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TEXTURAL PARAMETERS AND DEPOSITIONAL PROCESSES OF THE SUBSURFACE SERAU FORMATION, CAMBAY BASIN

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ABSTRACT

In the northeastern edge of Cambay Basin, Gujarat, sandstones of probable Cretaceous age are recorded in subsurface. The textural parameters reveal that the sands are fine to very fine, moderately well to poorly sorted, fine skewed and lepto-to mesokurtic. Following Visher (1969), the cumulative probability curves suggest (a) dominance of saltation population, (b) subordinate suspension population and (c) occasional presence of surface creep population. The relationship between textural parameters and depositional processes is eastablished and based on such relation a fluvial environment is suggested for these sands.

INTRODUCTION

In the present paper, the author has carried out granulometric study of sandstones from Serau Formation, Cambay Basin, with a view to establish relationship between textural parameters and depositional processes and also to predict sedimentary environment which involves judicious application of both statistical parameter technique and visual curve shape study.

STRATIGRAPHY AND SETTING

The sandstones under study were collected from subsurface between 1865.0 and 2062.0 m. of Serau East well. The well is located in the southwestern part of Sanchor Basin which is in northern continuation of the oil bearing Cambay Basin (Fig. 1). In this well, the sandstone sequence unconformably overlies granitic Basement and is subsequently overlain by basalts of Deccan Trap. This sandstone sequence with basal conglomerate and interbedded shales has been named as Serau Formation by Roychoudhary *et al.* (1972). The sandstones are dirty white to pale brown, micaceous with ferruginous stains and coatings. The matrix of these sandstones is essentially clayey. Lithologically, Serau Formation resembles Barmer Sandstone, Himmatnagar Sandstone,

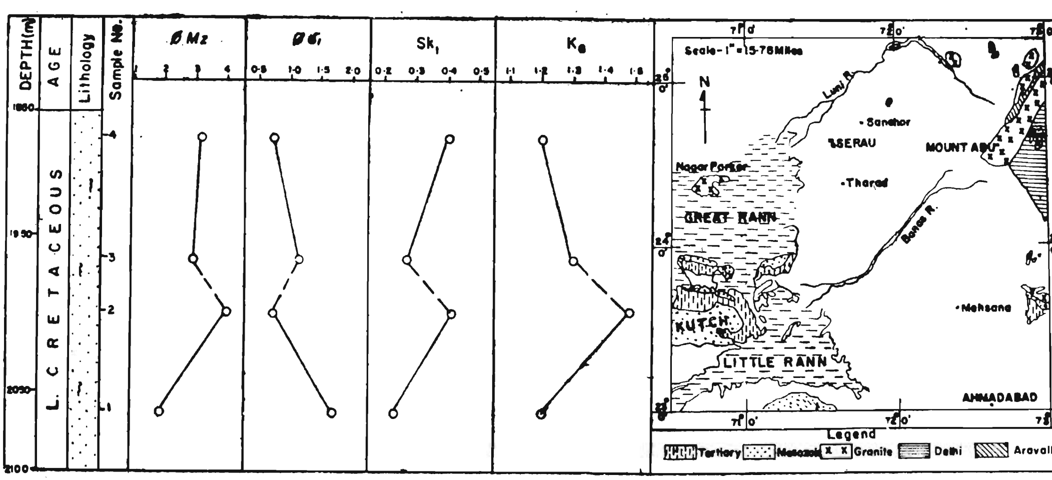

Fig. 1. Stratigraphic Variation in Grain size Parameters of Sandstones of Serau Formation.

Location map of Serau Area, (after Roychoudhary. et *al.* 1972).

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and Nimar Sandstone and based on stratigraphic correlation, Roychoudhary *et al.* (1972) have assigned a probable Lower Cretaceous age to Serau Formation.

METHODS

Mechanical sieve analyses (using 1ϕ sieve interval) were carried out on 8 core samples after proper disaggregation. The data were plotted as cumulative curves on probability paper to assure maximum accuracy in determining grain-size parameters by the graphic method (Folk, 1965). Statistical measures for average grain-size, sorting, skewness and kurtosis proposed by Folk and Ward (1957) were then obtained from values intercepted at specific percentiles on these curves.

TABLE-1.—Textural Parameters for Sandstone sequence of Serau Formation

Sample no.	Depth in Meters	Graphic Mean (-ϕ) (Mz.)	Inclusive Graphic Standard Deviation (ϕ) (σ_1)	Inclusive Graphic Skewness (Sk_1)	Graphic Kurtosis (K_G)
4B	1865 to 1867	3.05	0.487	0.24	1.04
4A	Do.	3.28	0.987	0.57	1.36
3B	1965 to 1966	3.00	0.997	0.40	1.70
3A	Do.	2.84	1.28	0.142	0.90
2B	1997 to 1998	3.83	0.64	0.25	1.25
2A	Do.	4.16	0.80	0.58	1.70
1B	2061 to 2062	2.30	1.74	0.20	1.40
1A	Do.	1.30	1.59	0.25	0.90

RESULTS

Table-1 summarises the grain-size parameters, derived from graphic measures (Folk and Ward, 1957) for 8 samples under study. On the whole, the sands are fine and very fine. Medium sand is a minor component and is seen at the base. Using Folk's (1965) sorting nomenclature, six samples are either moderately sorted or poorly sorted. While one sample is well sorted, the other one is moderately well sorted. Most samples have fine to strongly fine skewed and meso- to leptokurtic grain-size distributions.

The vertical profile for the sandstone sequence shows a variation in mean size, standard deviation, skewness and kurtosis (Fig. 1). The variation at a glance suggests that there are at least two sedimentary units, viz. (1) Lower unit between 2062.0 to 1997.0 m. and (2) Upper unit between 1965.0 and 1865.0 m. Both in lower and upper units, there seems to be a decrease in mean size and increase in sorting. Average size values also present an 'upward fining' sequence. Skewness and kurtosis show a contrasting feature. Skewness is in the range of positive values but it follows the trend similar to mean size with an increase in skewness in lower and upper units and decrease between two units. On the other hand, kurtosis in the lower unit shows an increase in leptokurtic values but between lower and upper units and within upper unit itself, there is a gradual decrease in leptokurtic values, finally grading to mesokurtic.

The grain-size distributions are in reality mixtures of one or more populations related to the processes of surface creep, saltation and suspension (Visher, 1969). It can be seen that in curves 1A and 1B of lower unit, three populations are present (Fig. 2). The poorly

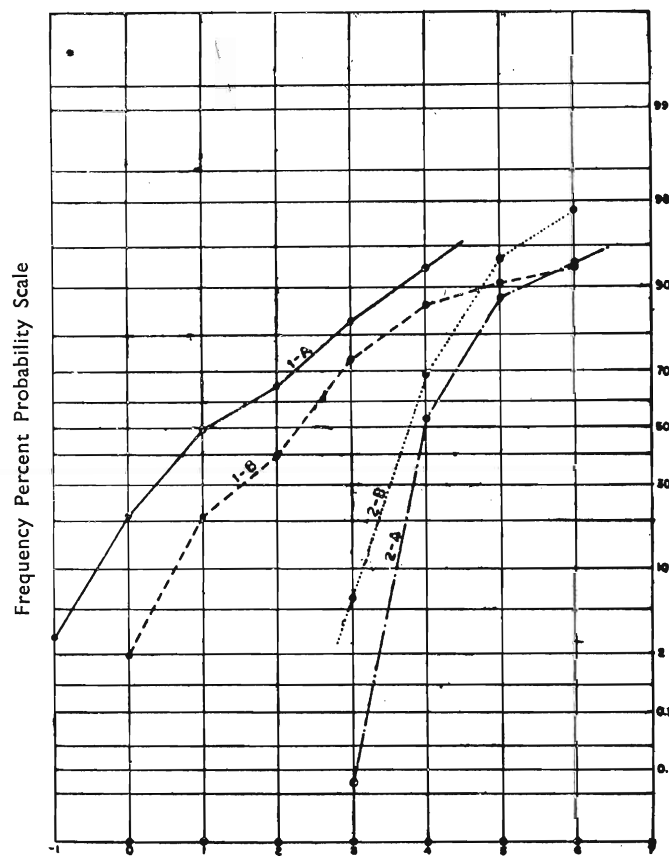

Fig. 2. Typical Log-Probability, Cumulative Frequency Curves of Sandstones of Serau Formation (Lower Unit).

sorted surface creep population is about 20 to 50 per cent of the distribution and occurs between—1.0 phi (2.00 m.m.) and 1.0 phi (0.50 m.m.) size interval. The saltation population is moderately sorted and ranges from 1.0 to 3.0 phi. The suspension population is poorly sorted and is about 15 to 20 per cent. On the other hand, in curves 2A and 2B of lower unit only two populations are present. The moderately well sorted saltation population ranges from 2.0 to 3.5 phi or even up to 4.0 phi, comprising about 60 to 70 per cent of the distribution. The suspension population is again poorly sorted with nearly 10 to 15 per cent of the distribution less than 30 microns.

In the curves of 3A and 3B of upper unit (Fig. 3) again there are three populations but their characters somewhat differ from those of 1A and 1B. Though the surface creep population is poorly sorted, it ranges from 5 to 20 per cent of the distribution and occurs between 0.00 phi (1.00 mm) and 2.00 phi (0.25 mm) size interval.

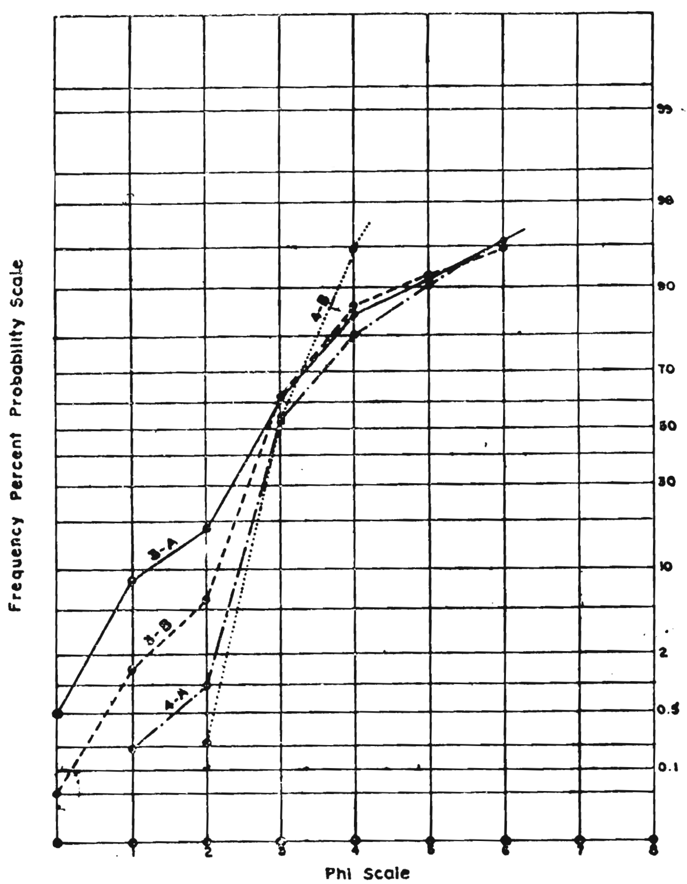

Fig. 3 Typical Log-Probability, Cumulative Frequency Curves of Sandstones of Serau Formation (Upper Unit).

The saltation population is moderately well sorted and ranges from 1.0 to 3.0 phi. The suspension population is poorly sorted and is about 15 to 20 per cent of the distribution. Thus it can be noted that in curves 3A and 3B, the percentages and size of relative coarser fraction transported by surface creep or traction process show an overall decrease as compared to curves of 1A and 1B. On the other hand, sands transported by saltation process show an increase in percentage and also better sorting. The suspension population, however, has about same percentage and range and thus continues to remain as constant and separate mode. The presence of two populations i.e. saltation and suspension in curves 4A and 4B brings out a similarity with those of 2A and 2B. However, in curve 4A a negligible amount of surface creep population (about 1 per cent only) is noted. The moderately well sorted saltation population which ranges from 2.0 to 3.0 phi comprises only 50 per cent of the distribution, and remaining 50 per cent is moderately to poorly sorted suspension population. Therefore, it is clearly seen that there is a decrease in percentage of saltation population while there is an increase in suspension population as compared to curves of 2A and 2B. This also suggests an overall increase in the amount of finer fraction.

ENVIRONMENTAL INTERPRETATION

The sandstone sequence of Serau Formation reveals following textural characters :

(1) Presence of two distinct sedimentation units.

(2) Average mean size of sands is between medium to very fine.

(3) An overall decrease in grain-size from older to younger horizons (upward-fining sequence).

(4) Sands are moderately to poorly sorted.

(5) Dominantly positively skewed and meso- to leptokurtic grain-size distribution of sands.

(6) At the base of both units, besides dominant populations like saltation and suspension, surface creep population is also noted. Between the units, however, it is less in the upper unit.

(7) At the top of both units, only saltation and suspension populations are present but in the upper unit comparatively suspension population dominates.

All these characters of sands under study broadly indicate a fluvial environment (Folk, 1965 ; Visher, 1965a & 1969). The presence of a finer mode remains an essential part of the river load and is therefore available for deposition with sand fraction. Also, an abundance of such fines in a river system always exceeds the available energy which can remove finer fractions, and hence sands show variations in sorting and kurtosis values (Friedman, 1967).

The presence of poorly sorted surface creep population along with saltation and suspension populations indicate that basal sands of each unit may be deltaic distributary sands. On the other hand, the sands from younger layers of each unit suggest mainly fluvial sands interbedded with deltaic distributary sands. The log-probability curves from both of these units (Figs. 2 and 3) resemble quite closely with curves representing Pennsylvanian Bluejacket—Bartlesville deltaic sands of the Oklahoma shelf and sands from Almond and Lance Formations, Wyoming (Visher, 1969, p. 1096).

Sands of Serau Formation, therefore represent a genetic association of deltaic and fluvial environments of deposition. The above conclusion is subject to the handicap of the limited core samples for the entire column (Fig. 1).

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