NanoSIMS: A new technology for the study of early life on Earth

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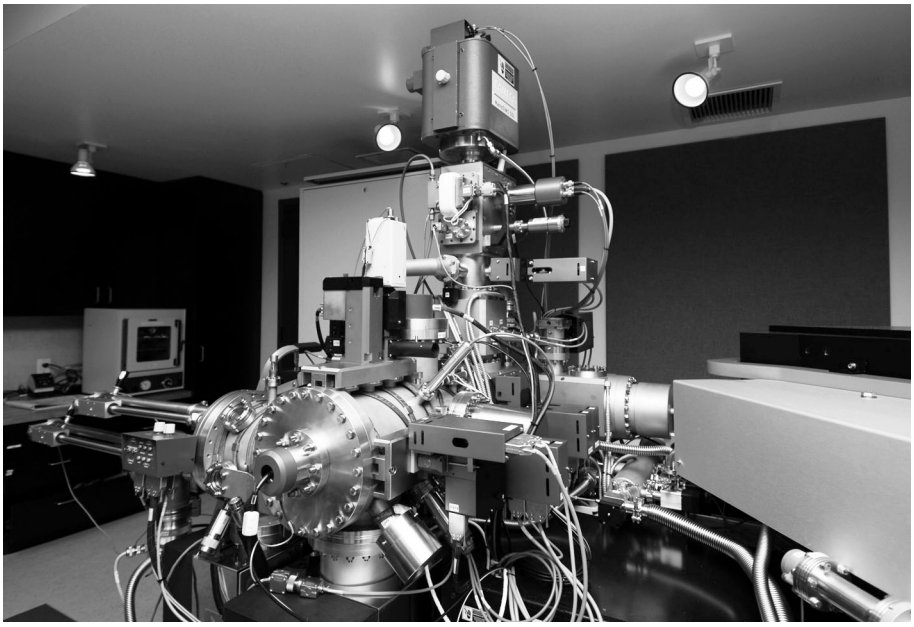
The search for signs of the earliest life on Earth extends to organic particles of micrometer size, which may be the remains of ancient microbes. A quantitative geochemical characterization of such particles is crucial to assessing their biologic origin, and to excluding abiotic hydrothermal products or younger post-depositional contaminants. The new technology of secondary ion mass spectrometry for ultrafine features (nanoSIMS) is an ideal technique for performing this challenging analysis. Its resolution of 0.10 μm for elemental mapping and of 3 μm for isotopic analysis allows for the investigation of particles that are too small to be measured with conventional microprobes. Here, as an example, we present a nanoSIMS study of organic matter included within a 3,45 Ga stromatolite from the Strelley Pool Formation, Western Australia. Quantitative measurements of $\delta^{13}C$, N/C, and $\delta^{34}S$ were carried out from particles that rarely exceed 5 μm in size. Measured $\delta^{13}C$ values range from -8.6 to -26.1‰, C/N ratios from 0.0141 to 0.0087, and $\delta^{34}S$ values from 36.6 to -10.1‰. Multiple explanations can account for these values, which record complex interactions of primary biochemical processes, diagenesis and metamorphism. Nevertheless, they are consistent with the hypothesis that the organic particles are the remains of an ancient microbial community. Geochemical evidence adds, therefore, to sedimentological evidence, providing new insights for the interpretation of the Strelley Pool stromatolites.



CAMECA NanoSIMS 50L at the Caltech Center for Microanalysis