

1. Introduction

Many delta's across the globe suffer from drowning due to sea level rise or land subsidence in combination with sediment starvation. To examine the sediment budget of delta areas based on measurements of sediment deposition, it is essential to distinguish the sediment that has entered the area from upstream areas from sediment that has been redistributed within the area. This pilot study aims to explore the prospects to distinguish between external and internal sediment sources based on the geochemical composition of the sediment deposited.



Fig. 1 Former polder area 'Kleine Noordwaard'

2. Methods

This study was carried out in the 'Kleine Noordwaard', a recently (2009) inundated former polder area in the south-western part of the Netherlands. In contrast to many tidal creeks and flats, the polder area has not received inputs of severely contaminated river sediment between the 1930s and 1980s, since it was embanked since the early 19th century.

We sampled the top sediment layer along multiple transects across the study area using a transparent corer tube (Fig.2) and measured the thickness of the sediment layer deposited on the polder soil. Additional samples were collected from sediment traps installed in the channel near the inlet of the system (Fig.3, Fig. 4, external source) and from the former polder soil and islands (internal sources).

All samples were analysed for metal concentrations using a Thermo Fisher Scientific Niton® handheld XRF analyser.

Distinguishing internal and external sediment sources in a tidal freshwater wetland, the Netherlands

E.C. van der Deijl^a, M. van der Perk^a, N. Kik^a, E. Verschelling^{a,b}, H. Middelkoop^a ^a Utrecht University, Faculty of Geosciences, The Netherlands ^b Deltares, the Netherlands







Fig. 3 Sediment trap

3. Results

The external and internal sediment sources of the sediment deposited in the Kleine Noordwaard could be discriminated based on the zinc (Zn) and rubidium (Rb) concentrations. These two elements exhibit a different linear relation for the more contaminated external sediment originating from the Rhine River and the less contaminated, internally redistributed sediment originating from the topsoil of the former polder area (Fig. 5).



Fig. 5 Relation between Zn and Rb concentrations for external and internal sediment in the Kleine Noordwaard

Because the Zn and Rb concentrations of the Rhine and polder sediments making up the sediment mixture were unknown, the mixture proportions for each sample were estimated by constraining their respective statistical distributions based on the samples that exclusively consisted of sediment from the Rhine river or polder topsoil.



Fig. 4 Installation of sediment trap



Fig. 6 Mixing proportion of external Rhine sediment to sediment deposited in the Kleine Noordwaard The mixing proportion of external Rhine sediment shows considerable spatial variation with large values of around 0.7 in the central transect and southern part of the area and small values of less than 0.2 in the eastern part and the eastern edge of the island (Fig. 6). The thickness-weighted average mixing proportion for the sediment deposited in the Kleine Noordwaard area was estimated to be 0.50-0.55.

4. Conclusions

The results suggest that on average approximately 50-55% of the sediment deposited in the Kleine Noordwaard area originated from external sediment from the Rhine river. This implies that a substantial part of the deposited sediment comprises remobilised and internally redistributed sediment, which should be accounted for in sediment budgets of the area.

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