Microscopy TODAY

Coming Events

2017

Developmental Biology
July 13–17, 2017
Minneapolis, MN
www.sdbonline.org/meeting?ResourceID=2715

Atomic Layer Deposition
July 15–18, 2017
Denver, CO
www.ald-avs.org

Materials Research Congress
August 20–25, 2017
Cancun, Mexico
www.mrs.org/imrc-2017

International Frontiers of Electron Microscopy in Materials Science
September 10–15, 2017
Johannesburg, South Africa
http://femms2017.org

Microscience Microscopy Congress and EMAG2017 (mmc2017)
July 3–6, 2017
Manchester, UK
www.mmc-series.org.uk

Denver X-Ray Conference
July 31–August 4, 2017
Big Sky, MT
www.dxcicdd.com

Microscopy & Microanalysis 2017
August 6–10, 2017
St. Louis, MO
www.microscopy.org

2018

Microscopy & Microanalysis 2018
August 5–9, 2018
Baltimore, MD
www.microscopy.org

2019

Microscopy & Microanalysis 2019
August 4–8, 2019
Portland, OR
www.microscopy.org

2020

Microscopy & Microanalysis 2020
August 2–6, 2020
Milwaukee, WI
www.microscopy.org

2021

Microscopy & Microanalysis 2021
August 1–5, 2021
Pittsburgh, PA
www.microscopy.org

2022

Microscopy & Microanalysis 2022
July 31–August 4, 2022
Portland, OR
www.microscopy.org

More Meetings and Courses
Check the complete calendar near the back of this magazine.

Carmichael's Concise Review

Did Life Begin Soon After the Earth Formed?

Stephen W. Carmichael
Mayo Clinic, Rochester, MN 55905

carmichael.stephen@mayo.edu

There are no confirmed microfossils older than 3,500 million years (Myr) on Earth. Recently Mathew Dodd, Dominic Papineau, Tor Grenne, John Slack, Martin Rittner, Franco Pirajno, Jonathan O'Neil, and Crispin Little may have identified evidence of microbial life on Earth from at least 3,770 Myr ago or perhaps as long ago as 4,280 Myr [1]. This would be relatively near the accepted time that the Earth was formed about 4,567 Myr ago!

Microfossils that have biosignatures are considered evidence of early life. These take the form of tubes, knobs, filaments, and/or branching filaments that are likely biogenic. They are similar to younger microfossils in the same kinds of jasper rocks as well as to modern iron-oxidizing bacteria, and they are not the product of any known non-biologic chemical reactions. Dodd et al. pointed out that modern forms of these are known to form at hydrothermal vents on the ocean floor, and therefore life may have begun in a similar environment. A candidate location is a region in northern Québec, Canada, known as the Nuvvuagittuq Supracrustal Belt (NSB) that represents a fragment of the Earth's primitive ocean floor with pillows of lava and where the metamorphosed remains of hydrothermal vents may be preserved as highly localized iron-rich carbonate rocks. Samples from the NSB were examined by light microscopy (transmitted and reflected) as well as scanning electron microscopy (SEM) in back-scattered electron and secondary electron imaging modes. Other microscopy methods were correlated to analyze mineral targets including laser scanning confocal micro-Raman spectroscopy, electron probe micro-analysis, focused ion beam milling, and laser ablation inductively-coupled plasma mass spectrometry.

To assess the biogenicity of the NSB putative microfossils, Dodd et al. considered if the microscopic structures they found could have possibly been formed by abiogenic mechanisms. Considering their structures as twisted iron-containing filaments with microscopic dimensions, identical to younger microfossils and modern bacteria, and their

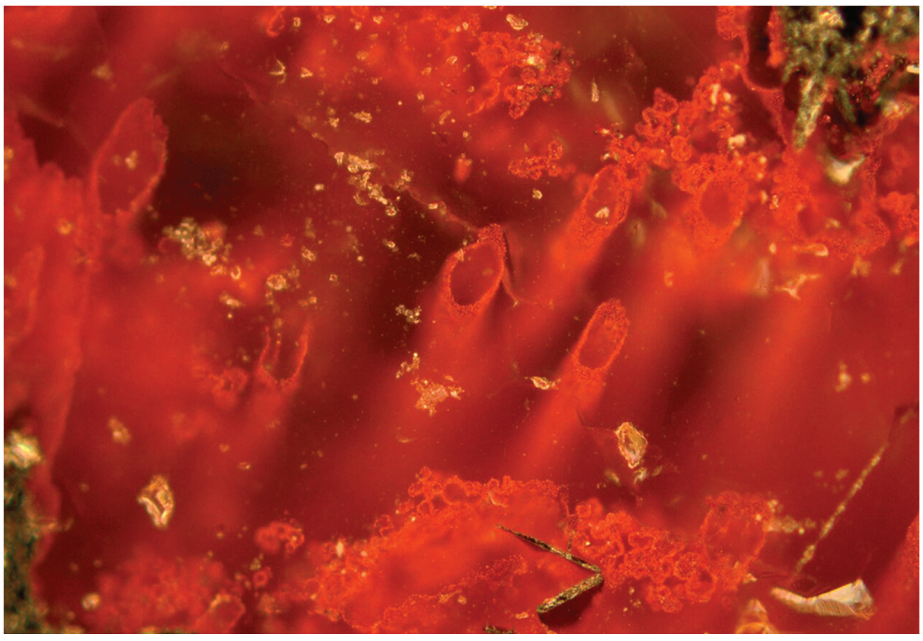


Figure 1: Haematite (containing ferric oxide) tubes from the NSB hydrothermal vent deposits. Photo credit: Matthew Dodd.

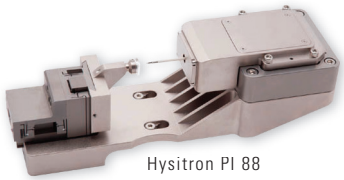
doi:10.1017/S1551929517000608

BRUKER

Quantitative Nanomechanical Testing

Enhanced with the Power of Electron Microscopy

Bruker's comprehensive suite of in-situ nanomechanical instruments combines powerful electron microscopy with small-scale mechanical testing. Each system is capable of a wide variety of testing modes, enabling unprecedented insights into nanoscale material behavior across the research spectrum.



Hysitron PI 88

www.bruker.com/nanomechanical-testing-MToday

Hysitron PI 95

Innovation with Integrity

Nanomechanical Testing

attachment to tubes (Figure 1) and terminal knobs, they concluded that their observations could not be explained by any known single or combined abiogenic pathway. Many filaments and tubes were also found inside concretions of jasper, similar to younger fossils of marine animals found in limestone. Of particular note is the presence of carbonate rosettes, 50 to 200 μm in diameter, which typically contained microscopic inclusions of carbonaceous material and apatite. Similar modern rosettes with concentrically layered minerals are attributed to mineralized bacteria, although those structures are most likely abiogenic but require biomass to form through chemically oscillating reactions. In fact, rosettes and slightly larger granules from the NSB contain phosphorus (an element vital in biology) in apatite within the carbonate rosettes, which suggests a biologic origin. This conclusion, along with the occurrence of microfossils nearby some structures, indicates an origin involving micro-organisms in the Nuvvuagittuq seafloor more than 3,700 Myr ago.

If these conclusions are supported by future studies from this laboratory and others, then they will have a profound impact on the search for life on other planets. Dodd and his mentor Papineau suggest that ancient submarine-hydrothermal vents should be viewed as increasingly likely sites for origins of life on Earth, as well as primary targets in the search for extraterrestrial life.

References

[1] MS Dodd et al., *Nature* 543 (2017) 60–64.
[2] The author gratefully acknowledges Dr. Dominic Papineau for reviewing this article.

MT

https://doi.org/10.1017/S1551929517000608 Published online by Cambridge University Press

Incomparable...

...and still innovating

DiATOME
diamond knives

ultra 45° • cryo • histo
ultra 35° • histo jumbo
cryo immuno • ultra sonic
ultra AFM & cryo AFM
trimtool 20 • trimtool 45
trimtool 90

Free customer service

Sectioning tests with biological and material research specimens of all kinds. We send you the sections along with the surfaced sample, a report on the results obtained and a recommendation of a suitable knife. Complete discretion when working with proprietary samples.

Re-sharpening and reworking service

A re-sharpened Diatome diamond knife demonstrates the same high quality as a new knife. Even knives purchased in previous years can continue to be re-sharpened. The knives can be reworked into another type of knife for no extra charge, e.g. ultra to cryo or 45° to 35°.

Exchange service

Whenever you exchange a knife we offer you a new DiATOME knife at an advantageous price.

Over 40 years of development, manufacturing, and customer service

DiATOME U.S.

P.O. Box 550 • 1560 Industry Rd. • Hatfield, Pa 19440
Tel: (215) 412-8390 • Fax: (215) 412-8450
email: sgkcck@aol.com • www.emsdiasum.com