



Segregation of Olivine Grains in Volcanic Sands In Iceland - Implications for Mars

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Abstract

Dark sand is widespread on the planet Mars especially in the north polar region and in the floor of several craters. On Earth, volcanic sands are present in desertic areas like volcanic islands such as Canaria Islands, Iceland, Réunion, or Hawaii, and arid to semi-arid volcanic provinces. Their compositions display a large variety of grains including basaltic minerals, volcanic glasses, cinders, and lithic fragments derived from explosions. These sands have been poorly studied, mainly because of the predominance of quartz-bearing sand and the lack of large deserts dominated volcanic sands. In Iceland, one lava plain (Lambahraun), in the southwest of the country, is composed of basaltic minerals eroded from two shield volcanoes. In this plain it is possible to analyze variations in composition from eolian sorting. This location has been used as a natural laboratory to test wind effects on volcanic grains.

Composition of sand and source rocks were achieved with fluorescence X. An enrichment in Mg, Fe and Ni is observed for most sand samples compared to source rocks. This enrichment can be explained by a significant increase in the proportion of olivine. Indeed, this mineral is dominated by Mg and Fe. Ion microprobe results indicates that the olivine grains contain strong proportion of Ni (0.16% in average), whereas other grains are devoid of Ni. Thus, Nickel corresponds to a good chemical indicator of variations of olivine proportion in the different samples. As these three elements (Mg, Fe, Ni) are enriched simultaneously in sand, they may indicate a higher proportion of olivine in sand.

It has been observed from thin sections that olivine constitutes typically 5 to 10% of rock mineralogy, whereas it constitutes about 20% of grains in sands, in agreement with results from elementary chemistry.

In addition, sand sizes for all sand samples were measured from a laser granulometer. The most sorted sands correspond to those with the highest Ni and Mg fraction, therefore demonstrating that the enrichment in olivine is related to the eolian sorting.

Applications of these results to previous studies about volcanic sands on Mars suggest that the physical sorting of olivine grains should be taken into account when extracting composition from orbital IR data. Olivine-bearing sands observed by the Mars Exploration Rovers in Meridiani Planum and Gusev could also have formed from rocks less enriched in olivine that what is observed in sands.

