

Abstract

This thesis presents an investigation of the environmental condition of the Skagerrak and northern Kattegat based on sedimentological and geochemical parameters in recent deposits. The main basis for five papers included is the detailed documentation of sediment parameters, such as grain size, mineralogy in the very-fine-sand and clay fractions, and heavy metal content and speciation.

The geographic pattern of grain-size changes has been evaluated in order to interpret the sediment transport pathways (paper I). The interpretative model is based upon the principle of selective entrainment and deposition of the finer fractions of the sediment.

Consistent with the grain-size results, the regional heavy-mineral variations in the very-fine-sand fraction (63-125 μm) allow the Skagerrak and northern Kattegat to be divided into six, statistically tested, provinces (paper II). The mineralogical composition of the detrital sediments reflects the rock types in the provenance area, and is a useful indicator of general sediment transport directions. Two principal sources were identified, the mineralogically immature, Quaternary deposits of Scandinavian origin, and the mature, primarily Tertiary and Mesozoic sediments exposed in the southern North Sea and in north-western Europe.

The semi-quantitative distributions of clay minerals are presented for the Skagerrak and northern Kattegat (paper III). Four principal sources, the southern North Sea, the central North Sea, the Swedish west coast, and the southern Kattegat, are described. Correlation between clay content and the contents of smectite, kaolinite and chlorite in the Skagerrak suggests that sorting influence the clay-mineral distribution.

New methods to calculate a sediment supply budget for the eastern Skagerrak are presented, based on variations in the heavy-mineral composition in the very-fine-sand fraction (63-125 μm , paper IV). These variations are related to depositional conditions, transport mechanisms, and the specific mineralogical compositions of the sediment sources. The effects of hydraulic sorting on the mineralogical composition that are induced during transport need to be dealt with before calculating the sediment budget. Three methods are presented: 1) HER (Hydraulic Equivalent Ratio) 2) CEP (Calibrated Equivalent Percentage), and 3) CHER (Calibrated Hydraulic Equivalent Ratio). The results, as well as theoretical arguments, suggest that the CHER method gives the most reliable budget calculations. According to the CHER calculations, approximately 85% of the deposited sediments in the eastern Skagerrak are from sources in the southern North Sea. The remaining 15% are believed to originate from the reworking of Quaternary deposits, along the Swedish west coast.

The normalisation of heavy metals is discussed together with an initial documentation of heavy metal speciation and a discussion of the general bioavailability of heavy metals (paper V). The results of three different normalisation procedures are presented (<2 μm , <16 μm and Al contents). It is suggested that within the studied region the Al and <16 μm normalisation results are comparable. Speciation shows that the heavy metal contents in general are bound to the residual and organic matter phases, although a wide variation is noted. It is interpreted from the speciation distribution that in general the bioavailability of heavy metals is higher in eastern and central Skagerrak than in the southern parts of the Skagerrak.

Key words: Skagerrak, Kattegat, grain size, heavy minerals, clay mineralogy, sediment supply budget, heavy metals, metal speciation