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Low $\delta^{13}C$ in tests of live epibenthic and endobenthic foraminifera at a site of active methane seepage

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To investigate the use of benthic foraminifera as a means to document ancient methane release, we determined the stable isotopic composition of tests of live (Rose Bengal stained) and dead specimens of epibenthic *Fontbotia wuellerstorfi*, preferentially used in paleoceanographic reconstructions, and of endobenthic high-latitude *Cassidulina neoteretis* and *Cassidulina reniforme* from a cold methane-venting seep off northern Norway. We collected foraminiferal tests from three pushcores and nine multiple cores obtained with a remotely operated vehicle and a video-guided multiple corer, respectively. All sampled sites except one control site are situated at the Håkon Mosby Mud Volcano (HMMV) on the Barents Sea continental slope in 1250 m water depth.

At the HMMV in areas densely populated by pogonophoran tubeworms, $\delta^{13}C$ values of cytoplasm-containing epibenthic *F. wuellerstorfi* are by up to 4.4 ‰ lower than at control site, thus representing the lowest values hitherto reported for this species. Live *Cassidulina neoteretis* and *C. reniforme* reach $\delta^{13}C$ values of -7.5 and -5.5 ‰VPDB, respectively, whereas $\delta^{13}C$ values of their empty tests are by 4 ‰ and 3 ‰ higher. However, $\delta^{13}C$ values of empty test are never lower than those of stained specimens, although still lower than empty tests from the control site. This indicates that authigenic calcite precipitates at or below the sediment surface are not significantly influencing the stable isotopic composition of foraminiferal shells. The comparatively high $\delta^{13}C$ rather results from upward convection of porewater and fluid mud during active methane venting phases at these sites. These processes mingle tests just recently calcified with older ones secreted at intermittent times of less or no methane discharge.

Since cytoplasm-containing specimens of suspension feeder *F. wuellerstorfi* are almost exclusively found attached to pogonophores, which protrude up to three centimeters above the sediment, and $\delta^{13}C$ values of bottom-

water dissolved inorganic carbon (DIC) are not significantly depleted, we conclude that low test $\delta^{13}C$ values of *F. wuellerstorfi* are the result of incorporation of heavily ^{13}C depleted methanotrophic biomass that these specimens feed on, rather than due to low bottom-water $\delta^{13}C_{DIC}$. Alternatively, the pogonophores, which are rooted at depth in the upper sediment column, may serve as a conduit for depleted $\delta^{13}C_{DIC}$ that ultimately influences the calcification process of *F. wuellerstorfi* attached to the pogonophoran tube well above the sediment/water interface. The lowest $\delta^{13}C$ of live specimens of the endobenthic *C. neoteretis* and *C. reniforme* are within the range of pore water $\delta^{13}C_{DIC}$ values, which exceed those that could be due to organic matter decomposition, and thus in fact document active methane release in the sediment.

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