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Stratification, Bed Forms, and Flow Phenomena (with an Example from the Rio Grande)

Flow in alluvial channels is controlled by many variables, most of which are interdependent and adjust mutually. Bed form, for example, adjusts in response to changes in depth and slope, to changes in diameter, density, and shape of particles, and to changes in viscosity and density of the sediment-water mixture. Because stratification is the product of migrating bed forms, it too is complexly related to many variables. The concept of flow regime allows a grouping of the combined effects of these variables.

Five distinct stratification types were recognized in shallow trenches in the Rio Grande bed near El Paso, Texas. Four of these stratification types are products of specific bed forms observed in this section of the river during the preceding irrigation season, when discharge, velocity, depth, channel width, temperature, and sediment concentration had been measured and bed forms mapped at the trench areas. The five stratification types that can be related in a general way to flow phenomena follow. (1) Large-scale trough cross-stratification (sets 0.2–2 feet thick), volumetrically the most important sedimentary structure, forms by dune migration in the upper part of lower-flow regime where water depths exceed one foot. (2) Small-scale trough cross-stratification (sets 0.1 foot thick) commonly veneers the river bed and forms by ripple migration in the lower part of the lower-flow regime. (3) Tabular cross-stratification (sets 0.2–2 feet thick) forms by migration of bars or of terrace-like features in the lower-flow regime. (4) Horizontal stratification is the product of plane-bed transport achieved in the upper-flow regime, and is preserved in thin sheet-like sets on bar surfaces. (5) Parallel stratification, represented in a thin silt and clay layer mantling the forms on the emerged river bed, is deposited by settling of suspended material as flow slackens.

Stratification is potentially one of the most useful indicators of flow environment. However, stratification is the product of many complexly interrelated variables, some of which leave no discrete geologic record. Stratigraphers have traditionally interpreted stratification in terms of velocity depth, and (or) slope. Such interpretations are incomplete considerations of the problem and are commonly incorrect. It is more correct and useful to state environment simply in terms of flow regime, the integrated resultant of all variables.

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X-Ray Spectrographic Analysis of Minute Mineral Samples

X-ray spectrographic analysis is applied to the analysis of one milligram aliquots of mineral samples. Investigation of the sulpho-salt family of minerals indicated a need for non-destructive analysis of minute quantities of mineral samples usually available for study. Thus the X-ray spectrograph method offered a likely possibility.

The apparatus used in the spectrographic analysis consisted of a Norelco generator, a vacuum sample container (in which the sample is inverted), and circuit panel equipped with a scintillation counter and pulse height analyzer.

Standardization was achieved by analysis of 100 milligram aliquots of selected mineral samples using the fusion technique. The samples were fused in 100:1 ratio of potassium pyrosulphate and the intensity ratios of the elements compared with those obtained from artificial standards to give the atomic ratios. Working curves were then prepared from finely ground 1 milligram aliquots of the analyzed minerals.

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Effect of Hurricanes on Nearshore Sedimentary Environments of Coastal Bend Area of South Texas

Tropical storms of hurricane strength (winds>75 mph) cross the coastline between Tampico, Mexico, and Port Arthur, Texas, with a frequency of approximately one storm in two years. Greatest geological effects are produced by waves driven by winds that sometimes gust to 200 mph and by the tremendous elevations of water level that occur during storm tides (maximum of 22 ft. recorded at Port Lavaca, Texas, during Hurricane *Carla*, Sept., 1961). The comparison of a part of the nearshore environmental complex of the coastal bend area of south Texas before and after Hurricane *Carla* shows the effects of the storm.

The *inner continental shelf* bottom was both a contributor and a receiver of hurricane deposits. As the storm moved landward, it picked up mollusk shells indicative of depths up to 12 fathoms (for example, *Dinocardium*, *Semele*, *Strombus*, *Murex*, *Atrina*) and removed Pleistocene (?) rock fragments, coral blocks, and other materials from the sea floor, and deposited all these on the barrier island. After the storm passed inland, water rushed from the lagoon back to sea through numerous channels cut into the island by the storm. These currents deposited a thin layer (0.5–1.5 in.) of sand over what was previously sandy mud bottom out to depths of about 60 ft. and a graded layer of fine sand, silt, and clay farther out on the shelf.

The seaward side of the barrier island (Padre Island) was severely altered. The storm removed a belt of foredunes 20–50 yards wide from the seaward side of the island and left a belt of larger dunes, partly stabilized by vegetation, with wave-cut cliffs up to 10 ft. high. Waves breaching inland deeply excavated many dunes along their flanks. The formation of a broad, flat "hurricane beach," consisting of poorly sorted sand and coarse shell, drastically altered the beach profile.

The landward side of the barrier island (*wind-tidal flats*) received much washover material containing placers of surf zone and beach mollusks (especially *Donax* sp.). The storm also submered high-level mud flats along the landward side of Laguna Madre and covered them with a fresh layer of mud.

A much milder storm (*Cindy*) passed through the area in September, 1963, and a small bar was deposited over the seaward edge of the pre-existing "hurricane beach."

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Late Tertiary and Quaternary Events as Interpreted from Radiolaria in Antarctic Sediments

A study of the radiolaria from the tops of more than 80 cores spaced around the Antarctic continent between 35° and 77°S. has revealed two distinct faunas, the boundary between them corresponding closely with the position of the South Polar Front (Antarctic Conver-