters and some younger mare surfaces ~3.1-3.5 Gyr in age. There may be an explanation for this. Schmitz and co-workers in a series of papers have given fossil evidence for a large amount of L-chondrite material falling on Earth ~470 Myr ago and suggest that the impact flux may have been higher by 2 orders of magnitude for 10-30 millions of years (e.g., Science 300, p.961, 2003; MaPS 41, A159, 2006). Copernicus, 800 Myr in age, falls about 62% above the constant flux curve in the attached file.

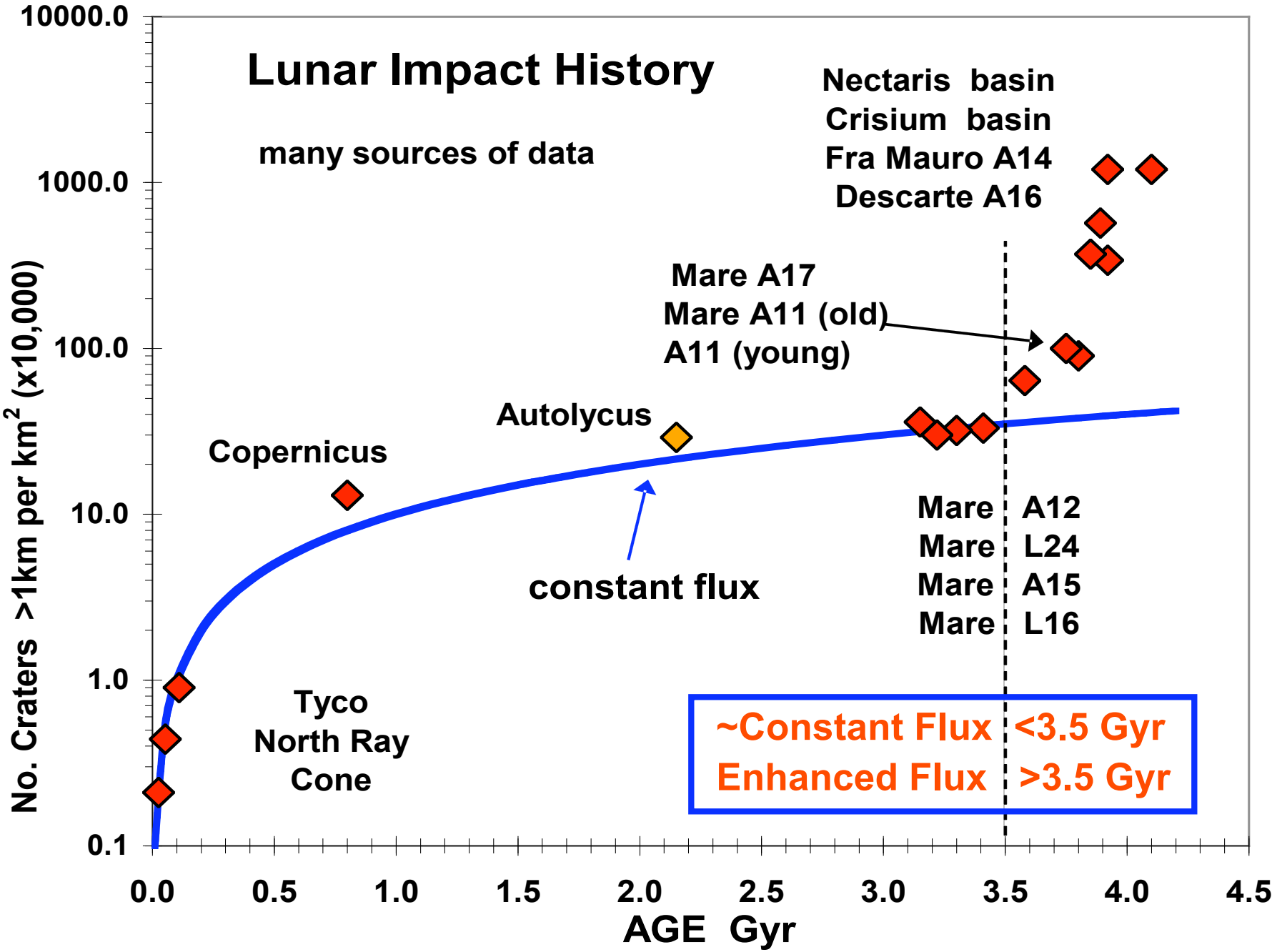
IF Copernicus falls above the curve because of the impact flux spike ~470 Myr ago, then 62% of 800 Myr implies that it has a crater excess equivalent to about 500 Myr, measured against normal flux. The extra 500 Myr from Copernicus is equivalent to a factor of 50 flux increase for 10 Myr or a factor of 20 flux increase for 25 Myr. Thus, Copernicus data may be consistent with fossil evidence for an enhanced impactor flux of L-chondrites ~470 Myr ago.

The young (<100 Myr) craters would not reflect this enhanced flux, and the old mare surfaces would show a crater anomaly of only ~14%. I suspect uncertainty in various data that define the constant flux curve would not reveal a 14% anomaly.

The data for Autolycus suggest an enhanced flux of ~700 My, or slightly more than that indicated by Copernicus. (It falls closer to the curve than Copernicus, but it is older in age.). However, the data for Autolycus are more uncertain, so I consider this not a disagreement.

The point is that both the flux curve as shown in the file AND those data falling above the curve may be real. We require more lunar data.

Regards, *Donald Bogard, ARES, Code KR, NASA/JSC*


Lunar Impact History
many sources of data
Nectaris basin
Crisium basin
Fra Mauro A14
Descarte A16
Mare A17
Mare A11 (old)
A11 (young)
Autolycus
Copernicus
constant flux
Mare A12
Mare L24
Mare A15
Mare L16
Tyco
North Ray
Cone
~Constant Flux <3.5 Gyr
Enhanced Flux >3.5 Gyr
No. Craters >1km per km2 (x10,000)
10000.0
1000.0
100.0
10.0
1.0
0.1
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
AGE Gyr