TOWARDS AN IMPROVED MORPHOMETRIC DATABASE OF VALLEYS AND FANS ON MARS. D. C. A. Silva[1], D. A. Vaz[1,2], G. Di Achille[2], [1]CITEUC, Centre for Earth and Space Research of the University of Coimbra, Observatório Astronómico da Universidade de Coimbra, Almas de Freire, 3040-004 Coimbra, Portugal (davidvaz@uc.pt), [2]INAF - Istituto Nazionale di Astrofisica, Osservatorio Astronomico d'Abruzzo, Via Mentore Maggini, 64100 Teramo TE, Italy.

Introduction: Martian fan-shaped deposits have been the subject of study for their presumed deltaic origin, which is thought as a good indicator on how the atmospheric conditions and climate evolved on Mars [1-3]. Therefore, the study of these deposits constitutes one of the few ways to constrain the amount of water that existed on the surface, providing valuable indications regarding the paleoenvironmental conditions. However, these deposits present a large morphological diversity suggesting different depositional settings.

In [4] is argued that two different types of depositional fans are present on the Martian surface. These two different sets of fans were identified by measuring and correlating the volume of sediments eroded from the valleys and deposited into the fan-shaped deposits. Type I fans were linked with limited fluvial-deltaic activity, probably developed through alluvial processes, glacial processes, landslides or other gravity driven flows. In contrast, Type II fans have relatively less sediments accumulated near the valley mouths, suggesting basin dispersion of sediments probably linked with deltaic environments.

In this abstract we discuss the improvements we are making to the existing valley-fan volumetric database [4] (https://ars.els-cdn.com/content/image/1-s2.0-S0012821X19307447-mmc2.zip). Namely, we are improving the quality of the data used for areas already included in the database (replacing HRSC data with newly available CTX DTMs) and completing the database with new areas (Fig. 1). In addition, in order to better understand the sedimentary conditions in which these deposits were formed we discuss our plans to integrate in the database other sources of information, such as deposition ages estimated from crater counts and mineralogical information. With this effort we seek to improve the deposits' classification and perform a more robust mass balance analysis in the future.

Objectives: The first version of the fan and valley morphometric database analyzed in [4] was based in a combination of datasets (CTX, HRSC and HiRISE DTMS and orthoimages). However, the coarser spatial resolution of HRSC DTMs is not ideal to measure the volume of smaller deposits and valley networks, therefore our priority is to use newly acquired CTX data to generate new datasets for the areas already included in the database. New deposits will also be surveyed where new CTX data is available.

In order to constrain the age of the deposits we will perform crater-counts for each study area. The overall age distribution of the fans will be appraised, aiming to test a possible dual formation age scenario hypothesized in [7]. Mineralogical and thermal-inertia summary data will be integrated in the database, providing additional constrains on the interpreted depositional environments and subsequent post-depositional evolution.

Finally, this updated global database will be systematically studied in order to try to identify different populations of events and investigate the plausibility of different formation processes.

Data and Methods: In order to have the best possible data, we intend to use CTX DTMs and orthoimages covering the fan-shaped deposits and correspondent valley networks. When not available, HRSC or HiRISE imagery will be used. Based on a preliminary data survey, we expect to: 1) be able to double the number of areas included in the database (increasing the morphometric and volumetric survey from 60 to ~120 areas, Fig.1) and 2) replace part of the morphometric measurements previously made with HRSC data with new CTX data.

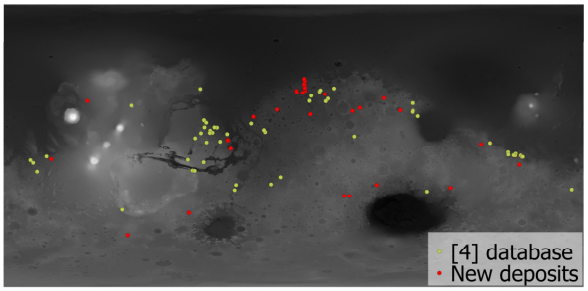

Figure 1 – Map of the deposits surveyed in [4] and the location of the new fan-shaped deposits with suitable CTX or HRSC coverage.

We will generate DTMs and orthoimages with ISIS and NASA Ames ASP [8, 9]. To compute the volume of material removed from the valleys and deposited on the fans we will use the custom algorithms described in [4].

The crater counts will be made using QGIS (fig. 2) and isochrones will be fitted using *Craterstats* software, according to the methods described in [5].

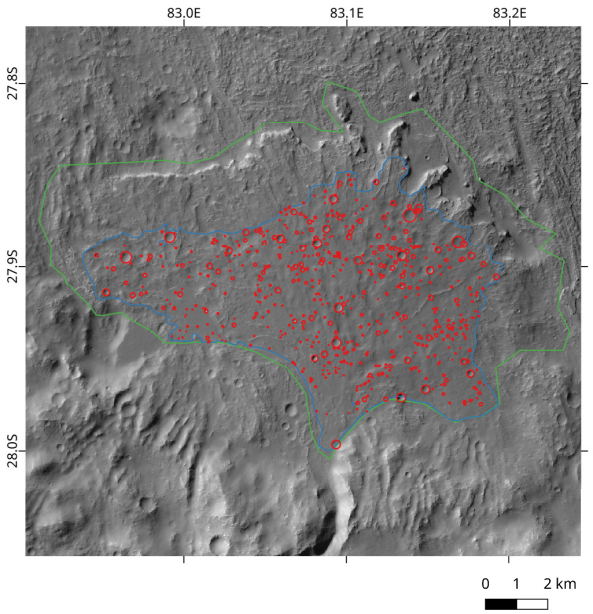

Figure 2 – Example with the craters mapped for the "West of Suzhi" deposit. The craters with diameter above 25 m were mapped in the area where perceivable erosion was not too intense (blue outline), alongside with the fan-shaped deposit outline (green outline). The fitted isochron corresponds to an age of 2±0.3Ga.

The analysis of the mineral compositional for each fan may allow the detection of water related minerals, alterations or hydrated materials [6]. We will collect and spatially integrate summary mineral indices from CRISM MRDRs (and MTRDRs, when available) using the mapped fan polygons for each deposit.

Preliminary results and discussion: Even though this work is still in progress, we already have processed 35 new areas with CTX coverage. Ten areas already included in the [4] database have been updated with CTX data and other 7 have been completed by adding new DTMs that cover the total length of the valley and respective fan deposit.

We have also estimated the age of 50 fan-shaped deposits. Fig. 3 display the relation between fan volumes, ages and deposit type. A preliminary analysis suggests the existence of two clusters: Type II fans (of likely deltaic origin) seem to have been deposited until Early Hesperian times, while most Type I fans (whose origin may not be related with fluvio-deltaic origin) have younger ages. This agrees with the age bimodality discussed in [7] and matches the morphometric and volumetric duality discussed in [4]. In terms of volumes, the preliminary data suggests a decrease of volumes with time. Nevertheless, we see that several areas do not follow the mentioned trends. That could be justified by the large uncertainties associated with the age and volume estimates or it could mean a more complicated sequence of events at a global scale. Including more fans in this analysis will certainly help to understand how and when the Martian fan-shaped deposits formed.

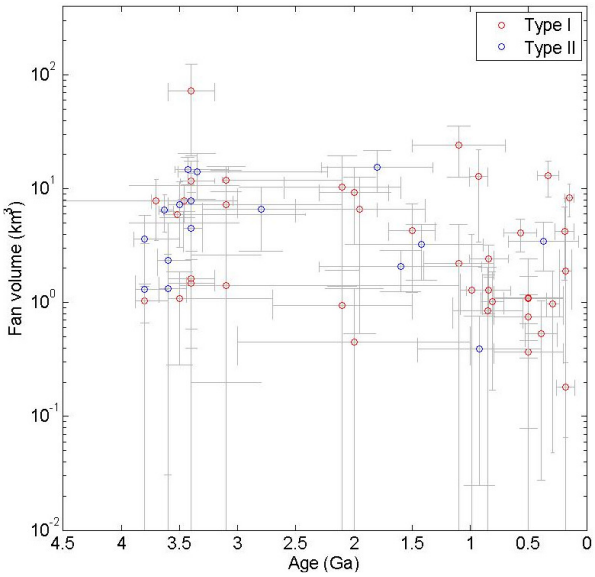

Figure 3 – Fan volumes, estimated ages and fan type [4]. This plot only shows 50 areas where crater counts were performed.

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