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Geological and geochronological constraints on claims for Earth's earliest life in the Eoarchean of Labrador

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The time at which life on Earth began is one of humankind's most enduring scientific questions, but the further back in time one looks, the greater the difficulty of identifying and accurately dating biogenicity. It is generally accepted that host rocks to chemofossils (the only form of evidence earlier than ca. 3.5 Ga stromatolites) must represent deposition in near-surface environments with access to water. But even if this criterion is met, the host rock must also be dated unambiguously [1].

In the Saglek region of northern Labrador, isotopically light carbon in pelitic metasediments was claimed to be evidence for life before 3.95 Ga [2]. Although the host rock in this case is a suitable potential host for bioactivity, the age estimate relied on a combination of questionable field relationships in complex TTG gneisses, together with a highly subjective interpretation of zircon geochronology. The claim also overlooked geochronology and Hf isotopes published much earlier (see [3]) from host metasediments that are consistent only with a much younger age, after ca. 3Ga.

We present new SIMS U-Pb zircon data from the same gneiss outcrop used by [2] to propose a 3.95 Ga age for evidence of life. These data reveal a complex sequence of magmatic and structural events that contradicts previous interpretations. Critically, a granite that cross-cuts gneissosity and was previously used by [2] to infer a minimum age of ca. 3860 Ma for metamorphism and deformation, contains significant xenocrystic zircon from the tonalite host, which formed at ca. 3880 Ma. Instead, high-U magmatic zircon indicate granite emplacement during a regionally recognised event at ca. 2.7 Ga. In addition, the claimed relationship between these gneisses and graphite-bearing metasediments can be refuted by ages from detrital zircon in the latter, indicating deposition after ca. 3Ga. This case is another demonstration that the geochronological context of an early terrestrial biogenicity claim is critical in its interpretation.

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[2] Tashiro, T. et al. (2017). Nature 549, 516-518

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