SIZE ANALYSIS OF THE INDUS RIVER SANDS WEST PAKISTATN

By

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ABSTRACT

In this paper an attempt has been made to evaluate the grade of the sand-sized material in the Indus alluvium between Kalabagh and Skardu. The most widely used statistical devices of quartile measures were applied to describe the sediments. Some of the results obtained are comparable with those of similar work carried out by the authors in other parts of the world.

INTRODUCTION

The River Indus originates at an elevation of 1700 feet on the northern flank of Kailash mountains in Tibet, and before it joins the Indian Ocean near Karachi in West Pakistan, it flows for about 2000 miles, partly in the mountainous terrain of the Himalayas and partly over the plains of Sind and the Punjab. This investigation relates to a study of the alluvial deposits in the upper reaches of the river, along a strech of about 500 miles between Skardu in the Great Himalayas and Kalabagh in the Outer Himalayas.

From Kalabagh to Amb, for a distance of about 165 miles, the river is easily reached. Most of this sector is serviced by metalled and fairweather roads. The sample sites at Kalabagh, Khushalgarh and Attock are also accessible by railway. Upstream from Amb, right up to Skardu, the Indus is approachable only by mule-track and foot-path running in a zig-zag fashion along the steep slopes of the valley. The construction of an all weather road, intended ultimately, to connect Gilgit and Skardu with the area investigated is already in progress. Gilgit and Skardu are also linked by air with Rawalpindi.

The Indus alluvium has been investigated by the previous workers including the author and most of the published works describe the mineralogy and economics of the Indus sands. No studies on the size analysis of the Indus alluvium have so far been published.

PHYSIOGRAPHY

The region under investigation lies between longitudes 75°38' and 71°35', and between latitude 35°18' and 32°55' N. The southern limit of the area is thus about 10° north of the tropic of the Cancer. The mountains gradually rise from around 3000 feet in altitude at the southern limit of the area to over 20,000 feet in the north. These mountain ranges have been classified on the basis of altitude as Great Himalayas with an elevation of over 20,000 feet, Lesser Himalayas between 12,000 and 15,000 feet and in the Outer Himalayas the elevation varies between 3000 to 4000 feet. All these mountain systems have distinct topographical features depending on the rock formations and their attitude to the sculpturing agents.

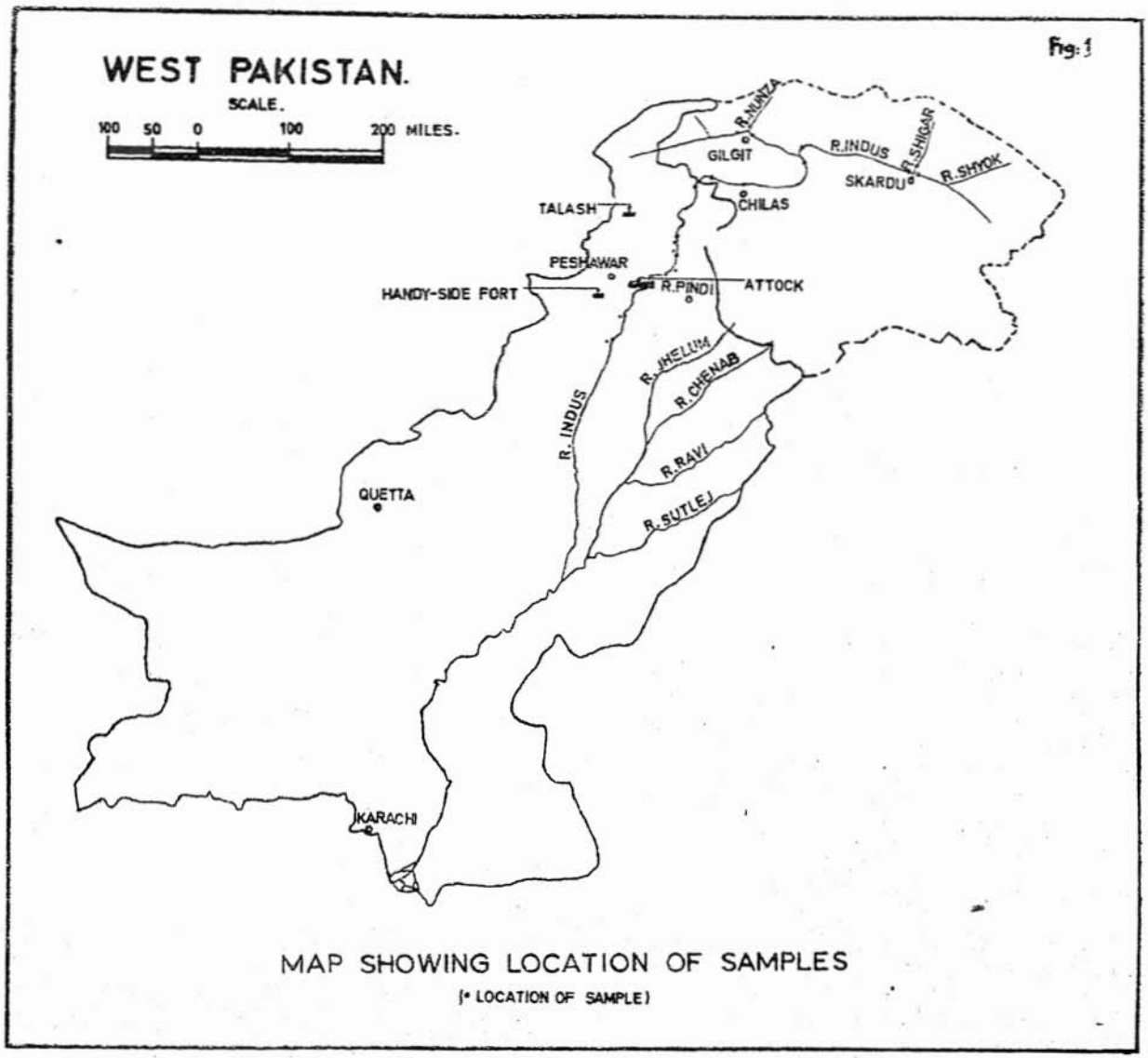
In the upper reaches, where the river Indus traverses the Great and Lesser Himalayas, it flows through valley gorges which are attributed to antecedent drainage. Above the present valley floor steep walls rise abruptly for two to three thousand feet. Near the confluence with tributaries the valley tends to widen and lake type features are displayed. Many of the tributaries are hanging valleys with cirques displayed in their upper reaches.

The gradient of the Indus valley in the Great Himalayas, between Skardu and Chillas is 29 feet per mile. Lower down the course is less steep and between Chillas and Pattan the valley floor drops at the rate of 17.1 feet per mile. Between Amb and Attock the valley is old and the river has changed courses many

times. The gradient is low and there is little corrosion. The valley is broad at places, more than two miles in width, and a huge load of gravels and sands is deposited, covering the flood-plain to its rim. The valley floor between Amb and Attock descends at the rate of 6 feet per mile. Downstreem from Attock, during its course through the Outer Himalayas, the Indus again flows through a narrow gorge with precipitous walls rising for 1,000 - 1,500 feet. Between Attock and Kalabagh, the valley floor has a gradient of 2.7 feet per mile.

DESCRIPTION OF ALLUVIALS

The alluvial deposits of the sector of river Indus studied in this investigation are essentially sands and gravels. On the basis of composition and mode of occurrence, two main categories can be distinguished. One of these is a dominantly sandy deposit which occupies extensive patches mantling the valley floor and the high flood marks. The other is an assortment of closely-packed pebbles, cobbles and boulders with sand in the interstices. The first sediment is referred to as mantle sand and the second as gravel deposit. Mantle sand is widespread downstream from Attock. At Khushalgarh, most of the alluvials of the valley floor are of homogenous nature, with only a few erratic thin patches of closely packed gravel deposit. Upstream of Attock rather less than one third of the alluvials are sand deposits.



The gravel deposits normally contain less than one-third of sand and the remainder of course clastics. Pebble-counts reveal that 65-75% of the gravels derive from acid igneous rocks, 15-25% from intermediate-basic igneous rocks and 5-10% from metamorphic rocks. The first group includes grandoiorite, grantite, granite gneiss, pegmatite and aplite and the second diorite, dolerite, gabbro and basalt. Vein quartz, limestone and schist are most common among the metamorphic components.

Medium to very fine sand usually predominates in the mantle deposit, with angular to subangular grains common in the finer fractions (less than 0.25 mm), the grains over this size being commonly sub-rounded to rounded. Wind winnowing may give rise to patches with a dark grey tinge, enriched in black micas. Streaks of heavy mineral concentrates are conspicuous, though usually of no great size.

PROCEDURES

For size analysis the samples were collected from the freshly deposited alluvium in the valley floor upto one foot depth. Between Kalabagh and Kabulgram, samples were selected from six localities, including both the above sites. Samples from Hunza, Gilgith and,Shigar tributaries and from the Indus alluvium at Skardu were also studied.

The analysis were restricted to sand-sized material between 2 mm and. 065 mm grade, In the laboratory the test samples were obtained from the field samples by cone-and - quartering- Nearly equal amounts of test samples were taken in each case and sieved by manual shaking. The sieve analysis was done with test sieve screen fitted with mesh of British Standard system 410, made by Endcloth (Filter) Ltd., London. Five sieve screens of 16, 30, 60, 120, and 200 mesh were used according to Wentworth's grade scale these represent the following intervals.

1.	+ 16 mesh	2 mm.	very coarse sand.
2.	− 16 + 30 mesh	1 mm.	coarse sand-
3.	− 30 + 60 mesh	½ mm.	medium sand.
4.	− 60 +120 mesh	¼ mm.	fine sand.
5.	−120 +200 mesh	1/8 mm.	very fine sand.
6.	−200 mesh	1/16mm.	silt.

The samples from sand and gravel deposite were treated separately. The sample retained in the pan below 200 mesh screen was taken as silt, and no further division was attempted to evaluate the clay fraction, which forms an insignificant part in the samples. The amount of material retained on each sieve was weighed, and proportional parts of the whole sample determined. From the weight percentage of the fractions, cumulative percentages were calculated; and with these data cumulative curves were constructed (Table. 2)

The most widely used statistical devices for comparing and describing sediments are quartile measures, median sorting coefficient, quartile skewness, and quartile kurtosis. These measures are obtained from median, 1st and 2nd quartiles, and 90 and 10 percentiles, derived from a cumulative curve. A short description of these is given below:—

Md is the median parameter or a measure of the average size ; 40 percent of the meterial is lager and 50 percent smaller than the median. Q3 and Q1 are the quartiles - that is, the size value associsted with the intersection of 25 and 75 percent lines with the cumlative curves. P90 and P10 are the 90 and 10 percetiles, i.e., the size associated with the percent values respectively. The first quartile, by convention, refers to the diameter value which has 75 percent of the larger and 25 percent smaller. The third quartile diameter has 25 percent coarser and 75 percent finer grade.

RESULTS

Size distribution

The grade of the meterial treated to size analysis ranges between 2 mm and .065 mm. The maximum accumulation of the material falls in three classes between 0.5 mm and 0.125 mm. which accommodate over three fourth of the material in the bulk. The remaining portion is divided among 0.065 mm, 1 mm and 2 mm classes, as arranged according to their order of abundance The samples from mantle deposit yielded only four classes between 1 mm and 0.065 mm, whereas those from the gravel deposit are coarser in size and contain a varying amount of material in t[illegible] 2 mm class (Table 1).

Unimodal distribution is recorded in almost all th samples from the mantle deposit, whereas grave deposit yielded both unimodal and bimodal distribution. In the 16 samples from mantle deposits (Table 1,) 11 samples have their chief modes in 0.25 mm class, 3 in 0.065 mm and 1 each in 0.[illegible] 0.125 mm classes. As shown in Table [illegible] modes in 7 samples contain over 50 material, in 6 samples over 40 pescent and in the remaining 3 samples between 30 and 39 percent.