Re: Lecture of the Week: Could We Tell Life if We Saw It?

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"Wirt Atmar" <atmar@xxxxxxxxxxxxxxxxx> wrote in message
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> AICS Research, Inc. is pleased to present a Lecture of the Week, ...
> The webpage for the lectures is:
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> http://aics−research.com/lotw/
>
> March 20, 2006
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> Could We Tell Life If We Saw It?
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> ALH84001 in 2004
> Joe Kirschvink
> California Institute of Technology
> 34 min. (requires QCShow Player)
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> How can we hope to distinguish true biological microfossils from random assemblages of crystalline mineral material ? especially if the life that those microfossils might represent were potentially an independent origin of life, billions of years ago, on another planet, and is now likely extinct? That's the question that has raged around the structures found in the Allen Hills 84001 meteorite.
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> As UCLA's William Schopf has written, "There are fine lines between what is known, guessed, and hoped for, and because science is done by real people these lines are sometimes crossed. But science is not a guessing game. The goal is to know. 'Possibly... perhaps... maybe' are not firm answers and feel−good solutions do not count. With regard to the famed Mars meteorite, for example, life either once existed on Mars or it didn't. Meteorite ALH84001 either holds telling evidence or it doesn't. Eventually, hard facts will sort it out."
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> Schopf has been among the harshest critics of the earliest interpretations of life in ALH84001. "Probably the best way to avoid being fooled by nonbiologic structures is to accept as bona fide fossils only those of fairly complex form. This may seem an unreasonably

> stringent rule for truly ancient fossils since the earliest kinds of cellular life (here and presumably elsewhere) almost certainly were very simple ? probably individual, tiny, spheroidal cells. But until we have a sounder base of knowledge and better rules to separate nonfossils from true, it is best to err on the side of caution."
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> CalTech's Joe Kirschvink agrees, but comes to a different conclusion. Microfossil paleontologies based on morphologies are undoubtedly flawed. In morphology's place however, Kirschvink compellingly argues that the fingerprint of natural selection can be detected by the very complexity and purity of the results that selection produces. While there are no biological processes that can not be reproduced in some manner by non−life processes, the results of simple inorganic syntheses are haphazard at best.
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> Magnetite exists in ALH84001, and Kirschvink argues that it was biologically produced, primarily by subjecting it to a Venn diagram analysis of seven different physical characteristics, each ranging from hard to easy, and in the process pointing out that ALH84011's magnetite is of an even higher quality than is capable of currently being manufactured by human processes.
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> Magnetotactic bacteria were discovered on Earth only in the 1960's, but we now know of south− and north−pole seeking bacteria. For an organism evolved to exist in ponds within a narrow range of oxic−anoxic conditions, where light doesn't penetrate and gravity is overwhelmed by random Brownian motions, the evolution of magnetotaxis is an exceptionally clever solution to the problem determining orientation.
>
> Although Mars no longer has either a magnetic field or liquid water, it is strongly presumed that Mars once had both, and the most parsimonious, simplest explanation for the high−quality magnetite crystals that appear in ALH84001 is that they were synthesized by organisms similar to terrestrial bacteria.

Interesting lecture. It led me to seek more information on magnetotactic bacteria. Here is a good review (and the source of some of Kirschvink's slides):
http://www.calpoly.edu/~rfrankel/NatRevMicro.pdf

If (and as Darwin said "Oh, what a big if!") the magnetite crystals are a product of Martian organisms, it is possible that the function of these crystals had nothing to do with magnetotaxis. I note that the crystals are grown within lipid vesicles which seem to form by invagination from the plasma membrane. Is it possible that the magnetite is simply either a waste product or a way of storing iron? Some of these organisms produce Greigite (Fe_3S_4) rather than Hematite (Fe_3O_4). The fact that the solid mineral is produced in contact with a membrane reminds me of Wachtershauser's hypothesis regarding pyrite (FeS_2).

It is also interesting that the trait of being south−seeking or north−seeking
seems to be a heritable trait which does not depend on DNA genetics.
Instead, it seems to be a feature of morphology which is directly passed
on to offspring since the cell divides by bisecting its long axis.
As with Sonneborne's classic studies of cilia orientation in Paramecia,
there is an experimental manipulation which can reverse the original orientation;
the fact that this 'acquired characteristic' is heritable shows that
the inheritance does not involve DNA.

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