# Nitrate- and nitrite dependent anaerobic oxidation of methane

OLIVIA RASIGRAF[1], BAOLI ZHU[1], DORIEN M. KOOL[2], MIKE S. M. JETTEN[1] AND KATHARINA F. ETTWIG[1]

[1]Department of Microbiology, IWWR, Radboud University Nijmegen, The Netherlands
[2]Royal NIOZ, Department of Marine Organic Biogeochemistry, Texel, The Netherlands

The first described enrichment culture capable of anaerobic oxidation of methane (AOM) coupled to nitrite and nitrate reduction was a consortium of *Methylomirabilis oxyfera* bacteria (80%) and archaea (10-20%) [1], the latter later named AOM-associated archaea (AAA) [2]. However, after prolonged incubation (several months) with elevated nitrite the AAA disappeared from the enrichment culture, and *M. oxyfera* bacteria were shown to oxidize methane without an archaeal partner. Subsequent isotope labeling studies with *M. oxyfera* showed that it can produce oxygen from nitric oxide, which is then used for methane oxidation via a monooxygenase reaction [3]. The isotope fractionation factors for carbon and hydrogen during methane oxidation by *M. oxyfera* were determined, and were in the same range as previously reported for aerobic methanotrophs [4]. Recently we investigated the capacity of *M. oxyfera* bacteria to fix $CO_2$ via the Calvin-Benson-Bassham cycle and their unusual lipid composition. Furthermore, based on the genomic information and physiological studies, the AAA were shown to possess the capacity for reverse methanogenesis and nitrate reduction. AOM by both *M. oxyfera* and AAA is of great interest for the understanding of and the linkage between the biogeochemical cycles of methane and nitrogen.

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# Deposition of the precursor sediments of banded iron formations

B. RASMUSSEN[1]*, B. KRAPEZ[1], J.R. MUHLING[1,2] AND D.B. MEIER[3]

[1]Dept of Applied Geology, Curtin University, Kent Street, Bentley, WA 6102, Australia (*correspondence: b.rasmussen@curtin.edu.au)
[2]CMCA, The University of Western Australia, Stirling Highway, Crawley, WA 6009, Australia
[3]School of Earth and Environment, The University of Leeds, Leeds, LS2 9JT, United Kingdom

Banded iron formations (BIFs) are derived from iron-rich chemical sediments whose composition is used to make inferences about the early Precambrian ocean, atmosphere and biosphere. Before geochemical information from BIFs can be reliably interpreted, their origin and post-depositional history must be understood. However, the identity of the original sediments and how those sediments were deposited is contentious due to a long history of post-depositional overprinting and the absence of direct modern analogues. Most depositional models are based on the interpretation that the initial precipitate comprised ferric oxyhydroxides that formed when ferrous iron was oxidized in the water column and settled on the seafloor. The lack of well-defined grain-shapes and current-generated structures has been used to infer a pelagic origin for the primary sediments.

New sedimentological and petrographic studies of well-preserved intersections of BIF in the 2.63-2.45 Ga Hamersley Group, Western Australia, show the presence of abundant silt-sized spherical particles (or microgranules) in mm-thick chert microbands. The microgranules are most common in the least-altered BIF where they define sedimentary laminations, implying a depositional origin. They were deposited in lamina sets comprising a basal microgranule-rich lamina overlain by amorphous mud with dispersed microgranules. Seafloor silicification is interpreted to have preferentially replaced the amorphous clay matrix, implying that the precursor sediment must have comprised two particle sizes: silt and clay. Micrograding is interpreted to record plane laminations resulting from deposition of iron-rich muds entrained in dilute turbidity currents. The presence of micrograded structures in other BIFs, implies that resedimentation of precursor sediments was common.

A model is proposed in which ferruginous oceans with elevated silica favoured the growth of iron-silicate minerals proximal to active ridge systems. The hydrothermal muds accumulated on a sloping seafloor and were resedimented by dilute turbidity currents, and deposited on the basin floor as thin, laterally extensive sheets.

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