Response to Robert Karl Stonjek on Chemosynthesis

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From: Michael Ragland (*ragland666_at_webtv.net*)
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This "appears" to possibly be examples of "chemosynthetic" organisms but the researchers acknowledge they are poorly understood. My own view is chemosynthesis preceded photosynthesis and we would not be alive today as an organism had it not been for chemosynthesis although it was photosynthesis which allowed life to incredibly flourish and diversify and managed to kill off many chemosynthetic organisms. http://www.geo.unimib.it/Conisma/KIELBIO.htm Mud diapirs and mud volcanoes are present at different sites along the crestal area of the Mediterranean Ridge. The geological deformation of this accretionary prism pressurizes the circulating fluids which are expelled from sediments. Relatively dense macrobenthic communities, mainly composed of mollusks were observed in cores and video images recorded at the top of the Napoli Dome, S of Crete. A box−corer taken (fig. 1−2) near a "black spot", showed 3 cm of fluid, surficial, pteropod mud containing some lucinids (fig.3). Other lucinids and vesicomyids (fig.4) were recognized on the top of other bottom samples collected on the Napoli Dome. All these taxa are known to host bacterial gill symbionts, which exploit the reduced gases emitted from the mud volcano for the synthesis of organic compounds. The chemosynthetic organic compounds provide energy to the molluscan hosts, allowing them to thrive in these otherwise inhospitable, extreme environments. The precise type of chemotrophy which characterizes the bacteria linked to the anoxic lakes and to the mud volcanoes and the different type of producers involved in these trophic webs are still far to be completely understood. C.Corselli, D.Basso (1996) −First evidence of benthic communities based on chemosynthesis on the Napoli mud volcano (eastern Mediterranean). Marine Geology, 132: 227−239 ACKNOWLEDGEMENTSWe are grateful to the Italian Consiglio Nazionale delle Ricerche (CNR) for the ship time of the R/V Bannock and R/V Urania. Funds from Consiglio Nazionale delle Ricerche (CNR), and EU MAST Programme Projects: MARFLUX (MAST I), PALEOFLUX (MAST II), SAP (MAST III). EU−Workshop on Extreme Marine Environments, Kiel 19−22 November 1998 Re: Is chemosynthesis older than photosynthesis?Date: Thu Mar 16 13:23:34 2000Posted By: Neil Saunders, Post−doc/Fellow, Molecular Cell Physiology, Vrije UniversiteitArea of science: EvolutionID: 953094577.Ev Message:Hi Raul, Thanks for this question−it is a good one. Here is the short answer: yes, chemosynthesis is a more viable option for early life and yes, we believe that it predates photosynthesis. Now for the longer answer! There is a lot of debate about the composition of the early earth. It was hot and therefore volcanically active. There would have been large out− gassings of water vapour into the atmosphere and frequent electrical storms, all as depicted in the pictures that you mention. In the 1950's, biologists Harold Urey and Stanley Miller tried to simulate the early atmosphere by passing electrical discharges through mixtures of water vapour, methane and ammonia, and they showed that many basic biochemicals could be formed in this way, including sugars, amino acids and the bases of nucleic acids. These experiments have shaped the way that scientists think about how life started ever since. The experiments assumed that the early atmosphere was reducing−that is, rich in hydrogenous compounds such as methane. Since then there has been much debate about this, with many scientists now believing that the atmosphere was less reducing than previously assumed. However, one thing we are quite sure of is that the early atmosphere was not oxygen−rich. The oldest known rocks contain very low amounts of "banded iron ores", formed when iron reacts with free oxygen. These types of ore increase over time, starting about 2.5 billion years ago. So it seems that free oxygen appeared and increased over time, and the only source of oxygen that we know for this is photosynthesizing micro−organisms. But we have fossil evidence for simple, single−celled organisms long before this time. They must have had very simple metabolisms and the simplest that we know of are chemosynthetic. They were probably similar to the kingdom of micro−organisms called Archaea, that exist today. They often live in extreme environments and can derive energy by oxidising simple compounds or even elements, like iron or hydrogen. Photosynthesis had to wait for 2 things: (1) the production of chlorophyll, or a similar compound, that could capture energy from sunlight, split water and generate hydrogen and (2) the ability to combine that hydrogen with carbon dioxide to make sugars. But once photosynthesis was established, the organisms that could perform it spread to take over the earth. Of course, the new oxygen was toxic to the previous inhabitants and they were banished to the extreme corners of the earth for ever! And in time, organisms evolved that could tolerate and use the oxygen.This is a vast and fascinating topic, with many unanswered questions and contentious areas. If you want to read more, a good discussion of the early earth can be found in a great book, "Life: An Unauthorised Biography" by Richard Fortey. There are also excellent resources at:http://www.talkorigins.org/This is the Talk.Origins archive, which discusses many evolutionary topics, including the early earth.Neil Saunders Current Queue | Current Queue for Evolution | Evolution archives Try the links in the MadSci Library for more information on Evolution. MadSci Home | Information | Search | Archives | Mad Library | MAD Labs | MAD FAQs | Ask a question | Join Us! MadSci Network, webadmin@www.madsci.org© 1995−2000. SS16 Permeable Sediments − Physics, Biology and GeochemistryDate: Thursday, June 17, 2004Time: 10:00 AMLocation: Room 100 Biddanda, B A Grand Valley State University, Muskegon, USA, biddandb@gvsu.eduJohengen, T H

University of Michigan, Ann Arbor, USA, johengen@umich.eduRuberg, S NOAA Great lakes Environmental Lab, Ann Arbor, USA, steve.ruberg@noaa.govRediske, R Grand Valley State University, Muskegon, USA, redisker@gvsu.eduKendall, S Grand Valley State University, Muskegon, USA, kendalsc@gvsu.eduMeadows, G University of Michigan, Ann Arbor, USA, gmeadows@engin.umich.eduColeman, D Institute for Exploration, Mystic, USA, dcoleman@ife.org ECOLOGY OF A SUBMERGED SINKHOLE IN LAKE HURON: IS THERE EVIDENCE FOR CHEMOSYNTHESIS, AND CHEMOSYNTHESIS−BASED HETEROTROPHIC PRODUCTION?Dissolution of Silurian−Devonian aquifer in the Lake Huron Basin has produced karst formations (sinkholes) through which groundwater seeps into the lake bottom. Using a remotely operated submersible, we explored one such sinkhole ecosystem during September 2003. Venting groundwater at 100m depth was 4−5 C warmer and had 10−fold higher conductivity than ambient lake water. A 1−2m thick dark cloudy nepheloid layer with a strong hydrogen sulfide odor prevailed just above the venting area. This layer was characterized by very high concentrations of organic matter (up to 400 mgC/L having a C:N molar ratio of 8−9), sulfate and chloride. Bromide, acetate and formate were also present at lower concentrations. Compared to surface water, vent water was characterized by 10−fold higher dissolved organic matter, bacterial biomass as well as heterotrophic bacterial production. Significant uptake of 14C−bicarbonate in dark incubations provided preliminary evidence for occurrence of chemosynthesis in this sulfide−rich, oxygen−poor, organic−rich, aphotic environment. Could the observed high rates of heterotorphic production be supported by intense chemosynthetic production of organic matter within this submerged sinkhole ecosystem in the Laurentian Great Lakes?