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Determination of the Ni isotope fractionation in microfossils embedded in the aragonite phase

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Stable nickel isotopes are known to fractionate by biological processes and their measurements can be important biomarker. In searches for ancient fossilised materials such as microbial cells, the Ni isotope fractionation record can be preserved after death and fossilization of microstructures. Typically, transition metal isotopes in microfossils are difficult to measure accurately because of their low concentration in the fossil. Furthermore, microsized fossil structures are difficult to isolate from the host phase. Thus, the measurement of their chemical composition can be conducted only by a few analytical methods. We have applied femtosecond-laser ablation/ionisation time-of-flight mass spectrometry (LIMS) to measure chemical composition of the fossilised material embedded in the aragonite phase and accurately derive the Ni isotopic fractionation pattern. High resolution depth profiling method was applied to isolate fossilised material composition from the host phase. The mass peak intensity correlation and peak integration methods were subsequently applied to derive isotope concentrations. The accuracies and precision in permill level or better of the isotope values were achieved. For comparison the studies of Ni isotopes were conducted on inorganic samples. The instrument used in the studies is a miniature mass analyser developed for space research holding promisses that differentiation between abiotic and biogenic microstructures in rocks can be studied also in situ on the surfaces of Solar System bodies.

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