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Segregation of olivine grains in volcanic sands in Iceland and implications for mineralogy on Mars

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Basaltic sands cover several plains in volcanic regions on Earth and dominate the aeolian sediments on Mars but basaltic sands are not as well characterized as felsic sands. The Lambahraun sandy–lava plain in Iceland was chosen as a martian analog to study the physical sorting of basaltic sands. The strong winds affecting the plain and its young age (4000 yr) have preserved unaltered sand grains. Sands displayed subtle differences in bulk chemical composition from the basaltic source rocks suggesting that mineral abundances are modified by the aeolian transport. A paired enrichment in Mg and Ni in sands relative to the source rock is observed and results from a higher proportion of olivine grains in sand. This enrichment is variable among sand samples and is correlated with the decrease of the mean grain size of sand; a value related to the degree of aeolian sorting. This enrichment is explained by the presence of well-developed olivine minerals in the source rocks, olivine hardness and density, and the removal of plagioclases. As olivine has been detected by spectral data in several sand dunes on Mars, these results have important implications for martian studies. It shows that olivine abundances deduced from spectral data on martian sand dunes could overestimate that of the source rocks. Spectra of Icelandic sands have been analyzed showing strong differences between bedrock and sandy plains in Lambarhaun. Sand spectra have also been taken in other basaltic plains; they always display a difference in spectral bands between sand and rocks that are not only due to grain size variation. In general, our results show that mineral segregation in basaltic sands should be considered when mineralogical and chemical data of the Mars surface are interpreted.