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INSOLUBLE RESIDUE ANALYSIS OF LIMESTONE IN KOLHAN GROUP

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ABSTRACT

The data from the insoluble residue analysis of nearly ninety eight samples collected from different horizons fully corroborate the petrogenetic evidences obtained from the petrographic and field features of the Kolhan Limestone. High grade limestones containing nearly 10% of insolubles constitute about half of the limestone samples. Only in ten samples, the silt-clay portion dominates over the sand portion and such very high grade pockets (containing at times about 95% $CaCO_3$) on chemical analysis should show almost equal distribution of SiO_2 and Al_2O_3, both together totaling to 5 to 10%. In the remaining forty samples the sand fraction clearly outweighs the silt-clay fraction and these varieties of equally high grade pockets should analyze SiO_2 content distinctly greater than the percentage of Al_2O_3.

INTRODUCTION

The variability in the sand-silt ratio even in the high grade pockets of the Kolhan Limestone is thus very well brought out by the insoluble residue analysis (Table 1).

Table 1 Percentage of soluble carbonate and insoluble residue in the Kolhan Limestone

(1)	(2)	(3)	(4)	(5)
Sample Nos.	Soluble carbonate (mainly $CaCO_3$)	Total insoluble residue	Sandy insoluble residue	Silt-Clay insoluble residue
1	95.10	4.90	1.57	3.33
1a	73.68	26.32	17.30	9.02
2	93.62	6.38	1.26	5.12
3	95.19	4.80	1.53	3.27
4	94.46	5.54	2.21	3.33
4a	60.24	39.76	32.03	7.73
5	94.67	5.33	0.92	4.41
6	95.18	4.92	1.33	3.49
7	87.09	12.91	5.69	7.22
8	94.24	5.76	1.85	3.91
9	90.71	9.29	1.59	7.70
10	92.99	7.01	4.32	2.69
11	89.78	10.22	7.84	2.38
12	93.35	6.65	4.05	2.60
13	95.74	4.26	2.09	2.16
14	93.36	6.64	3.68	2.96
14a	80.53	19.47	12.23	7.24
15	90.64	9.16	5.52	3.64

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16	94.73	5.27	2.48	2.79
17	87.81	12.19	6.82	5.37
18	89.91	10.09	6.93	3.16
19	89.20	10.30	6.81	3.99
20	88.03	11.97	8.02	3.95
21	93.09	6.91	3.71	3.20
22	90.12	9.96	7.16	2.80
23	93.78	6.22	3.03	3.19
24	89.54	10.46	6.96	3.50
25	91.38	8.62	4.83	3.79
26	94.07	5.93	2.72	3.21
27	89.20	10.79	7.19	3.60
28	90.43	9.57	6.21	3.36
29	87.31	12.69	9.47	3.22
30	87.57	12.43	9.32	3.11
31	89.53	10.47	7.11	3.36
32	91.63	8.32	5.37	2.95
33	89.71	10.28	6.66	3.62
34	90.44	9.56	5.79	3.77
35	85.99	10.01	7.64	6.37
36	92.88	7.12	3.15	3.97
37	93.15	6.85	3.78	3.06
38	95.55	4.45	1.73	2.72
38a	89.77	10.23	5,35	4.88
39	89.38	10.62	6.44	4.18
40	88.43	11.57	7.32	4.25
41	93.29	6.71	4.34	2.37
42	89.41	10.59	5.43	5.16
43	87.14	12.86	8.51	4.35
44	85.30	14.70	9.71	4.99
45	84.14	15.86	7.49	8.37
45a	84.27	15.73	13.85	1.88
46	86.85	13.15	5.81	7.34
47	86.11	13.89	10.04	3.85
48	84.28	15.72	5.67	10.05
49	82.71	17.28	9.09	8.19
50	86.49	13.51	6.03	7.48
51	86.26	13.74	3.21	10.53
52	85.60	14.40	6.09	8.31
53	82.15	17.85	10.21	7.64
54	84.23	15.77	5.97	9.80
55	85.80	14.19	8.89	5.30
56	84.94	15.06	10.03	5.03
57	77.56	22.44	14.73	7.71
57a	66.55	33.45	22.76	10.69

58	74.81	25.19	18.04	7.15
59	81.12	18.88	11.31	7.57
60	78.44	21.56	13.53	8.03
61	75.28	24.72	19.37	5.35
62	79.44	20.56	13.60	6.96
63	78.19	21.80	10.46	11.34
64	81.49	18.51	13.32	5.19
65	81.48	18.52	6.57	11.95
66	81.24	18.76	13.36	5.40
67	75.70	24.29	10.13	14.16
68	75.53	24.47	6.85	17.62
69	71.43	28.57	6.12	22.45
70	75.45	24.55	3.82	20.73
71	73.06	26.94	6.35	20.59
72	70.06	29.94	7.48	22.46
73	70.59	29.41	10.46	18.95
74	73.03	26.97	18.83	8.14
75	72.32	27.68	19.82	7.86
76	74.67	25.33	15.17	10.16
77	60.13	39.86	26.49	13.37
78	69.05	30.95	9.82	21.13
79	69.07	30.93	25.37	5.56
80	59.22	40.78	24.15	16.63
81	59.04	40.96	23.48	17.48
82	67.75	32.25	15.15	17.10
83	66.24	33.76	9.78	23.98
84	60.59	39.41	8.57	30.84
85	61.28	38.72	11.46	27.26
86	69.42	30.58	6.38	24.20
87	62.65	37.35	8.63	23.72
88	69.19	30.81	16.62	14.18
89	57.49	42.51	15.49	27.02
90	68.32	31.68	17.25	14.48
91	53.23	46.77	33.37	13.40
92	65.32	34.68	25.36	9.32
93	60.32	39.68	20.63	19.05
94	69.66	30.34	14.42	15.92
95	66.11	33.89	8.02	25.87
96	52.17	47.83	43.19	4.64
97	48.59	51.41	20.15	31.26
98	25.60	74.40	42.88	31.52

In the average high grade limestone which forms the bulk of the main horizon, the picture looks apparently more consistent. Of the fifteen samples analyzed, (insoluble residue content nearly 15%), as many as ten exhibit a dominance of sand over silt-clay and only four show a positive reverse relation. What is more interesting is the fact that the reverse relationship is shown by specimens collected adjacently from the same locality which provides the usual samples (sand dominant over silt), thus confirming again the somewhat erratic nature of the sand-silt-clay distribution in the insoluble residue. However, the dominant trend of the very high pockets (sand-silt ratio > 1) is maintained in the average high grade samples. Chemical analyses of such high grade samples are available and all show a dominance of SiO_2 percentage over Al_2O_3 + Fe_2O_3 +/- MnO as is clear from the following:

Components	1.Average of 60 samples (%)	2. High grade limestone (%)
SiO_2	7-8 (estimated by author from percentage insolubles)	11.4
Al_2O_3 + Fe_2O_3	0.88	2.1
CaO	50.58	47.3
MgO	0.53	0.6
Loss on ignition	39.78	37.0
Insolubles	8.29	16.0 (estimated by author from percentage $CaCO_3$ – 83.4)

The insoluble residue analyses of the Kolhan Limestone would be of great economic significance in deciding the high or low grade character of the deposits, particularly in view of the uniformly low Mg content of these rocks. The beneficiation process to be adopted for the upgrading of the limestones would be to a large extent controlled by the nature of the insolubles, whether silt-clay rich or sand-rich. The problem will ofcourse be rather complicated due to the somewhat erratic nature of the distribution. In the present state of our knowledge it is premature to assess the environmental and petrogenetic significance of the residue analysis.

The data on the residue analysis of the medium grade limestones (nearly 25% insolubles) are equally interesting and instructive (Table 1) of the twenty samples analyzed, more than half contain sandy fractions distinctly out-weighing the silt-clay fractions and thus follow the usual trend already noted. In the rest (mostly from Jagannathpur area) a reverse trend is observed, which is in agreement with the petrographical evidence regarding the dominantly argillaceous facies of the limestones in the southern part of the basin. Chemical analyses are not available to substantiate the above on the basis of the SiO_2 and Al_2O_3 percentages.

Deterioration in the quality of the limestones is on the basis of the above, mostly due to admixture of ciliceous particles, rather than clayey impurities except locally. Confirmation of the erratic nature of the quality of the limestones based on the haphazard distribution of insoluble residue is available of the above table which shows that the insolubles jump from 22.44 to 33.45%, from 4.90 to 26.32%, from 5.54 to 39.76% and from 6.64 to 19.47% in the two parts of the same sample (cf. Sample Nos. 1, 1a, 4, 4a, 14, 14a, and 57, 57a).

Chemical analyses of the low grade limestones reproduced below serve to confirm the high silica content of such rocks particularly in the northern part.

From Basakuti		Low grade limestones
SiO_2	22.10	26.9

Al_2O_3	8.51	5.2
Fe_2O_3	0.39	2.5
CaO	35.80	35.6
MgO	0.72	1.3
Na_2O	1.34	-
K_2O	0.32	-
MnO	0.84	Combined with Al_2O_3

A few specimens from the low grade limestone show an abnormally high content of insolubles, nearly 50% or above due to quartz admixture or clayey impurities. Such specimens represent either highly silicified limestone (indistinguishable from calcareous arenite by insolubles only) or calcareous shale, the later particularly true of the southern part which shows a gradual transition from the calcareous to the argillaceous facies in the field.

CONCLUSION

The behaviour of the insolubles in the low grade limestones (ca 35% insolubles) follows the same trend as discussed above. The deterioration of the limestone quality in the southern part of the basin is clearly due to the development of an argillaceous facies of limestone with practically no silicification in contrast with the northern half where the sand-silt ratio may be as high as 3 obviously due to quartz admixture, probably of metasomatic origin. Even the low grade phyllitic limestones show a marked dominance of sandy residue over silt-clay, signifying that contributon of quartz grains of sand grade from the phyllitic shale is greater than that of silt-clay. Alternatively this may be due to silica replacement which is a common feature in the northern part of the basin. The dominance of clayey material in the south attests to weak circulation equated with a shallow lagoonal basin of low current intensity.

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