

39. DATA REPORT: MAJOR-ELEMENT CHEMISTRY OF HOLE 896A GLASS¹

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INTRODUCTION

Ocean Drilling Program Hole 896A (1°13.01'N, 83°43.39'W) is in 3440 m of water east of the Galapagos Platform in the equatorial eastern Pacific Ocean. At this site in 5.9 Ma crust, basement rocks were recovered over the depth range of 195.1 meters below seafloor (mbsf) to 469 mbsf. These rocks are mostly pillow lavas, but massive flows, breccias and dikes are also present. Many of the lavas and flows have quenched glass on their exteriors, and breccias commonly contain glass. Glass was analyzed by electron microprobe in six laboratories as part of shore-based studies of the rocks. These analyses are collected here so that all the chemical analyses are available in one publication. The analyses are interpreted in individual publications elsewhere in this volume.

METHODS

Analyses by Fisk were done on a 4-spectrometer CAMECA SX-50 at Oregon State University (except for Sample 148-896A-12R-1, 52–55 cm, which was analyzed with the nine-spectrometer ARL microprobe at the Smithsonian Institution). The CAMECA SX-50 analyses were conducted with an accelerating voltage of 15 kV, a beam current of 30 nA, and a beam diameter of 10 μm . The standards were basalt glass A-99 (Jarosewich et al., 1980) for Si, Ti, Al, Fe, and Ca. Mineral standards for the elements Mg, Na, K, Mn, P, and Cr were Kakanui augite, Kakanui anorthoclase, Hohenfels sanidine, pyroxmangite, Durango fluorapatite, and Tiabaghi chromite, respectively. Counting times for all elements were 10 s, except for aluminum and titanium, which were counted for 20 s. Backgrounds were counted above and below the peaks for half of the peak counting time and background offsets were ± 500 to ± 700 units except for Mg, which was ± 1300 units to avoid interference from a higher order Ca peak. Na was always analyzed first. The PAP correction procedure supplied by Cameca was used to calculate the weight percentage of oxides from X-ray counts. Analyses of Sample 148-896A-12R-1, 52–55 cm, with the ARL microprobe used a beam current of 150 nA and an accelerating voltage of 15 kV. Standard glass A-99 was used to monitor the standardization during the analysis of Site 896 glass, and the averages and standard deviations of these analyses are given in Table 1.

Analyses by Teagle were made with a 4-spectrometer CAMECA Camebax microprobe at the University of Michigan. The accelerating voltage was 15 kV and the beam current was 10 nA. The beam was rastered over a $3 \times 3 \mu\text{m}$ area, and the counting time for all elements was 30 s. Background offsets were ± 600 units, except for magnesium, which was ± 750 units. Smithsonian glass standard VG-2 (Jarosewich et al., 1980) was used to calibrate silicon and aluminum. The other elements were standardized on minerals as follows: K and Na on feldspars, Ca on wollastonite, Mg on a magnesium-rich garnet, Fe on synthetic ferrosilicate, Ti on geikilite, Mn on a manganese oxide, Cr on a chrome-rich garnet, and P on a phosphate. The PAP correction procedure supplied by Cameca was used to calculate oxide weight percentages from X-ray intensities. Average analyses and standard deviations of standard glasses VG-2 and VGBS are given in Table 1.

Analyses by McNeill were done on a CAMECA SX-50 microprobe at the University of Tasmania. The accelerating voltage was 15 kV and the beam current was 20 nA. For analysis the beam was scanned over a $6 \times 4 \mu\text{m}$ area. Counting times on peaks were 20 s for Fe and K, and 10 s for the other elements. Backgrounds were counted for half of the peak-count time. Standards were: VG-2 for Si, Al, Mg, and Ca; Kakanui anorthoclase for Na; Durango apatite for P; microcline (USNM 143966) for K; Ilmen Mt. ilmenite for Ti; and Tiabaghi chromite (USNM 117075) for chrome. The PAP correction procedure supplied by Cameca was used to convert intensities into oxide weight percent. Analyses of the standard VG-2 are given in Table 1.

Analyses by Furnes were done on a CAMECA Camebax microprobe using a 15 kV accelerating voltage, a 5 nA beam current, and a 1 μm beam diameter. Peaks were counted for 10 s and the backgrounds for 5 s. The standards used were wollastonite for Si and Ca, MnTi alloy for Mn and Ti, Al_2O_3 for Al, FeO for Fe, MgO for Mg, omphacite for Na, and orthoclase for K. The correction procedure was MAGIC IV (Colby, 1968).

Analyses by Bach were done on a CAMECA SX-50 microprobe using 15 kV accelerating voltage, a 20 nA beam current, and a beam diameter of 20 μm . Peak intensities were counted for 20 s, except for K and P, for which 40 s count-times were used. Backgrounds were counted for half of the peak count-times and the correction procedure was the PAP program supplied by CAMECA. The pure mineral standards were used as follows: wollastonite for Si and Ca, MnTiO₃ for Ti and Mn, Al_2O_3 for Al, Fe_2O_3 for Fe, MgO for Mg, albite for Na, orthoclase for K, CePO_4 for P, and ZnS for S.

RESULTS

Average oxide abundances for glass from basalts from the five laboratories are presented in Figure 1 and Table 2. The data are arranged in order of increasing depth and "N" indicates the number of analyses in each average. Absence of P_2O_5 and Cr_2O_3 for some analyses indicates that these elements were not analyzed.

Interlaboratory comparisons of identical samples indicate that there are consistent differences for some of the elements (Fig. 2). For example, SiO_2 values are consistently higher in the University of

¹Alt, J.C., Kinoshita, H., Stokking, L.B., and Michael, P.J. (Eds.), 1996. *Proc. ODP, Sci. Results*, 148: College Station, TX (Ocean Drilling Program).

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Table 1. Analysis of standards.

Standard (analyst)	N	SiO ₂	TiO ₂	Al ₂ O ₃	FeO*	MgO	CaO	Na ₂ O	K ₂ O	MnO	P ₂ O ₅	Cr ₂ O ₃	Total
VG-2 published (Jarosewich et al., 1980)		50.81	1.85	14.06	11.84	6.71	11.12	2.62	0.19	0.22	0.20		99.62
VG-2 average (Teagle)	25	51.18	1.83	14.02	11.66	6.67	10.83	2.62	0.20	0.22	0.18	0.02	99.42
	1s	0.59	0.04	0.08	0.17	0.08	0.08	0.06	0.01	0.03	0.02	0.02	
VG-2 average (McNeill)	9	50.36	1.85	14.23	11.98	6.78	10.89	2.50	0.20	0.18	0.22		99.19
	1s	0.18	0.01	0.08	0.30	0.07	0.06	0.01	.001	0.01	0.06		
VGBS published (Jarosewich et al., 1980)		51.52	1.30	15.39	9.13	8.21	11.31	2.48	0.09	0.17	0.12		99.72
VGBS average (Teagle)	19	52.14	1.30	15.37	9.20	7.86	11.10	2.65	0.08	0.16	0.10	0.03	99.99
	1s	0.41	0.04	0.11	0.15	0.07	0.10	0.05	0.01	0.03	0.02	0.02	
A-99 published (Jarosewich et al., 1980)		50.94	4.06	12.49	13.30	5.08	9.30	2.66	0.82	0.15	0.38		99.19
A-99 average (Fisk session 1)	14	50.70	4.05	12.58	13.32	5.02	9.30	2.63	0.84	0.19	0.45	0.01	99.09
	1s	0.16	0.05	0.06	0.15	0.08	0.13	0.08	0.02	0.03	0.05	0.01	
A-99 average (Fisk session 2)	15	50.98	4.04	12.39	13.15	5.06	9.12	2.65	0.84	0.18	0.45	0.02	98.90
	1s	0.17	0.08	0.08	0.14	0.05	0.31	0.06	0.02	0.04	0.04	0.02	
A-99 average (Fisk session 3)	16	50.83	4.01	12.43	13.28	5.11	9.27	2.66	0.84	0.19	0.45	0.02	99.10
	1s	0.26	0.11	0.09	0.19	0.06	0.13	0.06	0.02	0.03	0.04	0.02	

Notes: N = number of analyses in average. FeO* = all iron as FeO.

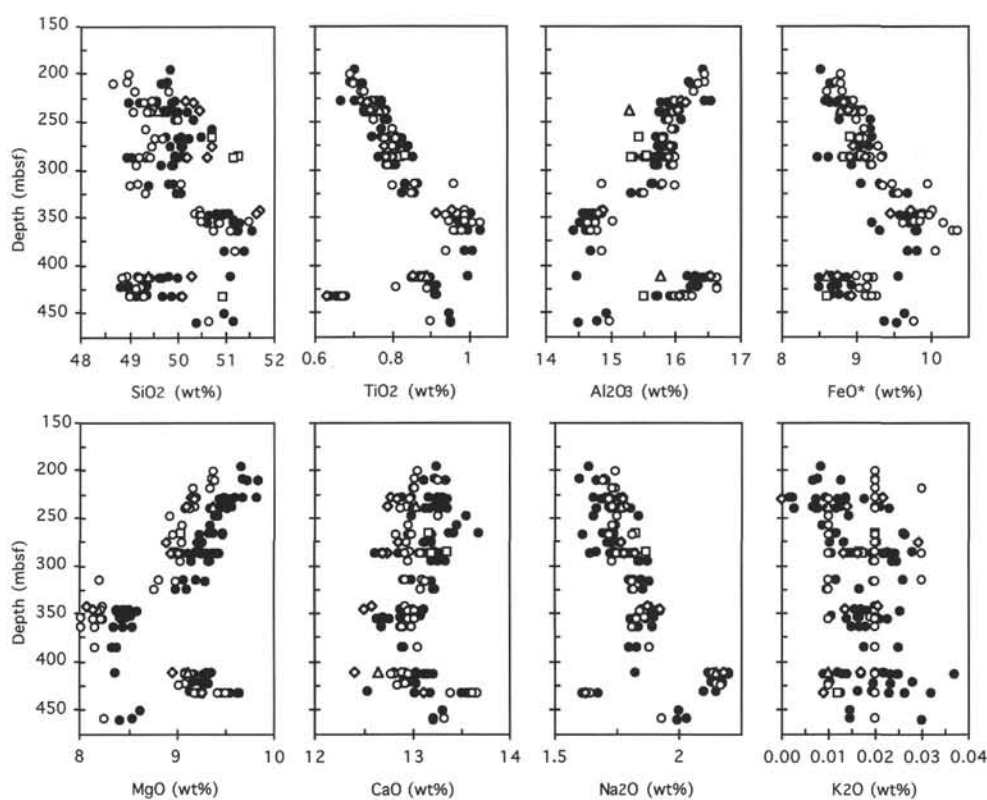


Figure 1. Glass chemistry analyses from Hole 896A by five laboratories plotted vs. depth. Solid circles = Fisk, open circles = McNeill, diamonds = Teagle, squares = Furnes, and triangles = Bach.

Michigan analyses (Teagle) than in those of Oregon State University (Fisk), and MgO and CaO values of Teagle are consistently lower than those of Fisk. The MgO measured using the microprobe at Oregon State University is consistently 0.25 wt% higher than the MgO from the other laboratories.

This difference is not related to differences in instruments, to correction procedure, or to accelerating voltage because all laboratories used Cameca instruments, 15 kV accelerating voltages, and PAP correction procedures. Differences between laboratories, however, may be related to the standards used, the beam conditions (beam current, and beam diameter), and counting strategies (background offsets, counting times, and rastered vs. stationary beam). Because of the

number of variables, it is not possible to determine which of these resulted in the differences in Si, Mg, and Ca in the three laboratories with the most data. One factor that may contribute to the differences of MgO by the different laboratories is the position of the background offset for Mg. Oregon State University analyses used a larger background offset for Mg than the other laboratories which may have resulted in lower Mg background intensities, and thus larger peak-minus-background values.

The average of 25 MgO analyses of VG-2 by Teagle (Table 1) is within 1 σ of the reported value (Jarosewich et al., 1980), but the 19 analyses for VGBS by Teagle have an average MgO that is 0.35 wt% (this is 5 σ) below the reported value (Jarosewich et al., 1980). It is

Table 2. Microprobe analyses of Hole 896A glass.

Core, section, interval (cm)	Piece no.	Depth (mbsf)	Analyst	N	SiO ₂	TiO ₂	Al ₂ O ₃	FeO*	MgO	CaO	Na ₂ O	K ₂ O	MnO	P ₂ O ₅	Cr ₂ O ₃	Total
148-896A-																
1R-1, 36-40	8	195.46	Fisk	3	49.85	0.70	16.42	8.52	9.66	13.25	1.64	0.01	0.14	0.03	0.07	100.29
2R-1, 63-66	14	201.53	McNeill	4	48.99	0.69	16.46	8.78	9.37	13.06	1.74	0.02	0.16	0.04	0.07	99.38
3R-1, 15-25	4	210.05	Fisk	2	49.77	0.69	16.20	8.72	9.68	13.24	1.60	0.01	0.13	0.02	0.05	100.11
3R-1, 16-18	4	210.06	McNeill	4	48.94	0.70	16.45	8.73	9.36	13.02	1.70	0.02	0.12	0.04	0.07	99.15
3R-1, 26-31	5	210.16	Fisk	3	49.70	0.72	16.23	8.69	9.84	13.34	1.67	0.01	0.11	0.02	0.07	100.41
3R-1, 34-41	7	210.24	Fisk	3	49.67	0.72	16.22	8.65	9.72	13.11	1.71	0.01	0.14	0.04	0.04	100.04
3R-1, 55-57	7	210.45	McNeill	4	48.65	0.70	16.35	8.78	9.39	13.26	1.69	0.02	0.12	0.05	0.08	99.09
4R-1, 10-13	2	219.00	McNeill	4	49.11	0.72	16.27	8.80	9.35	13.00	1.74	0.03	0.15	0.04	0.05	99.26
4R-1, 75-80	9C	219.65	McNeill	4	49.83	0.73	16.27	8.59	9.17	13.03	1.73	0.02	0.15	0.05	0.04	99.61
5R-1, 18-21	5	228.58	Fisk	3	49.96	0.67	16.45	8.62	9.83	13.31	1.70	0.00	0.13	0.04	0.04	100.75
5R-1, 58-64	10	228.98	Fisk	3	49.56	0.70	16.55	8.58	9.59	13.16	1.66	0.01	0.13	0.03	0.08	100.04
5R-1, 79-82	14	229.19	Fisk	1	49.34	0.77	15.82	9.18	9.63	13.05	1.88	0.03	0.13	0.08	0.07	99.98
5R-2, 32-34	1C	229.64	Fisk	3	49.96	0.76	15.99	8.76	9.49	12.90	1.72	0.00	0.14	0.03	0.07	99.81
5R-2, 33-35	ID	229.65	McNeill	4	49.46	0.75	16.00	8.95	9.20	12.99	1.76	0.02	0.14	0.04	0.08	99.39
5R-2, 33-35	ID	229.65	Fisk	3	49.57	0.77	15.97	8.87	9.69	13.26	1.76	0.01	0.14	0.06	0.06	100.17
5R-2, 35-36	1E	229.67	Teagle	22	50.17	0.72	16.09	8.82	9.14	12.79	1.77	0.02	0.17	0.06	0.07	99.80
5R-2, 85-89	4	230.17	Fisk	6	49.55	0.77	16.06	8.87	9.54	13.33	1.70	0.01	0.14	0.06	0.05	100.09
5R-2, 89-93	5	230.21	Fisk	4	49.90	0.74	15.93	8.81	9.57	13.36	1.78	0.01	0.14	0.05	0.10	100.38
5R-2, 89-93	5	230.21	McNeill	4	49.29	0.74	16.09	8.87	9.16	12.97	1.72	0.01	0.13	0.05	0.05	99.08
5R-2, 93-97	6	230.25	Fisk	3	49.22	0.77	15.88	8.73	9.43	13.23	1.69	0.01	0.14	0.07	0.06	99.22
5R-2, 97-100	7	230.29	Fisk	4	48.98	0.74	15.76	8.64	9.43	13.25	1.73	0.02	0.13	0.04	0.06	98.79
5R-2, 97-100	7	230.29	Teagle	4	50.35	0.74	16.16	8.83	9.19	12.84	1.77	0.00	0.22	0.07	0.06	100.23
6R-1, 60-64	7	238.50	Fisk	3	49.79	0.73	15.91	8.83	9.56	13.31	1.76	0.01	0.15	0.04	0.05	100.14
6R-1, 70-72	8	238.60	Fisk	3	49.91	0.79	15.91	8.98	9.57	13.28	1.77	0.01	0.13	0.06	0.05	100.45
6R-1, 70-72	8B	238.60	Bach	12	49.60	0.77	15.30	8.79	9.38	13.04	1.77	0.01	0.17	0.06		99.00
6R-1, 79-81	9A	238.69	McNeill	4	49.41	0.76	16.02	9.07	9.19	12.94	1.73	0.02	0.16	0.04	0.06	99.40
6R-1, 81-82	10	238.71	Fisk	3	49.73	0.77	15.92	8.98	9.48	13.28	1.71	0.02	0.15	0.05	0.06	100.15
6R-1, 138-140	ID	239.28	Teagle	27	50.45	0.74	16.05	8.90	9.11	12.75	1.79	0.01	0.16	0.05	0.06	100.07
6R-1, 139-141	ID	239.29	Fisk	3	49.85	0.78	16.06	8.99	9.51	13.23	1.77	0.01	0.12	0.06	0.08	100.45
6R-2, 18-21	2	239.56	McNeill	4	49.44	0.78	16.03	9.02	9.13	12.87	1.77	0.02	0.15	0.05	0.05	99.31
6R-2, 18-21	2	239.56	Fisk	3	49.70	0.74	15.89	8.89	9.52	13.28	1.78	0.00	0.13	0.03	0.03	99.98
6R-2, 21-28	3	239.59	Fisk	3	49.79	0.73	15.99	8.91	9.40	13.30	1.76	0.01	0.15	0.07	0.07	100.17
6R-2, 28-38	4	239.66	Fisk	2	49.70	0.78	15.93	8.78	9.44	13.30	1.81	0.01	0.13	0.03	0.03	99.94
6R-2, 39-45	5	239.77	McNeill	4	49.08	0.77	15.96	9.07	9.13	13.00	1.76	0.02	0.12	0.03	0.09	99.03
6R-2, 39-45	5	239.77	Fisk	6	49.96	0.78	15.74	8.93	9.38	13.18	1.74	0.02	0.17	0.04	0.06	100.00
6R-3, 0-5	1	240.78	McNeill	4	49.36	0.74	16.05	8.96	9.09	13.03	1.76	0.01	0.14	0.04	0.07	99.25
6R-3, 0-3	1	240.78	Fisk	3	50.03	0.73	15.78	8.90	9.44	13.13	1.72	0.01	0.15	0.04	0.06	99.99
6R-3, 30-34	4	241.08	Fisk	3	50.20	0.76	15.76	8.90	9.34	13.36	1.67	0.01	0.13	0.06	0.06	100.25
7R-1, 52-55	10	247.92	McNeill	4	50.00	0.75	15.90	8.99	8.92	13.27	1.75	0.01	0.15	0.03	0.07	99.84
7R-1, 52-55	10	247.92	Fisk	2	49.94	0.79	15.86	8.78	9.43	13.00	1.84	0.01	0.12	0.03	0.00	99.78
7R-1, 132-141	22	248.72	Fisk	3	50.33	0.78	16.09	9.18	9.39	13.54	1.66	0.01	0.12	0.03	0.06	101.20
8R-1, 141-149	29	258.51	McNeill	4	49.34	0.80	15.95	9.11	9.06	12.95	1.73	0.01	0.15	0.04	0.06	99.20
8R-1, 141-145	29	258.51	Fisk	6	50.71	0.77	16.00	9.19	9.35	13.46	1.74	0.01	0.15	0.05	0.05	101.48
9R-1, 0-4	1	266.70	Fisk	3	50.51	0.77	15.80	9.21	9.33	13.43	1.70	0.01	0.16	0.02	0.07	101.01
9R-1, 8-11	3	266.78	Fisk	3	49.74	0.75	15.70	8.93	9.38	13.38	1.71	0.01	0.14	0.04	0.05	99.82
9R-1, 17-21	6	266.87	Fisk	3	50.08	0.79	15.82	9.06	9.48	13.69	1.73	0.03	0.15	0.05	0.03	100.91
9R-1, 17-21	6	266.87	Furnes	9	50.70	0.80	15.44	8.92	9.03	13.17	1.83	0.02	0.17			100.08
9R-1, 78-81	13	267.48	McNeill	4	49.54	0.78	15.79	9.11	8.95	12.99	1.81	0.02	0.17	0.04	0.06	99.26
9R-1, 87-92	15	267.57	Fisk	3	50.24	0.82	15.82	9.03	9.47	12.96	1.61	0.01	0.12	0.04	0.10	100.23
9R-1, 125-130	24	267.95	McNeill	4	49.68	0.81	15.79	9.03	8.96	12.83	1.72	0.01	0.14	0.05	0.07	99.09
9R-1, 125-130	24	267.95	Fisk	3	50.00	0.82	15.76	8.98	9.23	13.20	1.74	0.03	0.13	0.05	0.05	99.97
10R-1, 22-23	3	276.62	Fisk	3	50.11	0.84	15.85	9.17	9.25	13.13	1.72	0.01	0.12	0.06	0.09	100.35
10R-1, 24-27	4	276.64	Teagle	12	50.73	0.78	15.92	8.95	8.90	12.86	1.77	0.03	0.17	0.10	0.06	100.26
10R-1, 28-32	4	276.68	Fisk	3	49.86	0.84	15.80	9.04	9.27	13.12	1.73	0.02	0.13	0.04	0.08	99.92
10R-1, 50-57	7	276.90	McNeill	4	49.48	0.80	15.97	9.28	9.05	12.94	1.76	0.02	0.15	0.04	0.07	99.56
10R-1, 50-57	7	276.90	Fisk	3	50.08	0.81	15.73	9.16	9.22	13.20	1.71	0.01	0.11	0.05	0.03	100.13
11R-1, 0-3	1	286.00	McNeill	4	49.38	0.78	15.96	9.36	8.97	12.97	1.74	0.02	0.13	0.06	0.06	99.43
11R-1, 0-3	1	286.00	Fisk	3	49.95	0.80	15.75	9.08	9.20	13.23	1.73	0.03	0.13	0.05	0.04	99.99
11R-1, 8-10	3	286.08	Fisk	3	50.10	0.81	15.78	9.03	9.25	13.21	1.67	0.02	0.11	0.05	0.05	100.09
11R-1, 73-75	8A	286.73	Furnes	9	51.28	0.83	15.56	9.05	8.97	13.36	1.87	0.02	0.17			101.12
11R-1, 106-108	9	287.06	Fisk	4	49.98	0.83	15.65	9.11	9.30	13.20	1.72	0.02	0.13	0.03	0.07	100.03
11R-1, 109-110	10	287.09	Fisk	4	50.01	0.81	15.70	9.00	9.32	13.08	1.75	0.02	0.13	0.04	0.04	99.90
11R-1, 111-113	10	287.11	Furnes	7	51.16	0.81	15.31	8.84	9.01	13.20	1.82	0.02	0.19			100.35
11R-1, 132-136	12	287.32	Fisk	3	50.03	0.81	15.78	9.12	9.24	13.27	1.64	0.02	0.11	0.06	0.07	100.14
11R-1, 140-143	14	287.40	Fisk	4	50.00	0.79	15.74	9.04	9.26	13.07	1.73	0.02	0.12	0.07	0.04	99.89
11R-2, 20-22	IC	287.64	Fisk	5	49.99	0.81	15.70	9.06	9.40	13.26	1.79	0.01	0.14	0.05	0.06	100.27
11R-2, 24-30	2	287.68	Fisk	5	50.17	0.85	15.51	9.16	9.44	13.29	1.73	0.02	0.15	0.04	0.06	100.42
11R-2, 28-37	1B	287.72	Teagle	9	50.22	0.80	15.89	9.12	8.95	12.75	1.82	0.01	0.21	0.06	0.08	99.91
11R-2, 30-40	3	287.74	McNeill	4	49.21	0.78	15.88	9.19	9.00	13.08	1.77	0.01	0.15	0.03	0.07	99.17
11R-2, 40-43	4	287.84	Teagle	55	50.62	0.78	15.90	8.91	9.02	12.70	1.78	0.02	0.16	0.06	0.05	99.99
11R-2, 40-43	4	287.84	Fisk	3	49.05	0.78	15.55	8.46	9.25	12.69	1.76	0.01	0.14	0.05	0.04	97.78
11R-2, 60-63	7	288.04	Fisk	3	49.96	0.78	15.82	8.81	9.37	13.11	1.75	0.01	0.14	0.06	0.06	99.87
11R-2, 63-72	8	288.07	McNeill	4	49.42	0.80	15.99	9.34	9.05	12.93	1.75	0.03	0.10	0.04	0.07	99.52
11R-2, 63-70	8	288.07	Fisk	3	49.42	0.79	15.56	8.63	9.36	12.63	1.78	0				

Table 2 (continued).

Core, section, interval (cm)	Piece no.	Depth (mbsf)	Analyst	N	SiO ₂	TiO ₂	Al ₂ O ₃	FeO*	MgO	CaO	Na ₂ O	K ₂ O	MnO	P ₂ O ₅	Cr ₂ O ₃	Total
15R-2, 1-5	1A	325.70	Fisk	3	49.99	0.83	15.46	9.50	9.11	13.22	1.86	0.02	0.15	0.07	0.08	100.28
17R-1, 55-59	6A	344.05	McNeill	4	50.45	0.99	14.85	10.03	8.23	12.93	1.88	0.02	0.10	0.05	0.07	99.60
17R-1, 55-59	6A	344.05	Teagle	32	51.72	0.95	14.88	9.73	8.07	12.59	1.88	0.02	0.16	0.07	0.06	100.14
17R-1, 91-92	8	345.91	Fisk	3	50.94	0.96	14.62	9.71	8.44	12.96	1.92	0.02	0.23	0.06	0.09	99.94
17R-2, 95-100	8	345.95	Teagle	9	51.64	0.92	14.82	9.46	8.13	12.50	1.92	0.01	0.18	0.06	0.04	99.69
17R-3, 13-15	1	346.57	Fisk	3	50.82	0.95	14.56	9.78	8.39	13.00	1.88	0.02	0.18	0.08	0.09	99.74
17R-3, 14-16	1	346.58	McNeill	4	50.35	0.97	14.85	9.89	8.22	13.00	1.87	0.02	0.16	0.03	0.04	99.40
17R-3, 15-20	2	346.59	Fisk	3	51.09	0.97	14.73	9.99	8.46	13.11	1.85	0.02	0.19	0.03	0.06	100.50
17R-3, 83-85	8	347.27	Fisk	3	51.04	1.00	14.68	9.87	8.51	12.88	1.92	0.01	0.17	0.08	0.06	100.21
17R-3, 107-115	13	347.51	Fisk	2	50.93	0.96	14.69	9.87	8.38	12.98	1.90	0.02	0.17	0.05	0.06	99.99
17R-3, 108-110	13	347.52	McNeill	4	50.47	0.99	14.75	9.99	8.18	12.95	1.86	0.02	0.11	0.06	0.07	99.45
17R-3, 115-118	14	347.59	Fisk	3	50.84	0.95	14.69	9.70	8.44	13.10	1.88	0.02	0.18	0.07	0.07	99.93
17R-4, 65-70	4B	348.55	Fisk	3	50.66	0.99	14.64	9.59	8.43	12.98	1.89	0.02	0.13	0.06	0.05	99.44
17R-4, 68-70	4B	348.58	McNeill	4	50.49	0.94	14.78	9.88	8.19	13.02	1.84	0.02	0.14	0.07	0.07	99.44
17R-4, 70-76	5	348.60	Fisk	3	50.83	0.99	14.68	9.77	8.59	13.08	1.93	0.03	0.15	0.04	0.04	100.11
18R-1, 63-70	6	353.73	Fisk	3	51.17	0.97	14.76	9.85	8.53	13.08	1.88	0.01	0.13	0.08	0.08	100.53
18R-1, 87-90	9A	353.97	Fisk	3	50.86	0.95	14.76	9.80	8.40	12.70	1.84	0.02	0.12	0.05	0.06	99.55
18R-1, 92-94	9A	354.02	McNeill	4	50.50	0.95	15.02	9.77	8.21	12.99	1.86	0.02	0.15	0.05	0.07	99.59
18R-1, 93-96	9B	354.03	Fisk	4	51.18	0.97	14.73	9.85	8.47	12.88	1.90	0.02	0.15	0.04	0.07	100.25
18R-2, 35-38	5	354.90	Fisk	2	47.69	0.26	18.59	11.09	12.70	0.68	1.56	0.18	0.19	0.10	0.07	93.12
18R-2, 60-68	10	355.10	McNeill	4	51.50	0.99	14.64	9.86	8.01	13.04	1.83	0.02	0.14	0.04	0.06	100.12
19R-1, 4-7	1	356.04	Fisk	3	50.64	0.99	14.66	9.20	8.15	12.63	1.80	0.01	0.15	0.03	0.04	98.31
19R-1, 8-11	2	356.08	McNeill	4	50.84	1.01	14.65	9.63	8.14	12.95	1.83	0.02	0.14	0.06	0.07	99.34
19R-1, 68-74	12	356.68	Fisk	3	51.16	0.98	14.52	9.70	8.23	12.77	1.87	0.02	0.15	0.05	0.05	99.50
19R-1, 115-116	19	357.15	Fisk	4	51.29	1.01	14.54	9.78	8.43	12.71	1.83	0.02	0.13	0.05	0.04	99.83
19R-1, 115-116	19	357.15	McNeill	4	50.87	1.03	14.57	10.16	8.22	13.02	1.83	0.01	0.11	0.06	0.07	100.13
20R-1, 37-40	9	363.87	McNeill	4	51.10	0.98	14.79	10.29	8.16	12.99	1.82	0.02	0.14	0.05	0.06	100.40
20R-1, 43-48	11	363.93	Fisk	3	51.54	1.03	14.62	9.82	8.35	12.69	1.84	0.02	0.15	0.09	0.05	100.21
20R-1, 48-52	12	363.98	Fisk	3	51.22	0.97	14.42	9.32	8.53	12.91	1.89	0.02	0.13	0.05	0.06	99.51
20R-1, 48-52	12	363.98	McNeill	4	50.76	0.96	14.68	10.36	8.01	12.89	1.81	0.02	0.15	0.03	0.06	99.73
20R-1, 63-64	14	364.13	Fisk	3	51.25	1.00	14.65	9.79	8.44	12.87	1.84	0.02	0.14	0.04	0.04	100.06
22R-2, 124-125	1B	385.33	Fisk	3	51.38	0.99	14.69	9.81	8.33	12.90	1.83	0.02	0.13	0.07	0.05	100.21
22R-2, 124-127	17	385.33	McNeill	4	51.20	0.94	14.87	10.06	8.16	13.05	1.88	0.02	0.13	0.05	0.08	100.44
22R-2, 125-127	17	385.34	Fisk	3	50.98	1.01	14.68	9.68	8.38	12.92	1.80	0.02	0.13	0.06	0.06	99.72
25R-1, 0-5	1	411.30	Fisk	3	51.09	1.00	14.47	9.55	8.36	12.92	1.82	0.02	0.14	0.04	0.04	99.46
25R-1, 89-93	11	412.19	Fisk	3	49.16	0.85	16.31	8.66	9.31	12.81	2.12	0.01	0.12	0.05	0.06	99.46
25R-1, 89-93	11	412.19	McNeill	4	48.96	0.87	16.53	8.99	9.09	12.89	2.14	0.02	0.16	0.03	0.07	99.75
25R-1, 89-93	11	412.19	Teagle	20	50.30	0.86	16.54	8.74	8.96	12.40	2.18	0.02	0.13	0.05	0.06	100.24
25R-1, 103-108	13	412.33	Fisk	3	49.80	0.88	16.19	8.63	9.36	13.03	2.20	0.02	0.12	0.04	0.04	100.32
25R-1, 120-123	15	412.50	Bach	10	49.40	0.89	15.77	8.60	9.12	12.65	2.15	0.01	0.16	0.04	0.04	98.90
25R-2, 32-35	4	413.12	Fisk	3	50.01	0.89	16.35	8.71	9.29	13.22	2.20	0.01	0.12	0.06	0.04	100.91
25R-2, 32-35	4	413.12	McNeill	4	48.85	0.87	16.54	9.23	9.15	12.96	2.17	0.01	0.12	0.02	0.06	99.98
25R-2, 35-38	5	413.15	Fisk	3	49.69	0.87	16.42	8.50	9.32	13.06	2.15	0.02	0.12	0.03	0.07	100.24
25R-2, 41-44	8	413.21	Fisk	3	49.64	0.88	16.35	8.70	9.33	13.12	2.17	0.01	0.10	0.06	0.08	100.42
25R-2, 61-64	11	413.41	Fisk	3	49.64	0.89	16.45	8.41	9.18	12.75	2.33	0.06	0.15	0.04	0.07	99.96
25R-2, 61-64	11	413.41	McNeill	4	49.24	0.85	16.55	9.17	9.09	12.81	2.16	0.02	0.15	0.05	0.05	100.14
25R-2, 65-67	12	413.45	Fisk	3	49.39	0.90	16.39	8.75	9.18	13.17	2.20	0.01	0.13	0.07	0.04	100.23
25R-2, 108-110	19	413.88	Fisk	3	49.21	0.86	16.34	8.71	9.17	12.92	2.14	0.02	0.13	0.04	0.04	99.58
25R-2, 115-116	21	413.95	Fisk	3	49.37	0.89	16.29	8.79	9.28	13.03	2.18	0.03	0.16	0.04	0.04	100.11
25R-2, 133-135	23	414.13	Fisk	3	49.44	0.90	16.44	8.72	9.18	12.90	2.13	0.02	0.11	0.05	0.06	99.94
25R-3, 10-15	2	414.36	McNeill	4	49.22	0.88	16.64	9.14	9.08	12.78	2.16	0.02	0.11	0.04	0.07	100.14
26R-1, 100-104	14	422.00	Fisk	2	48.99	0.92	16.25	8.94	9.24	12.97	2.13	0.03	0.17	0.01	0.11	99.77
26R-1, 104-106	15	422.04	Fisk	3	49.37	0.90	16.35	8.75	9.16	12.96	2.18	0.01	0.13	0.04	0.06	99.91
26R-2, 62-69	12	423.12	Fisk	3	48.82	0.90	16.23	8.67	9.33	12.89	2.17	0.02	0.12	0.03	0.05	99.24
26R-2, 67-69	12	423.17	McNeill	4	49.25	0.81	16.65	9.14	9.09	12.92	2.15	0.01	0.15	0.04	0.05	100.26
26R-3, 37-40	5	424.23	Fisk	3	48.94	0.90	16.32	8.50	9.27	13.04	2.18	0.02	0.14	0.06	0.03	99.40
26R-3, 46-48	6	424.32	McNeill	4	49.15	0.89	16.63	9.03	9.03	12.84	2.17	0.01	0.13	0.04	0.05	99.97
27R-1, 56-59	6	431.06	Fisk	3	49.37	0.91	16.19	8.65	9.27	12.54	2.15	0.02	0.13	0.05	0.06	99.35
27R-1, 59-63	7	431.09	Fisk	2	49.03	0.92	16.12	8.76	9.13	12.54	2.10	0.02	0.12	0.02	0.08	98.84
27R-2, 105-109	13	433.00	Fisk	3	49.13	0.68	15.71	8.92	9.65	13.19	1.63	0.01	0.11	0.07	0.08	99.18
27R-2, 105-109	13	433.00	McNeill	4	49.28	0.67	16.17	9.26	9.45	13.64	1.62	0.02	0.13	0.03	0.05	100.32
27R-2, 105-106	13	433.00	McNeill	4	50.08	0.67	15.98	8.91	9.18	13.39	1.61	0.02	0.14	0.02	0.07	100.07
27R-2, 114-121	14	433.09	Fisk	3	49.03	0.65	15.72	8.59	9.63	13.01	1.61	0.03	0.12	0.04	0.05	98.49
27R-2, 114-117	14	433.09	Furnes	10	50.94	0.67	15.50	8.60	9.25	13.60	1.63	0.01	0.15	0.05	0.05	100.34
27R-2, 121-124	15	433.16	Teagle	18	50.12	0.63	16.06	8.93	9.26	13.12	1.63	0.01	0.18	0.04	0.08	100.06
27R-2, 124-130	15	433.19	McNeill	4	49.03	0.64	16.07	9.12	9.43	13.66	1.62	0.02	0.12	0.03	0.07	99.81
27R-2, 130-136	16	433.25	Fisk	3	49.70	0.66	15.93	8.88	9.56	13.55	1.67	0.03	0.12	0.04	0.05	100.18
27R-2, 136-142	17	433.31	Fisk	3	49.87	0.68	15.98	9.16	9.65	13.50	1.64	0.02	0.12	0.04	0.08	100.73
27R-2, 136-142	17	433.31	McNeill	4	49.30	0.67	16.26	9.20	9.50	13.61	1.64	0.02	0.12	0.04	0.08	100.44
29R-1, 128-134	19	450.98	Fisk	3	50.98	0.95	14.93	9.64	8.62	13.31	2.00	0.01	0.15	0.06	0.07	100.72
30R-1, 6-13	2	459.36	Fisk	3	51.16	0.95	14.79	9.37	8.53	13.21	2.03	0.01	0.12	0.06	0.05	100.29
30R-1, 50-55	8	459.80	McNeill	4	50.67	0.90	14.97	9.77	8.25	13.33	1.93	0.02	0.15	0.06	0.07	100.12
30R-1, 110-112	1C	460.40	Fisk	3	50.39	0.95	14.51	9.54	8.41	13.22	1.99	0.03	0.12	0.07	0.07	99.29

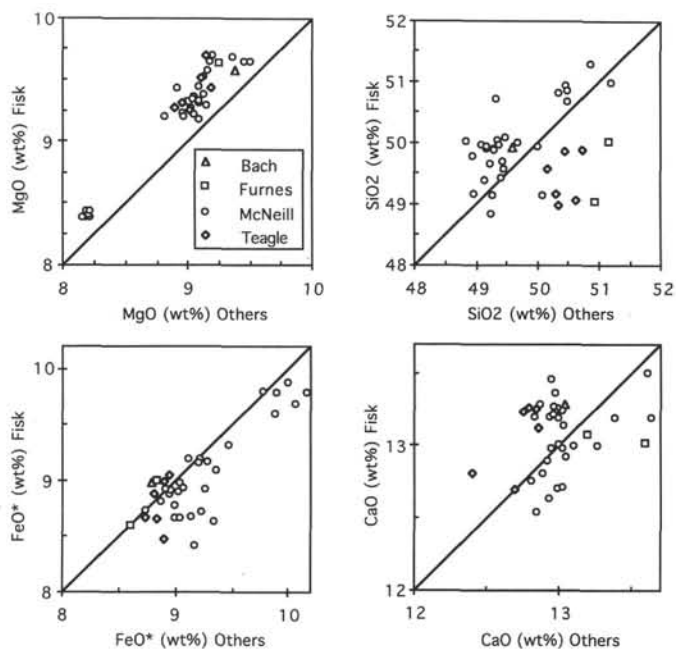


Figure 2. Comparison of microprobe analyses of MgO, SiO₂, FeO*, and CaO from the five laboratories. Analyses from the Oregon State University microprobe are plotted vs. analyses of glass from the same piece by other laboratories.

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