Impact Crater Degradation and the Timing of Resurfacing events in Oxia Planum

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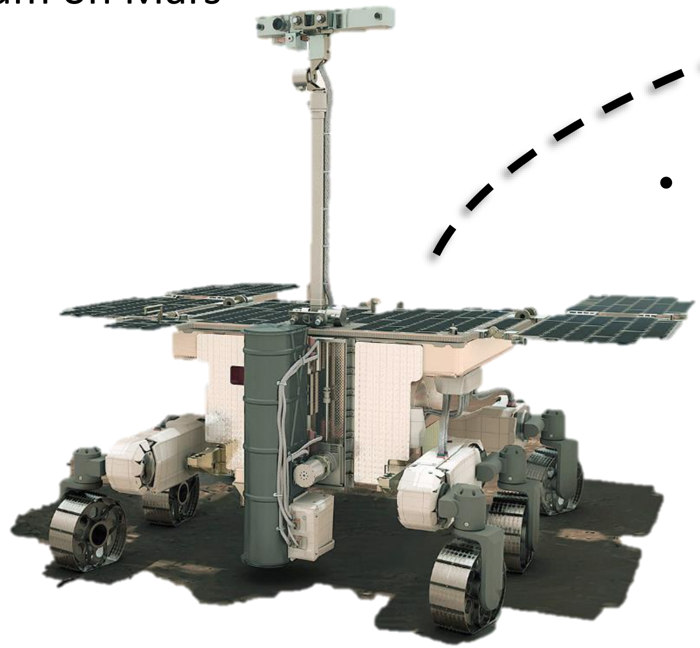
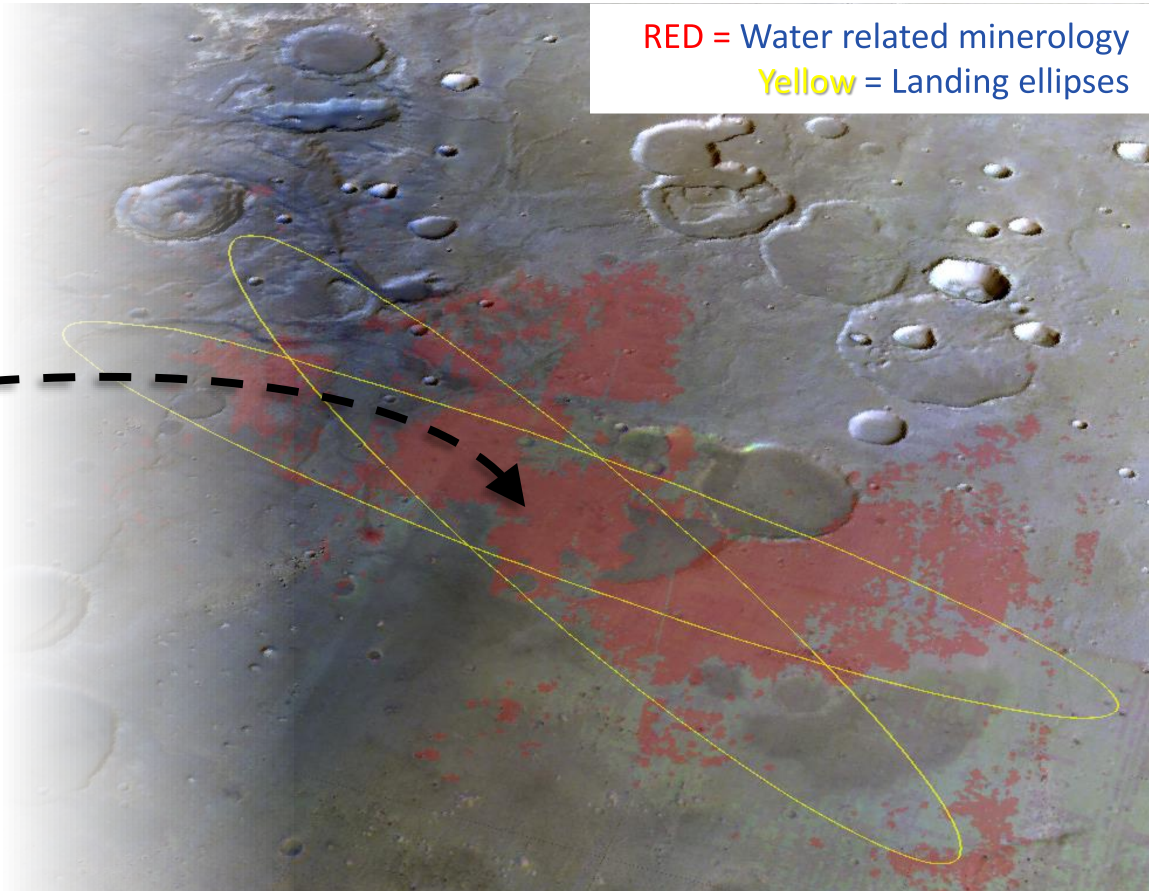
- In 2022 the ExoMars rover *Rosalind Franklin* is going to Oxia Planum on Mars



- Oxia Planum was chosen because it formed when condition on mars where most likely to have been able to support life



But how old is Oxia Planum and when did the important events in its geological history occur?

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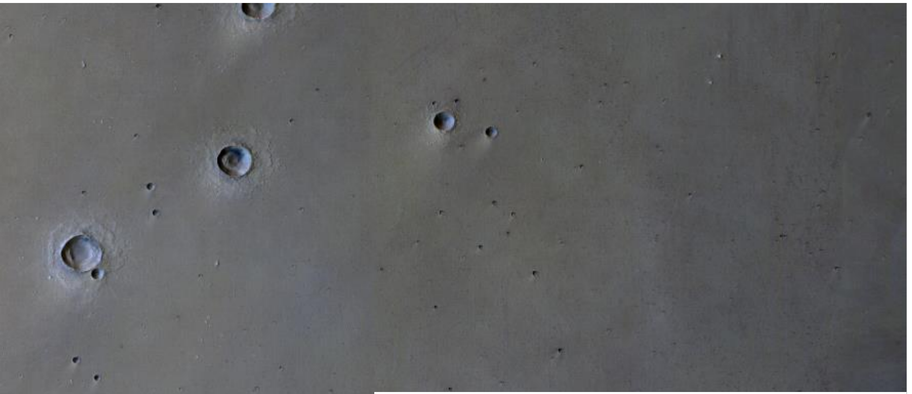
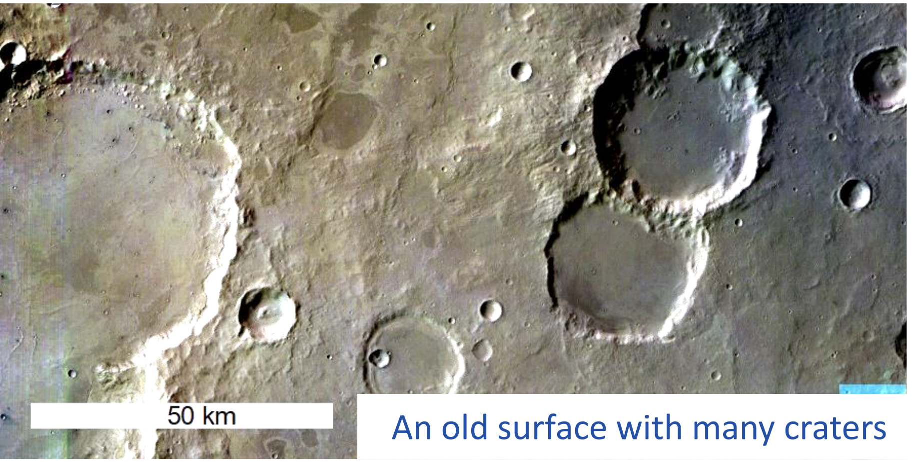
How old is the surface?

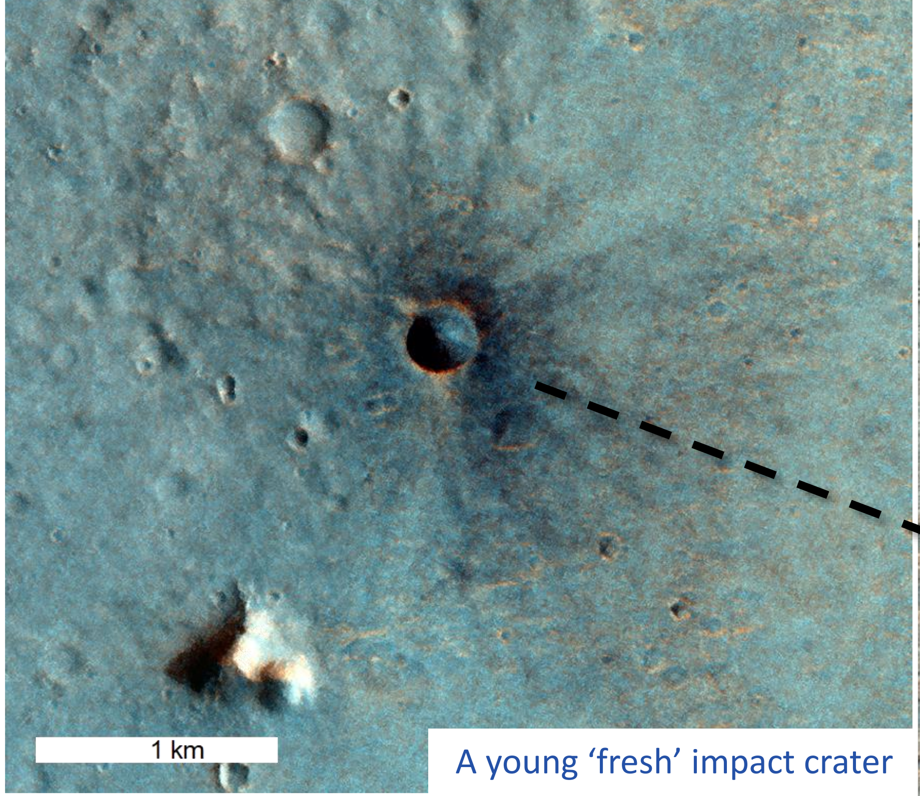
- To determine how old the surface of a planet is we can look at the number and sizes of impact craters have accumulated there.



A young surface with few craters

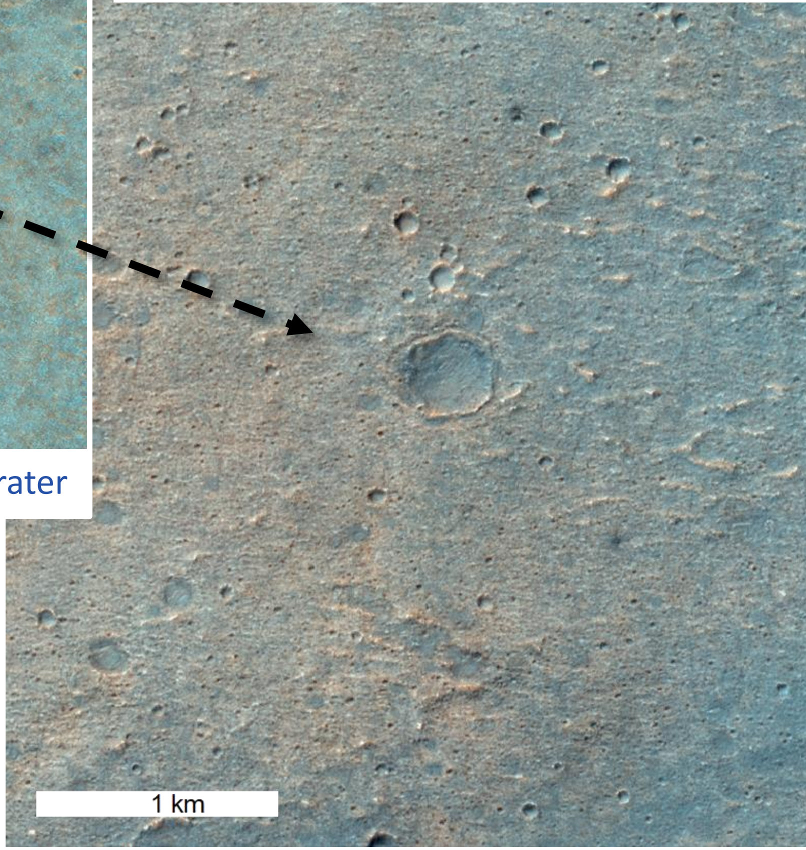


An old surface with many craters



A young 'fresh' impact crater

An older eroded and infilled impact crater



- Over time individual impact craters will become eroded by the various processes that happen on the planets surface

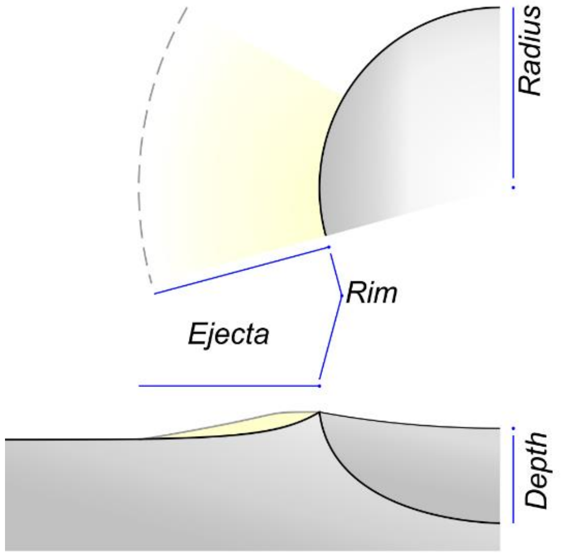
we have looked at the size frequency distribution of impact craters with different amounts of erosion

Images Credits: HRSC (DLR, FUB) CASSIS (UoB, UA)

Degradation morphologies

- We created classification scheme to recorded how each a crater has been modified from a ‘fresh’ shape for four aspects of it morphology
- Examples of craters with the less degraded (top) and more degraded (bottom) morphology in each category

The anatomy of a fresh impact crater



Plan view

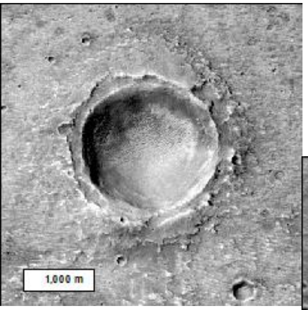
Cross section view

The Open University

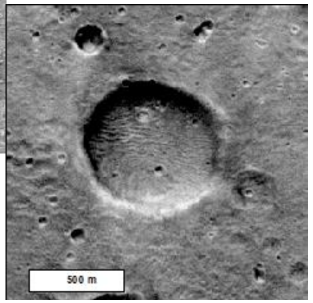
What are the association and Where are the more degraded craters?

Ejecta removal

Eroded

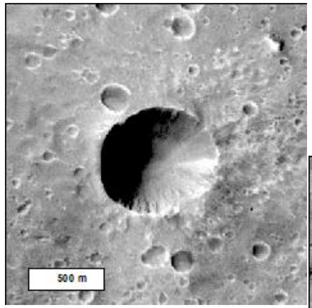


Removed

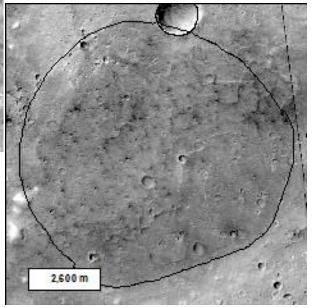


Crater rim removal

Sharp rim

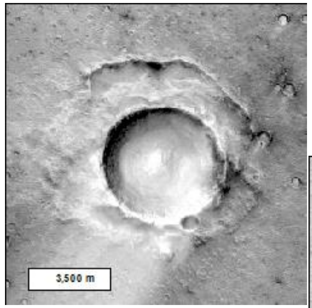


Rim removed

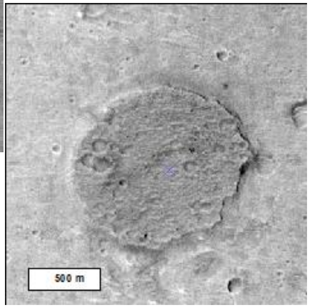


Crater floor infilling

Bowl

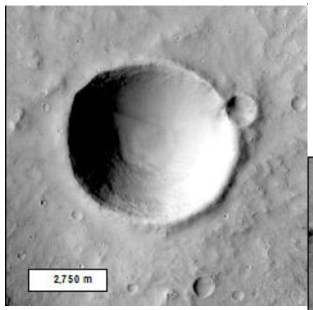


Flat/inverted

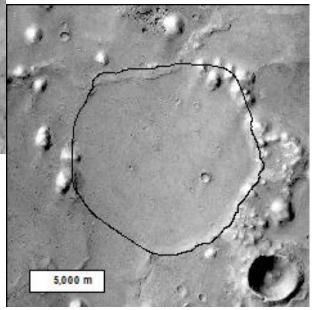


Burial of the crater

Overlying



Buried



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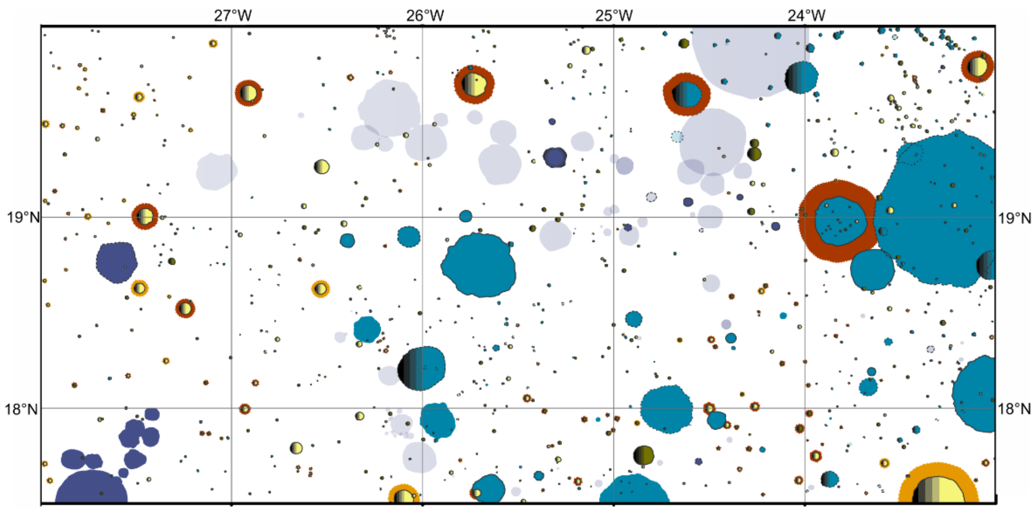
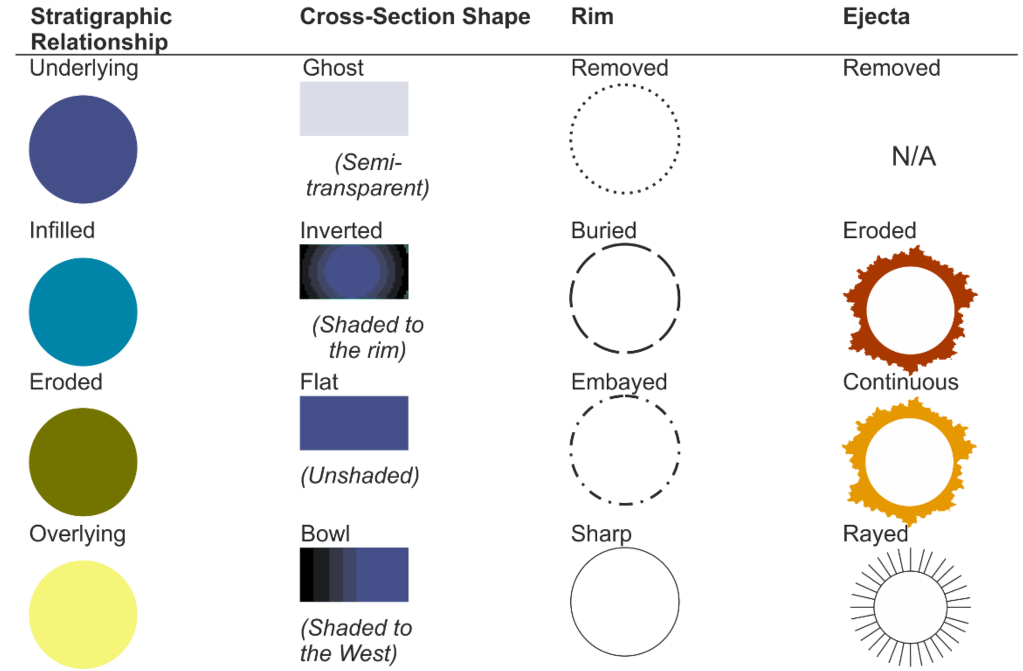
Distribution and likelihood association

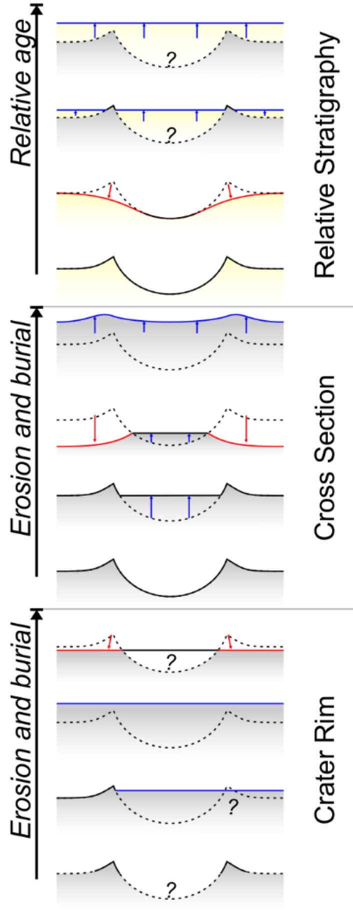
The distribution of degraded impact craters



Symbology



The Likelihood that any two degradation feature occur together (0.0; These features never occur, to 1; they always occur together)



		Ejecta (More degraded →)				Crater Rim (Erosion and burial →)				Cross section (Erosion and burial →)			
		Rayed	Continuous	Eroded	Removed	Sharp	Embayed	Buried	Removed	Bowl	Flat	Inverted	Ghost
Relative Stratigraphy	Underlying				0.160	0.005	0.026	0.103	0.519	0.010	0.121	0.025	0.509
	Infilled		0.006	0.006	0.387	0.021	0.248	0.483	0.064	0.251	0.159	0.033	0.072
	Eroded		0.017	0.181	0.258	0.429	0.036	0.065	0.009	0.375	0.006		
	Overlying		0.211	0.189	0.417	0.482	0.003	0.007	0.003	0.331			
Cross Section	Ghost				0.152		0.121	0.139	0.429				
	Inverted				0.018		0.010		0.113				
	Flat			0.006	0.097	0.032	0.054	0.090	0.132				
	Bowl		0.081	0.164	0.587	0.625	0.111	0.217	0.008				
Crater Rim	Removed			0.005	0.139								
	Buried		0.004	0.006	0.321								
	Embayed			0.010	0.127								
	Sharp		0.119	0.236	0.331								

What can we do with this?

The timing of resurfacing events

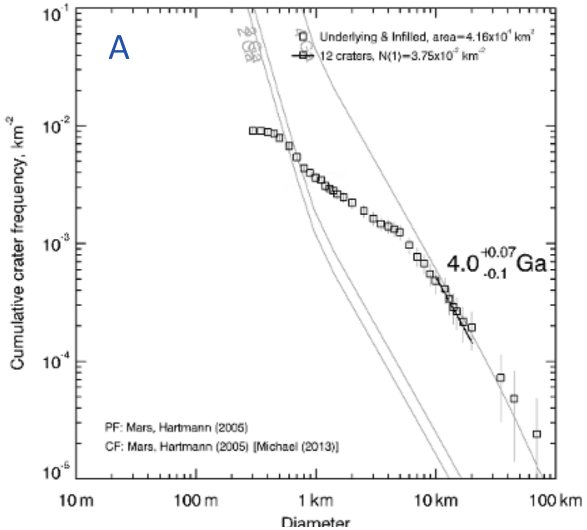
- Burial and rim erosion are the strongest differentiator of impact crater populations.
- '*underlying*' and '*infilled*' craters show burial was not uniform. Where as '*overlying*' and 'eroded' craters show erosion was more uniformly distributed
- We can model the time since:

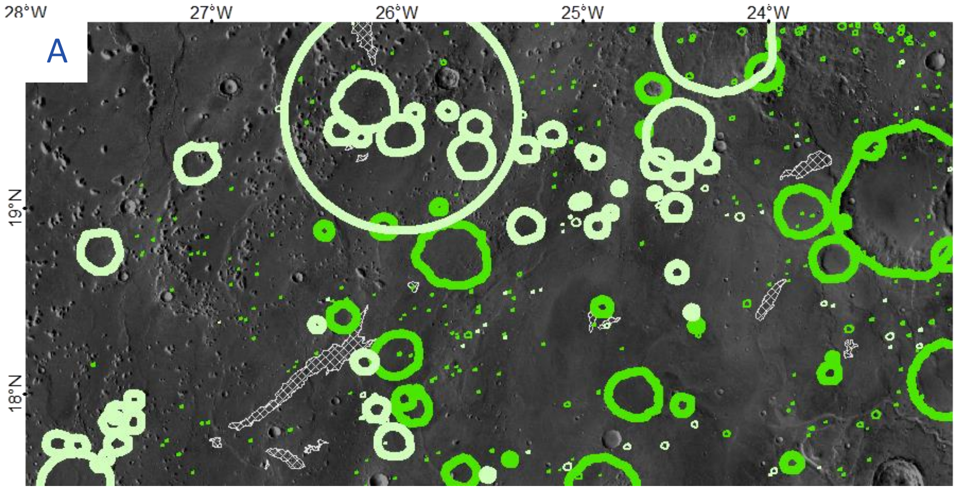
A – '*buried*' and '*infilled*' craters where formed and buried

B – '*eroded*' and '*overlying*' (fresh) craters formed

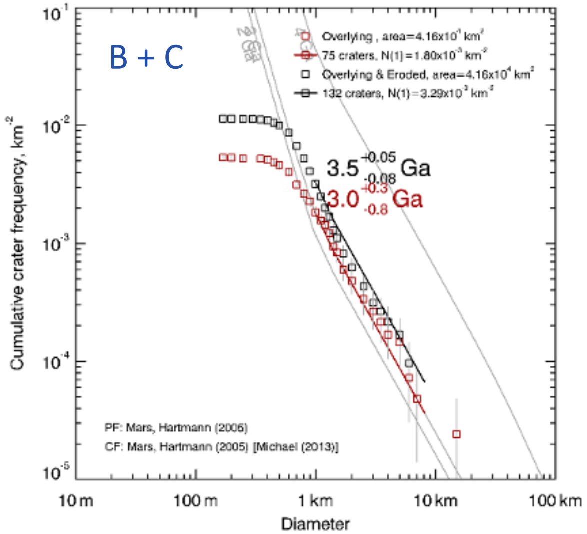
C – The time since '*overlying*' (fresh) craters where formed (the time since cratered stop becoming '*eroded*')

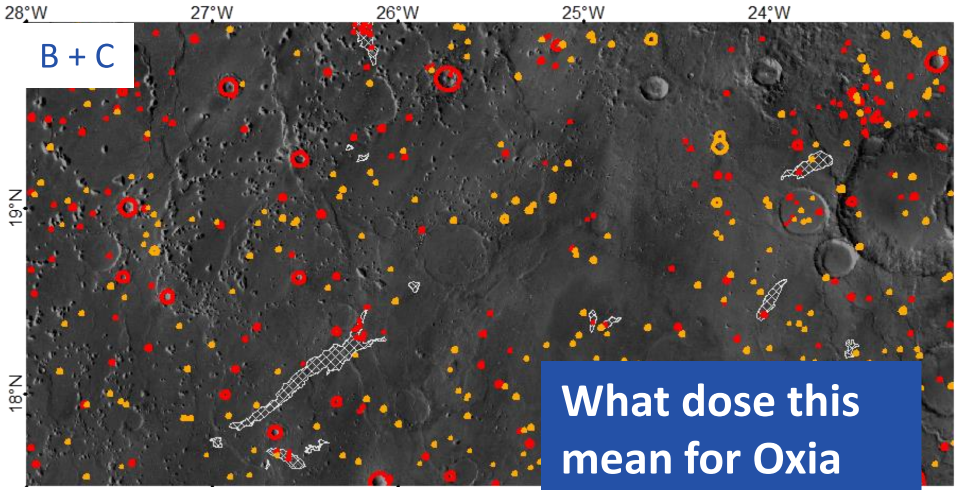
The population of '*buried*' (**light green**) and '*infilled*' (**dark green**) impact craters





The populations of '*eroded*' (**orange**) and '*overlying*' (**red**) impact craters



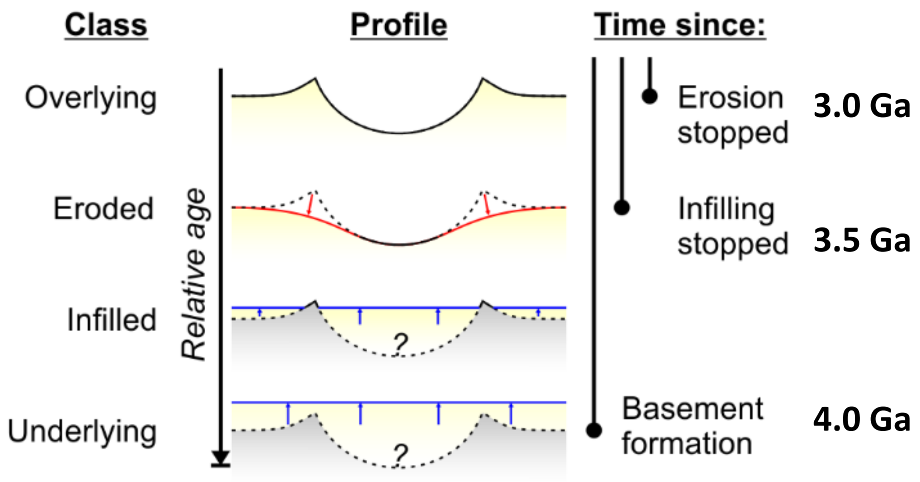


What dose this mean for Oxia Planum?

Implications – what does this mean?

- The regional basement, (with the clay mineralogy) is **4.0 Ga** old
- Completely buried craters are at lower elevations than infilled craters which suggests topographically controlled (ie; sedimentary) burial process
- Craters have not been infilled since **3.5 Ga**
- A more uniform erosional process dominated eroding craters. Craters with degraded ejecta are bowl shaped meaning heterogeneous sedimentation had stopped
- Since **3.0 Ga** erosion has not strong enough to remove the crater rims or ejecta
- Erosional process became less intense meaning regional erosion must have happened during this time

Profiles of the craters used to determine this sequence of events



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