Experimental fossilization: Biomolecule-mineral interactions

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The study of the oldest traces of life on Earth remains often problematic because of the difficulty to claim their biogenicity with certitude, as illustrated by the Apex 'microfossils' controversy [1,2,3]. Furthering our capabilities to unambiguously identify ancient microfossils requires laboratory experiments to better constrain the chemical evolution of biomolecules during advanced fossilization processes, and the influence of minerals in particular [4]. Here, we submitted RNA to hydrothermal conditions within a gel of clay mineral stoichiometry at 200°C for 20 days, using different water/mineral ratios. NMR investigations revealed that the organic fraction of the residues is no more RNA, but rather consists of particles of various chemical composition as indicated by STXM-XANES. Rather than pure clays, SEM and TEM data show that the mineralogy of the experimental residues includes amorphous silica, aluminosilicates and nanophosphates associated with nanophyllosilicates. This assemblage evokes the 3.5 Gy Apex 'microfossils', suggesting that these 'microfossils' may have formed through interactions between biomolecules and amorphous phases during an hydrothermal history.

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