show sensitive responses to temperature and hydrological conditions. Organic-clay association could prevent organics from microbial degradation, which in turn impacts carbon cycle. Co-occurrence of microbial functional groups accelerates the reduction of iron within clay minerals. It is found that the ocean across the Permian-Triassic boundary is featured by hot, anoxic conditions with low concentration of sulfate and nitrate. Organisms of different trophic levels show varied responses to the deteriorative environmental conditions. Microbes play important roles in changing the oceanic chemistry and global warming at that time. Two episodes of faunal mass extinction and environmental crisis were proposed. Enhanced anoxia and euxinia were present in association with microbialites and giant oolites in early Griesbachian, Dienerian-Smithian transition and Smithian-Spathian. Oceanic stratification in Neoproterozoic results in the differentiation of bio-habitat and thus the different geomicrobiological processes, which in turn causes the separation of DOC pool and DIC pool and thus a carbon cycle different from that in Phanerozoic. Large DOC pool is present in association with anoxic or euxinic conditions during Doushantuo deposition. Photosynthetic autotrophs are dominant in Early Doushantuo but later replaced by chemoheterotrophs due to the expansion of euxinic zones. Thrombolites were demonstrated to be of microbial origin in Mesoproterozoic in North China craton. Two important replacements of microbes were found to relate to the change in oceanic chemistry and the enhanced input of nutrients resulted from volcanism, respectively. Eukaryote was documented to diversify at that period. Mesoproterozoic oceans are characterized by the decrease in DIC pool, the shallow chemocline and low concentration of sulfate.

Key Words: Geomicrobial functional group; Global change; Oceanic chemistry; Extreme environments

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现代海洋极端环境微生物的地质作用及其分子和同位素响应年度报告

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摘 要 围绕现代海洋极端环境条件下微生物分布特征和环境因子相互关系的研究在前期工作积累的基础上进行了更深入的分析,通过对北极冰川前沿和西南印度洋深海微生物资源的调查,初步了解了微生物群落结构的多样性及微生物的部分生态功能,为探索地质历史时期的微生物生命过程提供了良好的资源;发现西南印度洋深海微生物群落结构与钙、磷、硫等元素具有相关性,为揭示深海微生物的地球化学循环创造了条件;对深海环境铁还原菌的研究对探讨古海洋环境与生命的协同演化具有重要意义。开展了微生物对模拟环境条件如海洋酸化及火山爆发等地球历史时期的重大地质突变事件为背景,在现代海洋环境中进行了一系列的模拟研究,针对目前研究相对薄弱的环节,重点研究了海洋酸化及火山灰添加对浮游异养细菌的影响,初步揭示了浮游细菌对大气CO_2升高及火山爆发事件的反馈,完善了地质突变期海洋生态系统反馈的认识。另外,在深部生物圈MCG古菌的研究上取得了重要进展。MCG是迄今为止发现分布最为广泛的一类未培养古菌,被认为是海底深部生物圈中最丰富,并且最活跃的类群之一,很可能在全球物质和能量循环过程中发挥了重要的作用。课题组发现MCG古菌在系统发育上处于一个深的分支,代表了一类自然界较古老的古菌,显著不同于目前分类已确定的所有古菌门类,并提议将MCG古菌归类于一个全新的门类,命名为深古菌门(Bathyarchaeota)。这是目前首个由中国学者提议的古菌门的分类,是古菌和生命起源和演化研究的重要进展之一,也将为该领域的科学研究起到积极推动作用。

关键词：海洋　极端环境　微生物　地质作用　同位素

The Geological Roles and Isotopic Responses of the Extremophiles in the Modern Ocean

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Abstract: We conducted further investigations on the microbial distribution characteristics and its relation with environmental factors, mainly on Actic ice front area and South-west Indian deep ocean. Our results revealed the dynamic microbial community structures and the ecological functions of some microbial groups, thus provided precious biological materials to explore the geological functions of microorganisms in the Earth history. Meanwhile, the microbial structure in the South-west Indian deep ocean was found to be related with some elements including Calcium、Phosphorus、and Sulfur, providing data and research basis for further scientific studies on revealing the biogeochemical roles of marine microorganisms. We conducted a series of environmental simulating experiments such as marine acidification and volcanic eruption which represent important geological events in the earth history. We focused on the responses of planktonic heterotrophic bacteria towards marine acidification and supplementing with volcanic ashes, our study supplements current understanding on the responses of marine ecosystem in the geological disrupting events. Moreover, we have made significant progresses on MCG archaea in the deep subsurface biosphere. MCG is one of the most widely distributed cosmopolitan uncultivated archaea, regarded as the most abundant and active archaeal group. MCG is probably playing important roles in the biogeochemical roles on Earth. We found that MCG is placed in a deep branch on the phylogenetic tree, representing an ancient group of archaea, and distinct from all known archaeal Phylum. Therefore, we propose to name MCG as a novel archaeal Phylum as "Bathyarchaeota". Proposing of MCG into a new archaeal phylum would stimulate research interests in this unknown fascinating archaeal group.
Key Words: Ocean ;Extreme environments ;Microorganism; Geological function; Isotope

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第四纪异常气候环境与地质微生物 2013 年度报告

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摘　要 第四纪异常气候下微生物的响应和反馈的研究不但对了解现代全球变暖背景下微生物与气候变化之间的关系具有启示作用,同时对也为地质历史时期微生物和环境之间的协同演化的假设提供验证的案例。因而,第四纪异常环境下地质微生物的研究是联系微生物作用的现代过程与地质过程的桥梁。该研究借助于洞穴沉积物、泥炭沉积物和长江中游的湖泊沉积