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Conversion Electron Mössbauer Spectroscopy on Mars?

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Given the spectacular success of backscattering Mössbauer spectroscopy (b–MS) on the Mars Exploration Rovers, the inclusion of the method in future robotic missions to Mars seems evident. The addition of a Conversion Electron Mössbauer Spectroscopy (CEMS) facility will be possible in an extremely simple way. This is due to the fact that both techniques to a large extent make use of the same hardware, and that the Martian atmosphere can be used as an electron counting gas. b–MS spectra and CEMS spectra will be obtained simultaneously.

The main difference in the two techniques is the depth selectivity. By means of CEMS information from approximately the top 0.2 μm of material is obtained, while information from the top 100–200 μm is obtained by means of b–MS. Comparison of spectra obtained by each method can provide depth–selective information on the dust/soil, soil transport, oxidation processes or weathering of rocks and the role of water in these processes. In this contribution, we shall give examples of what can be learned about the geological history of a given sample by the use of CEMS together with b–MS.

The CEMS experiment further gives new opportunities for very sensitive dust detection, and can be supplemented by methods that gather distinct sub–populations of dust particles in terms of different properties. We demonstrate how CEMS can increase the usefulness of a b–MS spectrometer, allowing for measurements on samples that are not accessible by usual b–MS and give examples of experiments that can be done on

Mars when having access to both techniques.

Results obtained for terrestrial samples by this technique will be shown to highlight the potential of the technique to contribute to the understanding of geological systems. Finally, test results using a Martian atmosphere and our present ideas how to construct a CEMS detector for operation on Mars will be presented.