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## Methane seepage effects on biodiversity and biological traits of macrofauna inhabiting authigenic carbonates

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### Abstract.

Authigenic carbonate rocks at methane seeps are recognized as hosting diverse and abundant invertebrate assemblages, with potential forcing from fluid seepage and hydrography. Mensurative studies of carbonate macrofauna (>0.3 mm) at Hydrate Ridge, OR revealed little effect of water depth and overlying oxygenation (at 600 m and 800 m) but a large influence of seepage activity on density, taxonomic composition, diversity, and biological traits (feeding, lifestyle, motility, size and calcification). Rocks exposed to active seepage had 3-4 x higher total macrofaunal densities than under inactive conditions. Assemblages exhibited higher species richness and reduced evenness (greater dominance) under active seepage than inactive conditions, but no difference in H' or J'. Actively seeping sites were characterized by errant (motile), bacterial grazing, small- and medium-sized, heavily calcified species, whereas inactive sites exhibited a greater diversity of feeding modes and more burrowers, sessile, large and lightly calcified species. Active rocks supported more exogonid (Syllidae), ampharetid, and cirratulid polychaetes, provannid snails, pyropeltid limpets, nemerteans, and sponges; whereas inactive rocks supported higher densities of ophiuroids, isopods, gammarid amphipods, hydroids, *Typosyllis* (Syllidae) and tanais. Transplant experiments, in which rocks were transferred between active and inactive sites at Hydrate Ridge North (600 m), revealed that assemblages respond within 13 mo to increases or cessation of seepage, taking on the feeding, size and calcification characteristics of the background fauna at the new site. Lifestyles and motility patterns shifted more slowly as the sessile, attached species did not track seepage as quickly. Provannid snails and pyropeltid limpets rapidly colonized rocks transplanted to active sites and disappeared when transplanted to inactive sites. Given the known variability of fluid fluxes and rapid community response, a mosaic of communities changing in space and time is hypothesized to generate the relatively high species diversity at methane seeps.

Key words: biodiversity, biological trait analysis, carbonate, deep sea, macrofauna, methane seep, oxygen, Hydrate Ridge

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