



The foraminiferal record of pollution and recovery of the formerly heavily polluted Idefjord, Sweden/Norway

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Abstract: Idefjord, a sill fjord between Sweden and Norway, is a unique marine environment where a pollution-recovery cycle is to be completed. The fjord has a history as one of the most polluted marine environments in Scandinavia. Idefjord has received large amounts of effluents from paper and pulp industry for more than one century. Besides organic matter large amounts of heavy metals were discharged into the fjord. The effluents led to severe oxygen depletion and resulting hypoxia and anoxia in most areas of the fjord. Hydrogensulfid developed and characterized the bottom water of the fjord over long periods. Over the last decades, after ambitious efforts of sewage treatment, the fjord is gradually recovering.

Two sediment cores, one from each basin, were analyzed in this study. Benthic foraminiferal content has been investigated together with heavy metal content, ^{210}Pb -dating and X-ray radiographs of the cores, to reconstruct the environmental history of the fjord. Five foraminiferal zones could be defined and correlated between the cores. The oldest zone is characterized by oxic conditions and a normal marine foraminiferal fauna dominated by *Bulimina marginata*. A faunal shift occurred around 1800 A.D. in which the calcareous assemblage changed to an agglutinated fauna dominated by *Adercotryma glomerata*. The change was initiated mostly by natural processes, but human influence has become increasingly important for the environment. Another faunal shift occurred around 1960. Here the fauna altered from the *Adercotryma glomerata* assemblage to a *Spiroplectammina biformis* assemblage. The onset of the change started earlier in the outer basin due to its position closer to the source of effluents. These effluents are also the main cause for the collapse and death of the benthic community in the 1970s. In the outer basin of the fjord the foraminiferal fauna has started to recover during the last two decades. The fauna is dominated by an assemblage of

Ammodiscus spp. and *Spiroplectammina biformis*. In the innermost area of the fjord, however, the recovery has just begun.

The Idefjord sediment records provide a rare possibility to obtain knowledge that allows us to understand the mechanisms and processes acting on marine environments subjected to both human impact and natural processes. Idefjord is possibly the only marine area in the world where there is almost no tidal activity affecting sediment accumulation, where a pollution-recovering cycle is almost completed and where there is a series of separate fjord basins, and where the different basins are characterized by different stages of recovery.