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Upside down in the oxygenated Archean mud

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When and where did biological O_2 production and accumulation begin on Earth? The answer to this question remains debated. In this presentation we will make the case that biological O_2 production and accumulation began hundreds-of-millions of years before the Great Oxidation Event in benthic cyanobacterial communities. In some sunlit waters, O_2 production seems to have sufficiently outpaced destruction to permit O_2 accumulation near the sediment-water interface. These claims are supported by the phylogenetic record, which places the earliest cyanobacteria on the seafloor, the nitrogen isotope record, which requires nitrate accumulation in marine bottom waters, and the thallium isotope record, which requires stable Mn oxide minerals on the seafloor. Box modelling shows that micromolar levels of dissolved O_2 were attainable in this scenario under plausible Archean conditions. The rise of O_2 was initiated on marine mud according to our synthesis. Counter to today, productive late-Archean shelves may have been more oxidizing on the bottom and more reducing on the top.