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High resolution surface analysis of basaltic grains to support transport mode estimation for Martian sediments

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Abstract

Fine scale surface morphology of fluvial and aeolian transported basaltic grains were analysed by optical microscopy, Raman and SEM methods. Several morphological surface features were identified, including six types that have already been known on quartz grains on the Earth. However most of the identified features could not be classified according to the quartz based terminology, partly because the large heterogeneity of initial composition and the immature state of the grains. Five new feature types were determined using SEM pictures. Although groups of grains with different morphology could be separated, but analysis of more aeolian and fluvial grains is necessary from other places, to set up more precise morphology Mars relevant groups in case of the both transport medium.

1. Introduction

The past existence of liquid water on Mars is an important current research topic [1], especially the astrobiology relevant aspects [2, 3, 4]. Despite large volume of liquid water is not expected currently, only small amount is possible [5, 6], wide range of water and ice melting related features is present on Mars [7, 8]. The European ExoMars 2020 rover will provide the first deep drill there [9], with acquiring probably deposited sedimentary grains at the landing sites [10, 11], where the separation between fluvial and aeolian transported grains is among the aim [12]. On the Earth this separation is relatively easy as mature aeolian grains differ much from fluvial ones, partly as they are highly mature, well rounded plus polished surface and mainly of quartz type.

The micromorhology of sand-size quartz grains are analysed proximately for a century. Their shape and the surface morphological features depend on the transport mode and constantly change during the transport. Based on the grain micromorphology the transport mode could be reconstructed, as different morphologies are created in different environments. This approach may also important in case of the reconstruction of Martian environment.

The aim of this study is to compare different microtextures of basaltic fluvial and aeolian grains from the Earth to identify and compared to know micoretexutral features on quartz grains, as there are mainly basaltic composition rocks on Mars. First of all, we tried to apply the micromorphological classification of quartz to the basic particles to see could similar features be formed on them. These examinations can contribute to understanding the processes on Mars, determining the transport medium and reconstructing former environments within the framework of the EXM 2020 program.

There are basaltic aeolian grains from Mars analog collection of the European Space Agency (ISAR) [www.isar.cnrs-orleans.fr] and fluvial basaltic grains from the Azores-Islands [13] were among the examined samples. The Icelandic aeolian sample originates from the tholeiite composition Lambahraun volcanic plain [14, 15], while the fluvial sample comes from the island of São Miguel (Azores).

2. Research methods

The micromorphological features were examined by optical and electron microscopy and then the mineral composition was measured by Raman spectroscopy. First time, we tried to identify the general and specific characteristics of the samples with the NICON Eclipse E600 POL microscope at 4, 10, 20 and 40x magnification. Then the particles were glued onto a glass plate, and after installing a 10 nm thick carbon layer. High resolution images were taken with the Tm4000 Plus Tabletop electron microscope at Eötvös Loránd University. The used Raman

spectroscopy instrument was a Kaiser Optical Systems RamanRxn1™. The spectral performance of this instrument changes from 150 cm^{-1} to 1850 cm^{-1} and the resolution is 6 cm^{-1} in the midrange. The wavelength of the laser is 785 nm.

3. Summary

The analysis targeted particles from 0.5 mm to 1 mm size. The morphology was found to be much more diverse and exotic than that of quartz, but some quartz type microtextures could be identified by SEM pictures: conchoidal fracture, different steps or marks (fluvial); upturned plates, bulbous edges, chemical precipitation, dissolution etching (aeolian) (Figure 1). We tried to name previously unclassified micromporhological features, like cracked surface, isometric shape with rough surface pattern, depressions with different size and shape. Identification problems may be caused the shorter transport times, and the minerals composition (olivine, pyroxene) are less resistant to external influences. It is difficult to infer the characteristics of Mars's sediment particles, but this study can be useful, because there was active water presence long ago, while the effect of the wind is still significant today. In summary, these information could help to identify the settling environments of grains on Mars as well.

Acknowledgements

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References

[1] Hargitai and Kereszturi 2015. Encyclopedia of Planetary Landforms, Springer, 2015, [2] Domagal-Goldman SD & Wright KE. The astrobiology primer v2.0, Astrobiology, 16, 561-653, 2016., [3] deVera et al., International Journey of Astrobiology, 13, 35-44, 2014. [4] Marschal et al. 2012. Planet. Space Sci. 71, 146-153, [5] Reiss et al. 2007. 38th LPSC #1993., [6] Pal & Kereszturi 2017. Icarus 282, 84–92. [7] Ramsdale et al. 2017. Planet. Space Sci. 140, 49-61. [8] Kereszturi 2014. Planet. Space Sci. 96, 35-50. [9] Vago et al. 2017. Astrobiology 17, 6-7. [10] Ettahri M.A. et al. 2018. 49th LPSC #2448., [11] Kereszturi et al. 2016. OLEB 46, 435-454., [12] Kapui et al. 2018 Planet. Space Sci. 163, 56–76, [13] Kapui et al. 2018. 49th LPSC #1501., [14] Sinton et al., 2005, [15] Licciardi et al., 2006

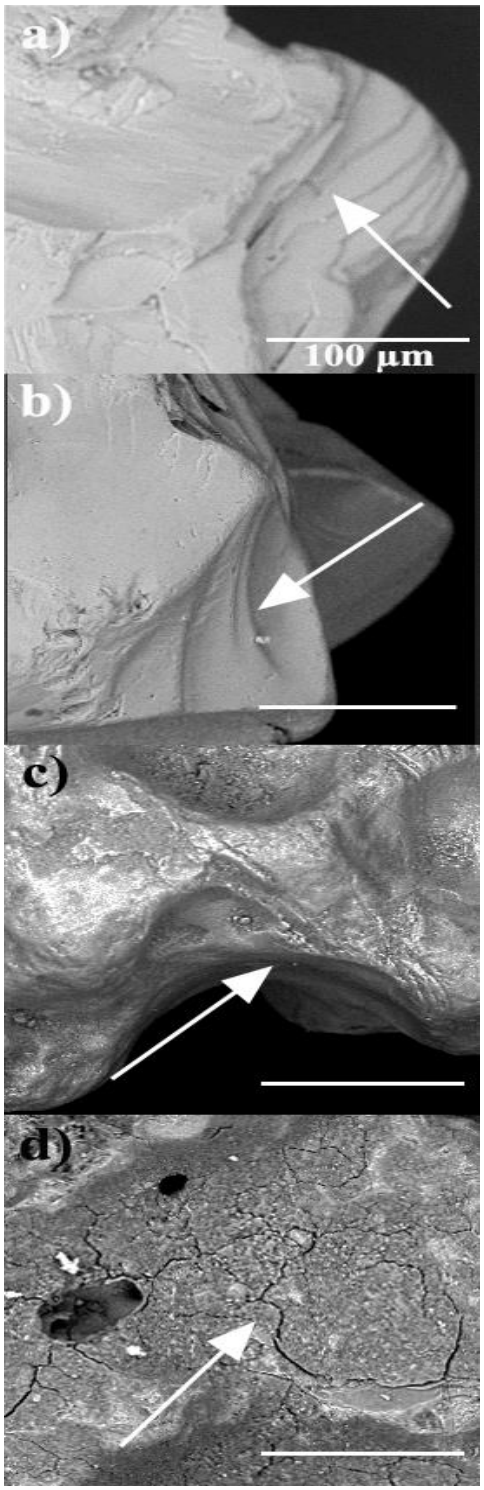

Figure 1: Some identification marks on different fluvial grains: the straight (a) and arcuate (b) steps and bulbous edges (c), and cracked surfaces (d) on the some aeolian grains can be seen on the pictures.