**A GLOBAL MORPHOLOGICAL STUDY AT HIGH RESOLUTION ON THE DUNE FIELDS ON MARS.** E. Gardin[1], P. Allemand[1] and C. Quantin[1], [1] Laboratoire des Sciences de la Terre, Université de Lyon, Ecole Normale Supérieure de Lyon, Université Claude Bernard Lyon 1, CNRS, France, Bat Géode, 43 bd du 11 Novembre, 69622 Villeurbanne cedex, France (emilie.gardin@univ-lyon1.fr).

**Introduction:**

The shape of aeolian dunes is controlled by the wind regime, local topography and sediment supply [1]. We observe aeolian dunes in many places on Mars but we do not know yet if these dunes are created under current atmospheric conditions or not. They could constitute a record of the past wind conditions.

Since 2007, a Martian Global Digital Dune Database is available to the scientific community [2]. This database stores attributes of more than 550 dune fields located inside impact craters between 65°N and 65°S of latitude, in a Geographic Information System (GIS). The GIS gathers the sizes of the dune fields and the main type of dunes observed as well as the main wind directions returned from the main dune geometries.

We proposed here to complete this GIS with the high resolution imagery (MOC, HRSC, CTX and HiRiSE pictures). The goal of this study is to realize a new morphological survey at high resolution (up to 25 cm per pixel) for the whole set of middle latitude dune fields. Are there evidence of past wind regimes, and so past climate conditions recorded in these dune fields?

**Data set:**

All the available THEMIS infra-red and visible, HRSC, MOC, HRSC, CTX and HiRiSE images covering the dune fields have been downloaded. The images have been geo-processed integrated into the GIS. That allows us to obtain image mosaics with an optimal resolution for each dune fields down to 25 cm per pixel.

**Classification of the dune fields**:

The simple typology of the aeolian dunes distinguishes barchanoïd forms and transverse dunes that are created under unidirectional wind [3-4-5]; longitudinal dunes are created by a bidirectional wind [6] and star dunes [7] that are created under multiple wind directions. Based on this simple typology, we reported for each dune field the different types of dunes observed as well as their orientations. On some dune fields, dark streaks [8] have been analysed and their related wind directions have been reported.

Barchans and barchanoïd shapes are observed in more 35% (Table 1). 14 % of the dune fields expose transverses dunes. These results imply that most of dunes were formed by a unidirectional regime. Longitudinal dunes are observed in only 22 % of cases.

The spatial distribution of the type of dune is not random (figure 1). For instance, there are entire regions only with barchans and barchanoïd dunes like on the Eastern side of Agyre. This could reveal region with low sand supply.

| | dune fields |
|---|---|
| Barchans + Barchanoïd forms | 35.0 % |
| Transverse dunes | 14.0 % |
| Longitudinal dunes | 22.0 % |
| Chronology (Transversal dunes/ Linear dunes, dark streak on Barchans) | 28.0 % |
| No chronology (B with 2 opposite directions) | 46.5 % |
| Only one recorded direction (as on Earth) | 52.0 % |

*Table 1: Proportion of dune fields in function of the topology and in function of the coexistence above the fields obtained by the morphological study realized at high resolution.*

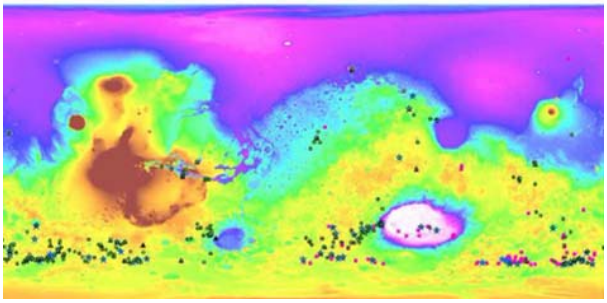

*Figure 1 : Martian dune repartitions between 65°N and 65°S according to the dune types: barchans and barchanoïd (Green dots), transverse dunes (Blue stars), longitudinal dunes (Black triangles) and undefined dunes (Pink squares).*

**Complex history of dune fields:**

By studying in detail the dune type inside a single dune field, we highlighted 3 cases: one simple case and 2 complex cases. 1) The first case is when the morphology of all the dunes of one dune field is driven by a single wind direction (Figure 2). 2) The second case is complex when individual dune morphology returned 2 distinct directions of unidirectional wind regime (Figure 3). 3) The third case is complex when the dune morphology is returning one unidirectional regime and one bi-directional regime (Figure 4). The two last cases are not observed on Earth.

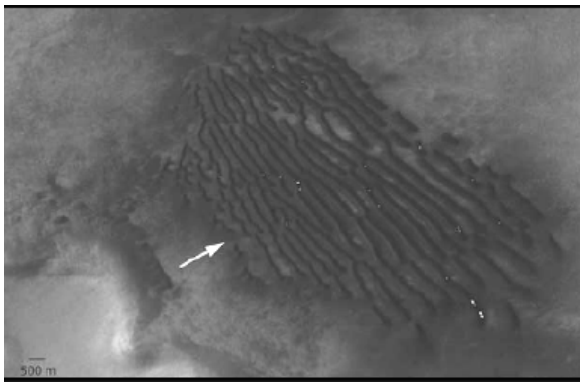


*Figure1 : Image mosaic showing the simple case 1*

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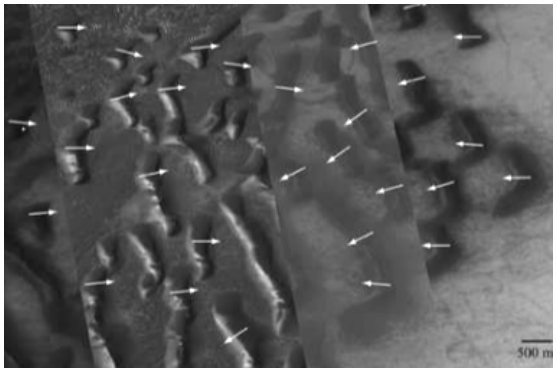


*Figure 2 :Image mosaic the complex case 2*

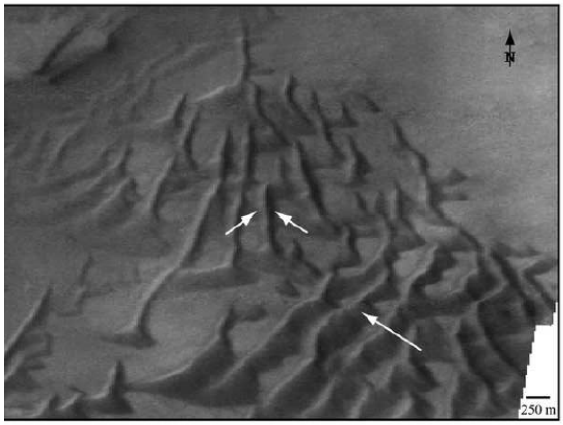


*Figure 3 :Image mosaic of the complex case 3*

In certain complex cases, we are able to draw a chronology between the wind regimes. That is the case for instance in figure 4 where pre-existing barchans are reworked in longitudinal dunes. The bidirectional regime that originated the longitudinal dunes postdates the unidirectional regime that created the barchans. We were able the draw such chronology in 28.0% of dune field.

However, we were unable to give a chronology to the dune field with two different directions in 46.5% of cases.

**Conclusions**: We exposed a global study at high resolution of the Martian Aeolian dunes. Our study revealed heterogeneities inside single dune field. Some dune fields may have formed by several aeolian regimes and in certain case by successive distinct Aeolian regimes. This may indicate that Martian dunes are so pertinent markers of recent climatic changes.

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**References**: [1]: McKee (1979). [2]: Hayward, R.K. et al. (2007), *JGR*, 112. [3]: Lancaster et al. (1989), *PPG*, 67-91. [4]: Edgett et al. (1994), *Icarus*, 448-464. [5]: Hersen, P. (2004), phd thesis. [6]: Lee, P. and Thomas, P. C. (1995), *JGR*, 5381-5395. [7]: Tsoar et al. (1983), *Sedimentology*, 567-578. [8]: Zimbelman, (1986), *Icarus*, 83-93.