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Combination of STXM and TEM to study geomicrobiological samples

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We combined Scanning Transmission X-ray Microscopy (STXM) and Transmission Electron Microscopy (TEM) to perform high spatial and energy resolution near-edge x-ray absorption fine structure (NEXAFS) and high resolution imaging on diverse samples of geomicrobiological interest. We will consider diverse samples including naturally and experimentally biomineralized bacteria[1], and bioweathered silicates[2,3]. Spectroscopy was performed at the C K-edge, Al K-edge, Ca $L_{2,3}$-edge, Fe L_3-edge, and N K-edge offering the possibility to characterize diverse biochemical compounds, unique bacterial spectroscopic signatures, and iron oxidation state at microorganism-mineral interfaces. Combination of TEM and STXM provides remarkably clear chemical state-specific images of fossilized microorganisms and microorganism-mineral interfaces at the nanometer scale and 0.1-0.3 eV energy resolution. The methodology presented here should be helpful in assessing the importance of microorganisms in the evolution of Earth's surface chemistry and in identifying them in early Earth and planetary materials.

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