Floor Fractured Craters at Syrtis Major, Mars - Distribution and Origin

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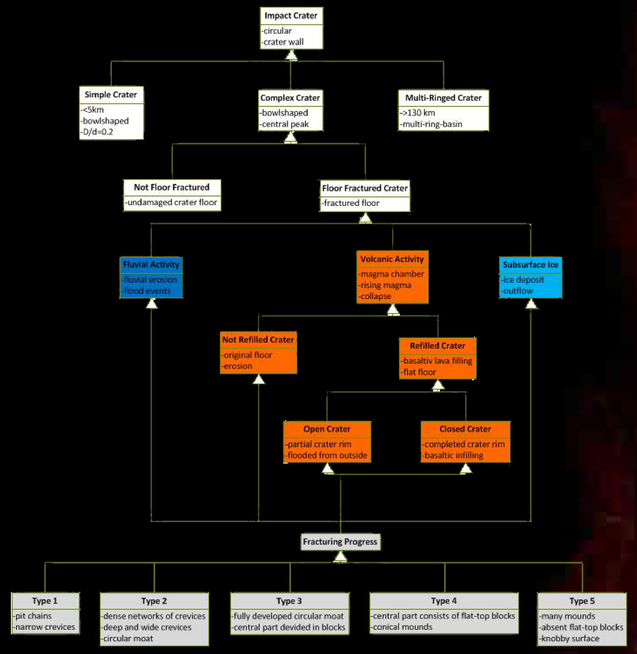
What are Floor Fractured Craters?



Mineralogy

HRSC, CTX and THEMIS data are used to analyze the craters. The fracturing features can be detected in the images. Various processes can be involved by the formation of FFC. To get information about the surface composition and mineralogy spectral data from CRISM can be used (Fig. 1). The crater interior is often covered by dust, so spectral data can not always provide a better insight. By the existence of special minerals the involved processes can be detected.

Fig. 1: *CRISM Orbit 0001112B located at 28,03°N, 73,33°E and CRISM Orbit 00009B14 located at 20,65°N, 50,17°E. Both Images are shown in the RGB-values (R=592nm, G=533nm,B=492nm).*

Open Questions!

- What are the reasons for the distribution of FFCs?
- Which processes are involved by the formation and development?
- Are FFCs volcanic, water or ice related landforms?
- Mineralogy?
- When did FFCs develop and which surface conditions where needed?

Where do we find them on Mars?

45.000 impact craters (≥ 5km) have been found on the martian surface. 300 of them are floor fractured- due to a lack of global high resolution covering- there might be unidentified craters [2]. The number of FFC can be estimated up to 1% of the total impact crater quantity on Mars (Fig. 3).

Floor Fractured Craters are located in different regions on Mars. One major occurence is at the dichotomy boundary, between the southern highlands and the northern lowlands. They are also observed in Arabia Terra, Syrtis Major and the Valles Marineris. In the southern highlands individual fractured craters can be identified (Fig. 2). Fretted Terrains are linked to the dichotomy boundary and often close to fractured craters.

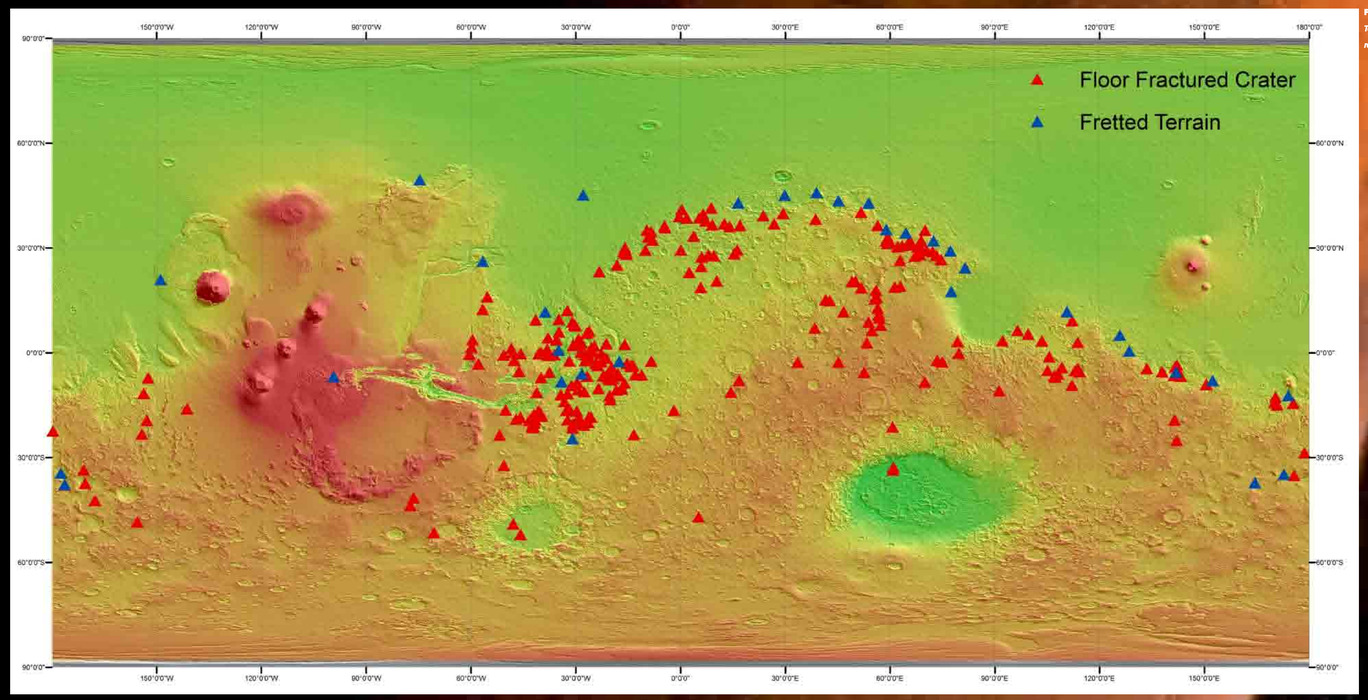


Fig. 3: *Floor Fractured Craters -Elevation model on Viking database. (A) 29,15°N, 70,26°E (B) 10,57°N, 56,48°E (C) 31,5°N, 68,19°E (D) 2,12°N, 53,43°E.*

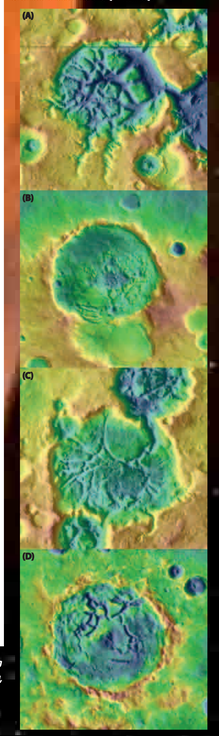
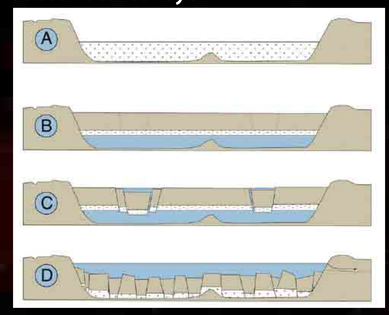


Fig. 2: *Distribution of Floor Fractured Craters (red) and Fretted Terrains (blue) on a global Mars map (MOLA). 258 Floor Fractured Craters have been identified (2- modified).*

Possible Origin

FFCs appear in different regions and environments on Mars. Various geologic processes are able to form the same surface feature. Lots of processes have been involved by the modification of impact craters, but which process was leading to the fracturing feature?

Subsurface Ice Layer



The melt and collapse of buried water ice is an hypothesis for the formation of chaotic terrains on Mars and can be used as a possible scenario for the formation of Floor Fractured Craters (Fig. 4). After the melting of ice the situation would become unstable, a collapse of the crater floor and the outflow of water would be the consequence [4].

Fig. 4: *(A) An impact crater is filled with water and ice. (B) More material is deposited in the crater, because of the pressure the Ice will melt. (C) The situation would become unstable and the fracturing starts. (D) It ends in a collapse of the crater floor, the water is able to cause outflow channels [4].*

Flood Events

There is a strong link between outflow channels, chaotic terrains and Floor Fractured Craters, fluvial activity is one of the involved processes. The surface is highly modified by fluvial activity (Fig. 5). Earth fissuring and seepage/ piping erosion can be possible processes for the fracturing features in the craters [5].

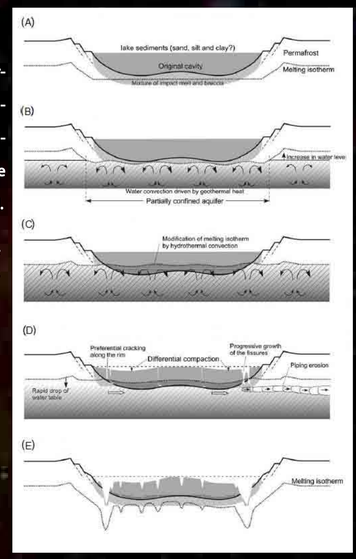
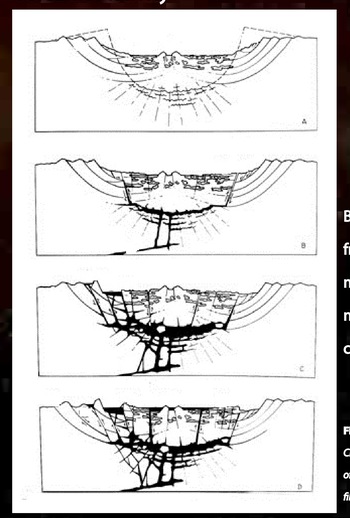


Fig. 5: *(A) Crater formation and filling (B) Rise of groundwater (C) Confined aquifer (D) Discharge event, after the discharge the water level will increase again and will lead to a new outflow event. (E) Collapse after depletion of groundwater [3].*

Volcanic Activity



Basaltic material is able to enter the crater floor through the fractured bedrock, shortly after the impact (Fig. 6). If the magma chamber beneath the crater becomes active later on, magma will rise and destroy the deposited material in the crater.

Fig. 6: *(A) An Impact occurs nearby a magma chamber and shock waves fracture the bedrock. The Crater is filled with sediments. (B) Rising magma through the fractured subsurface. (C) Partial filling of the crater interior and floor fracturing. (D) Collapse of the interior, development of plates and filling of the crater with lava [5].*

References

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