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# The chemical composition and mineralogy of meteorites measured with very high spatial resolution by a laser mass spectrometer for in situ planetary research

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The knowledge of the chemical composition of moons, comets, asteroids or other planetary bodies is of particular importance for the investigation of the origin and evolution of the Solar System. High resolution in situ studies on planetary surfaces can yield important information on surface heterogeneity, basic grain mineralogy and chemical composition of surface and subsurface. In turn, these data are the basis for our understanding of the physical and chemical processes which led to the formation and alteration of planetary material [1].
We investigated samples of Allende and Sayh al Uhaymir with a highly miniaturised laser mass spectrometer (LMS), which has been designed and built for in situ space research [2,3]. Both meteorite samples were investigated with a spatial resolution of about 10$\mu$m in lateral direction. The high sensitivity and high dynamic range of the LMS allow for quantitative measurements of the abundances of the rock-forming and minor and trace elements with high accuracy [4]. From the data, the modal mineralogy of micrometre-sized chondrules can be inferred [5], conclusions about the condensation sequence of the material are possible and the sensitivity for radiogenic elements allows for dating analyses of the investigated material.
We measured the composition of various chondrules in Allende, offering valuable clues about the condensation sequence of the different components of the meteorite. We explicitly investigated the chemical composition and heterogeneity of the Allende matrix with an accuracy that cannot be reached by the mechanical analysis methods that were and are widely used in meteoritic research. We demonstrate the capabilities for dating analyses with the LMS. By applying the U-Th-dating method, the age of the SaU169 sample could be determined.
Our analyses show that the LMS would be a suitable instrument for high-quality quantitative chemical composition measurements on the surface of a celestial body like a planet, moon or asteroid.

[1] Wurz, P., Whitby, J., Managadze, G. , "Laser Mass Spectrometry in Planetary Science", AIP Conf.Proc. CP1144(2009): 70-75.
[2] Rohner, U., Whitby, J.A. and Wurz, P. "A miniature laser ablation time-of-flight mass spectrometer for in situ planetary exploration", Measurement Science and Technology 14 (2003): 2159-2164.
[3] Riedo, A., Bieler, A., Neuland, M., Tulej, M. and Wurz, P., "Performance evaluation of a miniature laser ablation time-of-flight mass spectrometer designed for in situ investigations in planetary space research", Journal of Mass Spectrometry 48 (2013): 1 -15
[4] Neuland, M.B., Grimaudo, V., Mezger, K., Moreno-García, P., Riedo, A., Tulej, M. and Wurz, P., "Quantitative measurement of the chemical composition of geological standards with a miniature laser ablation/ionisation mass spectrometer designed for in situ application in space research", Meas. Sci. Technol. 27(2016), article ID:035904, 1 – 13.
[5] Tulej, M., Neubeck, A., Ivarsson, M., Riedo, A., Neuland, M.B., Meyer, S. and Wurz, P., "Chemical composition of micrometer-sized filaments in an aragonite host by a miniature laser ablation/ionization mass spectrometer", Astrobiol., 15 (2015): 669 – 682.