

Biomonitoring polluted sediments in Arctic regions - possibilities and challenges using benthic foraminifera. Case studies from northern Norway

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Biomonitoring pollution in marine environments using benthic foraminifera assemblages have proven to be a valid method for many regions. Two important reasons for their suitability are their sensitivity to changes in the environment and their rapid response time due to short life cycles. In addition, they are preserved in the sedimentary record, allowing for baseline studies of conditions prior to introduction of contaminants.

Species of benthic foraminifera that appear to tolerate polluted sediments are referred to as opportunistic species. This notion is in general used for species able to dominate environments that are too stressful for most species. The high latitude setting of the northern Norwegian coastal zone experience high seasonality and, hence, largely changing conditions throughout a year: variations in water mass domination, freshwater influence, temperature and current velocity. It is possible that an environment like this is inhibited by a higher amount of opportunistic species generally thriving under high stress conditions. This might make the use of benthic foraminifera for biomonitoring more challenging, as the faunal compositions may be a result of a complex set of processes. Consequently, large datasets are necessary in order to make reliable conclusions, which in time may be used as generalized guidelines for biomonitoring in this geographical area.

Here, we present preliminary results of benthic foraminiferal assemblages from two sites in Finnmark, northern Norway, which have been exposed to pollution. The main site is Repparfjorden, where the inner parts of the fjord were used as a submarine waste disposal site for mine tailings from a local copper mine during the 1970's. Results from four marine sediment cores (10-20 cm long) containing sediments classified to be in moderate to very bad state (according to Norwegian sediment quality criteria) are presented. The contamination is seen in intervals of elevated copper content dated to the 1970's. Metal availability studies have been performed on one of the cores. In addition, a sediment core from Hammerfest Harbour was studied. The core comprises 20 cm of sediments containing elevated levels of a variety of environmental pollutants and heavy metals from various sources (moderate to poor state, according to Norwegian sediment quality criteria). For comparison, surface sediments (upper 5 cm) from the unpolluted fjord Revbotn, located in proximity to the two polluted sites, are studied.

In the polluted cores, some correlations are seen between contaminants and faunal composition. However, none of these appear to be consistent for the entire area. This may be related to the difference in contaminants and the availability of the contaminants present at the two sites. In addition, other local influences such as grain size distribution and salinity variations, may contribute to a higher complexity of the faunal compositions. The study suggests that more comprehensive investigations of benthic foraminifera in contaminated sediments are needed for this region. In addition, it acknowledges the need for site-specific baseline studies of pre-polluted sediments.