

19. INTERLABORATORY COMPARISON OF LEG 46 BASALT STANDARDS

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and
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Because a number of laboratories planned to analyze Leg 46 basalts, three samples from Hole 396B were selected for interlaboratory comparison. These are: (1) Sample 7-1, 50-57 cm, a sparsely phyric pillow basalt with olivine and plagioclase phenocrysts from chemical unit A-1, (2) Sample 15-2, 120-133 cm, a piece of sparsely phyric cooling unit in chemical unit A-3, and (3) Sample 22-3, 28-38 cm, a phyric pillow basalt with olivine and plagioclase phenocrysts from chemical unit B-2. All samples appeared in hand specimen to be among the freshest available.

All three samples were returned to the NASA-Johnson Space Center in Houston, Texas, and were powdered and homogenized there. Each investigator was then sent a 25-gram split.

Six laboratories analyzed the three samples for major elements. Tables 1, 2 and 3 present the analyses as reported. The six laboratories are Centre Océanologique de Bretagne, Brest, France (COB, Bougault et al., this volume); the Department of Earth Sciences of Kanazawa University, Kanazawa, Japan (KAN, Sato, et al., this volume); the Laboratoire de Petrologie, Université de Nancy 1, Nancy, France (UN-1, Mevel et al., this volume); the NASA-Johnson Space Center, Houston, Texas (JSC, Dungan et al., this volume); the Institut für Mineralogie, Ruhr-Universität Bochum, Bochum, Federal Republic of Germany (R-UB, Flower et al., this volume); and the Vernadsky Institute of Geochemistry Academy of Sciences of the USSR, Moscow, USSR (VIG, Dmitriev, this volume). The XRF laboratory aboard the *Glomar Challenge* did not analyze the standards, but did analyze Samples 7-1, 53-55 cm, and 15-2, 129-131 cm, which are from the same intervals as standards 1 and 2. These analyses are included in Tables 1 and 2, respectively.

To facilitate comparison of the analyses each was recalculated to a dry and reduced state and then normalized to 100 per cent. These values are presented in Tables 4, 5, and 6, along with means, standard deviations, and the standard deviation as per cent of the mean. The shipboard analyses are not included in these averages because they were not done on the homogenized standard powders.

In general, the analyses from different laboratories are in good agreement with each other. As observed by Wright (1977) for the Leg 37 standards, however, there are some small but consistent differences between laboratories. These differences are not nearly large enough to affect the overall classification of the rocks or in most cases even the relative amounts of elements. The differences are large enough, though, to cause some difficulties with very detailed work, such as identifying chemical stratigraphy within major lithologic and chemical units. For some elements the variation between laboratories for one sample is as large or larger than the total variation found by the shipboard laboratory in the chemical sub-unit from which the sample came. This is illustrated by the FeO*-MgO plot in Figure 1. Great care is needed, then, in using analyses from different laboratories for such detailed work, and it seems best to use those from one laboratory for this kind of work.

Two laboratories analyzed the samples for trace elements. These data are presented in Table 7. These laboratories are the NASA-Johnson Space Center, Houston, Texas (JSC, Dungan et al., this volume) and the Institut für Petrographie und Geochemie der Universität (T.H.) Karlsruhe, Federal Republic of Germany (KAR, Emmerman and Puchelt, this volume). The agreement between the two laboratories is excellent.

REFERENCE

- Wright, T.L., 1977. Chemical Analyses of Interlaboratory Standards, In Aumento, F., Melson, W.G., et al., *Initial Reports of the Deep Sea Drilling Project*, Volume 37: Washington (U.S. Government Printing Office), p. 367-370.

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TABLE 1
As Reported Major Element Analyses of Leg 46 Basalt Standard #1—Sample 396B-7-1, 50-57 cm

	COB	KAN	UN-I	JSC	R-UB	VIG	GC ^a		
SiO ₂	49.30	49.41	48.98	48.96	49.24	49.95	48.45	48.70	49.42
TiO ₂	1.41	1.43	1.50	1.42	1.40	1.42	1.42	1.42	1.42
Al ₂ O ₃	15.64	15.86	15.47	15.28	15.46	15.77	15.73	15.63	15.63
Fe ₂ O ₃			3.11		3.58	2.85	3.13	3.16	
Fe ₂ O ₃ ^b	10.43	10.55		10.23					10.47
FeO			6.54		5.98	6.76	6.89	6.70	
MgO	8.03	7.98	7.71	8.26	7.72	8.10	7.97	8.04	8.03
CaO	11.89	12.00	11.76	11.76	11.63	12.03	11.50	11.45	11.82
Na ₂ O	2.46	2.39	2.41	2.61	2.54	2.41	2.65	2.69	2.56
K ₂ O	0.19	0.19	0.24	0.20	0.18	0.22	0.24	0.24	0.19
MnO	0.17	0.17	0.17	(0.20)	0.16	0.17	0.17	0.17	0.19
P ₂ O ₅	0.14	0.16	0.15		0.11	0.14			0.14
S					0.06				
CO ₂						0.06			0.23
L.O.I.				0.90					
H ₂ O ⁺	0.45	0.45	1.25			0.63			0.81
H ₂ O ⁻	0.54	0.54	0.65			0.60			
H ₂ O total					1.64		1.20	1.10	

^aShipboard analysis of Sample 396B-7-1, 53-55 cm.

^bTotal Fe as Fe₂O₃.

^cDry totals, not including any H₂O or CO₂.

^dIncluding total L.O.I. or H₂O^{total}, or H₂O⁺ + H₂O⁻.

^eIncluding H₂O⁺.

TABLE 2
As Reported Major Element Analyses of Leg 46 Basalt Standard #2—Sample 396B-15-2, 120-133 cm

	COB	KAN	UN-I	JSC	R-UB	VIG	GC ^a		
SiO ₂	49.31	49.37	48.86	48.61	49.02	49.69	48.64	48.34	49.90
TiO ₂	1.64	1.64	1.75	1.61	1.61	1.62	1.60	1.64	1.63
Al ₂ O ₃	15.28	15.28	15.11	14.93	14.97	15.26	15.29	15.29	14.98
Fe ₂ O ₃			2.75		2.20	3.32	3.38	3.08	
Fe ₂ O ₃ [*]	11.30	11.21		10.88					11.20
FeO			7.26		7.68	6.92	7.24	7.35	
MgO	8.11	8.19	7.88	8.35	7.96	8.02	7.78	7.99	7.93
CaO	10.99	10.99	10.49	10.69	10.58	10.95	10.52	10.45	11.02
Na ₂ O	2.63	2.56	2.82	2.89	2.97	2.69	3.02	3.03	2.68
K ₂ O	0.13	0.13	0.18	0.13	0.12	0.14	0.18	0.18	0.14
MnO	0.16	0.16	0.16	(0.19)	0.15	0.16	0.15	0.15	0.17
P ₂ O ₅	0.14	0.15	0.18		0.13	0.15			0.17
S					0.12				
CO ₂						0.02			0.13
L.O.I.				1.59					
H ₂ O ⁺	0.80	0.80	1.49			0.79			0.90
H ₂ O ⁻	0.91	0.91	1.18						
H ₂ O ^{total}					2.35		1.88	1.73	
Total	99.69 ^b	99.68 ^b	100.11 ^c	99.87 ^c	99.87 ^c	99.73 ^d	99.68 ^c	99.23 ^c	99.81 ^b

^aShipboard analysis of Sample 396B-15-2, 129-131 cm.

^bDry totals, not including any H₂O or CO₂.

^cIncluding total L.O.I. or H₂O total or H₂O⁺ + H₂O⁻.

^dIncluding H₂O⁺.

TABLE 3
As Reported Major Element Analyses of Leg 46 Basalt Standard #3—Sample 396B-22-3, 28-38 cm

	COB		KAN	UN-I	JSC	R-UB	VIG	
SiO ₂	48.62	48.79	48.27	48.58	48.24	49.06	48.32	48.09
TiO ₂	0.98	0.97	1.65	0.96	0.96	0.96	1.00	1.00
Al ₂ O ₃	18.11	18.05	17.30	17.16	17.55	17.79	17.72	17.82
Fe ₂ O ₃			3.20		2.96	3.18	2.83	2.94
Fe ₂ O ₃ *	8.51	8.51		8.01				
FeO			4.08		4.81	4.73	5.25	5.15
MgO	8.15	8.02	7.81	8.39	7.75	8.04	8.00	8.15
CaO	12.54	12.46	11.99	12.03	12.12	12.34	11.58	11.72
Na ₂ O	2.12	2.22	2.35	2.51	2.43	2.28	2.52	2.53
K ₂ O	0.18	0.18	0.23	0.19	0.18	0.17	0.23	0.24
MnO	0.13	0.13	0.14	(0.15)	0.13	0.13	0.14	0.14
P ₂ O ₅	0.09	0.09	0.14		0.07	0.09		
S					0.02			
CO ₂						0.03		
L.O.I.				1.81				
H ₂ O ⁺	0.90	0.90	1.58			0.80		
H ₂ O ⁻	0.96	0.96	1.09					
H ₂ O ^{total}					2.19		1.81	1.78
Total	99.43 ^a	99.42 ^a	99.83 ^b	99.79 ^b	99.41 ^b	99.60 ^c	99.40 ^b	99.56 ^b

^a Dry totals, not including any H₂O or CO₂.

^b Including total L.O.I. or H₂O^{total}, or H₂O⁺ + H₂O⁻.

^c Including H₂O⁺

TABLE 4
Dry-Reduced Analyses of Leg 46 Basalt Standard #1—Sample 396B-7-1, 50-57 cm

	COB	KAN	UN-I	JSC	R-UB	VIG	\bar{x}	σ	$\sigma(\%)$	GC ^a		
SiO ₂	50.00	49.90	50.11	50.01	50.40	50.17	49.55	49.75	50.05	0.25	0.50	50.00
TiO ₂	1.43	1.44	1.53	1.45	1.43	1.43	1.45	1.48	1.46	0.04	2.60	1.44
Al ₂ O ₃	15.86	16.01	15.83	15.61	15.82	15.84	16.09	15.97	15.84	0.14	0.88	15.82
FeO*	9.51	9.60	9.56	9.41	9.41	9.37	9.93	9.75	9.52	0.17	1.8	9.54
MgO	8.14	8.06	7.89	8.44	7.92	8.14	8.15	8.21	8.11	0.20	2.5	8.13
CaO	12.05	12.12	12.03	12.01	11.90	12.08	11.76	11.70	11.97	0.14	1.1	11.96
Na ₂ O	2.49	2.41	2.47	2.67	2.60	2.42	2.71	2.75	2.56	0.13	5.0	2.59
K ₂ O	0.19	0.19	0.24	0.20	0.18	0.22	0.24	0.24	0.21	0.03	12.0	0.19
MnO	0.17	0.17	0.17	(0.20)	0.16	0.17	0.17	0.17	0.17	0.00 ₄	2.6	0.19
P ₂ O ₅	0.14	0.16	0.15		0.11	0.14			0.14	0.02	14.0	0.14
S					0.06							
Total	99.98	100.06	99.98	100.00	99.99	99.98	100.05	100.02				100.00

^aShipboard analysis of Sample 396B-7-1, 53-55 cm.

TABLE 5
Dry-Reduced Analyses of Leg 46 Basalt Standard #2—Sample 396B-15-2, 120-133 cm

	COB		KAN	UN-I	JSC	R-UB	VIG		\bar{x}	σ	$\sigma(\%)$	GC ^a
SiO ₂	50.03	50.09	50.29	50.02	50.38	50.40	49.91	49.74	50.16	0.23	0.45	50.56
TiO ₂	1.66	1.66	1.80	1.66	1.70	1.64	1.64	1.69	1.69	0.06	3.4	1.65
Al ₂ O ₃	15.50	15.50	15.55	15.36	15.39	15.48	15.69	15.73	15.50	0.12	0.81	15.18
FeO*	10.31	10.24	10.02	10.07	9.93	10.05	10.55	10.41	10.14	0.20	2.0	10.21
MgO	8.22	8.30	8.11	8.59	8.18	8.13	7.98	8.22	8.23	0.19	2.3	8.04
CaO	11.15	11.15	10.80	11.00	10.82	11.11	10.79	10.75	10.94	0.17	1.5	11.16
Na ₂ O	2.67	2.60	2.92	2.97	3.05	2.73	3.10	3.12	2.90	0.19	6.4	2.72
K ₂ O	0.13	0.13	0.18	0.13	0.12	0.14	0.18	0.18	0.15	0.03	17.0	0.14
MnO	0.16	0.16	0.16	(0.19)	0.15	0.16	0.15	0.15	0.16	0.00 ₅	3.4	0.17
P ₂ O ₅	0.14	0.15	0.18		0.13	0.15			0.15	0.02	14.0	0.17
S					0.12							
Total	99.97	99.98	100.00	99.99	99.97	99.99	99.99	99.99				100.00

^a Shipboard analysis of Sample 396B-15-2, 129-131 cm

TABLE 6
Dry-Reduced Analyses of Leg 46 Basalt Standard #3—Sample 396B-22-3, 28-38 cm

	COB		KAN	UN-I	JSC	R-UB	VIG		\bar{x}	σ	$\sigma(\%)$
SiO ₂	49.31	49.49	49.84	49.99	49.77	49.84	49.65	49.33	49.72	0.23	0.46
TiO ₂	0.99	0.98	1.70 ¹	0.99	0.99	0.97	1.03	1.03	1.11	0.29	26.0
Al ₂ O ₃	18.37	18.31	17.86	17.66	18.10	18.07	18.21	18.28	18.05	0.25	1.4
FeO*	7.77	7.77	7.19	7.42	7.70	7.71	8.01	8.00	7.72	0.21	2.7
MgO	8.27	8.14	8.06	8.63	8.00	8.16	8.22	8.35	8.23	0.25	3.0
CaO	12.72	12.64	12.38	12.38	12.50	12.53	11.90	12.02	12.40	0.24	2.0
Na ₂ O	2.15	2.25	2.43	2.58	2.51	2.32	2.59	2.59	2.44	0.15	6.3
K ₂ O	0.18	0.18	0.23	0.19	0.18	0.17	0.23	0.24	0.20	0.03	13.3
MnO	0.13	0.13	0.14	(0.15)	0.13	0.13	0.14	0.14	0.13	0.00 ₅	4.2
P ₂ O ₅	0.09	0.09	0.14		0.07	0.09			0.10	0.03	30.0
S					0.02						
Total	99.98	99.98	99.97	99.99	99.97	99.99	99.98	99.98			

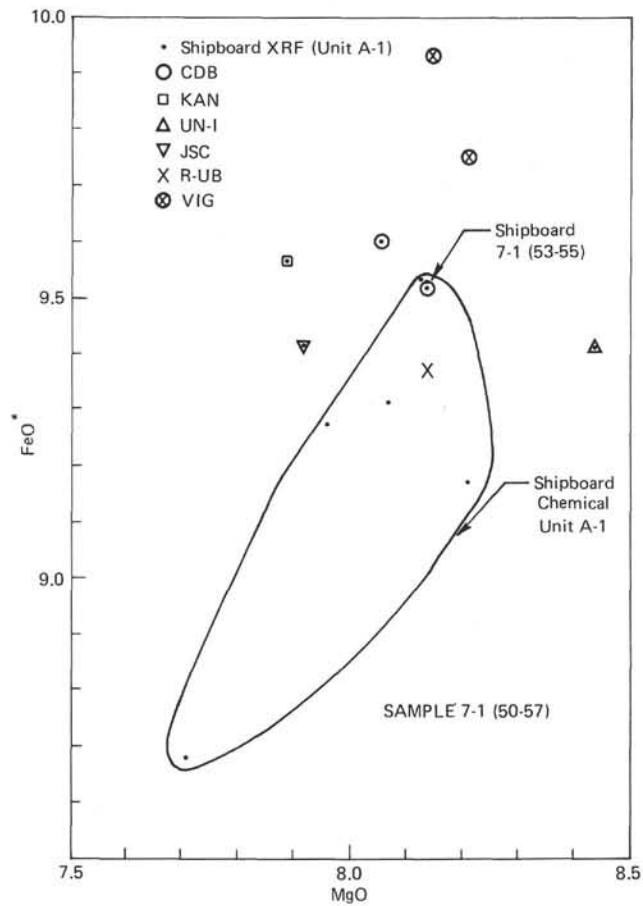


Figure 1. Normalized FeO^* versus MgO for the inter-laboratory standard, 7-1, 50-57 cm, along with the shipboard analyses of chemical unit A-1 to which that sample belongs.

TABLE 7
Trace Element Concentrations in DSDP Leg 46
Basalt Standards (ppm)

	7-1, 50-57 cm		15-2, 120-133 cm		22-3, 28-38 cm	
	JSC	KAR	JSC	KAR	JSC	KAR
Li		11		7		13
F		181		164		150
Sc	38.2	38.5	38.6	39.7	31.7	31.8
V		244		193		156
Cr	340	343	300	301	370	396
Ni	150	158	130	133	110	120
Zn		56		66		50
Sr		125		143		110
La	2.88	2.6	3.65	4.0	1.89	2.4
Ce	10.0	9.5	12.5	11.6	6.4	6.7
Nd		7.8		11.9		7.4
Sm	3.25	3.4	3.96	4.1	2.33	2.4
Eu	1.18	1.15	1.41	1.39	0.89	0.83
Tb	0.84	0.87	1.0	0.96	0.60	0.60
Dy		5.5		6.7		3.5
Yb	3.2	2.8	3.8	3.2	2.2	2.2
Lu	0.49	0.50	0.55	0.57	0.36	0.38
Hf	2.4	2.5	3.1	2.9	1.6	1.5