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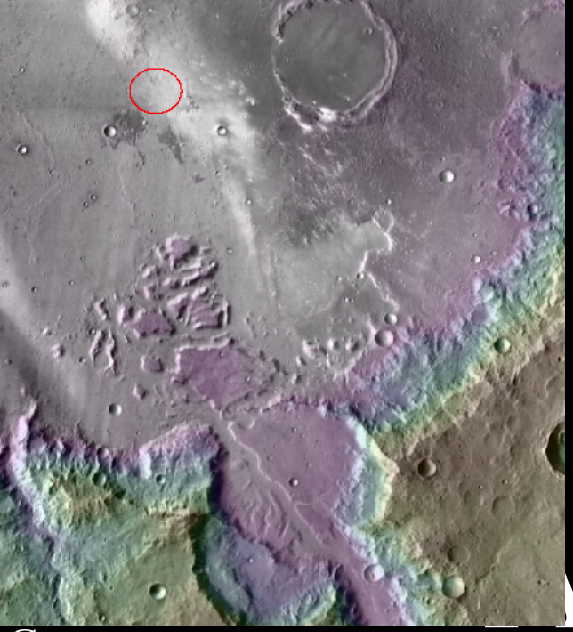


Gusev crater

NE syrtis, Midway, Jezero

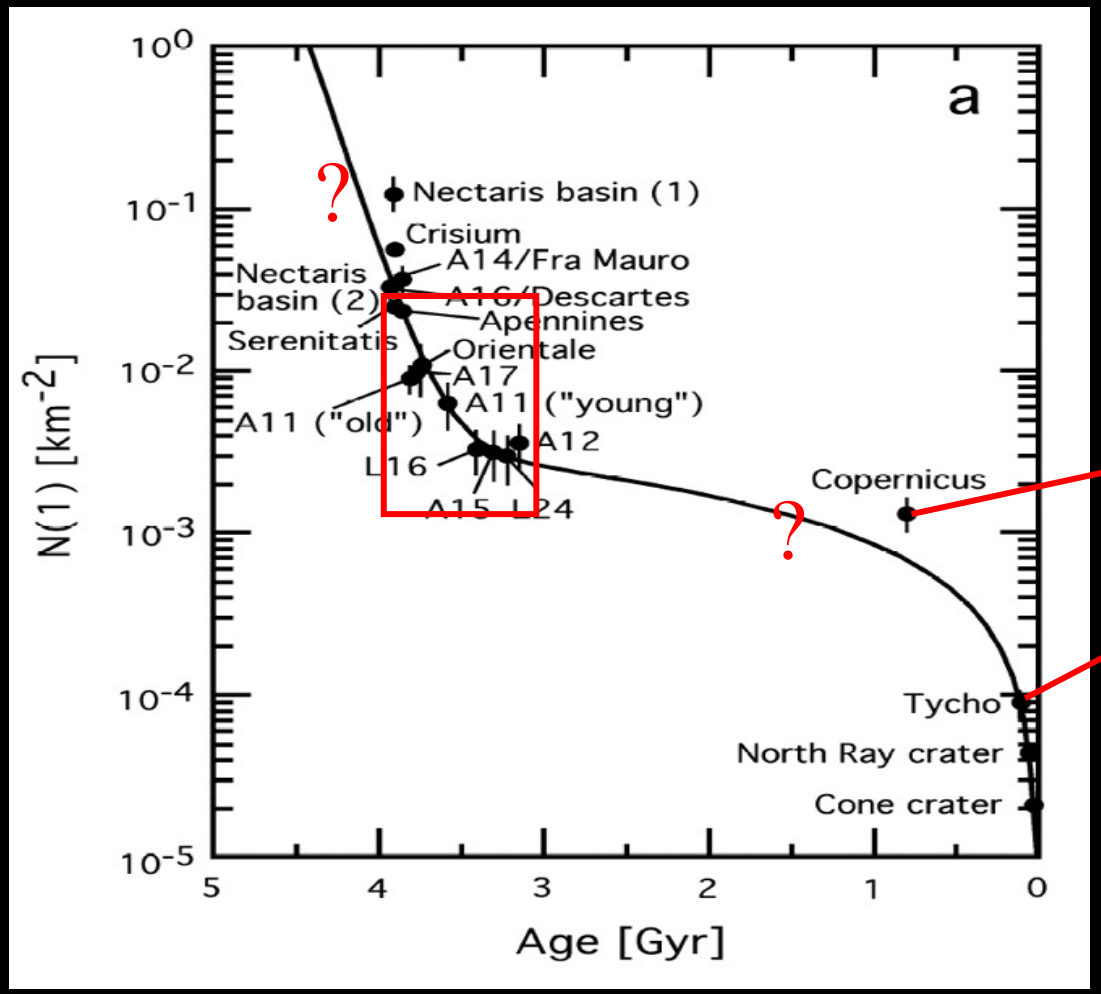
Age diversity of landing sites

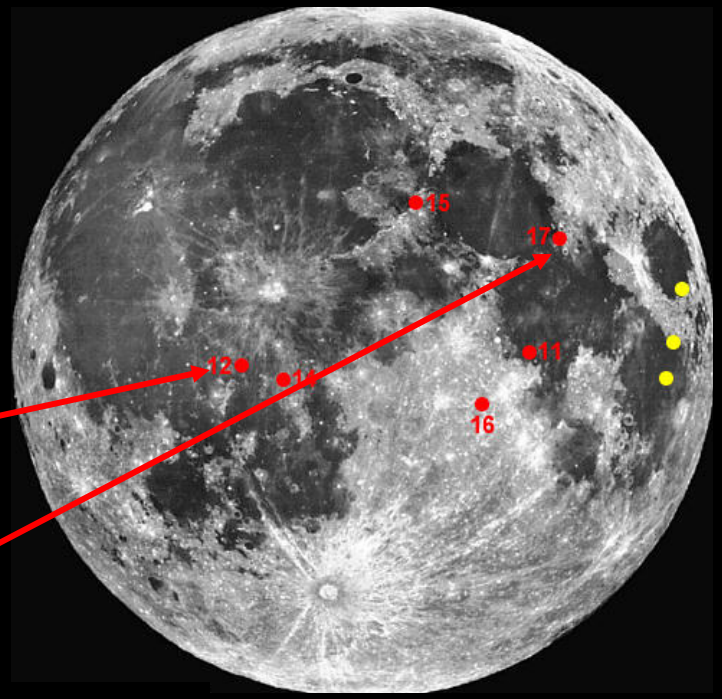
Quantin-Nataf C.[1], Mandon L.[1], Bultel B.[2], Werner S.[2]

[1] University of Lyon (France)

[2] University of Oslo (Norway)

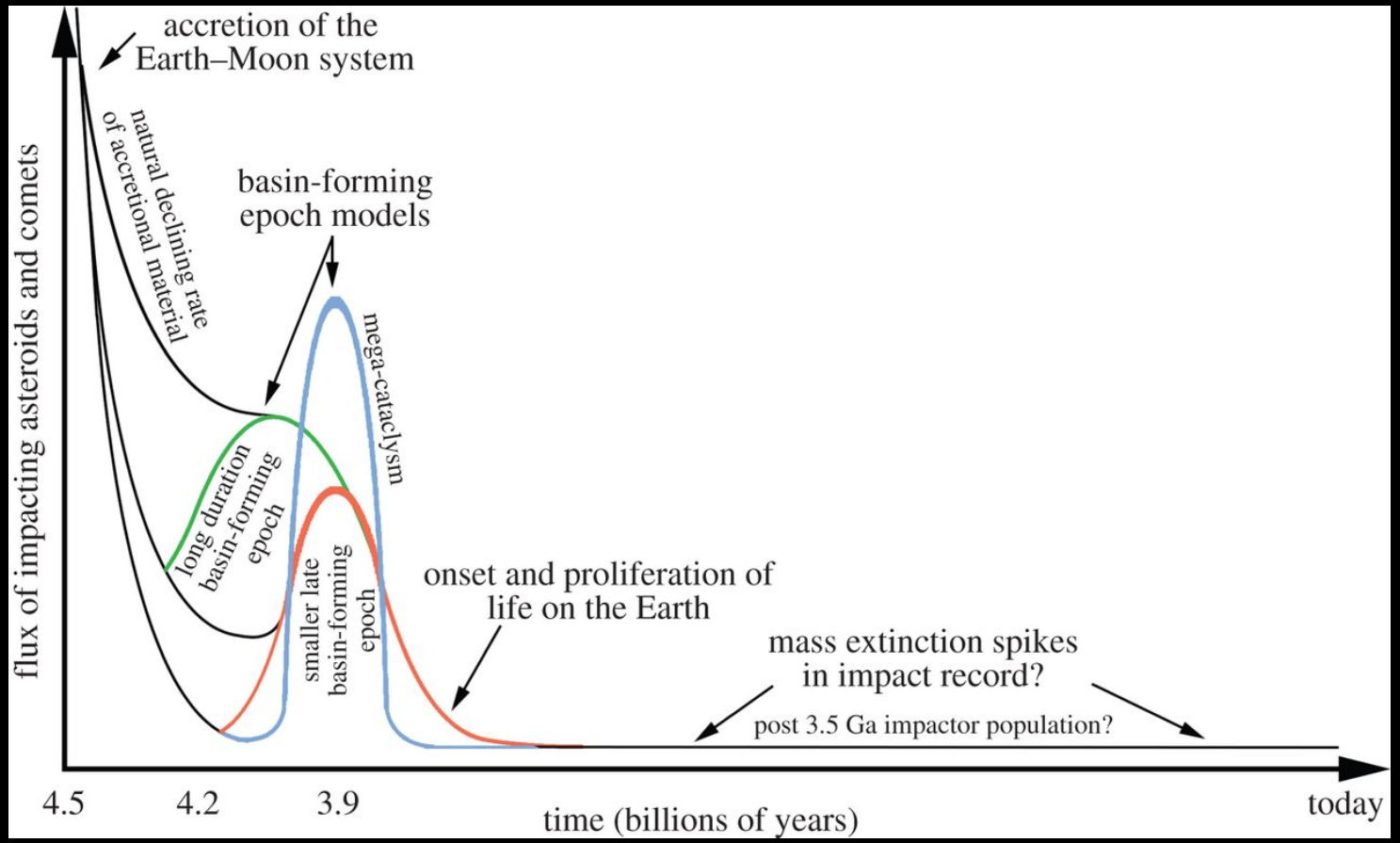
Uncertainty on Lunar Cratering Chronology





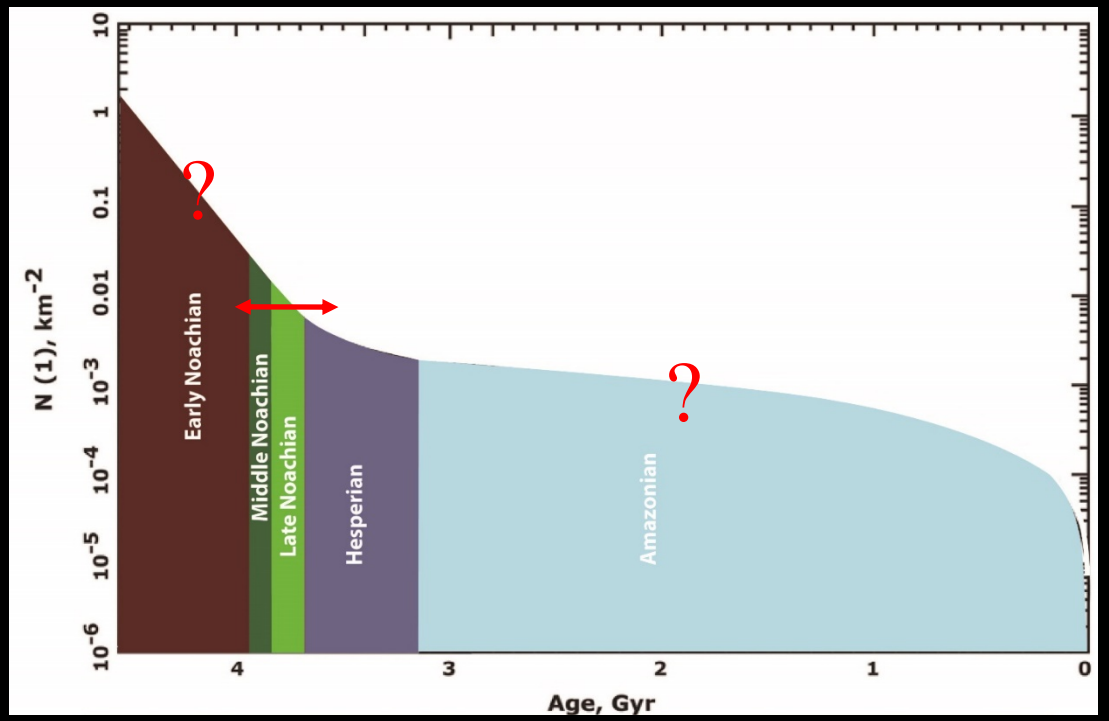
Stoffler et al. (2006)

Uncertainty on Lunar Cratering Chronology

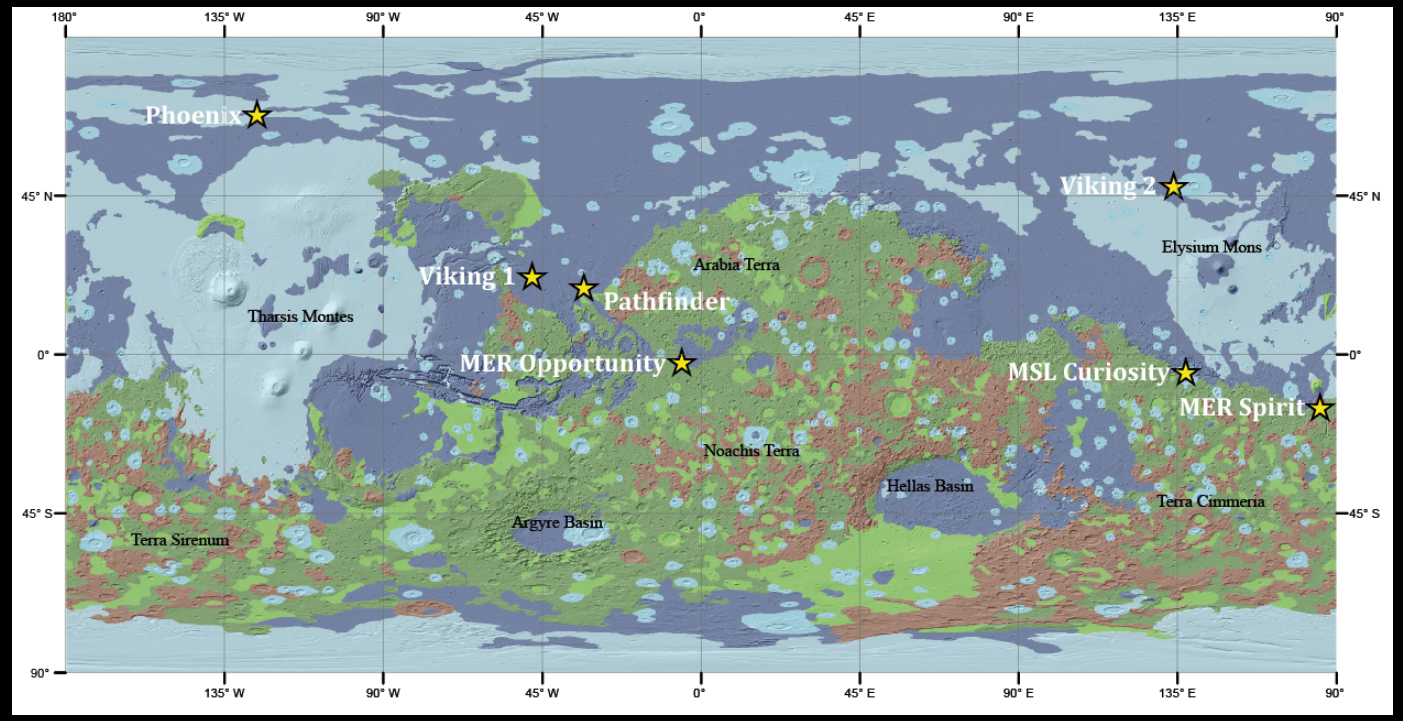


Crawford and Joy, 2014

Mars : chronology, uncertainty and weakness



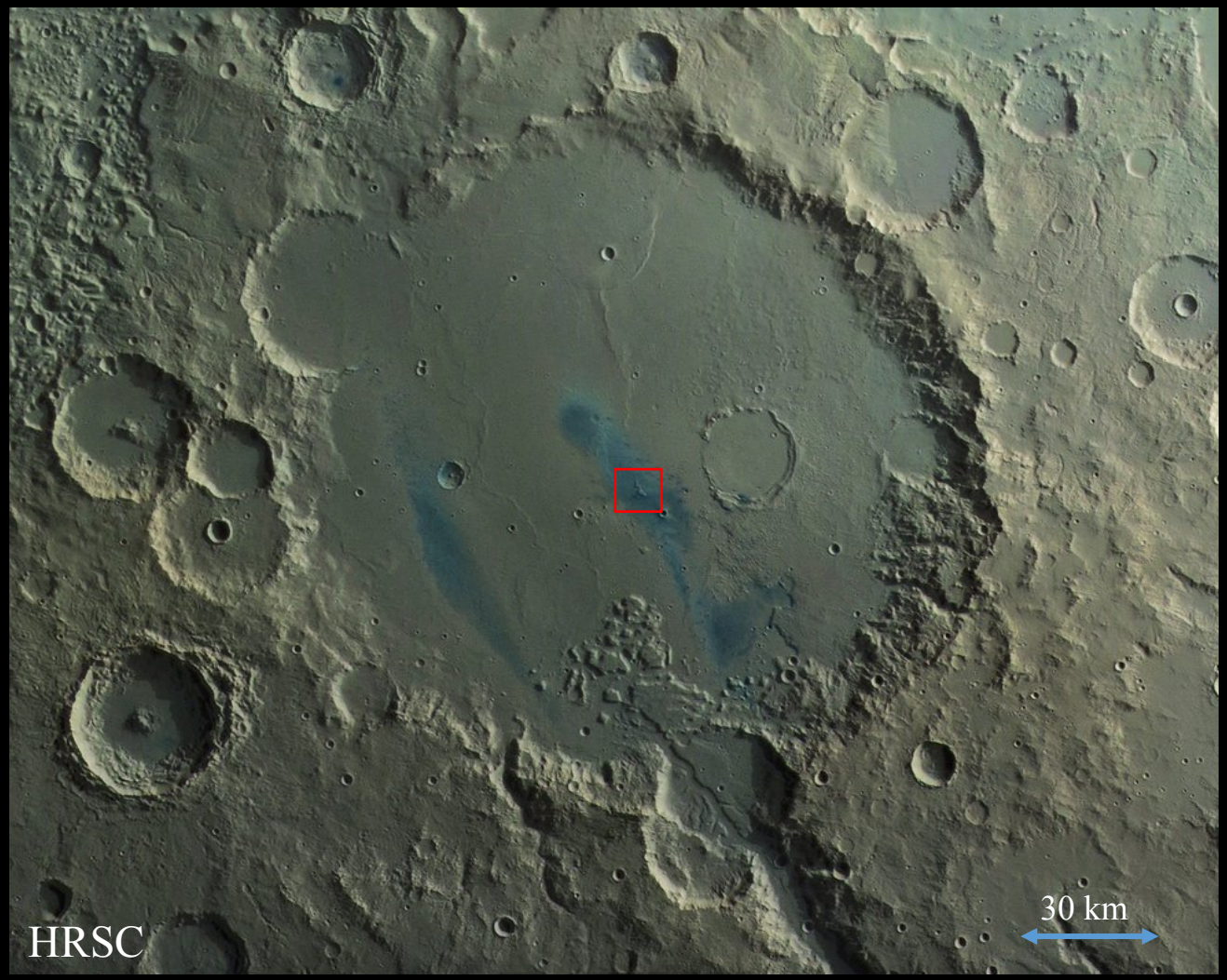
Modified from Hartmann and Neukum (2001)

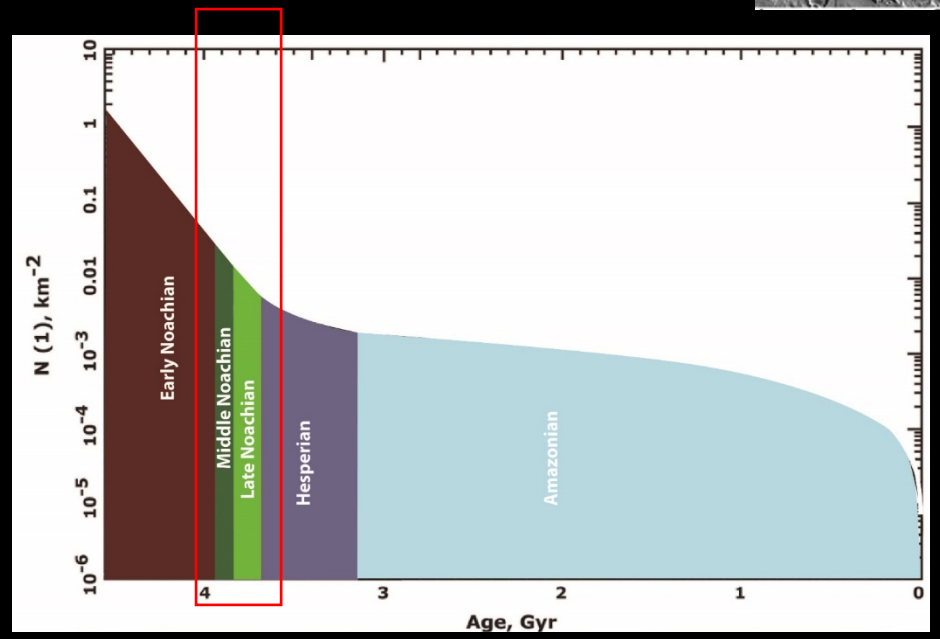


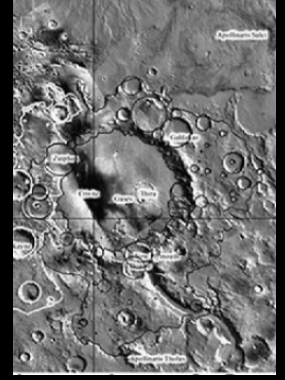
From Tanaka et al., (2014)

Uncertainties of at least 200 My for ages >3.7 Gy (Werner et al., 2014) and uncertainties muc larger for Amazonian period

Gusev crater-based chronostratigraphy



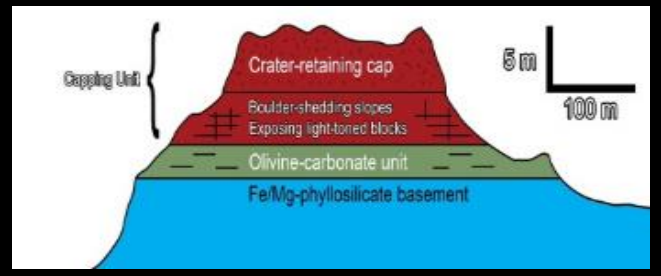




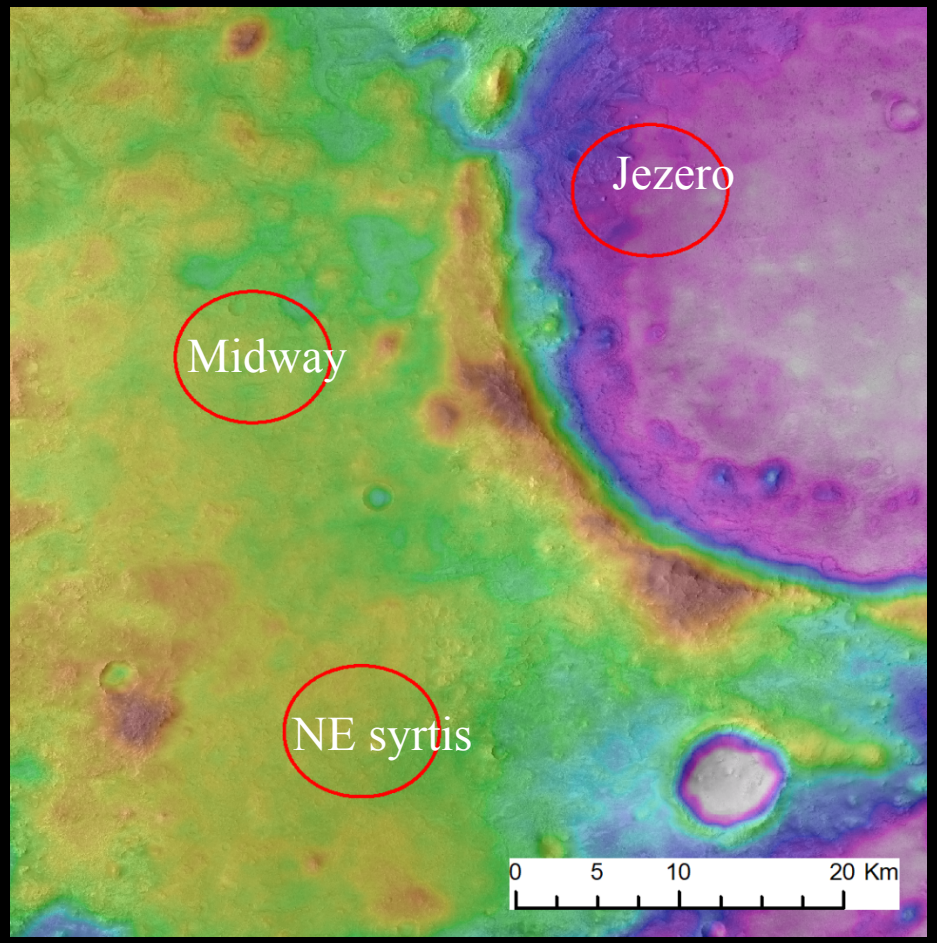
Crater formation : 4.1-3.9 Gy (Werner, 2008)
Early to middle Noachian

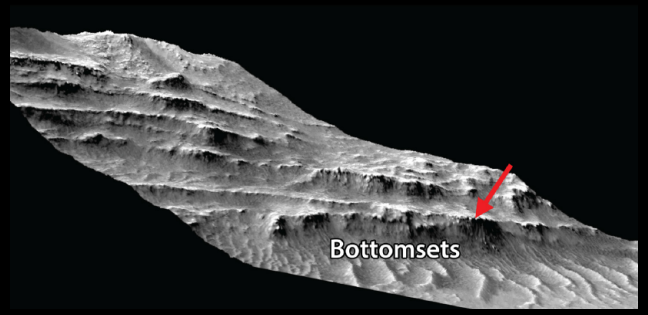
Volcanic infilling: 3.65 Gy (Greeley et al., 2005)

Main Stratigraphic units of NE syrtis, Midway and Jezero



Bramble et al., 2017





Youngest

Capping unit

Regional Olivine/carbonate unit

Altereted Basement

Oldest

From Bramble et al., 2017

Youngest

Floor unit

Deltaic deposits

Regional Olivine/carbonate unit

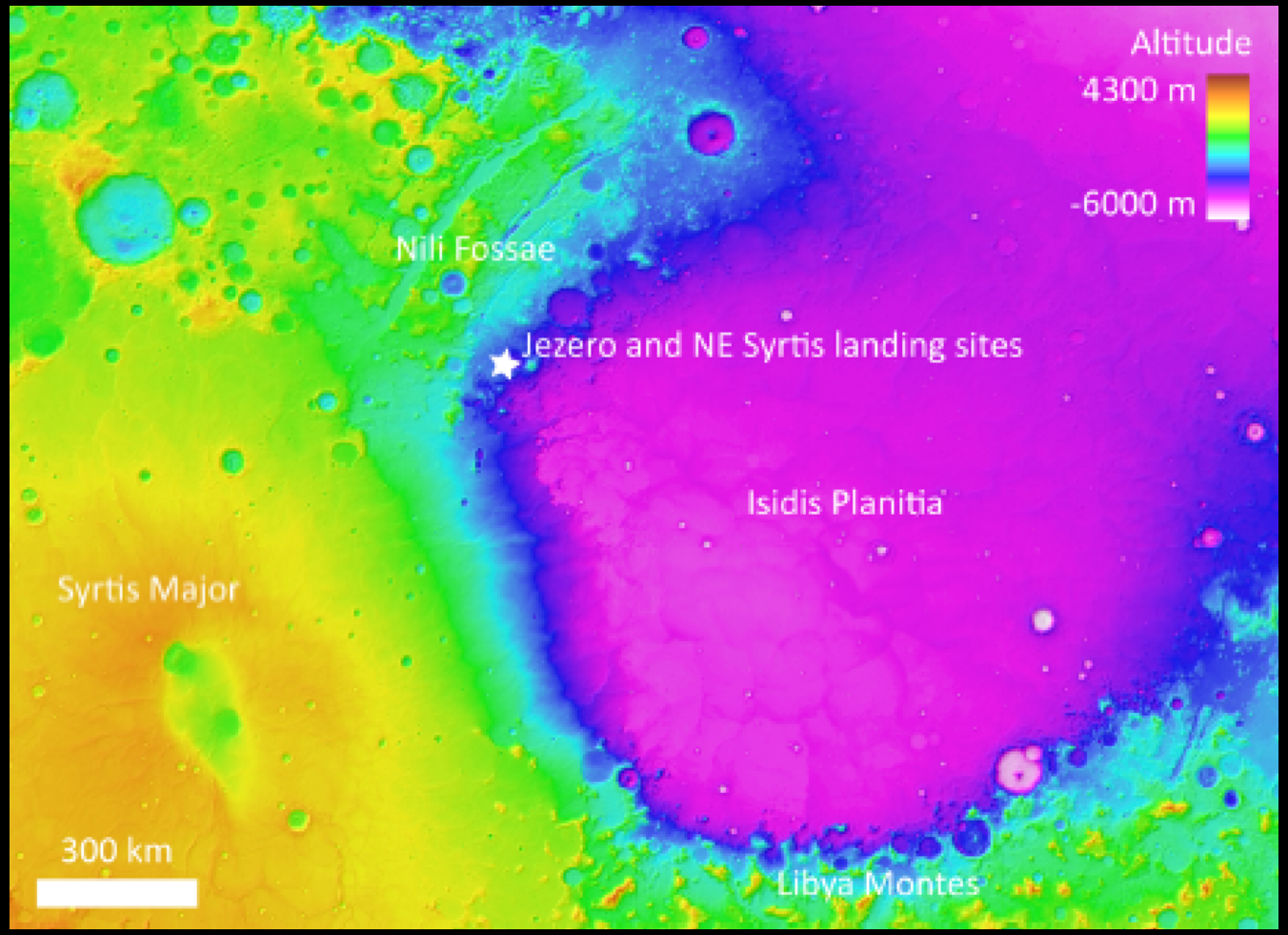
Jezero formation

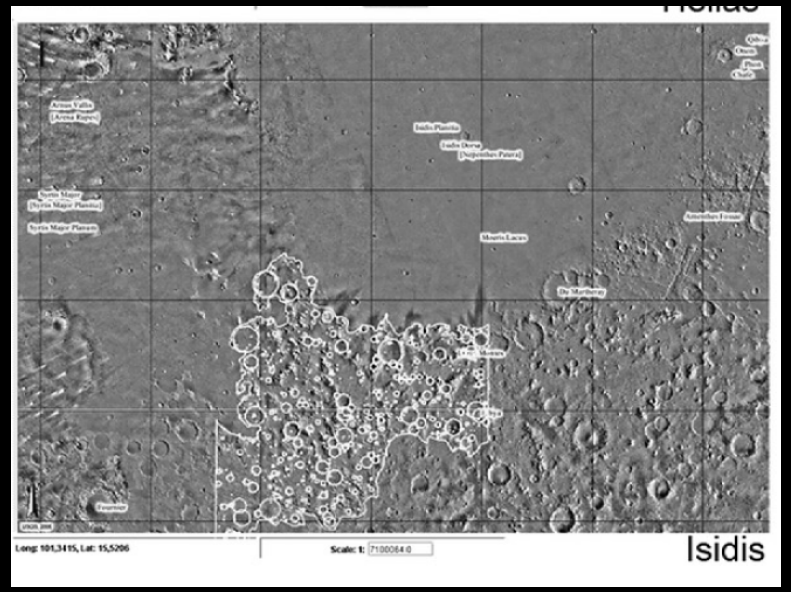
Oldest

From Goudge et al., 2015,

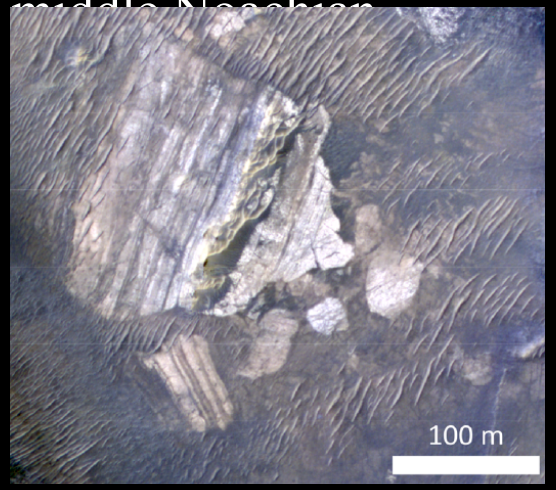
NE Syrtis and midway basement

- Noachian basement and Isidis formation





Isidis basin formation : 3.85 and 4.06 Gy (Werner, 2008)
Early to middle Noachian

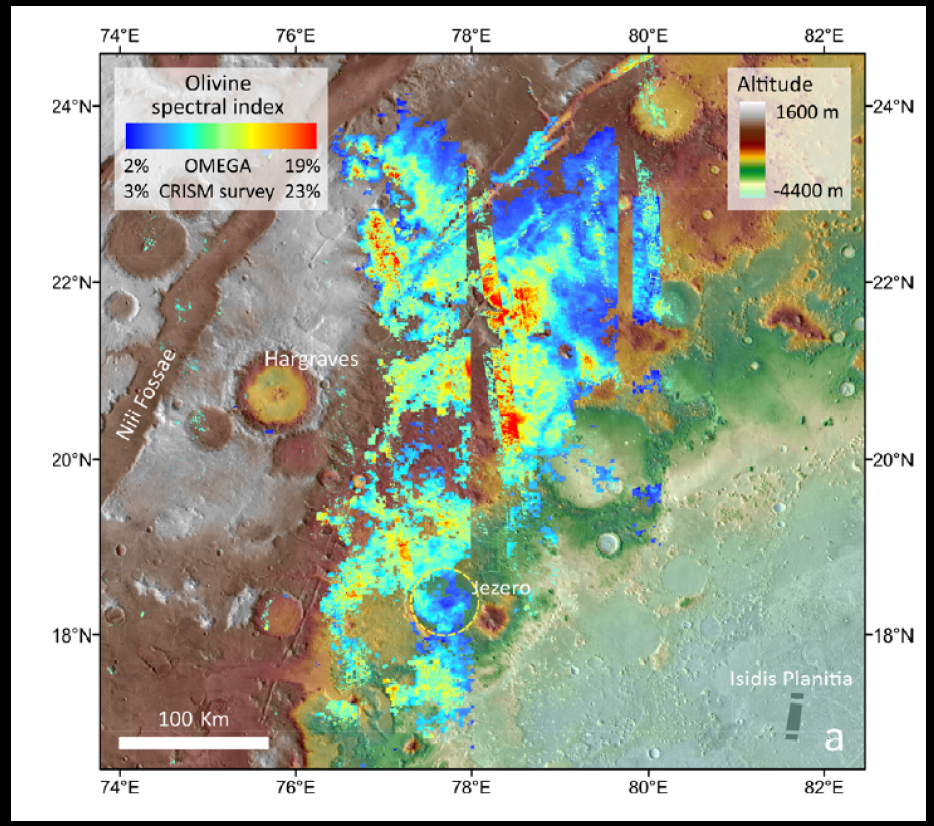


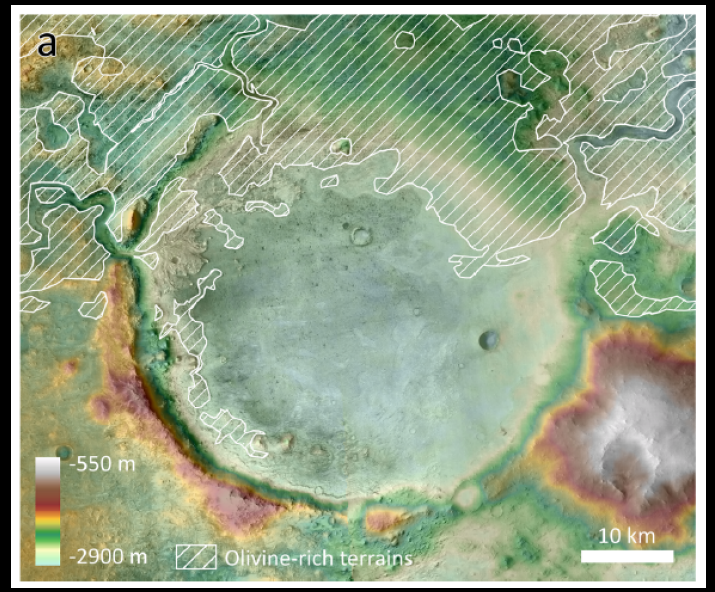
Megabreccias (Weiss et al., 2018) : > Isidis /Early Noachian

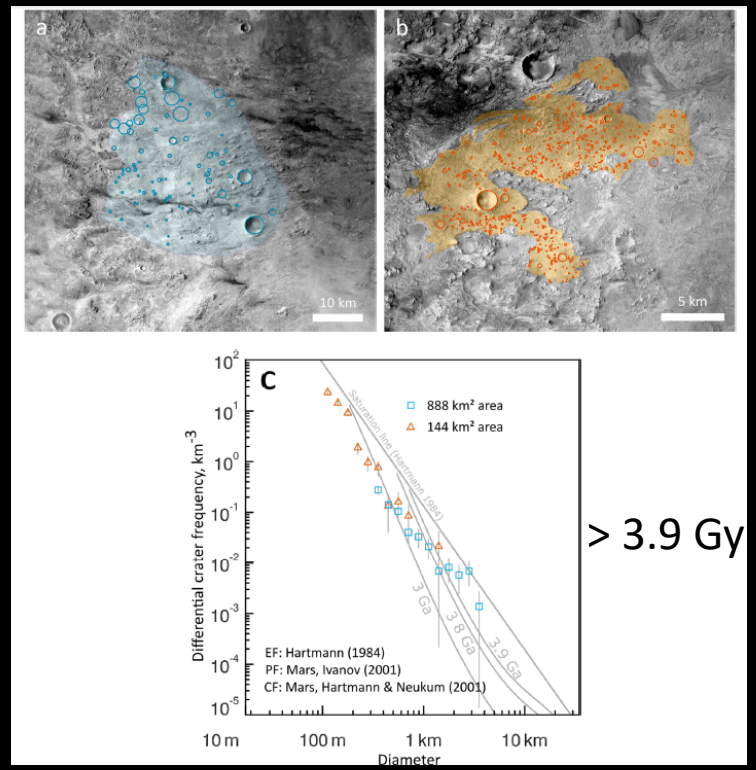
Jezero Formation

Olivine rich unit > 3.9 Gy

Jezero>Olivine rich unit> 3.9 Gy



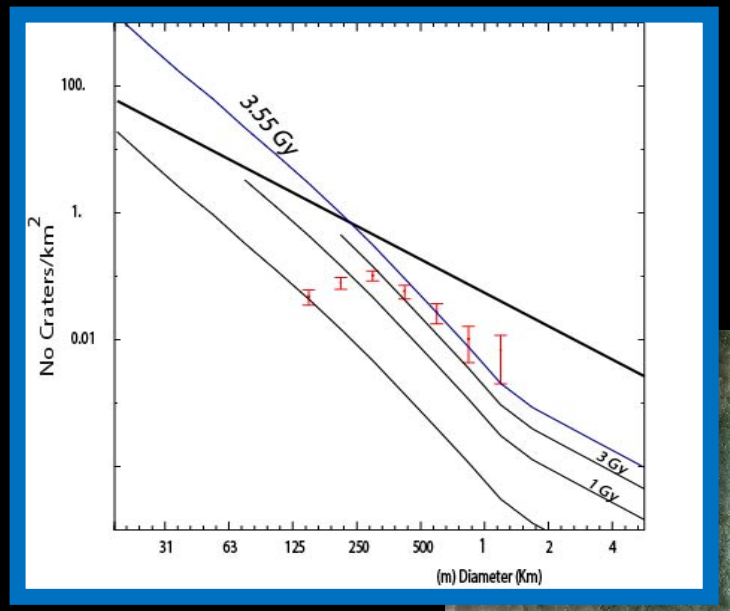




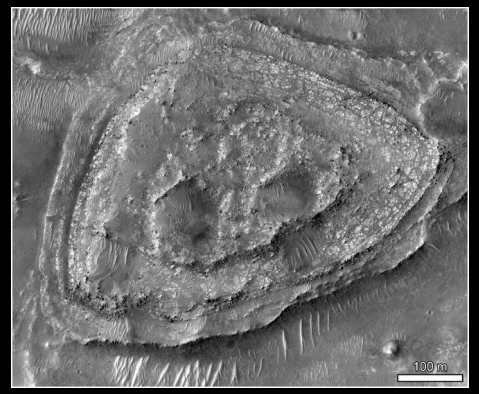
> 3.9 Gy

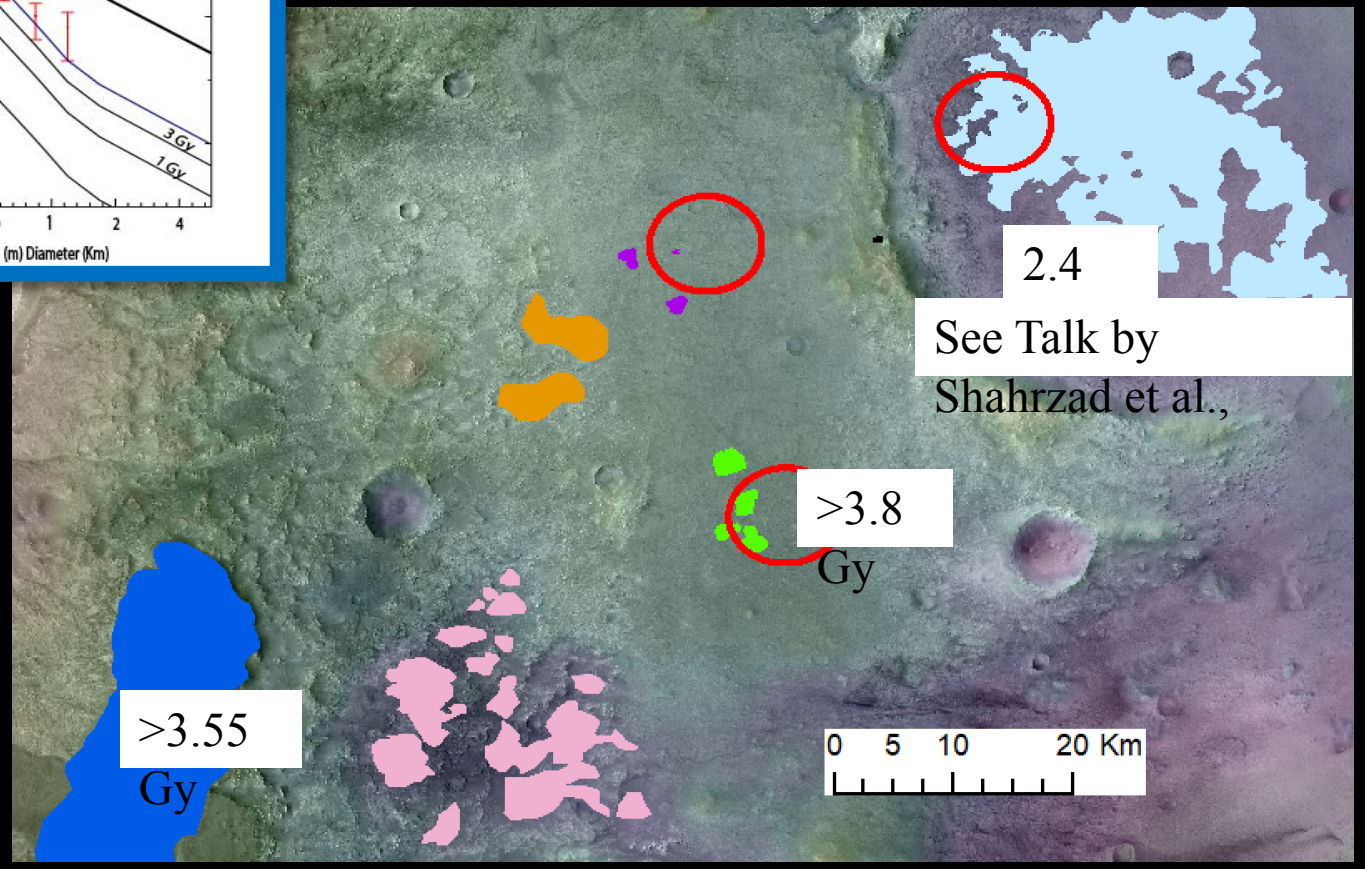
Mandon et al., submitted , 2018

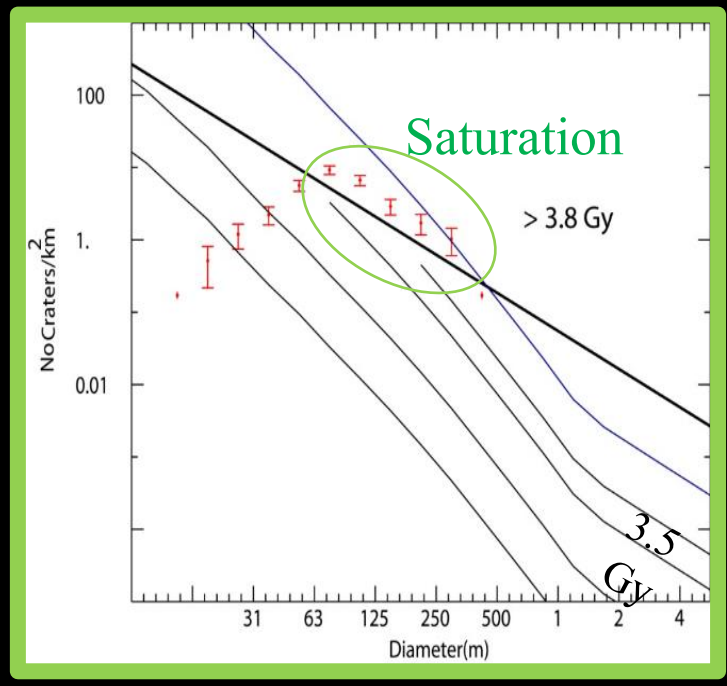
Crater-based ages of the crater-retaining units



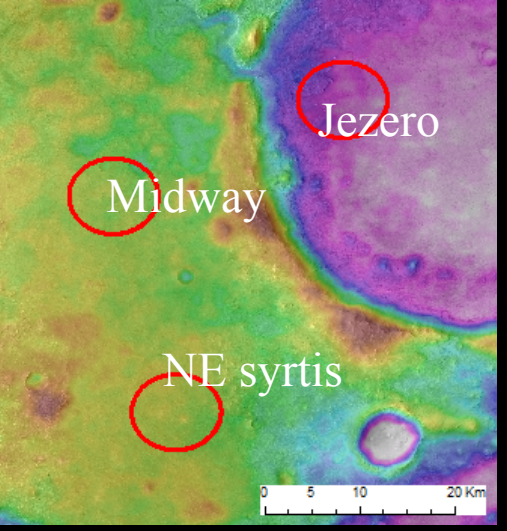
Syrtis lava flow







NE syrtis mesa's caps



Chronostratrigraphy of NE syrtis, Midway and Jezero

NE syrtis, Midway

Youngest

Capping unit	Noachian
Olivine/carbonate unit	Middle noachian
Altereted Basement	>Early to middle noachian

Oldest

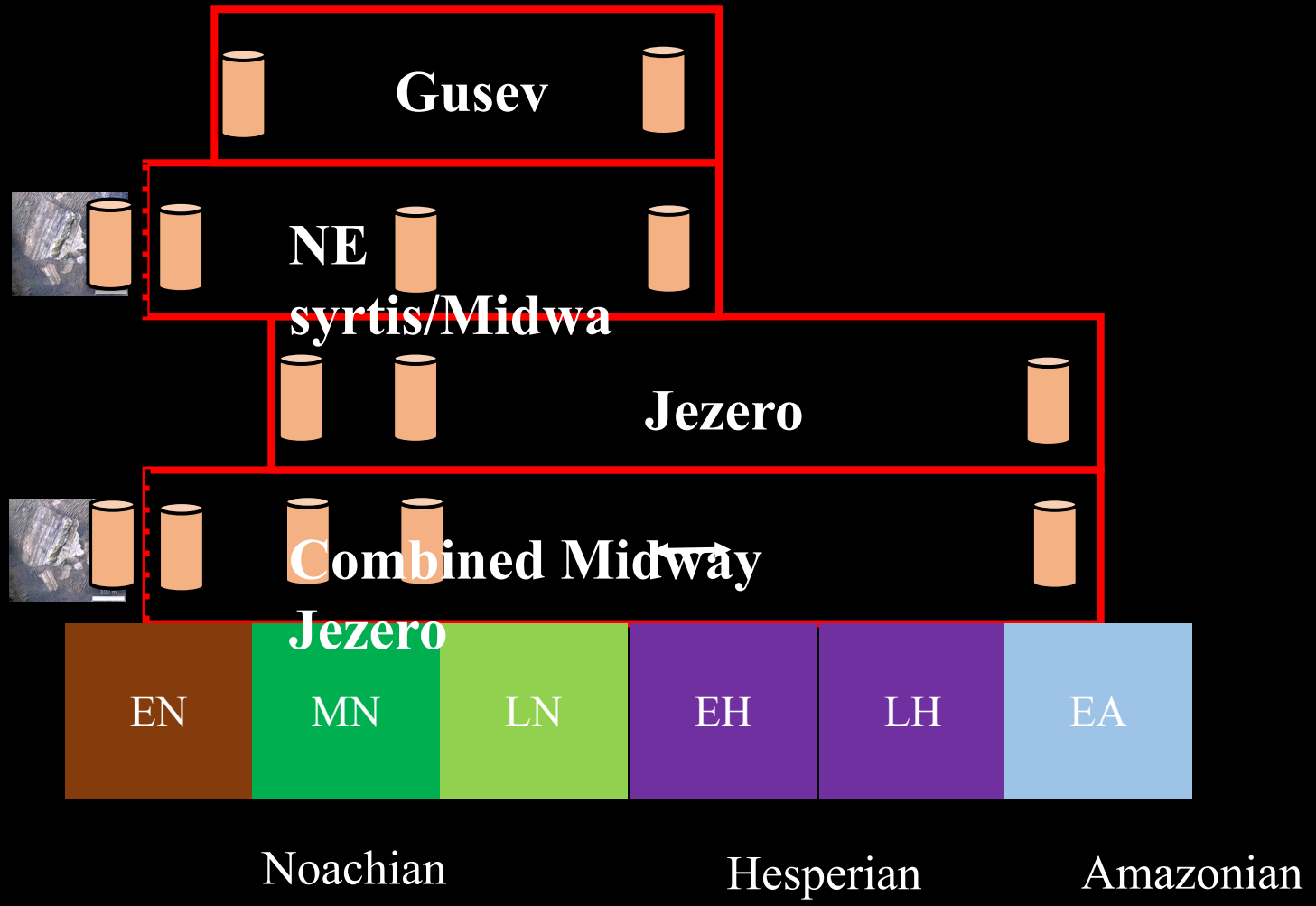
Jezero

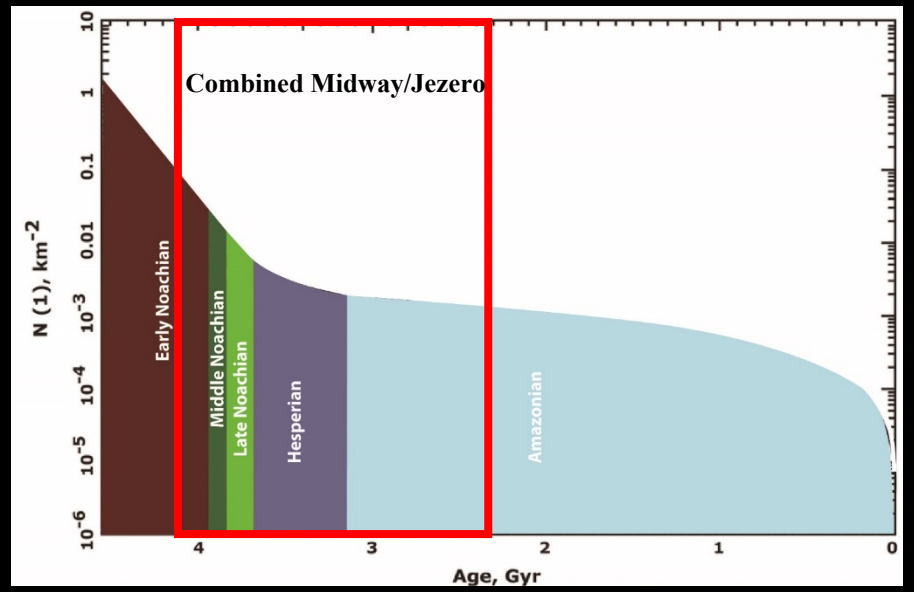
Youngest

Floor unit	Early Amazonian
Deltaic deposits	
Olivine/carbonate unit	Middle noachian
Jezero formation	Middle noachian

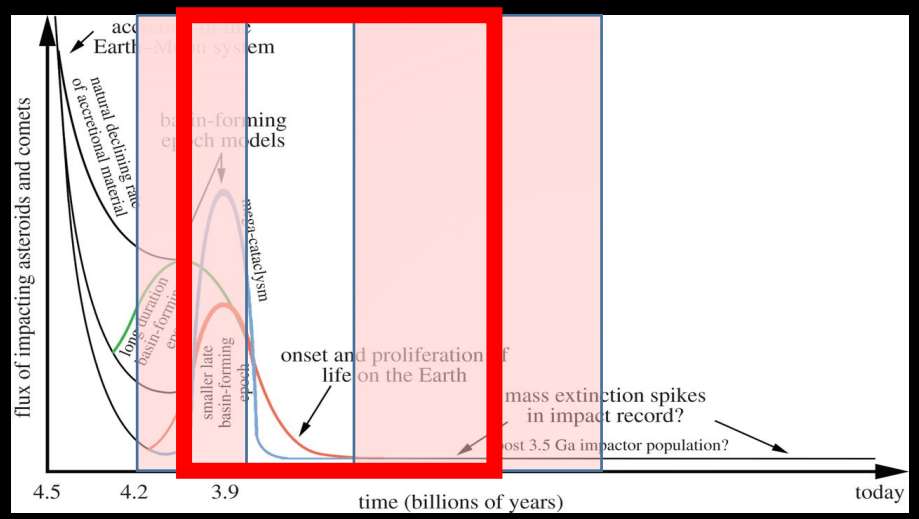
Oldest

Conclusions





Modified from Hartmann and Neukum (2001)



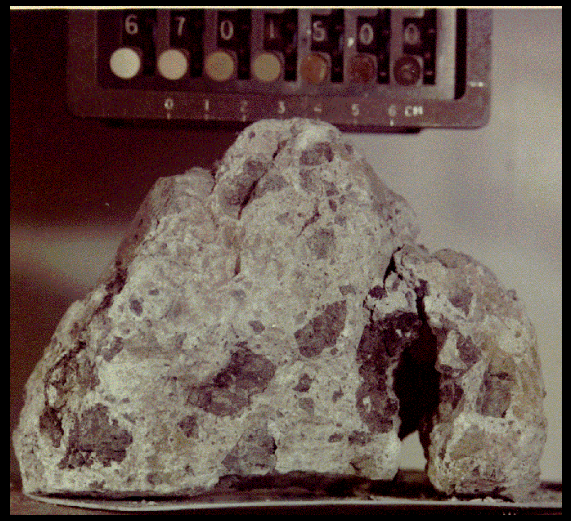
Modified from Crawford and Joy, 2014

Supplementary material
ability to date impact basin

Samples from Apollo 16 used to date Nectaris impact basin formation (attributed to Nectaris ejectas)

Stoeffler and Ryder, 2001

Sample*		Description	^{40}Ar–^{39}Ar	Rb–Sr
Fragmental breccias	14064,31	KREEP melt clast	3.81 ± 0.04	
	67015,320	feldspathic melt blobs	3.90 ± 0.01	
	67015,321	VHA melt blob	3.93 ± 0.01 (K–Ar)	
Glassy breccias and glass	61015,90	coat	1.00 ± 0.01	
	63503 particle lm	glass fragment	2.26 ± 0.03	
	67567,4	slaggy bomb	0.84 ± 0.03	
	67627,11	slaggy bomb	0.46 ± 0.03	
	67946,17	slaggy bomb	0.37 ± 0.04	
Crystalline melt breccias	14063,215	poikilitic impact melt	3.89 ± 0.01	
	14063,233	aphanitic impact melt	3.87 ± 0.01	
	14167,6,3	melt	3.82 ± 0.06	
	14167,6,7	melt	3.81 ± 0.01	
	15294,6	poikilitic, Gp.Y	3.87 ± 0.01	
	15304,7	ophitic, Gp. B	3.87 ± 0.01	
	15356,9	poikilitic, Gp. C	3.84 ± 0.01	
	15356,12	poikilitic, Gp. C	3.87 ± 0.01	
	60315,6	poikilitic	3.88 ± 0.05	
	63503 particle 1c	VHA?	3.93 ± 0.04	
	65015	poikilitic	3.87 ± 0.04	3.84 ± 0.02
	65785	ophitic	3.91 ± 0.02	
	72215,144	aphanite; felsite melts	3.83 ± 0.03	
	72255	aphanite; felsite melts	3.85 ± 0.04	
	72215,238b	aphanite	3.87 ± 0.02	
	73215	aphanite; felsite melts		3.84 ± 0.05
	77075,18	veinlet (Serenitatis)	3.93 ± 0.03	
	72395,96	poikilitic (Serenitatis)	3.89 ± 0.02	
	72535,7	poikilitic (Serenitatis)	3.89 ± 0.02	
	76055	magnesian, poikilitic	3.92 ± 0.05	
	76055,6	magnesian, poikilitic	3.78 ± 0.04	
	76055,6	magnesian, poikilitic		3.78 ± 0.04
Clast-poor impact melts	14073	subophitic 14310-group		3.80 ± 0.04
	14074	subophitic 14310-group	3.80 ± 0.04	
	14276	subophitic 14310-group		3.80 ± 0.04
	14310	subophitic	3.88 ± 0.05	3.79 ± 0.04
	14310	subophitic; plag	3.82 ± 0.04	
	65795	subophitic, very feldspathic		3.81 ± 0.04
	60635	subophitic, 68415-group		3.75 ± 0.03
	65055	subophitic, 68415-group	3.89 ± 0.02	
	67559	subophitic, 68415-group		3.76 ± 0.04
	68415	subophitic	3.80 ± 0.06	3.76 ± 0.04
	68416	subophitic, 68415-group		3.71 ± 0.02
Granulitic breccias and granulites	14063,207		3.90 ± 0.02	
	14179,11	clast	3.97 ± 0.01	
	15418,50		3.98 ± 0.06	
	67215,8		3.75 ± 0.11	
	67415		3.96 ± 0.04	
	67483,13,8		4.20 ± 0.05	
	72255,235b	clast	3.85 ± 0.02	



Breccia attributed to Nectaris (Apollo 16 sample 67015) NASA/Johnson Space Center photograph S72-37216.