

RESEARCH OF NATURAL BASALT GLASSES BY A METHOD MÖSSBAUER SPECTROSCOPY

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Redox equilibria and coordination states of iron in natural basalts glasses have been determined by Mössbauer spectroscopy. The natural glasses of oceanic basalts of region the Bouvet Triple Junction (Southern Atlantic), Mid-Atlantic Ridge (MAR) and East- Pacific Rise (EPR) were studied.

The ^{57}Fe Mössbauer spectra were obtained at room temperature using spectrometer MC-2201. The velocity scale of the obtained spectra was represented relative to the pour-iron absorber spectrum, and $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]\cdot 2\text{H}_2\text{O}$ was measured as a standard materials. The spectra of the studied glasses represent an asymmetrical doublet, the high-velocity peak which one is a little bit wider also less intensive in contrast to low-speed. At modeling of spectra the equalling of half-widths and intensities low- and high-velocity lines of each doublets was supposed. The parameters of spectra and content Fe^{2+} and Fe^{3+} in different structural positions are given in the Table 1.

Table 1. Mössbauer parameters of natural basalt glasses at room temperature

sample		$\text{Fe}^{2+}(\text{I})$				$\text{Fe}^{2+}(\text{II})$				$\text{Fe}^{2+}(\text{III})$				$\text{Fe}^{3+}_{\text{oct}}$			
		δ	Δ	Γ	S	δ	Δ	Γ	S	δ	Δ	Γ	S	δ	Δ	Γ	S
M A R	5л/8	0.95	1.68	0.50	38.3	1.06	2.71	0.34	18.0	1.02	2.15	0.36	31.5	0.56	0.66	0.49	12.3
	5л/7-2	0.76	1.77	0.54	48.8	0.89	2.92	0.37	19.3	0.79	2.35	0.43	23.7	0.41	0.46	0.58	8.2
	5л/167-2	0.87	1.46	0.52	33.7	0.91	2.50	0.39	27.5	0.88	2.03	0.36	27.5	0.43	0.60	0.53	11.3
	3ф/69-36	0.90	1.57	0.48	33.0	1.01	2.69	0.35	23.8	0.97	2.08	0.36	32.6	0.49	0.63	0.54	10.5
	3ф/123-3	0.87	1.36	0.44	23.2	0.94	2.54	0.36	27.6	0.91	1.95	0.31	37.8	0.37	0.62	0.43	11.4
	3ф/148-1	0.99	1.55	0.49	26.3	1.09	2.91	0.32	38.5	1.00	2.22	0.43	27.2	0.42	0.63	0.55	8.0
E P R	203-5	0.88	1.67	0.46	9.1	1.00	2.47	0.48	21.0	0.97	1.91	0.59	56.4	0.57	0.58	0.59	13.4
	218-3	0.82	1.57	0.42	10.8	0.94	2.52	0.55	26.5	0.89	1.99	0.53	48.9	0.44	0.59	0.53	13.7
	670-2	0.98	1.51	0.51	35.1	1.02	2.49	0.30	17.7	1.02	2.04	0.32	31.9	0.40	0.64	0.48	15.3
	238-4	0.73	1.61	0.39	12.7	0.96	2.40	0.48	35.6	0.97	1.78	0.47	37.9	0.49	0.77	0.67	13.8
B O U V E T	19-6	0.74	1.62	0.44	28.9	0.84	2.64	0.44	25.2	0.79	2.11	0.39	35.4	0.39	0.59	0.59	10.5
	19-13	0.84	1.52	0.40	14.1	1.00	2.63	0.46	28.0	0.91	2.03	0.43	38.9	0.40	0.48	0.58	19.1
	10-1	0.94	1.72	0.44	23.5	1.05	2.88	0.47	43.2	0.98	2.23	0.38	20.1	0.44	0.66	0.56	13.2
	31-1	0.80	1.72	0.44	17.9	0.88	2.55	0.42	44.3	0.86	2.05	0.33	21.3	0.45	0.41	0.54	16.3
	27-3	0.86	1.63	0.41	21.2	0.94	2.54	0.40	31.0	0.91	2.07	0.35	30.3	0.42	0.58	0.55	17.5
	17-1	0.82	1.58	0.47	22.3	1.06	2.64	0.43	15.2	0.97	2.11	0.42	34.4	0.41	0.40	0.51	28.0
	48-20	0.86	1.54	0.49	20.9	0.98	2.57	0.41	22.6	0.94	2.04	0.47	43.9	0.49	0.55	0.59	12.3

Three doublets are assigned to cations Fe^{2+} , occupying three various octahedral positions. The quadrupole doublet with the greatest values of isomer shift (δ) and quadrupole splitting (Δ) in the investigated basalt glasses is attributed to cations Fe^{2+} in less distorten octahedron [1; 2]. The positions Fe^{2+} with the isomer shifts have which one lower values are related more distorten octahedral positions. The large variety of structurally nonequivalent positions of iron indicates a high degree unregulated of oxygen environment iron.

At all investigated of natural glasses ferric iron is observed which one is in octahedral coordination [2]. Contents of Fe^{3+} are from 10 up to 28 % for glasses of region the Bouvet Triple Junction and does not exceed 15 % of total content of iron for glasses MAR and EPR. The redox ratio of iron in basalts from the East-Pacific Rise is a few higher than the redox ratio of iron oceanic basalts from the Mid-Atlantic Ridge.

The estimation of oxygen fugacities for basalt melts was carried out using an equation by Kilinc et al. [3]. For the learnt glasses the values f_{O_2} were calculated at temperature 1200°C (Table 2). The calculated

values of oxygen fugacity are expressed relative to a specific buffer curve, in this case the nickel-nickel-oxide (NNO) buffer of Huebner and Sato [4]. “Relative oxygen fugacity”, ΔNNO , is defined as $\log_{10} f_{\text{O}_2}$ (sample) – $\log_{10} f_{\text{O}_2}$ (NNO) at same temperature [4; 5].

Table 2. Relative oxygen fugacity (ΔNNO) for basalt glasses

	sample	$\text{Fe}^{3+}/\Sigma\text{Fe}$	ΣDixi	$-\log f_{\text{O}_2}$	ΔNNO
M A R	5л/8	0.123	0.57	8.65	-1.08
	5л/7-2	0.082	0.56	9.53	-1.97
	5л/167-2	0.113	0.42	8.52	-0.95
	3ф/69-36	0.105	0.54	8.99	-1.43
	3ф/123-3	0.114	0.51	8.69	-1.13
	3ф/148-1	0.080	0.46	9.38	-1.81
E P R	203-5	0.134	0.58	8.47	-0.90
	218-3	0.137	0.57	8.39	-0.82
	670-2	0.153	0.54	8.07	-0.51
	238-4	0.138	0.65	8.53	-0.97
B O U V E T	19-6	0.11	0.62	-8.992	-1.427
	19-13	0.19	0.70	-7.598	-0.033
	10-1	0.13	0.41	-8.187	-0.622
	31-1	0.16	0.54	-7.921	-0.356
	27-3	0.17	0.52	-7.704	-0.140
	17-1	0.28	0.69	-6.825	0.740
	48-20	0.12	0.53	-8.613	-1.048

The values ΔNNO definite on the studied basalts glasses tholeiitic of composition are higher than value ΔNNO for typical MORB lavas [6], which one lie in limits from –3 up –1. This significance is agreed the data obtained by Dmitriev et al. [7] for glasses MORB-2, which one were derived from a primary high-magnesian tholeiite melt, originating from a dry plagioclase lherzolite at $T \sim 1250^\circ\text{C}$ and $P = 5\text{--}9$ kbar.

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