

10. CHEMICAL ANALYSES OF INTERLABORATORY STANDARDS

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Four samples of basalt from Holes 332A and 332B were designated as standards to be analyzed by all investigators working on chemistry of Leg 37 basalts. In addition, wet chemical analyses of each standard were obtained from the U.S. Geological Survey's Denver rock analysis laboratory and from the U.S. National Museum. The analyses for major elements reported by all investigators are shown in Table 1.

For purposes of comparison each analysis was corrected for CO₂ and normalized to dry weight. Standards 1, 2, and 3 were corrected by calculating CO₂ as calcite and adjusting CaO accordingly. Standard 4 contains iron and magnesian carbonates and was corrected for a mixed carbonate consisting of 91% MgCO₃ and 9% FeCO₃. After normalization ferric iron was converted

to ferrous and all iron was expressed as "FeO." Where two iron values and/or CO₂ were not reported, an average value for Fe₂O₃ and CO₂ was assigned based on values given by the other laboratories. All adjusted and recalculated analyses are shown in Table 2.

The interlaboratory agreement is good in general although small but consistent differences are apparent when comparing the results of any two laboratories for the four standards. Analyses of Standards 1-3 are plotted on MgO variation diagrams in Figure 1. The total range of interlaboratory variation exceeds in some cases the variation found within single lithologic units analyzed on shipboard. This makes it difficult to make consistent chemical classifications when using analyses from different laboratories.

TABLE 1
Analyses of Interlaboratory Standards

	USGS	USNM	BREST	DAL	USSR	URI	WOODS	R-UB	IMP
Standard 1: Sample 332A-8-2, 2-15 cm									
SiO ₂	50.93	50.69	50.08	50.77	50.14	50.86	51.51	51.08	50.90
Al ₂ O ₃	14.60	15.23	14.26	14.79	14.54	14.50	14.60	14.42	14.40
Fe ₂ O ₃	3.04	3.08	3.07	2.64	3.60	3.01	2.89	3.09	3.47
FeO	7.04	7.02	6.92 ^a	7.41	7.26	7.19	7.11	7.00	7.00
MgO	7.20	7.15	7.32	7.33	7.35	7.23	7.53	7.27	7.50
CaO	12.07	12.22	12.25	12.24	12.10	12.24	11.99	11.98	12.10
Na ₂ O	2.24	2.13	2.23	2.21	2.24	2.23	2.17	2.14	2.23
K ₂ O	0.32	0.28	0.33	0.32	0.35	0.34	0.33	0.32	0.31
H ₂ O	0.82	0.82	0.82	1.00	0.89	0.91	0.93	1.10	1.10
TiO ₂	1.17	1.18	1.10	1.11	1.20	1.11	1.08	1.08	1.12
P ₂ O ₅	0.12	0.08	0.12	0.11	0.0 ^c	0.13	0.0 ^c	0.13	0.12
MnO	0.17	0.18	0.16	0.18	0.20	0.18	0.15	0.17	0.18
CO ₂	0.11	0.09	0.11 ^b	0.14	0.09	0.11 ^b	0.06	< 0.10	< 0.10
Total	99.93	100.20	98.77	100.25	99.96	100.04	100.35	99.88	100.53
	USGS	USNM	BREST	USSR	GUNN	WOODS	R-UB	IMP	
Standard 2: Sample 332A-40-2, 26-33 cm									
SiO ₂	47.72	47.42	47.50	47.40	48.83	48.08	47.94	47.42	
Al ₂ O ₃	17.45	17.82	17.17	17.24	16.82	17.77	16.88	17.52	
Fe ₂ O ₃	1.83	2.12	2.23 ^a	2.75	2.23 ^a	2.08	1.75	1.57	
FeO	4.57	4.41	4.17	4.10	4.43	4.34	4.60	4.90	
MgO	9.25	9.18	9.12	9.25	9.39	9.02	9.31	9.42	
CaO	15.10	15.34	15.46	15.00	15.49	14.99	14.82	15.38	
Na ₂ O	1.51	1.42	1.46	1.57	1.48	1.58	1.64	1.50	
K ₂ O	0.12	0.08	0.11	0.11	0.11	0.09	0.06	0.10	
H ₂ O	0.63	0.90	1.86	0.87	0.0	0.87	0.40	0.40	
TiO ₂	0.55	0.58	0.55	0.63	0.55	0.53	0.53	0.54	
P ₂ O ₅	0.06	0.05	0.07	0.0 ^c	0.07	0.0 ^c	0.10	0.05	
MnO	0.12	0.14	0.12	0.14	0.12	0.12	0.10	0.12	
CO ₂	0.96	0.98	0.97 ^b	0.96	0.97 ^b	0.86	0.68	0.68	
Total	99.87	100.44	100.79	100.02	100.49	100.83	98.81	99.60	

TABLE 1 – Continued

	USGS	USNM	BREST	DAL	USSR	GUNN	URI	WOODS	R-UB	IMP
Standard 3: Sample 332B-3-4, 26-36 cm										
SiO ₂	48.46	48.26	48.50	47.47	48.14	49.15	48.40	48.60	48.54	48.38
Al ₂ O ₃	20.18	20.53	20.22	20.44	19.74	19.46	19.81	19.59	19.60	20.02
Fe ₂ O ₃	1.39	1.51	1.47 ^a	1.22	1.90	1.47 ^a	1.34	1.29	1.27	1.50
FeO	4.55	4.46	4.57	4.84	4.56	4.62	4.75	4.82	4.65	4.65
MgO	7.66	7.59	7.75	7.73	7.60	7.73	7.55	8.16	7.74	7.92
CaO	14.83	14.95	14.90	15.14	14.88	15.00	14.95	14.61	14.51	14.80
Na ₂ O	1.54	1.47	1.37	1.49	1.60	1.46	1.55	1.60	1.58	1.55
K ₂ O	0.05	0.05	0.06	0.05	0.05	0.05	0.08	0.06	0.08	0.05
H ₂ O	0.66	0.67	0.63	0.60	0.58	0.0	0.59	0.68	0.70	0.70
TiO ₂	0.41	0.43	0.42	0.41	0.50	0.41	0.42	0.40	0.40	0.42
P ₂ O ₅	0.04	0.03	0.03	0.03	0.0 ^c	0.04	0.03	0.0 ^c	0.05	0.04
MnO	0.10	0.12	0.10	0.11	0.12	0.11	0.10	0.11	0.12	0.11
CO ₂	0.04	0.02	0.02 ^b	0.01	0.02 ^b	0.02 ^b	0.02 ^b	0.07	<0.10	<0.10
Total	99.91	100.90	100.04	99.54	99.69	99.52	99.59	99.99	99.34	100.24
	USGS	USNM	BREST	USSR	GUNN	URI	WOODS	R-UB	IMP	
Standard 4: Sample 332B-35-2, 51-58 cm										
SiO ₂	44.44	44.14	44.08	44.20	46.10	44.22	44.89	44.14	44.36	
Al ₂ O ₃	11.96	12.37	11.35	11.71	11.91	11.67	11.82	11.51	12.32	
Fe ₂ O ₃	2.76	3.00	2.99 ^a	3.45	2.99 ^a	2.74	2.61	3.08	2.92	
FeO	6.46	6.32	6.45	6.51	6.95	6.60	6.49	6.30	6.30	
MgO	18.99	18.89	19.16	19.25	19.48	19.16	19.34	19.14	18.99	
CaO	8.68	8.84	8.43	8.35	9.25	8.66	8.82	8.76	8.72	
Na ₂ O	1.55	1.41	1.53	1.52	1.69	1.60	1.53	1.45	1.53	
K ₂ O	0.18	0.15	0.19	0.16	0.18	0.17	0.18	0.20	0.17	
H ₂ O	1.82	2.22	4.18	2.24	0.0	1.56	2.64	2.10	2.10	
TiO ₂	0.44	0.46	0.46	0.48	0.47	0.47	0.43	0.45	0.46	
P ₂ O ₅	0.04	0.04	0.04	0.0 ^c	0.05	0.04	0.0 ^c	0.04	0.04	
MnO	0.15	0.16	0.15	0.21	0.16	0.15	0.15	0.16	0.16	
CO ₂	2.37	2.32	2.30 ^b	2.20	2.30 ^b	2.30 ^b	2.21	2.01	2.01	
Total	99.84	100.32	101.31	100.28	101.53	99.34	101.11	99.34	100.08	

Note: USGS = U. S. Geological Survey Denver Rock Analysis Laboratory. Method = wet chemical. Analyst = E. Engleman. USNM = U. S. National Museum. Method = wet chemical. Analyst = J. Norbert. BREST = Centre Nationale Pour Exploitation des Oceans. Method = X-ray fluorescence (XRF). Analyst = Pierre Cambon. DAL = Rock analysis laboratory, Dalhousie University. Method: SiO₂ – Fast neutron activation; CO₂ = automatic lead titrator; TiO₂ and P₂O₅ – calorimetric; H₂O⁺ and H₂O⁻ – gravimetrically; FeO – modified cold acid decomposition method of Wilson. All remaining oxides done by atomic absorption spectroscopy (AAS) after dissolution with HF/HClO₄. Analyst = P. Jagam, S. Parikh, V. Murphy, and M. Fratta. USSR = Institution of Geochemistry, USSR Academy of Science. Method = wet chemical (A. I. Ponomarev. The methods of the chemical analyses of the silicate and carbonate rocks. Academy of Sciences, Moscow, 1961). Analyst = A. V. Lebedkova. URI = University of Rhode Island. Method = SiO₂, H₂O – gravimetric; TiO₂, P₂O₅; Total iron as Fe₂O₃ – colorimetric; FeO – ration; all other oxides by atomic absorption spectroscopy (AAS). Analyst = R. Evans. WOODS = Woods Hole Oceanographic Institution. Method = fusion and microprobe spectroscopy; FeO by titrimetry; H₂O and CO₂ by gas chromatography. Analyst = G. Thompson. GUNN = Universite de Montreal. Method = X-ray fluorescence (XRF). Analyst = B. Gunn. R-UB = Ruhr-Universität Bochum. Method = X-ray fluorescence (XRF); Na₂O, K₂O, MnO – atomic absorption spectroscopy (AAS); FeO – titration; H₂O – instrumental. Analysts = P. Robinson and H. Henning. CO₂ determinations by H. Puchelt, Universität Karlsruhe. IMP = Imperial College, London. Method = X-ray fluorescence (XRF); Na₂O – flame photometry; FeO – titration; H₂O – instrumental. Analysts = M. F. J. Flower and H. Henning. CO₂ determinations by H. Puchelt, Universität Karlsruhe.

^aTotal iron reported as Fe₂O₃ is average value assigned based on values given by the other laboratories.

^bCO₂ not reported. CO₂ shown is average value based on values given by the other laboratories.

^cP₂O₅ not reported.

TABLE 2
Adjusted Analyses of Interlaboratory Standards

	USGS	USNM	BREST	DAL	USSR	URI	WOODS	R-UB	IMP
Standard 1									
SiO ₂	51.57	51.16	51.26	51.32	50.72	51.44	51.88	51.83	51.31
Al ₂ O ₃	14.78	15.37	14.60	14.95	14.71	14.66	14.71	14.63	14.52
"FeO"	9.90	9.88	9.91	9.89	10.62	10.01	9.78	9.92	10.20
MgO	7.29	7.22	7.49	7.41	7.43	7.31	7.58	7.38	7.56
CaO	12.08	12.22	12.39	12.19	12.12	12.24	12.00	12.03	12.07
Na ₂ O	2.27	2.15	2.28	2.23	2.27	2.26	2.19	2.17	2.25
K ₂ O	0.32	0.28	0.34	0.32	0.35	0.34	0.33	0.32	0.31
TiO ₂	1.18	1.14	1.13	1.12	1.21	1.12	1.09	1.10	1.13
P ₂ O ₅	0.12	0.08	0.12	0.11	0.0	0.13	0.0	0.13	0.12
MnO	0.17	0.18	0.16	0.18	0.20	0.18	0.15	0.17	0.18
Total ^a	99.69	99.69	99.69	99.73	99.64	99.70	99.71	99.69	99.65

	USGS	USNM	BREST	USSR	GUNN	WOODS	R-UB	IMP
Standard 2								
SiO ₂	49.17	48.73	49.11	48.88	49.68	49.31	49.49	48.56
Al ₂ O ₃	17.98	18.31	17.75	17.78	17.11	18.22	17.43	17.94
"FeO"	6.41	6.49	6.39	6.78	6.55	6.37	6.38	6.47
MgO	9.53	9.43	9.43	9.54	9.55	9.25	9.61	9.65
CaO	14.30	14.48	14.71	14.21	14.50	14.25	14.41	14.86
Na ₂ O	1.56	1.46	1.51	1.52	1.61	1.62	1.69	1.54
K ₂ O	0.12	0.08	0.11	0.11	0.11	0.09	0.06	0.10
TiO ₂	0.57	0.60	0.57	0.65	0.56	0.54	0.55	0.55
P ₂ O ₅	0.06	0.05	0.07	0.0	0.07	0.0	0.10	0.05
MnO	0.12	0.14	0.12	0.14	0.12	0.12	0.10	0.12
Total ^a	99.81	99.78	99.77	99.72	99.77	99.79	99.81	99.84

	USGS	USNM	BREST	DAL	USSR	GUNN	URI	WOODS	R-UB	IMP
Standard 3										
SiO ₂	48.87	48.56	48.81	47.99	48.59	49.41	48.91	49.02	49.32	48.72
Al ₂ O ₃	20.35	20.66	20.35	20.66	19.93	19.56	20.02	19.76	19.92	20.16
"FeO"	5.85	5.86	5.93	6.00	6.33	5.97	6.02	6.03	5.89	6.04
MgO	7.72	7.64	7.80	7.81	7.67	7.77	7.63	8.23	7.87	7.98
CaO	14.90	15.02	14.97	15.29	14.99	15.05	15.08	14.65	14.61	14.77
Na ₂ O	1.55	1.48	1.38	1.51	1.62	1.47	1.57	1.61	1.61	1.56
K ₂ O	0.05	0.05	0.06	0.05	0.05	0.05	0.08	0.06	0.08	0.05
TiO ₂	0.41	0.43	0.42	0.41	0.50	0.41	0.42	0.40	0.40	0.42
P ₂ O ₅	0.04	0.03	0.03	0.03	0.0	0.04	0.03	0.0	0.05	0.04
MnO	0.10	0.12	0.10	0.11	0.12	0.11	0.10	0.11	0.12	0.11
Total ^a	99.86	99.85	99.85	99.88	99.81	99.85	99.86	99.87	99.87	99.85

	USGS	USNM	BREST	USSR	GUNN	URI	WOODS	R-UB	IMP
Standard 4									
SiO ₂	47.62	47.21	47.62	47.19	47.54	47.44	47.71	47.33	47.20
Al ₂ O ₃	12.82	13.23	12.26	12.50	12.28	12.52	12.56	12.34	13.11
"FeO"	9.19	9.26	9.49	9.90	9.57	9.34	9.03	9.39	9.17
MgO	18.24	18.15	18.64	18.60	18.12	18.51	18.61	18.74	18.43
CaO	9.30	9.46	9.11	8.91	9.54	9.29	9.37	9.39	9.28
Na ₂ O	1.66	1.51	1.65	1.62	1.74	1.72	1.63	1.55	1.63
K ₂ O	0.19	0.16	0.21	0.17	0.19	0.18	0.19	0.21	0.18
TiO ₂	0.47	0.49	0.50	0.51	0.48	0.50	0.46	0.48	0.49
P ₂ O ₅	0.04	0.04	0.04	0.0	0.05	0.04	0.0	0.04	0.04
MnO	0.16	0.17	0.16	0.22	0.17	0.16	0.16	0.17	0.17
Total ^a	99.70	99.68	99.68	99.63	99.69	99.71	99.72	99.67	99.69

^aThe deviation of the total from 100% reflects the conversion of Fe₂O₃ to FeO.

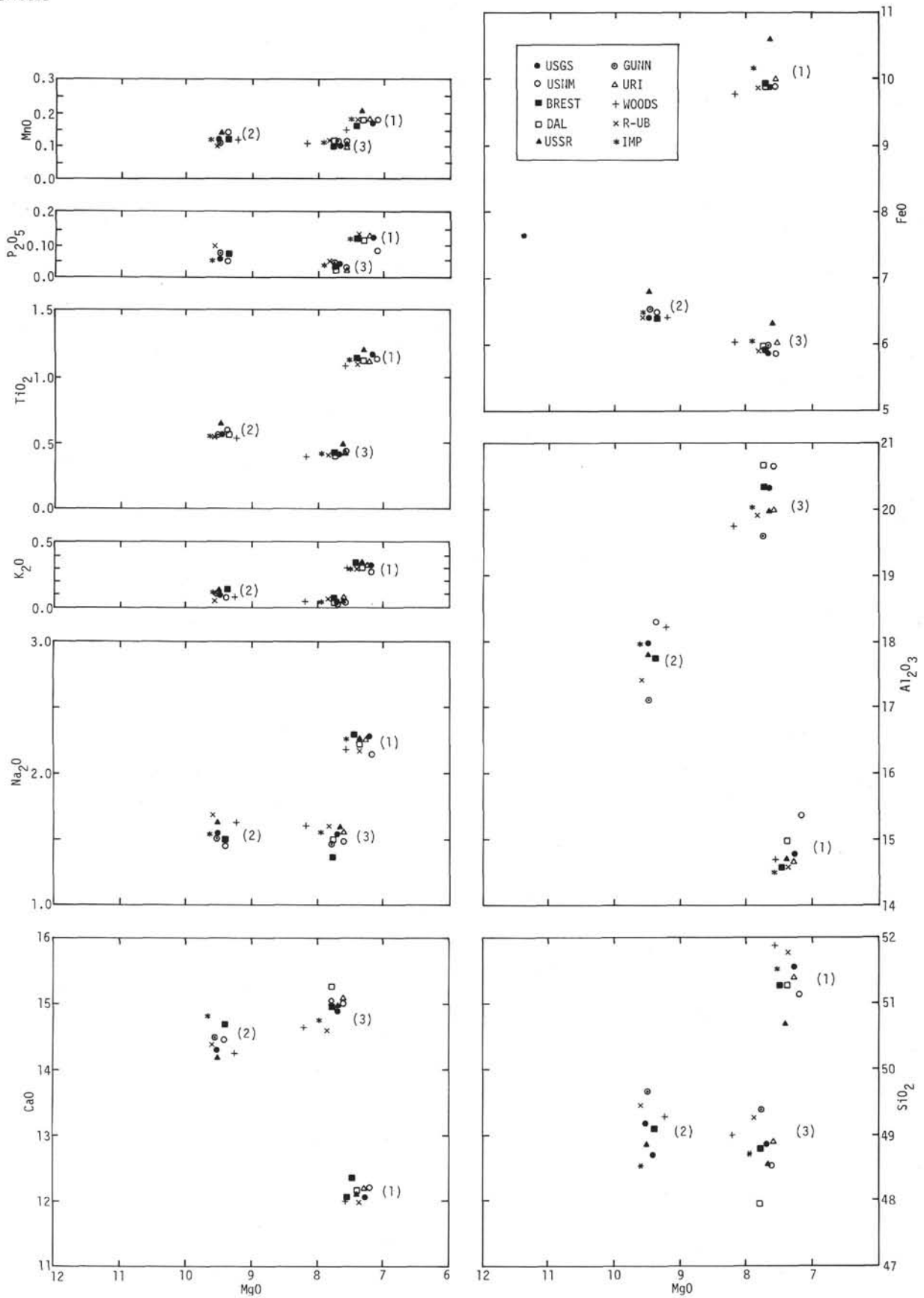


Figure 1. *MgO* variation diagrams for standard Samples 1, 2, and 3. Data are from adjusted analyses of Table 2. Laboratories coded as follows: ● USGS; ○ USNM; ■ BREST; □ DAL; ▲ USSR; ⊙ GUNN; △ URI; + WOODS; x R-UB; * IMP.