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Early diagenesis in benthic foraminifera under anoxic conditions from the Landsort Deep, Baltic Sea (IODP Site M0063)

Sha Ni[1,2], Nadine Quintana Krupinski[1], Jeroen Groeneveld[3,4], Karen Luise Knudsen[5], Per Persson[2], Andrea Somogyi[6], Inda Brinkmann[1], Marit-Solveig Seidenkrantz[5], and Helena L. Filipsson[1]

[1]Dept. of Geology, Lund University, Lund, Sweden (sha.ni@geol.lu.se)
[2]Centre for Environmental and Climate Research, Lund University, Lund, Sweden
[3]MARUM, Bremen University, Bremen, Germany
[4]Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Potsdam, Germany
[5]Centre for Past Climate Studies, Dept. of Geoscience, Aarhus University, Aarhus, Denmark
[6]Nanoscopium Synchrotron SOLEIL Saint-Aubin, 91192 Gif-sur-Yvette Cedex, France

The chemical composition of foraminiferal calcite is widely used for studying past environmental conditions and biogeochemistry. However, high rate of microbial-derived organic matter degradation and abundant dissolved metal sources in sediment and pore waters may impede the application of paleoenvironmental proxies due to formation of secondary carbonates on the outside and/or inside of foraminiferal tests. Secondary carbonate precipitation severely alters the foraminiferal geochemistry and can be difficult to eliminate through standard cleaning procedures for foraminiferal trace element analyses. Here we present results of the mineral composition and formation sequence of diagenetic coatings on the tests of foraminifera formed under extreme anoxic conditions in the Baltic Sea deepest basin (the Landsort Deep, IODP Exp. 347, Site M0063), as well as changing trace element concentrations of authigenic carbonates on the test on a millennial time-scale. The focus is on the diagenetic carbonates present on the tests of the low-oxygen tolerant benthic foraminiferal species *Elphidium selseyensis* and *Elphidium clavatum*. We applied geochemical and imaging methods by using scanning electron microscope imaging (SEM) and energy dispersive spectroscopy (EDS), synchrotron-based x-ray fluorescence microscopy (nano-XRF), RAMAN spectroscopy and laser ablation (LA)-ICP-MS, in order to ascertain the sedimentary diagenetic processes, and the foraminiferal authigenic mineral formation sequence. The authigenic carbonates were enriched in Mg, Mn, Fe and Ba, depending on the redox environmental conditions when the authigenic carbonates were precipitated. In particular, concentrations of redox-sensitive elements such as Mn and Fe were increased in bottom waters and sedimentary pore waters under oxygen-depleted conditions in the Landsort Deep, which resulted in Mn- and Fe-enriched carbonate formation. The diagenetic alteration on foraminiferal tests provides potential opportunity to investigate past sedimentary redox environment and primary productivity in the Baltic Sea.