

Morphology & Petrography of Pumice from the Central Indian Ocean Basin

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Majority of pumice are equant with high Corey's shape factor values. Petrographic studies indicate flow bands of isotropic nature, with varied vesicle shape and size, and the diffractograms show them to be mainly composed of amorphous silica together with lesser amounts of crystalline quartz and feldspars. Two types of pumice, without ferromanganese coating and with ferromanganese coating are observed.

Study of volcanogenic products helps in identification of palaeostrandlines, calculation of settling rates and assessment of volcanism on sedimentation, relation of volcanism and climatic changes and palaeo-currents^{1,2}. So far there are no reports of pumice within the Central Indian Ocean Basin (CIOB), except for pumiceous glasses from the DSDP cores and drift pumice in the Indian Ocean³. In this communication morphology and petrography of pumice from CIOB are given.

Samples of pumice (48) were collected using free-fall grabs, Petterson grabs and dredges from 21 stations (lat. 10°-15°S and long. 74°-84°E) from an average depth of 5000 m. In general, 2 types of pumice were observed: type A, without ferromanganese coating and type B, with ferromanganese coating. It was noticed that at times both the types occur within the same sediment domain of low sedimentation rates⁴ (1.64-5 mm.1000 y⁻¹).

The colour, shape and size parameters were studied. Specific gravity measurements were made on few of the samples. The shape of the samples was investigated using Zingg's system⁵ of b/a and c/b. For this the 3 axes long, intermediate and short (a, b, c) were measured (Table 1). Wilson and Huang's⁶ method was adopted to decipher the spread of shapes of the samples, by sub-dividing the Zingg plane into 9 zones based on b/a and c/b; and also the Corey's shape factor⁷ (CSF) was used. A Philips X-ray diffractometer was utilised for identification of the mineral phases in pumice. The physical conditions of operation were 40 kV, 20 mA current with CuK_α target and a rotation speed of 2-2 θ.min⁻¹.

Nature of pumice—The colour varies from brown to brownish grey to buff, and the size from <1 to 6 × 4 cm. The pumice displays varied shapes rang-

ing from highly irregular to sub-rounded to well-rounded. Two types of vesicles were observed, rounded to irregular of < 1 mm to 1 cm and linear or pipe vesicles up to 4 cm. The degree of vesicularity varies from sample to sample and also within the sample.

Vesicles which are tube-like (pipe-vesicles), typical of Krakatau, are formed by process of vesiculation which must have begun within the conduit or in the magma chamber and that most of the gases are emitted before the discharge of the lava occurs⁸. It is apparent that the size of the vesicles would act as a controlling factor for the overall shape of the sample. The shape factors studied reveal the samples to have a wide spread of shapes. Of the total 48 samples studied, 16 fall in zone Z9 (equant) and 8 in Z7 (oblate). CSF data (Table 1) show a wide range of values from 0.17 to 0.77, but mostly on the higher side. The smaller values indicate their non-spherical nature and hence their departure from the settling velocities of a sphere⁷.

The average specific gravity of the pumice in the present study is 0.65. This low value indicates the buoyancy of the pumice and their ability to remain afloat for a long period before settling onto the sea floor.

Petrographic studies reveal a greyish isotropic mass alternating with bands of crypto-crystalline material. Fluidal texture is quite distinct and along the flow lines opaques are present. Vesicles are pipe-like and few of them with rounded form. Some pumice show the presence of quartz crystals lying within the vesicles and in the interstices of glassy filaments. Bio-debris and in some cases micro-manganese nodules are also present in the vesicles. The diffractograms exhibit a major abundance of silica (3.5 and 4.27 Å), both in amorphous and in crystal-

Table 1—Zingg's Ratio, Shape Class and Corey's Shape Factor (CSF)

Samples	b/a	c/b	Zingg's shape class		CSF
				Z	
1	0.66	0.83	E	9	0.68
2	0.66	0.75	E	9	0.61
3	0.80	0.75	E	9	0.67
4	0.90	0.75	E	9	0.71
5	0.73	0.23	O	7	0.18
6	0.75	0.66	E	9	0.57
7	0.50	0.75	P	6	0.53
8	0.50	0.66	P	6	0.51
9	0.65	0.66	P	6	0.53
10	0.69	0.66	E	9	0.55
11	0.50	0.50	B	5	0.35
12	0.66	0.30	O	7	0.24
13	0.76	0.20	O	7	0.17
14	0.76	0.80	E	9	0.70
15	0.43	0.38	B	5	0.25
16	0.86	0.38	O	8	0.35
17	0.50	0.50	B	5	0.35
18	0.75	0.33	O	7	0.28
19	0.66	0.60	O	8	0.40
20	0.80	0.75	E	9	0.35
21	0.50	0.50	B	5	0.35
22	0.85	0.33	O	7	0.30
23	0.69	0.33	O	7	0.27
24	0.75	0.66	E	9	0.57
25	0.68	0.33	O	7	0.27
26	0.83	0.50	O	8	0.45
27	0.66	0.75	E	9	0.61
28	0.66	0.41	O	8	0.34
29	0.81	0.30	O	7	0.27
30	0.83	0.50	O	8	0.40
31	0.61	0.75	E	9	0.58
32	0.50	0.60	B	5	0.42
33	0.09	0.75	P	3	0.71
34	0.85	0.83	E	9	0.77
35	0.60	0.10	B	1	0.77
36	0.58	0.42	B	5	0.32
37	0.83	0.60	O	8	0.54
38	0.50	0.80	P	6	0.32
39	0.66	0.75	E	9	0.61
40	0.60	0.67	B	4	0.77
41	0.80	0.80	O	8	0.44
42	0.90	0.75	E	9	0.71
43	0.60	0.83	P	6	0.64
44	0.70	0.71	E	9	0.59
45	0.77	0.71	E	9	0.62
46	0.60	0.50	B	5	0.38
47	0.55	0.83	P	6	0.61
48	0.50	0.75	P	6	0.53

E = Equant; B = Bladed; O = Oblate; P = Prolate; Z = Zingg's shape class

line phases. Feldspars are the most dominant crystalline phase. The encrustations show todorokite to be the major Mn mineral together with lesser amounts of delta MnO₂.

The occurrence of pumice of varied vesicular nature indicates that no single factor can be attributed for their settling onto the sea floor. A combination of factors like (i) wearing out of the pumice, resulting in more equant shape and high CSF values and hence settling velocities nearing that of a sphere, as indicated by the positive correlation ($r=0.89$) between c/b and CSF, (ii) habitation by organisms within the vesicles and (iii) accumulation of suspended sediments in the vesicles could have influenced their settling onto the sea floor.

The occurrence of pumice quite consistently along with the nodules is of interest as regards their origin. The pumice are postulated to be products of the Indonesian arc volcanism but the former are of Recent Krakatauan origin and the latter may be of Tertiary times⁹⁻¹².

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