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Case Report Open Access

Size Analysis of the Kolhan Shales

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General

The Limestone Member of the Kolhan Formation is overlain by the Kolhan phyllitic Shale which is responsible for the lithostratigraphic name "Kolhan Shale Formation" to the entire sequence of deposits. Kolhan phyllitic Shale.

The phyllitic Shale is a dominantly grayish purple (5P4/2) to the dusky red (5R3/4) coloured rock in hand specimen with no other recognizable constituents. Green chloritic and black carbonaceous types are lacking. The shales are compact, more or less siliceous types with very thin laminations and developments of slaty cleavages and are sporadically associated with very thin sandy intercalations.

Inspite of the gentle recrystallizing effects due to the mild metamorphism, it is very difficult to prepare 'thin sections' satisfactorily and identify the various constituents properly. The identifiable minute quartz grains are silt-sized (<60 microns) and are prominently arranged in parallel microlaminations which are also marked by streaks of brownish limonite. In the clay matrix, slender flakes of illitic mica are observed. Chlorite is easier to recognize because of its slightly larger sizes. Most of it is prochlorite. A distinct laminated arrangement is often seen. Some sections show evidence of silicification by parallel streaks of minutely crystalline quartz disposed along the laminations. Black opaque magnetite dust, reddish hematite and rounded detrital or diagenetic glauconite complete the list of mineral constituents of the shale.

Various authors have drawn attention to the inadequacy of the thin-section method in the analysis of the mineralogical and textural characteristics of very fine grained sediments and rocks like clays and shales. This has been most convincingly demonstrated recently in a study of the mineralogical composition of Paleozoic shales of Illinois where X-ray diffraction absorption analysis of shales gives very different results as compared to the thin section analysis. The results of the application of a few other methods of analysis in the case of the Kolhan Shales are described below.

Mechanical size analysis

The mechanical size analysis of nearly seventy six samples of the phyllitic Shale collected from different parts of the basin in represented in Tables 1a and 1b. The standard procedure of disaggregation and disintegration was employed in the present investigation. After proper dispersion of the gently broken samples in 0.01 N Ammonium Hydroxide solution for days together, aided by intermittent stirring, the material was sieved through a mesh to separate the sandy fraction (>60 micron) from the silt-clay fraction. The pipette analysis of the latter was carried out with great care using Calgon or Sexocon (Sodium metahexaphosphate) as the noncoagulant, in order to separate the silt from the clay (<2 microns) and to get the various fractions of silt (coarse, medium and fine silt). Owing to the time consuming nature of the procedure, reproducibility tests could not be carried out, but done with caution, this method of mechanical size analysis gives reliable results. The features which are clearly brought out by a close inspection of the Tables 1a and 1b are summarized below:

1. There is a wide variation in the content of the sand sized particles (predominantly quartz) from as low as 2.38 to as high a 50.98 percent. The extreme values are however much rare. The model value lies between 14 and 15, although quite a large number of samples contain sand grade materials nearly 10 percent and an almost equally large number nearly 8 percent. The sandy nature of the rocks is therefore evident.

2. Silt sized particles form the dominant mode in the particle composition of these rocks, whose content varies between 40 and 91.64 percent. The two extreme values are as expected very rare and the majority of the samples contain between 70 and 80 percent of silt. The rocks are therefore sand bearing silty shales as suggested the data of size analysis.

3. The content of clay-sized particles is much subordinate and ranges between 3.57 and 25.23 percent, although the modal value centres around 15 percent.

4. There does not seem to be any consistent relation between the content of sand-size particles and that of silt-sized particles. The same thing holds true with respect to the relation of silt content with clay content. On account of the high content of silt, the sand /silt ratio is invariably much less than unity except in those few samples where the sand content reaches the maximum of nearly 50 percent. From the Tables 1a and 1b alone, it is evident that the variation in the content of the three constituents is arbitrary in any one locality and no trend is discernable.

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Sample Nos.	Sand	Silt			Clay
	>60 μ	60 μ-20 μ	20 μ-6 μ	6 μ-2 μ	<2 μ
(1)	(2)	(3)	(4)	(5)	(6)
1	13.21	15.68	35.73	21.47	13.93
2	14.88	2313	24.90	23.10	14.00
3	5.44	12.50	42.23	27.50	12.33
4	25.89	21.39	24.66	14.89	13.17
5	10.04	27.85	36.85	21.10	3.57
6	4.72	19.20	36.53	26.10	13.45
7	7.31	15.05	26.83	25.60	25.23
8	8.82	17.08	29.83	25.60	18.67
9	5.84	26.05	30.65	20.18	17.30
10	13.60	2.30	40.90	27.30	13.60
11	12.50	4.08	43.20	31.60	9.30
12	17.20	14.00	37.80	14.60	14.60
13	3.78	3,78	45.74	37.80	11.34
14	19.88	24.53	27.30	15.65	12.65
15	7.84	20.50	34.60	21.63	15.43
16	4.80	8.28	42.22	33.12	11.59
17	10.75	23.43	35.05	18.33	12.45
18	6.86	22.18	36.95	21.70	12.30
(1)	(2)	(3)	(4)	(5)	(6)
19	17.50	1.00	36.10	32.20	11.40
20	3.17	5.07	38.04	34.87	19.02
21	9.82	24.17	31.63	20.00	14.37
22	9.19	21.55	34.03	24.32	10.90
23	4.83	19.60	35.70	25.10	14.78
24	6.11	23.53	41.83	16.15	12.24
25	4.54	29.15	44.70	13.15	8.45
26	2.38	38.37	45.97	7.30	5.97
27	13.31	21.40	25.35	20.45	10.50
28	9.24	22.80	38.73	18.58	10.65
29	9.07	24.06	23.41	23.17	20.28
30	9.51	21.65	29.97	20.27	18.60
31	4.88	20.08	20.80	25.63	19.63
32	5.42	24.10	39.75	21.23	9.5
33	11.34	23.15	33.50	16.68	15.33
34	16.24	15.93	31.75	19.10	16.97
35	7.99	21.88	29.65	23.25	17.23
36	10.56	35.93	34.35	9.93	9.25
37	18.40	22.45	22.75	19.25	17.15
38	14.25	24.48	30.45	22.63	8.20
39	17.72	19.83	32.30	18.05	12.10
40	19.20	22.85	28.63	14.20	15.13
41	7.59	18.72	31.99	26.76	14.94
42	3.90	22.23	48.58	15.85	9.45
43	29.35	17.40	30.80	14.15	8.30
44	12.82	9.38	33.78	24.37	19.65
45	16.13	21.95	34.15	15.60	12.13
46	8.04	16.68	32.75	24.53	18.03
47	6.99	15.53	33.45	26.00	18.03
48	10.03	17.72	48.35	14.65	9.26
49	15.79	16.45	33.68	22.08	1200
50	6.56	21.15	37.40	20.85	14.05
(1)	(2)	(3)	(4)	(5)	(6)
51	18.91	21.50	28.60	13.38	17.62
52	10.18	25.45	29.60	19.00	15.78
53	16.29	25.55	39.90	11.53	6.73
54	14.33	17.33	34.10	20.73	13.47
55	4.31	20.75	29.17	27.90	17.85
56	7.57	27.10	34.80	16.90	13.63
57	5.09	24.60	34.55	22.70	13.05
58	13.01	15.70	27.05	26.15	18.10
59	8.86	16.03	29.58	20.98	34.57
60	8.01	19.98	53.95	10.75	7.33
61	12.62	23.78	39.70	15.28	8.63
62	12.98	23.78	39.70	15.28	8.63
63	7.75	20.63	36.70	22.20	12.72
64	9.63	20.40	38.65	23.65	7.67
65	11.50	20.25	35.78	20.57	11.90
66	15.68	16.93	22.38	22.95	22.18
67	15.72	13.53	50.63	12.97	7.15
69	8.72	12.93	39.13	21.60	17.63

Table 1a: Mechanical size analysis of the Kolhan Shale.

Sample Nos	Sand >60 μ	Silt			Clay
		60 μ- 20 μ	20 μ – 6 μ	6 μ -2 μ	<2 μ
70	38.83	8.48	32.11	8.44	12.14
71	44.38	6.44	21.05	12.43	15.65
72	44.07	14.46	14.32	12.13	15.01
73	32.59	22.87	19.68	12.95	11.90
74	48.96	10.74	18.49	12.72	9.08
75	36.86	20.62	18.45	12.61	11.45
76	50.98	9.27	15.54	10.03	14.19

Table 1b: Mechanical size analysis of the quartzose Kolhan Shales.