Biogeosciences Discussions, 3, S98–S101, 2006
www.biogeosciences.net/bgd/3/S98/
European Geosciences Union

Biogeosciences
Discussions

BGD

3, S98–S101, 2006

Interactive
Comment

Interactive comment on "Comets, carbonaceous meteorites, and the origin of the biosphere" *by* R. B. Hoover

R. B. Hoover

Received and published: 24 March 2006

Reply to Comments by Dr, Storrie-Lombardi regarding the manuscript "Comets, carbonaceous meteorites, and the origin of the biosphere"

I thank Dr. Storrie-Lombardi for these comments on the manuscript provided from the perspective of a Medical Doctor who is also a scientist. I fully agree that "proof of life" has been elusive, especially when the subject is that of extraterrestrial life. And it is clear that the essence of this debate is concentrated on two primary areas–

A. Biogenicity - Are the meteoritic microstructures biotic or abiotic? and B. Indigenicity - Are these forms indigenous or are they recent biological contaminants?

It is interesting that the concept of indigenous microfossils in meteorites sometimes evokes such a very strong response. Manfred Schidlowski remarked in his Volume of Exobiology that the study of microfossils in meteorites had become "taboo". Much of this reaction may be traced to the great "organized elements" debate of the early

1960's. I suspect that debate may have taken a different form if the researchers had had access to the powerful tools that I have been privileged to use. In their studies, Claus and Nagy treated the Orgueil and Murray meteorites with a variety of strong acids to extract "acid resistant microfossils" and in so doing they would have destroyed all remains preserved in the water soluble magnesium sulfate. It is interesting that the reaction is so strong that critics sometimes both invoke both challenges simultaneously - despite the logical contradiction that if the forms are abiotic they could not also be recent bio-contaminants.

It is for the reason that I was very much aware of these reactions that I have taken extreme precautions to prevent and recognize contamination. I have insured that all tools, stubs, tweezers, etc. were flame sterilized with a propane torch before being used for fracturing and handling the meteorite samples. This approach not only sterilizes, but also would vaporize, any microbes that might have been present on the tool or mount stub. In this way it is possible for me to be quite sure that the meteorite sample is not being contaminated as a result of my handling processes. Unfortunately, in the past many Museums have handled meteorites as "rocks" and they have not always been handled in the way that these most precious rocks deserve.

That is undoubtedly the reason that one sample of the Murchison meteorite that I received from the Field Museum in Chicago had become contaminated on the exterior surface with recent fungi. I certainly hope that the current studies will help persuade the Museums to instigate a much more careful program for handling and maintaining SNC and carbonaceous meteorites.) After I discovered that the Field Museum sample was contaminated, I still devoted a fair amount of time to the study of this sample. It was through this study that I made a number of observations for detecting and discerning recent bio-contaminants and recognizing them principally by the nitrogen content. And although it is generally thought that since the carbonaceous meteorites contain carbon therefore they must easily be contaminated with microbes I have not found this to be the case. The carbon in the meteorites is largely contained within the very long chain, macromolecular (IOM) insoluble organic molecules. These insoluble "kerogen-like" macromolecules are of absolutely no use whatsoever to organotrophic bacteria. Furthermore, the carbon isotope fractionation and the missing protein amino acids from the CI and CM carbonaceous meteorites provides sound evidence that these meteorites have not been contaminated with recent microorganisms. If they were, the very sensitive methods used by Dr. Steve Macko and Dr. Michael Engel would certainly detect all 20 of the protein amino acids in the meteorites. In the revised manuscript, I will have a new section to these diverse aspects of meteorite contamination. The friability of the Orgueil meteorite is in itself somewhat of a benefit for this research. Early on the museums discovered that great care to protect the Orgueil meteorite from atmospheric moisture or they would see their precious sample fall to pieces. Second, this property of Orgueil also clearly proves that the meteorite has never been subjected to liquid water since it arrived on Earth. For this reason, as you have clearly recognized, mats of filamentous prokaryotes, such as are seen in these images, could not have formed in the meteorite after it landed.

Your comment about visual observational skills is also very important. The ability to recognize living or fossil cyanobacteria and other filamentous prokaryotes is best done by phycologists, microbiologists, and paleontologists, who have studied these life forms and know their appearance, reproductive and specialized cells and features, life habits, sizes and size ranges, and ecology. Furthermore, it is also very important to understand the taphonomic and diagenetic changes that can occur after death and during the fossilization process. It is also important to recognize the strengths and limitations of the observational tool being used. The ESEM and FESEM instruments show structural features of the surface morphology with superb detail, but they do not reveal the interior. In the revised manuscript I will illustrate this point by showing optical microscopy images of living cells, trichomes and hormogonia of known cyanobacteria and then presenting the appearance of the same filaments as they are seen in the FESEM. I also agree that it is extremely important to develop a large data base of morphologies and the associated co-registered chemical data so that powerful mathematical ad statistical tools such as you are developing can be brought to bear on this important and interesting problem.

Your stimulating and insightful comments on this manuscript are very greatly appreciated.

Interactive comment on Biogeosciences Discussions, 3, 23, 2006.

BGD

3, S98–S101, 2006