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In situ detection of microbial fossils on planetary bodies by combined laser mass spectrometry and optical microscopy

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The in-situ detection of fossilised forms of microbial life on planetary bodies requires thorough analysis of the chemistry, mineralogy, and morphology of the putative fossil and its host. We developed a dedicated instrument suite that fulfils the severe requirements of space flight as well as the scientific performance for such an endeavour with high accuracy and reliability. The suite consists of a high vacuum compatible microscope with micrometre resolution and a mass spectrometer able to detect trace elements down to the ppb level with permill accuracy. The instrument suite is designed to fit on typical planetary landers. We built a flight prototype and we will present its architecture and design features, as well as its key performance factors.

Using the 1.9 billion year old gunflint chert as an analogue sample, we demonstrate how different types of microbial fossils and the host regions on the sample can be distinguished and selected for chemical analysis. We will present the results of the chemical and imaging analysis of the selected locations and assign the sampled locations to known groups of fossilized bacteria.