

MARTIAN DOUBLE CRATERS RECOGNITION BY DATING METHOD

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1- Introduction

Previous works have described the double craters formation on planetary surfaces [1,2]. Double craters larger than 1 km of diameter are attributed to the impact of binary asteroids. Some craters close to each other do not exhibit clear morphological evidences of their simultaneous formation.

In our previous study [3], we have described a method to extract a crater population located on an ejecta blanket representative of its age of formation. In this study we test this method to date the formation of a double crater population on Mars.

3- Double layered ejecta craters selection

In the absence of database, the research of Martian double craters has been performed by using THEMIS (THErMal Imagery System) imagery following these criteria:

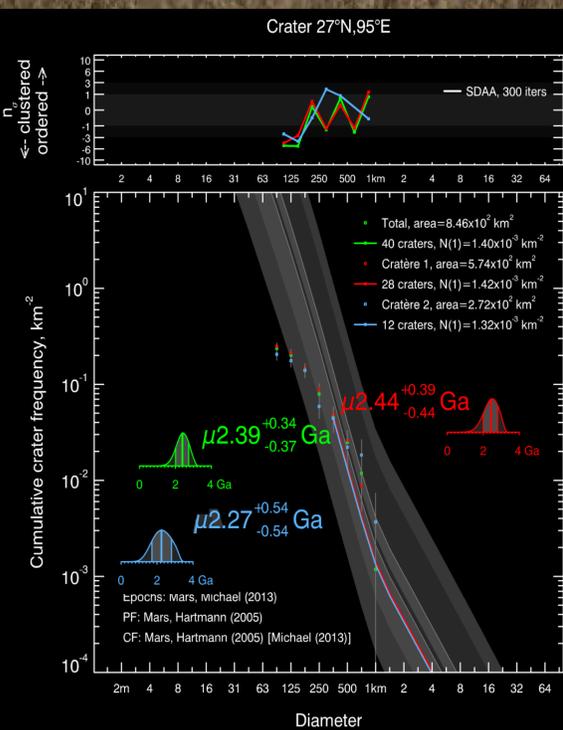


Fig.2 : Results on the dating of crater 27°N, 95°E

forming the doublet (corresponding to red and blue craters on Fig.1) and one by taking account all continuous ejecta (green area on Fig.1). Results are shown on Fig.3.

4- Results on model ages

In 85% of cases, the model age of the doublet is consistent with a binary impact. For two craters, corresponding to 15% of the dated population (crater 10°N, 164°W and 45°N, 41°W) the respective model age of the two craters is very close but no consistent with a double impact (Fig.3). In 80% of cases, double craters have been formed during the Amazonian (12 doublets), 7% during the Hesperian (1 doublet) and 13% during the Noachian (2 doublets) (Fig.4).

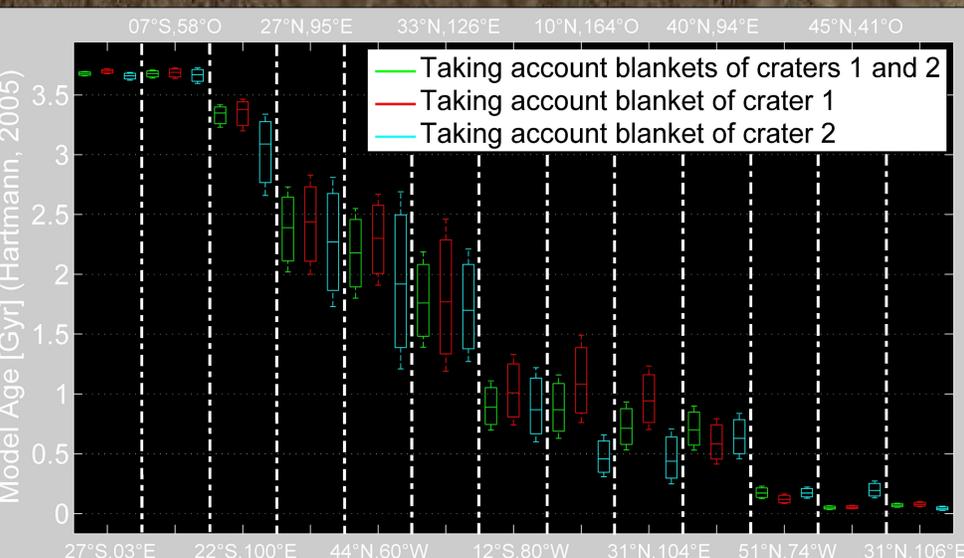


Fig.3 : Model ages of the thirteen double craters dated in this study. For each of them, the model age and its error obtained by the counting on each blanket are indicated (red and blue boxes). The model age and its uncertainty obtained by taking account the two layers is indicated by green boxes. Only two craters do not exhibit substantially the same mode age (10°N, 164°W and 45°N, 41°W).

2- Methods

Layered ejecta blankets of Martian impact craters larger than 5 km in diameter exhibit continuous morphology and offer a better and larger area for crater counts in comparison with rayed/ballistic ejecta deposits [4].

Datings have been therefore performed on this kind of craters. Counts were achieved by taking account craters larger than 100 m located on the ejecta blanket by using CraterTool [5] and CTX (ConteXt Camera) imagery (Fig.1). The derivation of each model age has been performed by using CraterStats II [6] with Hartmann's production function and chronology model [7] (Fig.2).

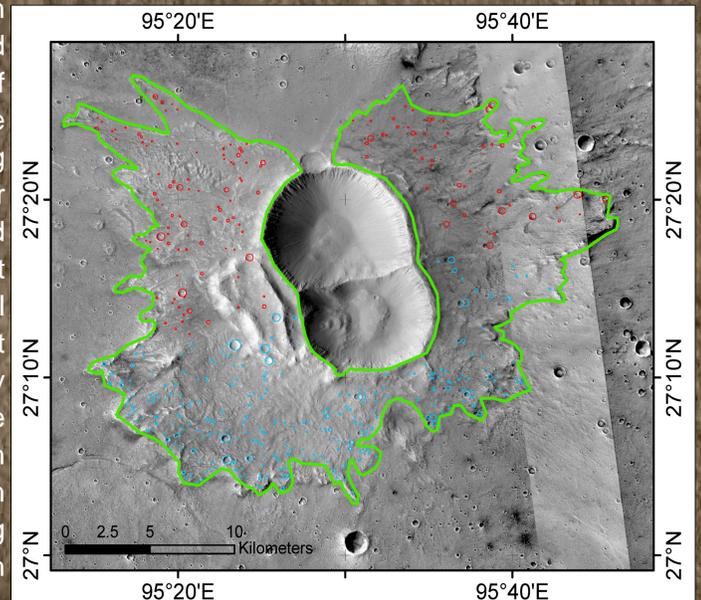


Fig.1 : Counting on a double layered ejecta crater. Model ages obtained for each crater of the doublet are very close attesting to the synchronous formation of these two craters. Some parts of the blanket are not taking account into the counting because they are dominated by secondary craters given the results of the randomness analysis [8].

Each CSFD (Crater-Size Frequency Distribution) has been analysed to avoid secondary craters populations [8] and then fitted using Poisson statistics [9].

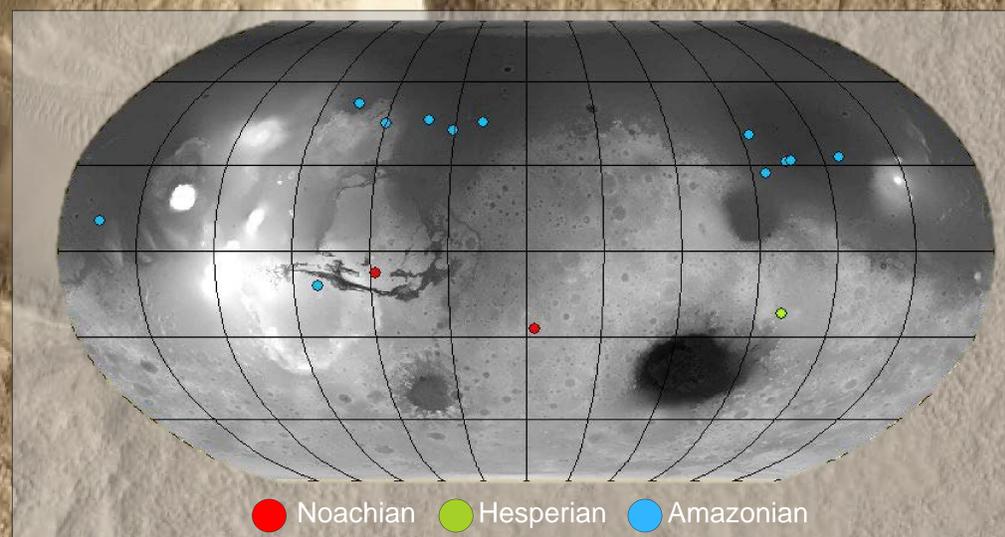


Fig.4 : Locations and epochs during from which each of the thirteen doublets have been formed.

5- Perspectives

Double craters dated here have been selected respecting criteria selection but we have to make this study more objective !

- By dating of all double craters present on a geological unit: Vastitas Borealis Formation below 45°N of latitude
- This unit exhibits numerous double craters and has not known large resurfacing episode since its emplacement [11].

A complementary study such as this one would allow to access to the record of large population of binary asteroids which have evolved in the Solar System.

References

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