Laser ablation mass spectrometry for in situ space research

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A miniature time-of-flight laser ablation mass spectrometer (LMS) was designed and built at the University of Bern for application in space exploration. The small size and light weight of the instrument make it suitable for operation on a rover on a planetary surface. The LMS is characterised by a high dynamic range, sensitivity to almost all elements and the viability of chemical composition measurements with high spatial resolution in lateral as well as in vertical direction. LMS also allows for measurements of isotope abundances with accuracy at the ‰ level, allowing dating of rocks and minerals with the Pb-Pb chronometer [1].

LIMS technique has not been deployed on any space mission to date, although miniaturisation of the instrumentation is possible and operation is robust. In this study, the excellent performance of LMS is demonstrated by measurements on geological standard reference samples. Furthermore, these samples are used to determine the sensitivity factors of the instrument and to proof the conformity of these factors. The results show that quantitative chemical composition measurements on a planetary surface are possible *in situ* with LMS and that valuable information on the mineralogy and chemistry of the sample can be obtained from LMS data [2]. The capability for chemical mapping and the investigation of features down to the µm size is demonstrated on a sample of the Allende meteorite [3]. In summary, LMS measurements on a planetary surface can deliver all data needed for detailed analyses of the chemical composition (elements and isotopes), mineralogy and age of the investigated material.

[1] Riedo et al. (2013), *Planet. Space Sci.* **87** : 1-13.
[2] Neuland et al. (2016), *Meas. Sci. Technol.* **27** 035904
[3] Neuland et al. (2014), *Planet. Space Sci.* **101** : 196-209.