DATATION OF MULTIPLE-LAYER EJECTA CRATER ON MARS. A. Lagain[1], S. Bouley[1], F. Costard[1], [1]GEOPS (UMR 8148) - Université Paris Sud, 91405 Orsay, France, anthony.lagain@u-psud.fr

Introduction: The Martian surface presents thousands of lobate ejecta craters. Their formation is in part due to the presence of volatiles in the subsurface [1, 2]. From ballistical analysis, each ejecta layer are formed at the same time [2]. The crater dating is not trivial and ejecta lobate craters have a sufficient surface to date their formation by counting craters present on their blankets. Knowledge of the formation age of this type of craters is therefore essential for informations on the subsurface in one place and at one time and to better constrain climatic variations on Mars.

Methodology: In order to better constrain the dynamic and evolution of layered ejecta craters, we did a detailed geological map of a multiple-layer rampart-crater on the basis of high resolution images (CTX, HiRISE, MOC, HRSC and THEMIS) (Fig.1). We estimated the formation age of the different morphological units. All craters whith diameters larger than 100 m were manually recorded with Crater Tool [5] on ArcGIS and craterisation curves are plotted with CraterStats [6] using the Hartmann production function [7]. The craterisation curve of the surrounding ground unit (Sg) was plotted by counting all craters larger than 1 km. Secondary craters population is excluded by identifying limited overcraterisation density areas [8] because overcraterisation induces an increase of the formation age.

Arandas crater: Arandas crater on Mars (15.17°, W, 42.77°, N), located in Acidalia Planitia, is a well preserved 25.1km multiple-layer ejecta rampart crater [9] (Fig.1) and provides an excellent opportunity to study potentials relations between craterisation density and ejecta morphology.

We defined six different geomorphological units on the ejecta blankets :

- The hummocky ejecta unit (**He**) adjacent to the crater rim extending up to approximately 2 kilometers is characterized by smooth materials with hummocky material.
- Adjacent to the He unit, the inner layer unit (**Il**) is characterized by the presence of radial ridges and a terminal ridge.
- The unit **Sil** exhibits radial ridges with lightly concentric crest on relatively irregularly surface.
- The unit, **Cil** shows a clear gradual disappearance of radial ridges and an increase of concentric crest.
- The outer layer (**Ol**) exhibits a lobate morphology and some relatively thick terminale lobes (**Dl**).

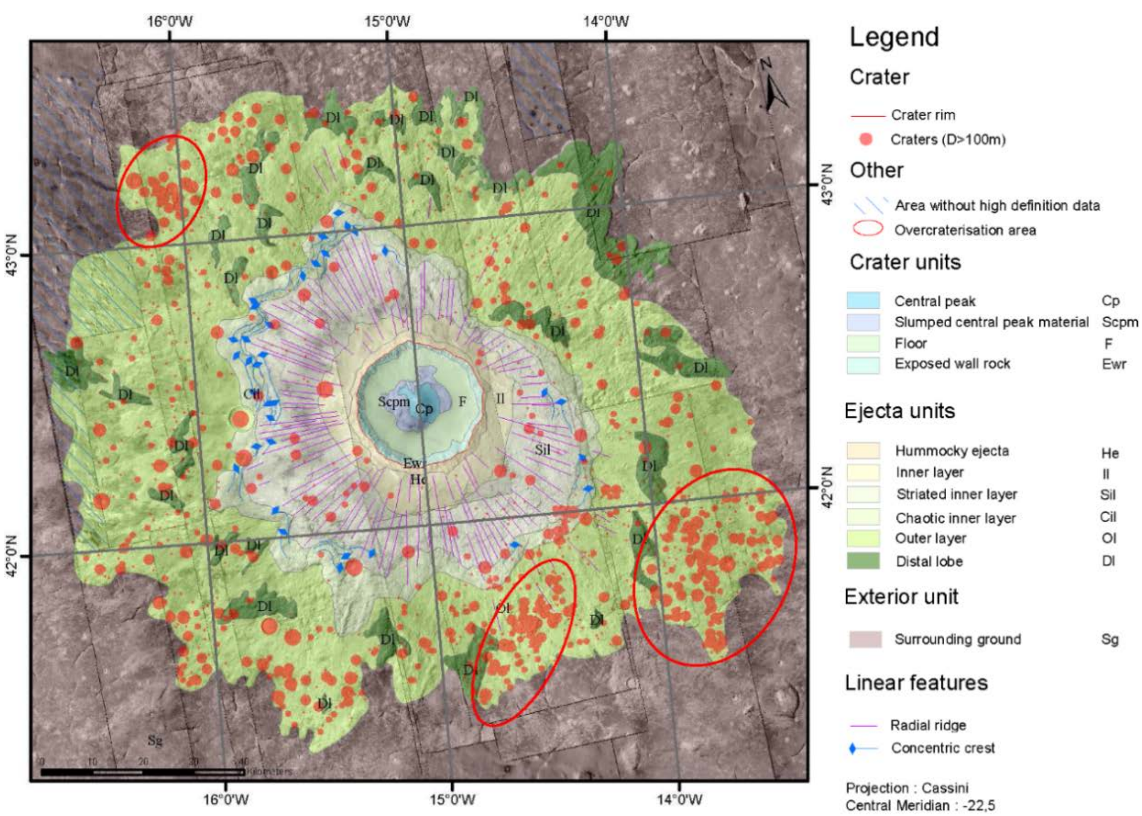

Figure 1 : Geological map of Arandas crater, Mars.

Results and discussion: The crater age is necessarily more recent than the age of the Sg surrounding unit : $3,18\pm^{0,09}_{0,15}$ Gyrs. But secondary craters fields considerably increases the crater age (Fig.2.b). The crater formation age with all recorded craters is 960±73 Myrs. Without these supposed secondary craters (red ellipses on figure 1), the age formation is 501±60 Myrs. That is why all units craterisation curves (Fig.2.a) was plotted excluding these craters fields. Our geomorphological and datation study indicate that the age of each unit increase with the distance to the crater rim. Depending on whether the ejecta unit on which the datation is done, the crater age formation vary from 134±28 Myrs (He and Il units) to 542±62 Myrs (Dl and Ol units). An intermediate a ge is obtained for the Sil and Cil units : 339±77 Myrs (Fig.2.a). The relatively large number of craters taken into account in that study (1100 craters) suggest reasonable errors bars for the ages.

We suggest two hypotheses to explain this observation. (1) The slope near the crater rim is more important than at distal units and slopes destabilizations and resurfacing processes are consequently more frequent in these areas.

Furthermore, the inner layer resurfacing processes is supported by a previous study [10] that suggest the inner ejecta layer slides off uplifted rim, assisted by basal snow and ice layer. (2) We overestimated the age of outter layer because we took into account possible secondary craters.

Conclusion: The crater age increase with the distance to the crater rim probably because resurfacing processes are more actives in the inner layer. The crater age must be determined only with craters population situated in the outer layer and by excluding secondary craters fields. The Ol and Dl units exhibit a relatively homogeneous cratering density (Fig. 1 and 2.a). According to our observations, Arandas crater was formed 542±42 Myrs ago. The project is on-going and more works is required to firmly establish this methodology to date the martian lobates ejecta ramparts craters.

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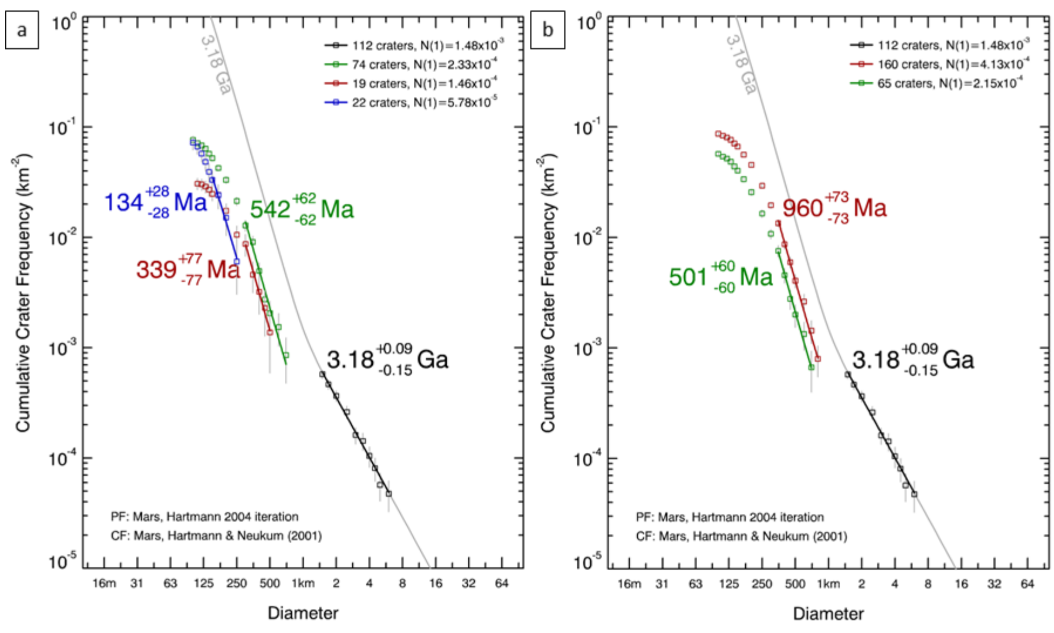

Figure 2 : **a** : Units age measurements. *Black* : Sg unit craterisation curve, *Green* : Dl and Ol units craterisation curve, *Red* : Sil and Cil units craterisation curve, *Blue* : Il and He units craterisation curve. (all units isochrons are plotted excluding secondary craters fields). **b** : Global age measurements. *Black* : Sg unit craterisation curve, *Red* : all units craterisation curve, *Green* : all units craterisation curve without secondary craters fields.

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