Gas-hydrate foraminifers: cellular adaptations and first association with putative methanotrophs

Joan Bernhard[1], Giuliana Panieri[2], Daniel J. Fornari[1], Mette Marianne Svenning[2,3]

[1]Woods Hole Oceanographic Institution Department of Geology & Geophysics, MS #52, Woods Hole, MA 02543, USA; jbernhard@whoi.edu
[2]CAGE - Centre for Arctic Gas Hydrate, Environment and Climate, Department of Geosciences, UiT the Arctic University of Norway, Dramsveien 201, N-9037 Tromsø, Norway
[3]Department of Arctic and Marine Biology, UiT the Arctic University of Norway, 9037 Tromsø, Norway

The foraminifera in sediments exposed to gas-hydrate dissociation are not expected to have cellular adaptations that facilitate inhabitation of chemosynthesis-based ecosystems because, to date, there are no known endemic seep foraminifera. To establish if foraminifera inhabit sediments impacted by gas-hydrate dissociation, we examined the cellular ultrastructure of Melonis barleeanus from the Vestnesa gas hydrate province (Western Svalbard, Norway; ~1200-m depth). Here, we focus on specimens from a multicore, collected with a real-time camera system (MISO; http://www.whoi.edu/website/miso), with indicators of gas hydrate emission (e.g., bubbling upon recovery, δ13Cmethane = -58‰). The M. barleeanus (n=4) had unusual pore plugs composed of a thick, fibrous meshwork; mitochondria were concentrated at the cell periphery, under pore plugs. While there was no evidence of symbioses with prokaryotes, one specimen had a large bolus of what appear to be methanotrophic bacteria concentrated near its aperture. The role or impact of these putative methanotrophs is unknown; digestive vacuoles lacked similar bacteria so they likely are not food. This is the first documented instance of bona fide living M. barleeanus in gas-hydrate sediments and first documentation of a foraminifer living in close association with putative methanotrophs. Our next task is to determine if such bacteria impact the stable isotope composition of M. barleeanus carbonate. Supported by NSF OCE-1634469, the WHOI Robert W. Morse Chair for Excellence in Oceanography, The Investment in Science Fund at WHOI, and the Research Council of Norway through its Centres of Excellence funding scheme (project number 223259).