

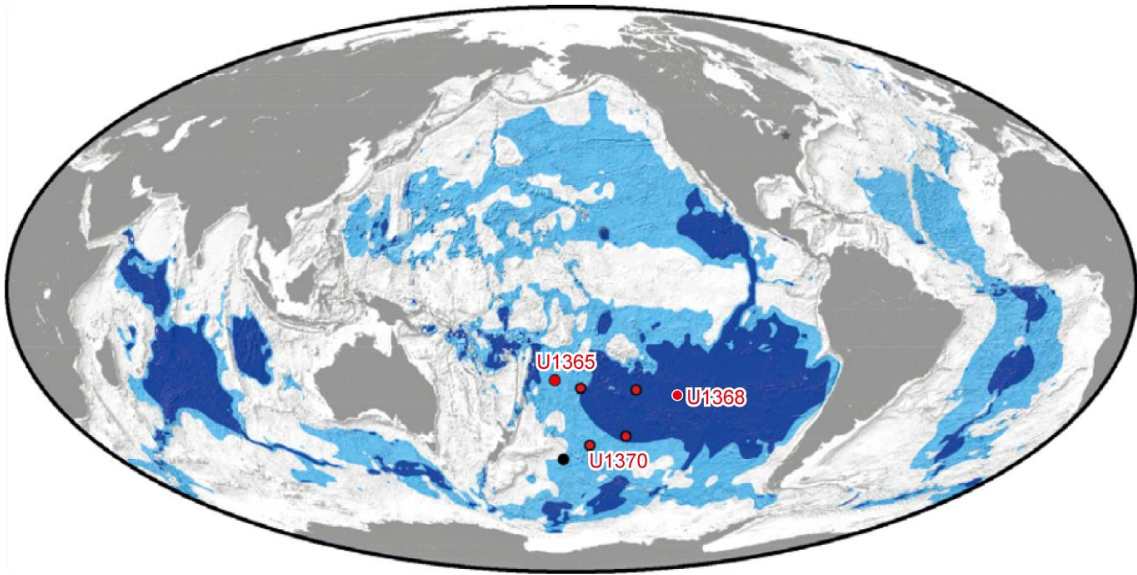
Supplementary Information

Aerobic microbial life that persists in oxic marine sediment for 101.5 million years

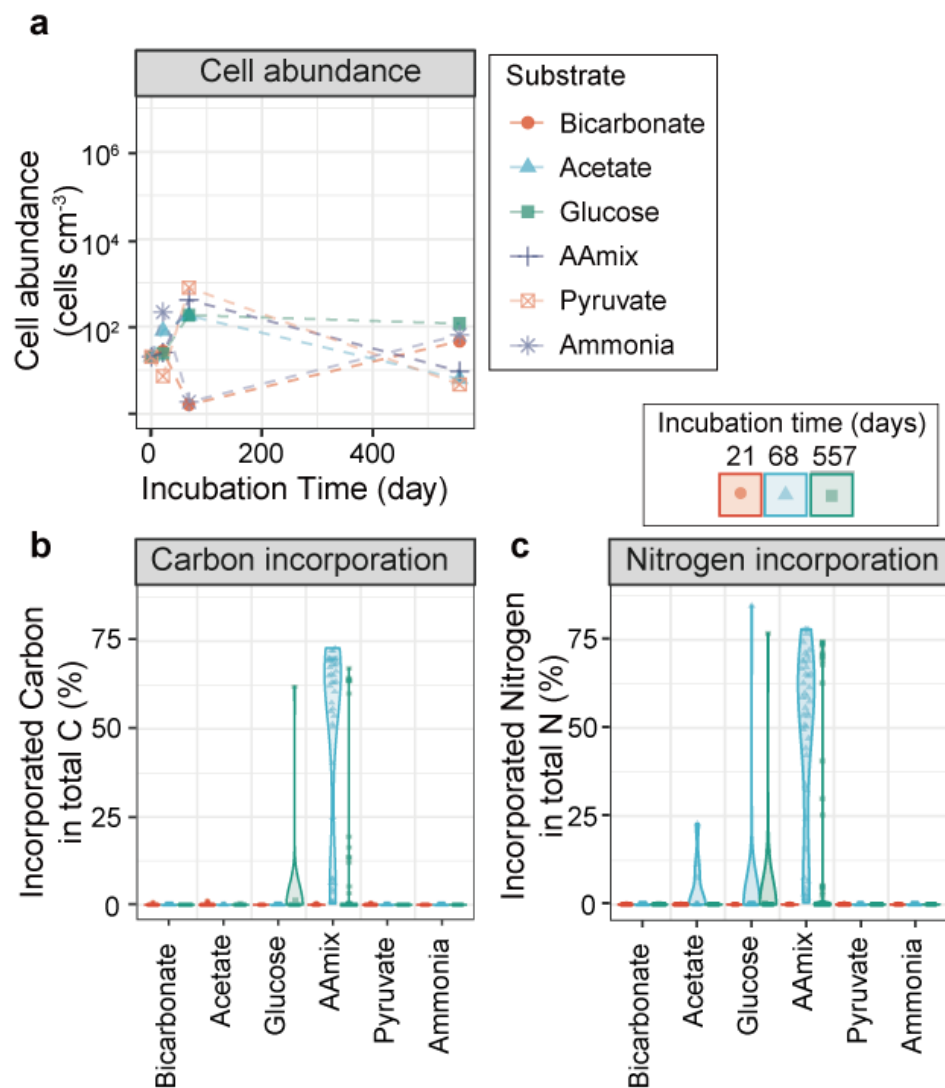
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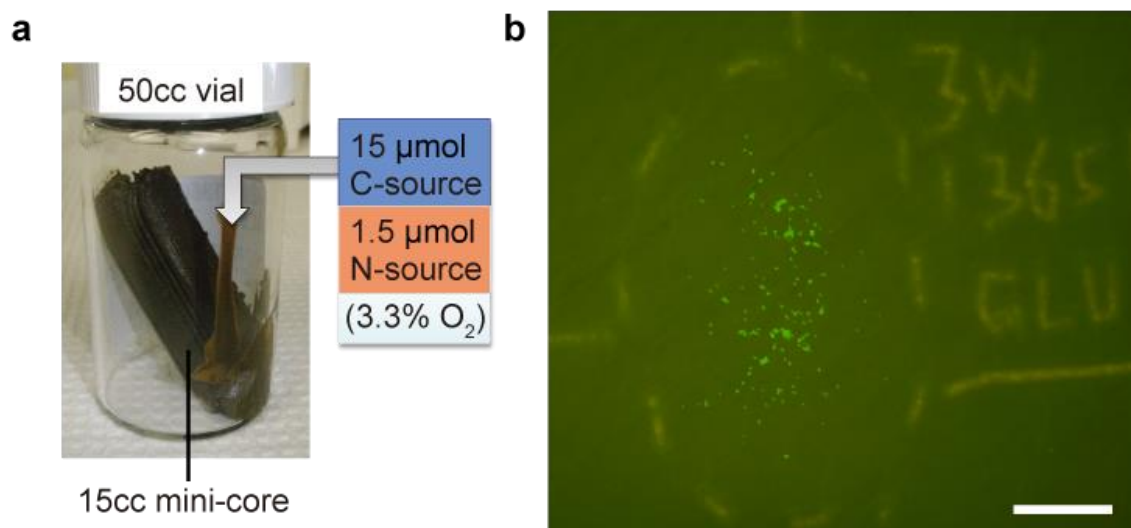
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Supplementary Figure 1 | Map showing locations of sampling sites. Sites are plotted on a global map of regions with dissolved oxygen and aerobic activity throughout the entire sedimentary sequence⁸. Dark blue indicates minimum areal extent of these regions and light blue indicates maximum extent of these regions.



Supplementary Figure 2 | Microbial responses to the addition of carbon and nitrogen substrates for incubation set up for U1370 7H-2. **a.** Plot of cell abundance during incubation. Cell abundances for Incubation time 0 are abundances in the sediment samples before incubation was initiated. For the samples incubated with carbon substrates (bicarbonate, acetate, glucose, and pyruvate), ammonia was added as nitrogen source. The incubation labeled “Ammonia” received ammonia as the nitrogen source with no additional carbon. $n = 19$ samples (one for Incubation time 0 and three time points [days 21, 68 and 557] per substrate). **b, c.** Incorporation of carbon- (**b**) and nitrogen- (**c**) substrates by microbes identified by NanoSIMS cellular ROIs (Supplementary Data 1). Substrate incorporation for each ROI was plotted over kernel density violin plots.



Supplementary Figure 3 | Incubation set up and NanoSIMS sample preparation.

a. Sediment samples were incubated in vials with addition of carbon and nitrogen substrates under microaerobic condition (U1365 8H-2, 9H-3, U1368 1H-2, 2H-5) and anaerobic condition (U1370 7H-6). **b.** Example image of FAC-sorting of cells on ITO-coated polycarbonate membrane (U1365 9H-3 with ^{13}C -glucose and ^{15}N -ammonia as substrates). Bar represents 50 μm . Similar images were obtained for 95 samples processed in this study.