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Q_1MdQ_3 INDICES SHOWING GRAIN-SIZE DISTRIBUTION ON MAPS

D.J. DOEGLAS[1])

SUMMARY

The use of Q_1MdQ_3 indices for classification and distinction of environments has been advocated by the author. He mentioned that the indices could be handled by data-processing machines used in trend-surface analysis. The present paper shows the value of Q_1MdQ_3 indices for presentation of the regional distribution of grain size on maps (figs. 1-3).

INTRODUCTION

Q_1MdQ_3 indices can be used for classification of all sizes of sediments and for determination of environments (Doeglas, 1968). In this paper the author mentioned that the indices could be handled by data-processing machines for trend-surface analysis.

The Q_1, Md and Q_3 values are obtained by rounding off the phi values of these parameters to integer phi units; for a positive phi value to the next higher positive phi unit and for negative values to the next higher negative phi unit. This simply comes down to a numbering of the Wentworth grades according to their highest positive or negative limiting phi value as shown along the top of the graph in figure 4. The Wentworth grade 1000-500 micron (phi 0-1) gets the number 1 and the grade 2000-1000 micron (phi -1 to 0) becomes $\bar{1}$. The minus sign is placed above the grade number on the analogy of the Miller indices in crystallography. A parameter lying within a Wentworth grade gets the value of the number of that grade. When one of the parameters falls exactly on a grade boundary it obtains the phi value of that boundary e.g. $Q_1 = 2.00$, the Q_1 index is 2.

As phi 0 is not needed as a number for the sand grades between 2000 and 500 micron (phi -1, 0 and 1) it is being used for the grades below 2 micron (above phi 9). In the few cases that one of the parameters falls on phi 0.00 the index value is assumed to be plus 1.

The Q_1MdQ_3 indices can be read off from cumulative curves; they can be calculated more easily and much faster by computer from weights or weight percentages of the grades, also from cumulative percentages. A print-out of the Q_1MdQ_3 calculation program 399, 1-4 can be obtained from the Computer Department of the Agricultural University, Wageningen, the Netherlands.

REGIONAL GRAIN-SIZE DISTRIBUTION

Thanks to the co-operation of Drs. J.H.J. Terwindt the Deltadienst of the Rijkswaterstaat in The Netherlands placed at the disposal of the author a large number of grain-size data of beach, dune and off-shore sediments in the south-west of The Netherlands. The Q_1MdQ_3 indices were calculated by a CDC-3200 computer of the Agricultural University in The Netherlands. As a data-plotting program was not available the indices were just drawn on sample

[1]) Department of Soil Science, Agricultural University, Wageningen, The Netherlands.

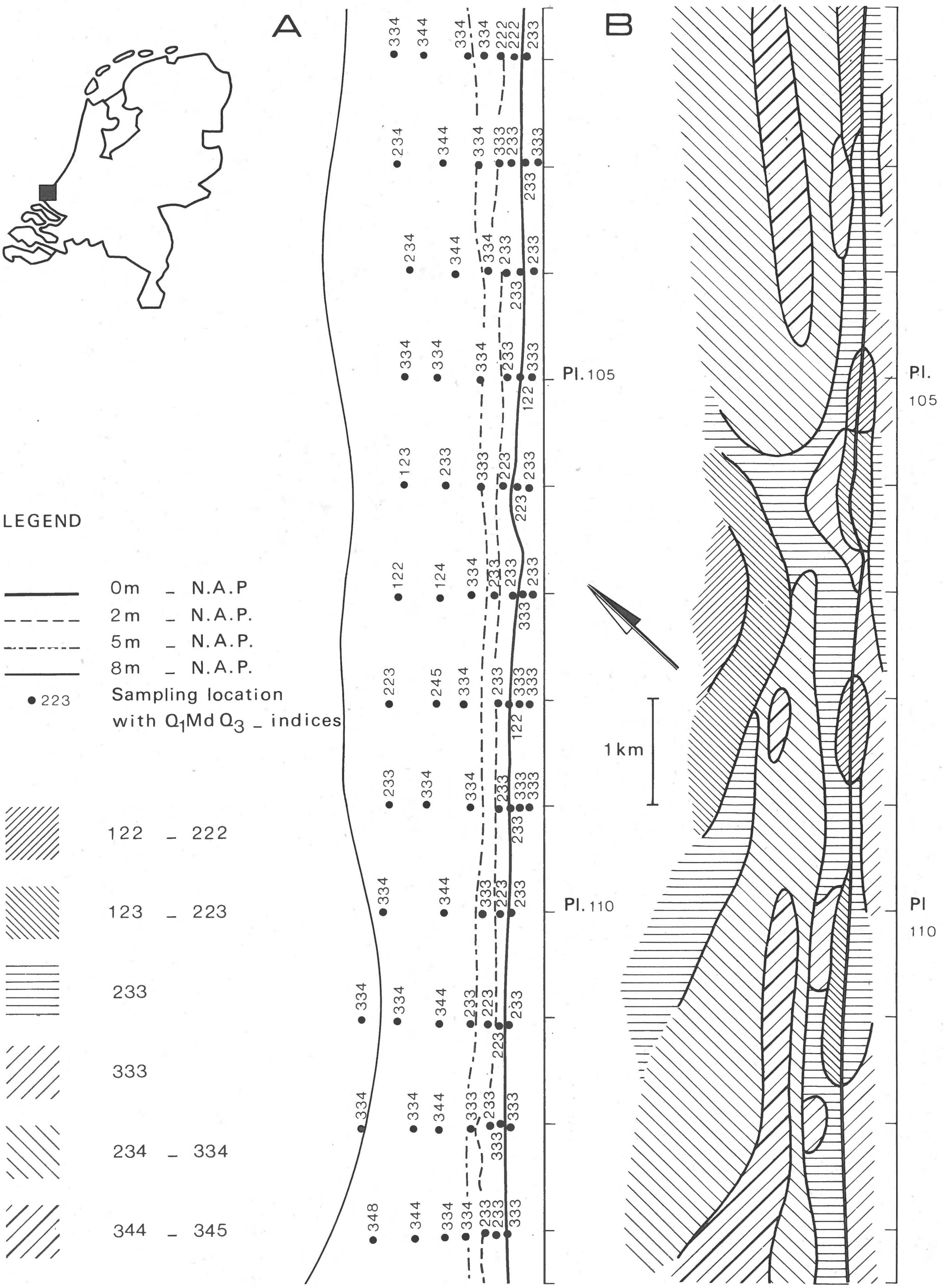

Fig. 1
Map of the coastal area of The Netherlands between km pile 102 and 114, about 10 km north of Hoek van Holland. A-Sample localities with Q_1MdQ_3 indices and depth contours. B-Areas with identical Q_1MdQ_3 indices.

locality maps (figs. 1A and 3). Areas with equal indices were outlined; the results being given in the figs. 1B and 3. Cumulative curves of sands from the area studied having identical indices, have been grouped together and are shown in fig. 4.

The sediments in the coastal area in the south-west of The Netherlands are medium, fine and very fine sands; some silty and clayey fine sands occur. The figures 1B and 3 show clearly the regular distribution of the Q_1MdQ_3 indices and the transitions of one type to the other. In the area 8 different Q_1MdQ_3 indices can be distinguished in mainly fine and very fine sands. Figure 4 shows how detailed the distinction by means of the indices is. The fine sands with Md = 3 fall apart in 233, 333 and 334; the very fine sands with Md = 4 in 344, 444 and 445 (the latter is not shown in fig. 4). In the medium sands with Md = 2 the range is 122, 222 and 223. All these sands are well sorted. Indices as 123 and 234 point to poorly sorted sands. In the silt-clay grades a series like 566, 567, 568, 569 indicates increasing lutum content (< 2 micron); 560 has more than 25% < 2 micron.

Figure 1A and B pictures the trend of the grain size distribution along the straight coast between km piles 102 and 114, about 4-16 km north of Hoek van Holland. Only a short description will be necessary. In the dunes and on the beach 233 and 333 sands are found; patches with coarser sands 122, 222, 123 and 223 occur on the lower beach and in the surf zone. In the zone between the coast line and 5 m -N.A.P. (mean sealevel) 233 sands dominate; locally 333 sands occur. Westward follows a broader zone with finer sands 234, 334, 344 and 345 which is interrupted in front of km piles 106-107 by slightly coarser 233 sands. Further seaward again coarser sands occur in front of km piles 106-109.

Figures 2 and 3 depict the off-shore area south of the Nieuwe Waterweg (Hoek van Holland). Southwest of Europoort an area of very fine sands 444 is surrounded by zones of respectively 344 and 334 sands. Further seaward the sands coarsen to 333 and 233.

Landward of this complex a strip of 333 sands is present; it runs along the coast of the island of Voorne southward to Goeree. In front of Voorne and Goeree it is narrow, westward of the estuary between these islands it broadens and forms the lower part of the sub-marine delta of the estuary.

In the mouth of the estuary stronger variations in grain size occur caused by the depths of the channels and bars, and the variations in current velocity and wave action. In the deeper parts of the channels sometimes fine sandy clayey silts 358, 479 and clayey silts 568 are found. On the bars fine and very fine sands 333, 334, 344, 444 and locally slightly silty fine sands 336, 345 occur. The beach and dune sands of Voorne and Goeree have mainly 333 indices.

In front of the Nieuwe Waterweg 334 sands predominate; between the jetties of the harbor more variations are present.

CONCLUSIONS

The intention of this paper is to demonstrate the value of Q_1MdQ_3 indices for the study of the regional distribution of grain size. The figures 1A and 3 show clearly that with only 3 indices 8 grain size types can be distinguished in a region with medium, fine and very fine sands. Each of these types has distinct regional distribution patterns. Gradual changes in the grain size frequency distribution are clearly shown. West of Voorne the 444 area is surrounded by a 344 zone which grades westward first into an area with 334 and then in one with 333 sands. West of Goeree 333 sands change westward into 334, 333 and 233 sands.

ACKNOWLEDGEMENTS

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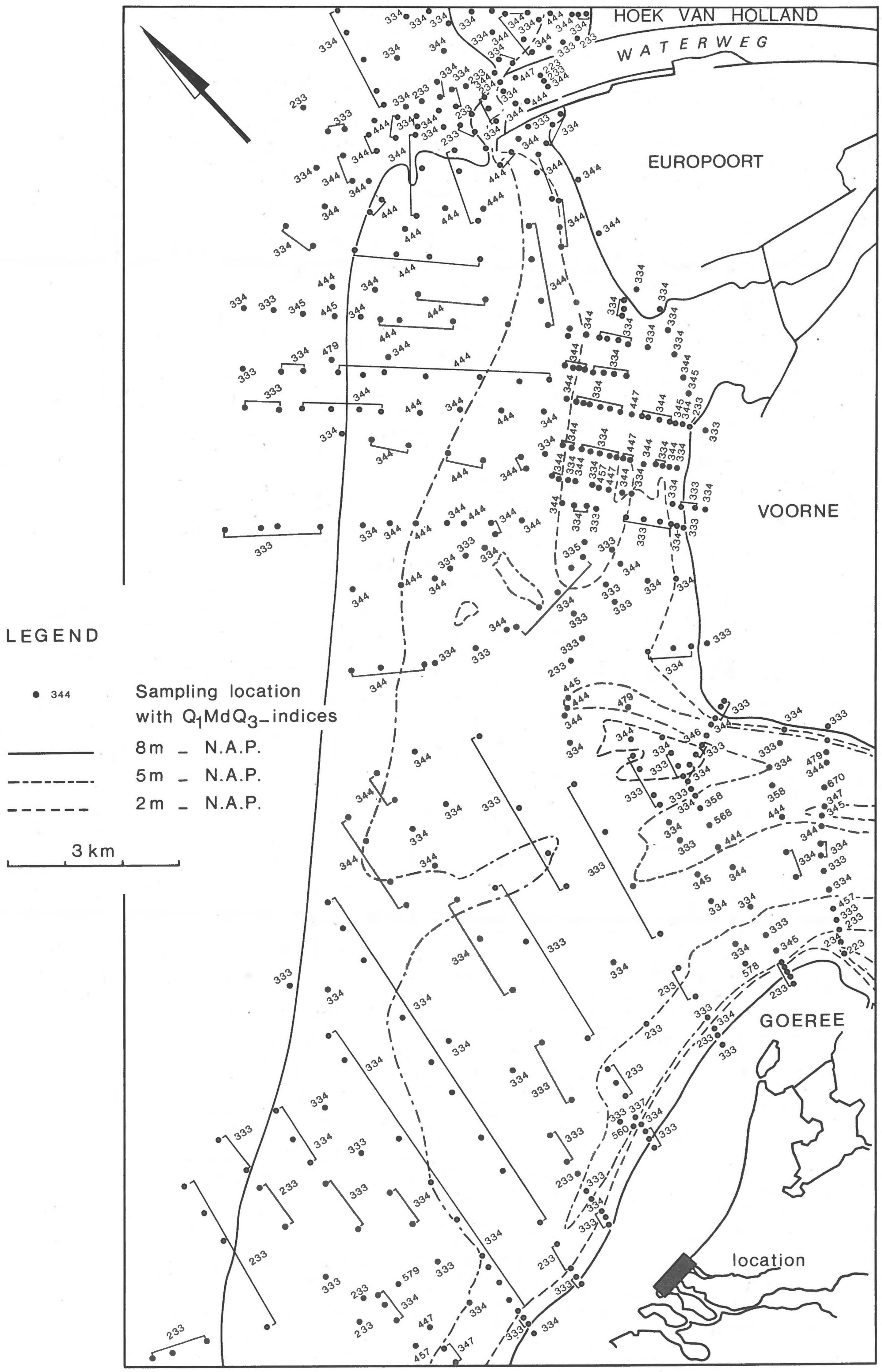

Fig. 2
Map of the coastal area of The Netherlands between the Nieuwe Waterweg (Hoek van Holland) and the island of Goeree with sample localities, Q_1MdQ_3 indices and depth contours. To prevent overcrowding of indices values sample localities with equal indices have been connected with lines.

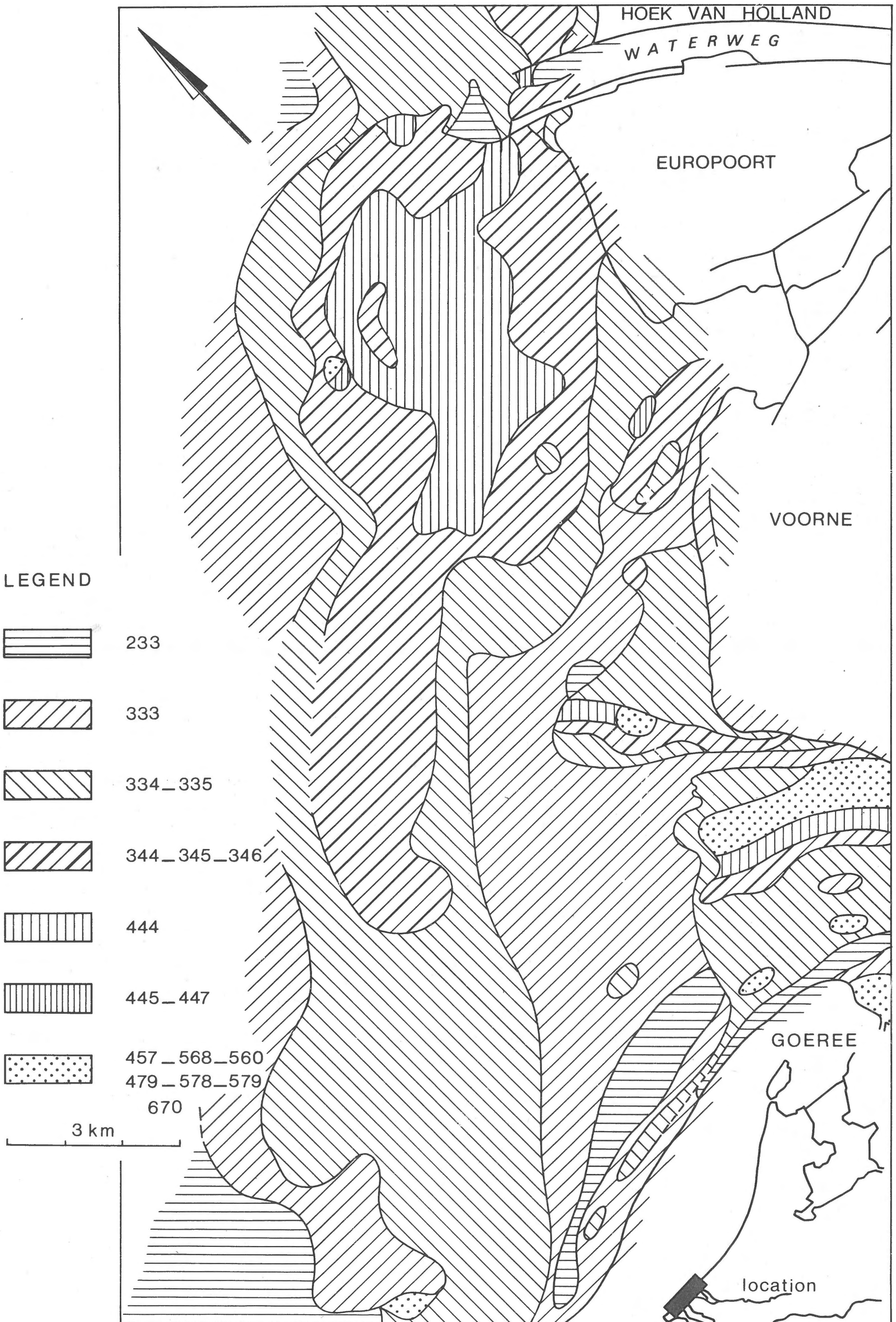

Fig. 3
Same area as in fig. 2, showing areas with equal $Q_1 MdQ_3$ indices.

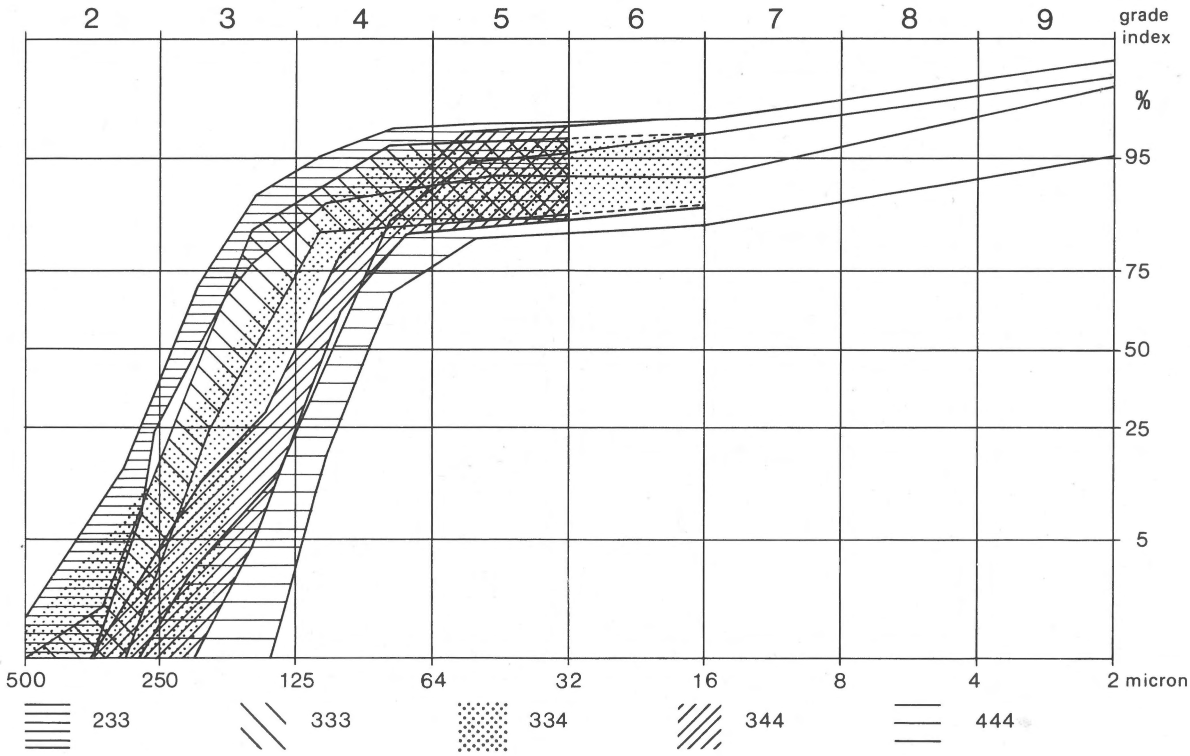

Fig. 4
Groups of size-frequency distributions with the same Q_1MdQ_3 indices of sands from the areas described have been plotted on logarithmic probability paper. The numbers of the Wentworth grades are given above the graph.