Active and Total Microbial Community Structure in relation to Metal Availability within Subsurface Sediments

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To understand the role of biology over geologic time scales and to appreciate past, current and future processes, the total microbial community (including metabolically active and dormant populations) must be characterized. The total microbial community is composed of varying metabolically active and dormant populations based on geochemical conditions. While metabolically active populations change the current geochemical conditions, understanding the total community structure can determine the potential processes available when geochemical conditions change in the future or when geochemical conditions were different in the past. Unlike surface populations that may experience rapid geochemical shifts, timescales for change in the deep subsurface may be over geologic time scales. Thus, dormant populations may become members of a seed bank, which can contribute to the diversity of future microbial communities while remaining examples of past conditions.

Sediment was collected during IODP Expedition 336 on the western flank of the mid-Atlantic ridge (North Pond) and was immediately cryogenically frozen. DNA and RNA were simultaneously isolated from the same sample at eight depths downhole using a uniquely developed extraction method. The V1-V3 region of the 16S gene and gene transcript was targeted using universal *Bacteria* specific primers. This approach targeted the <u>active</u> microbes via rRNA transcripts and the <u>total</u> population (live, dormant, dead) via DNA targets. X-ray Absorption Spectroscopy (XAS) was also used to map elements within the sediment samples chosen for molecular analysis. 16S rRNA gene transcripts extracted were quantified using quantitative rt-PCR. Greater microbial activity was observed at the sediment surface and diversity decreased with depth into the sediment. A majority of the lineages detected were heterotrophic, despite reduced metal species being present, suggesting the overall influence of very low carbon concentrations on community structure and function.

Holocene climate variability from Rio Martino Cave (Western Alps, northern Italy)

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The Alpine region of Europe currently experiences complex climatic conditions and this is also apparent during the Holocene. With this in mind, several flowstone cores were retrieved from Rio Martino Cave (Piemonte, Northern Italy, ca. 1530 m a.s.l.) in the western Alps, where the climate is dominated by North Atlantic synoptic systems. U/Th dating of several flowstones indicates that deposition started at the beginning of the Holocene. One core has been intensively studied using a multi-proxy approach (stable isotopes and rock magnetism). The $\delta^{18}O$ record show substantial variability through the Holocene, which is interpreted as changes in rainfall $\delta^{18}O$ recharging the cave catchment. Variations in $\delta^{13}C$ instead are interpreted as different degrees of soil development. A long-term trend in $\delta^{18}O$ is apparent, with relatively low values persisting from the commencement of deposition until ca. 6 ka. From 6 to 3 ka the $\delta^{18}O$ increases gradually before decreasing again from 3 ka onward. $\delta^{13}C$ shows a good degree of correlation with $\delta^{18}O$. This long-term trend may be related to changes in the seasonal patterns of precipitation. Superimposed on this trend there are numerous centennial scale oscillations which may reflect alternating periods of drier and wetter conditions.

Both stable isotope records and magnetic susceptibility, which mainly depend on the detrital content, show good correlations with lake level record and flood events in Lake Ledro.

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