Sandy beach-ridge formation along a high energetic coastline, Java, Indonesia.



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Introduction

Beach-ridge formation along the high energetic coastline of southern Java was possible due to ample long-term sediment supply. The aim of this pilot study is to determine the sandy sediment source and to obtain insight into transport and deposition mechanisms. Surficial sandy sediments along the system were analysed for grain size and shape distribution, bulk chemistry, and heavy mineral composition.





Heavy mineral composition

The non-opaque heavy mineral composition indicate an igneous source of both the river bedload sample (P1) and the three foreshore beach samples (T1f, T2f, and T5f), with high concentrations of augite (40-60 %) and titanite (30 – 50 %), and minor contributions of hornblende (3 - 13%) and hyperstene (2 - 6%).

Bulk chemistry (Olympus delta X-Ray Fluorescence Analyzer)

Comparable element composition of foreshore samples T1 - T5, with relatively high concentrations of Sr and Br, similar to Progo's bedload sample (P1) and the volcaniclastic products of Merapi's 2010 eruption (M1).





Grain size and shape distribution

(Sympatec HELOS KR laser diffraction particle size analyzer, and Sumpatec Qicpic dynamic image analyzer)

Dynamic image analysis (DIA) were conducted on four density classes of samples T1, T2, T5 and P1: a (2.0-2.5 g.cm⁻³), b (2.5-2.65 g.cm⁻³), c (2.65-2.85 g.cm⁻³), and d (heavy minerals; >2.85 g.cm⁻³). Low aspect ratios of foreshore sand samples (T1 and T5), indicate the importance of turbidity flow in the transport and deposition of sand grains, especially for the high density heavy mineral grains.



Conclusions

Volcaniclastic sediments from Merapi volcano were the most likely long-term sediment supply for beach-ridge formation along the 100 km strandline (T1 - T5). Recently constructed sabo-dams for lahar risk reduction, and the over-exploitation of river sand strongly reduced the sediment load of the rivers, indirectly causing strong coastal erosion of upto 5 m yr⁻¹.

Further research

1. What was the sediment supply rate in the past and do they reflect variability in volcanic eruption history (frequency and magnitude)?

2. Which mechanisms determine beach ridge formation, and can we develop a longshore transport model?

3. What was the sediment accumulation rates in the past, and what is the minimum sandy sediment supply rate needed to sustain a coastal equilibrium?

