Data report: bulk rock compositions of samples from the IODP Expedition 309/312 sample pool, ODP Hole 1256D[1]

Natsuki Neo,[2] Shusaku Yamazaki,[2] and Sumio Miyashita[2]

Chapter contents

Abstract

In this data report we present major and trace element abundances for 159 samples recovered from Hole 1256D during Integrated Ocean Drilling Program Expedition 309/312, determined by X-ray fluorescence and inductively coupled plasma–mass spectrometry (ICP-MS). These samples represent a large proportion of rocks taken from the Expedition 309/312 sample pool, a collaborative effort to provide comprehensive geochemical analyses of a representative suite of samples from Hole 1256D. The samples analyzed are distributed from the sheet and massive flows (~750 meters below seafloor [mbsf]), through the sheeted dike complex (1060.9–1406.6 mbsf), and to the late-stage crosscutting dike (~1500 mbsf) at the present bottom of hole underlying the two gabbro intrusions. Analytical procedures and accuracy of analysis are described and compared with shipboard analyses from Expeditions 309 and 312. There are clear compositional differences for some elements between the shipboard analyses and this study. Some of the samples collected during Expedition 312 were not completely dissolved by routine acid digestion, most probably because of the presence of zircon, resulting in low concentrations of elements hosted by zircon including Zr, Hf, Th, and U. These samples were further analyzed by ICP-MS following alkali fusion.

Most rocks sampled during Expedition 309/312 display normal mid-ocean-ridge basalt (N-MORB) signatures. However, three samples yield trace element patterns with light rare earth element enrichment patterns. The late dike recovered from the present bottom of Hole 1256D has a highly evolved N-MORB chemistry.

Introduction

Hole 1256D is in 15 Ma oceanic crust of the Cocos plate, which formed during an episode of superfast (~220 mm/y full rate; Wilson, 1996) spreading of the East Pacific Rise (Fig. F1). Following drilling operations during Ocean Drilling Program (ODP) Leg 206 (Wilson, Teagle, Acton, et al., 2003) and Integrated Ocean Drilling Program (IODP) Expedition 309/312 (see the **"Expedition 309/312 summary"** chapter), Hole 1256D now penetrates 1507.1 meters below seafloor (mbsf) and provides the first complete sampling of intact upper oceanic crust down to gabbros.

Four major lithologic zones were distinguished in Hole 1256D: lavas, transition zone, sheeted dike complex, and plutonic section

[1]Neo, N., Yamazaki, S., and Miyashita, S., 2009. Data report: bulk rock compositions of samples from the IODP Expedition 309/312 sample pool, ODP Hole 1256D. *In* Teagle, D.A.H., Alt, J.C., Umino, S., Miyashita, S., Banerjee, N.R., Wilson, D.S., and the Expedition 309/312 Scientists, *Proc. IODP,* 309/312: Washington, DC (Integrated Ocean Drilling Program Management International, Inc.). doi:10.2204/iodp.proc.309312.204.2009
[2]Graduate School of Science and Technology, Niigata University, 8050 Ikarashi 2-no-cho, Nishi-ku, Niigata 950-2181, Japan.
Correspondence author:
f05j007a@mail.cc.niigata-u.ac.jp

(Fig. F2). The upper part of Hole 1256D consists of a thick sequence of lavas (lava pond, ~250–350.3 mbsf and inflated flows, 350.3–533.9 mbsf) and sheet and massive flows (533.9–1004.2 mbsf) separated by a 60 m thick transition zone (1004.2–1060.9 mbsf) from the underlying thin sheeted dike complex (1060.9–1406.6 mbsf) (upper dikes, 1060.9–1348.3 mbsf and granoblastic dikes, 1348.3–1406.6 mbsf). The first gabbroic rocks were encountered at 1406.0 mbsf, and these intrusive gabbros extend to 1458.9 mbsf. Beneath these gabbros, a 24.2 m thick dike screen appears between 1458.9 and 1403.1 mbsf, which separates the upper gabbros from a second intrusive gabbro body between 1483.1 and 1495 mbsf. These lower gabbros are underlain by a further dike screen, and the lowermost rocks recovered from Hole 1256D are from a late-stage, crosscutting basaltic dike (1483.1–1507.1 mbsf) (see the **"Expedition 309/312 summary"** chapter).

The samples analyzed in this study are part of the Expedition 309/312 sample pool. This was a collaborative effort by shipboard scientists to ensure that a representative suite of samples were comprehensively chemically characterized for their major and trace element compositions. All samples were prepared for analysis at the National Oceanography Centre, University of Southampton, United Kingdom. Samples were cleaned by sawing and grinding to remove drilling contamination before multiple ultrasonic washes with millipore (18.2 MΩ) water to remove contamination. Samples were reduced to a coarse sand grain size using a fly press and reduced to powder by grinding in a Cr-steel shatterbox. Sample powders were then split into 0.5 to 20 g aliquots and distributed for chemical and isotopic analysis by scientists from the shipboard science party.

The pool samples of Expedition 309/312 provide a representative sample suite from the sheet and massive flows down to the late dike unit of the present bottom of hole. During the IODP Expedition 309/312, major and several trace element abundances were analyzed aboard ship by inductively coupled plasma–atomic emission spectroscopy (ICP-AES) (see the **"Expedition 309/312 summary"** chapter). In this study, 159 samples from the Expedition 309/312 sample pool were analyzed at Niigata University, Japan, by X-ray fluorescence (XRF) and inductively coupled plasma–mass spectrometry (ICP-MS). We report our analytical procedures and our estimates of the precision and accuracy of the analyses. Our new analyses are then compared to the shipboard data, though it should be noted that the pool samples and shipboard samples are not identical and were generally selected from a different positions. Finally, we briefly describe geochemical features of these analyses.

Methods and materials

Ten major elements (Si, Ti, Al, Fe, Mn, Mg, Ca, Na, K, and P) were analyzed by XRF (Rigaku RIX 3000) at Niigata University following the analytical procedures of Takahashi and Shuto (1997) (Table T1). For trace element analyses (Sc, V, Cr, Co, Ni, Zn, Ga, Rb, Sr, Y, Zr, Nb, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Yb, Lu, Hf, Ta, Pb, Th, and U), 159 samples were dissolved by HF-HNO_3 acid digestion following Takazawa et al. (2003). A total of 62 samples were also dissolved and analyzed by alkali fusion. Solutions were analyzed using an Agilent 7500a ICP-MS at Niigata University, calibrated using the reference values for BHVO-1 (basalt; Hawaii, U.S. Geological Survey [USGS]) of Eggins et al. (1997). Although we did not have enough sample powder to analyze all samples, selected trace elements (V, Cr, Ni, Rb, Sr, Y, Zr, Nb, Ba, Pb, and Th) were also determined by XRF to cross-check the ICP-MS data where possible.

This approach identified that for many samples cored during Expedition 312 and three samples cored during Expedition 309, there had not been complete dissolution during HF-HNO_3 attack, most probably because of the incomplete dissolution of acid-resistant minerals such as zircon and/or titanite. Therefore, all samples from Expedition 312 and three samples from Expedition 309 were dissolved by alkali fusion (Roser et al., 2000). In a variation of the Roser et al. (2000) method we dissolved fluxed samples in concentrated nitric acid as opposed to perchloric acid. Sample powders were dissolved in concentrated HF-HNO_3 using Pt crucibles and evaporated. Afterward, Na_2CO_3 alkali flux was added and heated in an electric furnace. The fluxed samples are dissolved in concentrated HNO_3, HCl, and ultrapure water. The samples were finally diluted ~20,000 times.

To check the accuracy of analyses, GSJ (Geological Survey of Japan) reference samples were analyzed by XRF. Major element data of JB-1a (basalt; Kitamatsuura), JB-2 (basalt; Oshima), and JB-3 (basalt; Fuji) are shown in Table T2. For trace element analyses, USGS Geochemical Reference Standard W-2 (diabase; Virginia) was dissolved and analyzed with every group of samples (Table T3). Major element and trace element abundances of shipboard standards BAS-206 and BAS-312 were also analyzed (Table T3).

For major elements, relative deviation (RD) values, an estimate of accuracy, between this study and recommended values are very low (Table T2). For trace elements, relative standard deviation (RSD) values, an estimate of precision, are <5% except for Sc, Co, Ni, Pb, and U. Trace element RD values of the average results from this study are less than ±4% for five sets of W-2 analyses compared to the recommended values of Eggins et al. (1997). RSD values of Zr, Hf, Th, and U that were dissolved by alkali fusion are <5%, but RD values for the recommended value (Eggins et al., 1997) are slightly higher (10%) for eight sets of sample analyses.

Table **T3** shows average (five analyses each) values of BAS-206 and BAS-312, RSD values and average standard deviation values for this study. RSD for most elements are <5% except for V, Cr, Ni, Cs, Ba, and Pb.

Sc analyses were strongly affected by a high blank of up to 8% of BHVO-1 counts per second, and therefore RSD values of Sc were high. Pb blanks were also high, possibly because of contamination by Pb from plastic solution storage vessels. The contamination of Pb from plastic vessels is demonstrated by the correlation between residence time in the plastic vessels and measured Pb abundances in the 5% HNO_3 solutions. Hence, Pb analyses also show highly dispersed results.

Results

Comparison of analyses by different dissolution procedures

Most of the elements analyzed by both dissolution methods (acid digestion and alkali fusion for ICP-MS analyses) show similar values within analytical error ranges. However, Zr, Hf, Th, and U concentrations in samples recovered during Expedition 312 show systematic differences between the two dissolution methods. Figure **F3** shows a comparison of analyses of the same sample (312-1256D-184R-1, 0–8 cm) dissolved by acid digestion and following alkali fusion. It is apparent that Zr, Hf, Th, and U concentrations are higher in the sample split prepared by alkali fusion compared to that treated by acid digestion. This relationship is true for all samples from Expedition 312 treated by both methods. The discrepancy between the two dissolution methods is interpreted by the presence of acid-resistant minerals containing Zr, Hf, Th, and U, and is discussed below. On the other hand, Zn, Cs, and Pb show slightly different values between two dissolution methods. As mentioned above, procedural blanks for Pb are high even for the acid digestion method. The Pb blanks are further increased when samples are prepared by alkali fusion. Pb abundances in Hole 1256D samples are significantly affected by high blank levels, but as the Pb data from acid digestion appear to be more accurate with lower blank levels, these values are used for all samples in this study.

The most remarkable differences in Zr concentrations yielded by the two dissolution methods is encountered in samples from deeper than 1300 mbsf. The Zr values by acid digestion are much lower than the Zr values by alkali fusion for the samples from a deeper level. It is also apparent that the Zr abundances by acid digestion are much lower than those returned during shipboard analyses of samples from deeper levels than 1300 mbsf (Fig. **F4**). The Zr abundances by alkali fusion yield concentrations consistent with the shipboard analyses. Furthermore, they show good correlation with XRF data (R^2 = 0.9802) (Fig. **F5**). This indicates that the Zr abundances by acid digestion are incorrect because of the incomplete dissolution of acid-resistant minerals. Consequently, the Zr values by alkali fusion are regarded as correct values.

Because acid-resistant minerals such as zircon and titanite are not completely dissolved by acid digestion, the elements contained within these minerals will not be correctly analyzed in samples containing these minerals. For example, zircon contains high concentrations of Zr and Hf, so abundances of Zr and Hf are poorly analyzed by acid digestion for the samples containing zircon. Because Th and U are also highly compatible with zircon (Mahood and Hildreth, 1983), these concentrations may also be lower than the true values for zircon-bearing samples. Analyses of samples from deeper than 1300 mbsf, prepared by acid digestion only, show discernibly lower Th and U concentrations than the analyses by alkali fusion (Fig. **F4**). We conclude that the presence of zircon in samples deeper than 1300 mbsf has affected our ICP analyses of splits prepared by acid digestion.

The presence of titanite, another common acid-resistant mineral, may result in low abundances of heavy rare earth element (HREE) concentrations in samples prepared by acid digestion due to very high compatibility of HREE into titanite. However, rare earth element (REE) concentrations by the two dissolution methods are in good agreement with each other, suggesting that the presence of titanites has not affected the REE abundances in this study.

In conclusion, we found that three samples (309-1256D-146R-1, 30–54 cm; 146R-2, 80–88 cm; and 155R-2, 60–80 cm) at above 1300 mbsf contain acid-resistant minerals because of much lower values for splits prepared by acid digestion than the splits prepared by alkali fusion. Therefore, the solutions dissolved by alkali fusion were used for these three samples to determine Zr, Hf, Th, and U concentrations.

Therefore, we use the Zr, Hf, Th, and U analyses which were dissolved by alkali fusion for the samples containing acid-resistant minerals. However, because the accuracy of analyses using acid digestion is generally higher than those of alkali fusion, for most trace elements we use data yielded by the standard acid digestion approach. Our preferred trace element analyses are shown in Table T4 and variations of trace element abundances are shown in Figure F7.

Zircons are usually contained in felsic rocks as accessory minerals. The analyses described above suggest that zircons may be contained in the dike rocks deeper than 1300 mbsf, though zircons were not reported on board (see the "Expedition 309/312 summary" chapter). This may be explained by the different degrees of differentiation in the dike complex, but a systematic difference in Mg-number, where Mg# = 100 × Mg/(Mg + Fe), is not recognized in samples above 1300 mbsf (Fig. F6). Higher degrees and different styles of hydrothermal alteration may be responsible for the appearance of zircon at the deeper level.

Comparison of data from this study and shipboard data

During Expedition 309/312, 10 major elements and 11 trace elements (Co, Zn, Sc, Cr, V, Cu, Zr, Y, Sr, Ba, and Ni) were analyzed by ICP-AES. Figures F6 and F7 compare the variations in major element and trace element abundances with depth using both the shipboard data and this study. For the major elements, downhole variations are generally consistent between the shipboard data and this study.

For the trace element analyses, comparison with the shipboard data is possible for the 10 trace elements analyzed on board; however, Cu, V, Cr, Ni, Zn, Y, and Zr values from this study are generally similar to the shipboard data. Sc values are significantly different between shipboard data and this study with Sc concentrations determined during Expedition 309 being much lower than our data. Co abundances determined aboard ship for samples in the vicinity of 1200 mbsf are much higher than our results. Sr abundances from Expedition 312 are in good agreement with our results, but Expedition 309 shipboard data tend to have higher Sr concentrations than those of this study. Shipboard Ba abundances from 800 to 900 mbsf tend to be higher, and those from 1100 to 1200 mbsf are lower than our results. Some of these discrepancies may be due to the different samples analyzed on board and in this study, but a significant component must be due to differences in analytical methods and analytical equipment and the difficulties of shipboard analysis. Table T5 shows results of BAS-206 and BAS-312 by shipboard and this study for major and trace elements. Major elements by shipboard and this study show generally similar values. However, our data tend to have higher values for some trace elements.

Brief summary of bulk rock chemistries of the basaltic rocks of Hole 1256D

Almost all basaltic lavas from Expedition 309/312 show normal mid-ocean-ridge basalt (N-MORB) signatures with flat, light rare earth element (LREE)-depleted REE patterns (Fig. F8). Only one analysis (Sample 309-1256D-80R-2, 92–102 cm; 781.47 mbsf) from the lava succession of Hole 1256D exhibits an LREE-enriched pattern similar to an enriched MORB pattern. Most analyses of the sheeted dike complex including granoblastic dikes also yield N-MORB-like REE patterns. However, two analyses of samples from the same core (Samples 312-1256D-189R-1, 0–13 cm; and 189R-1, 71–89 cm) return LREE-enriched patterns (Fig. F8). The late-stage dike (Sample 312-1256D-234R-1, 26–29 cm) recovered in the bottommost core from Hole 1256D shows N-MORB patterns but is characterized by highly evolved features (e.g., Mg# = 39; TiO_2 = 2.2 wt%). This analysis is one of the most evolved analyses throughout Hole 1256D. It is noticed that the uppermost lava pond, suspected to have solidified some 5–10 km off-axis, also shows relatively evolved chemistry (see the "Expedition 309/312 summary" chapter). This may imply that late-stage magmatism at Site 1256, as displayed by the late dike of the bottom of hole and lava pond of the top of lava sequence, is characterized by evolved magmas.

Summary

Major and trace element concentrations of 159 pool samples from Expedition 309/312 were analyzed by XRF and ICP-MS. Accuracy of major element analyses is high. Almost all trace elements have values consistent with recommended values. Major element concentrations determined by this study are generally similar to shipboard data as shown with respect to downhole variations. Trace element abundances of Zr, Hf, Th, and U of Expedition 312 samples were analyzed by alkali fusion method because of the presence of zircon.

When compared to shipboard data, our results for trace elements, V, Cr, Ni, Zn, Y, and Zr are similar in terms of downhole variations. Other elements tend to show wholly or partially different values, may be due to differences in analytical method or differences of analyzed samples.

Almost all basaltic rocks of Expedition 309/312 show N-MORB REE patterns. However, three samples (309-1256D-80R-2, 92–102 cm; 312-1256D-189R-1, 0–13 cm; and 189R-1, 71–89 cm) show LREE-enriched patterns. Moreover, one sample (312-1256D-234R-1, 26–29 cm) from the bottom of hole has highly evolved N-MORB chemistry. It may imply that late-stage magmatism as shown by the late dike and lava pond that formed the uppermost basement at Site 1256, is characterized by evolved magmas.

Acknowledgments

We thank the IODP Expedition 309/312 Science Party, the crew, and technical staff of the R/V *JOIDES Resolution* for their help. This project used samples and/or data provided by the Integrated Ocean Drilling Program (IODP). We thank Damon Teagle and his dedicated team of "rock-crushers" at the National Oceanography Centre, University of Southampton, for the preparation and distribution of Expedition 309/312 sample pool powders. Natsuki Neo, Shusaku Yamazaki, and Sumio Miyashita were supported by the Center of Deep Earth Exploration (CDEX) for travel fares. This study was supported by Grant in Aid of Ministry of Education and Science of Japan (17340162) and Grant for Promotion of Niigata University Project for Sumio Miyashita. We thank Yoshiko Adachi for discussions. This paper is greatly improved by critical review by Damon Teagle. We also thank for reviews by Susumu Umino, John MacLennan and Naoto Hirano, which improved substantially this paper.

References

Eggins, S.M., Woodhead, J.D., Kinsley, L.P.J., Mortimer, G.E., Sylvester, P., McCulloch, M.T., Hergt, J.M., and Handler, M.R., 1997. A simple method for the precise determination of ≥40 trace elements in geological samples by ICPMS using enriched isotope internal standardisation. *Chem. Geol.,* 134(4):311–326. **doi:10.1016/S0009-2541(96)00100-3**

Expedition 309/312 Scientists, 2006. Expedition 309/312 summary. *In* Teagle, D.A.H., Alt, J.C., Umino, S., Miyashita, S., Banerjee, N.R., Wilson, D.S., and the Expedition 309/312 Scientists. *Proc. IODP,* 309/312: Washington, DC (Integrated Ocean Drilling Program Management International, Inc.). **doi:10.2204/iodp.proc.309312.101.2006**

Imai, N., Terashima, S., Itoh, S., and Ando, A., 1995. 1994 compilation of analytical data for minor and trace elements in seventeen GSJ geochemical reference samples, "igneous rock series." *Geostand. Geoanal. Res.,* 19(2):135–213. **doi:10.1111/j.1751-908X.1995.tb00158.x**

Mahood, G., and Hildreth, W., 1983. Large partition coefficients for trace elements in high-silica rhyolites. *Geochim. Cosmochim. Acta,* 47(1):11–30. **doi:10.1016/0016-7037(83)90087-X**

Roser, B., Kimura, J., and Hisatomi, K., 2000. Whole-rock elemental abundances in sandstones and mudrocks from the Tanabe Group, Kii Peninsula, Japan. *Shimane Diagaku Chikyu Shigen Kankyogaku Kenkyu Hokoku,* 19:101–112.

Sun, S.-S., and McDonough, W.F., 1989. Chemical and isotopic systematics of oceanic basalts: implications for mantle composition and processes. *In* Saunders, A.D., and Norry, M.J. (Eds.), *Magmatism in the Ocean Basins.* Geol. Soc. Spec. Publ., 42:313–345.

Takahashi, T., and Shuto, K., 1997. Major and trace element analyses of silicate rocks using X-ray fluorescence spectrometry RIX3000. *Rigaku-Denki J.,* 28:25–37. (in Japanese)

Takazawa, E., Okayasu, T., and Satoh, K., 2003. Geochemistry and origin of the basal lherzolites from the northern Oman ophiolite (northern Fizh block). *Geochem., Geophys., Geosyst.,* 4(2):8605. **doi:10.1029/2001GC000232**

Terashima, S., Taniguchi, M., Mikoshiba, M., and Imai, N., 1998. Preparation of two new GSJ geochemical reference materials: basalt JB-1b and coal fly ash JCFA-1. *Geostand. Geoanal. Res.,* 22(1):113–117. **doi:10.1111/j.1751-908X.1998.tb00550.x**

Wilson, D.S., 1996. Fastest known spreading on the Miocene Cocos–Pacific plate boundary. *Geophys. Res. Lett.,* 23(21):3003–3006. **doi:10.1029/96GL02893**

Wilson, D.S., Teagle, D.A.H., Acton, G.D., et al., 2003. *Proc. ODP, Init. Repts.,* 206: College Station, TX (Ocean Drilling Program). **doi:10.2973/odp.proc.ir.206.2003**

Initial receipt: 14 October 2008
Acceptance: 3 March 2009
Publication: 17 June 2009
MS 309312-204

Figure F1. Seafloor topography of the East Pacific Rise and eastern equatorial Pacific Ocean. Hole 1256D is on 15 Ma oceanic crust of the Cocos plate.

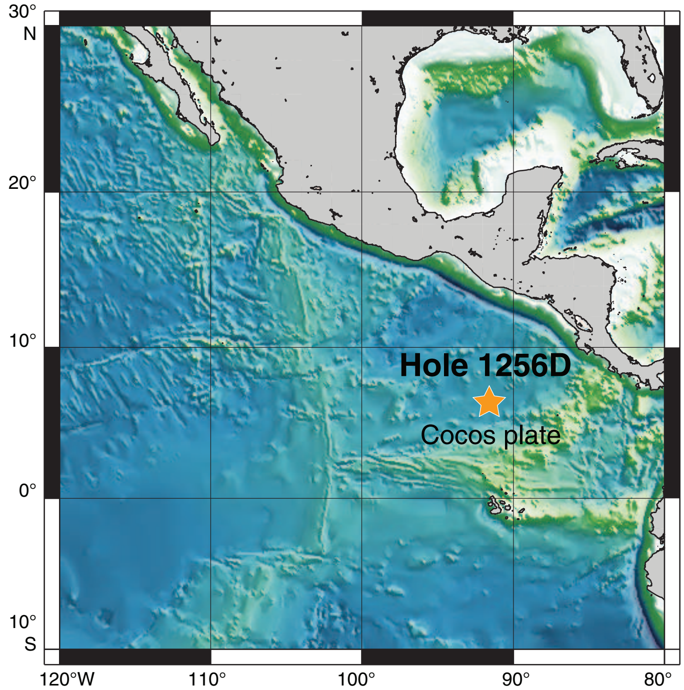

Figure F2. Simplified igneous stratigraphy of Hole 1256D following drilling operations on ODP Leg 206 and IODP Expedition 309/312, modified from Teagle et al. (2006).

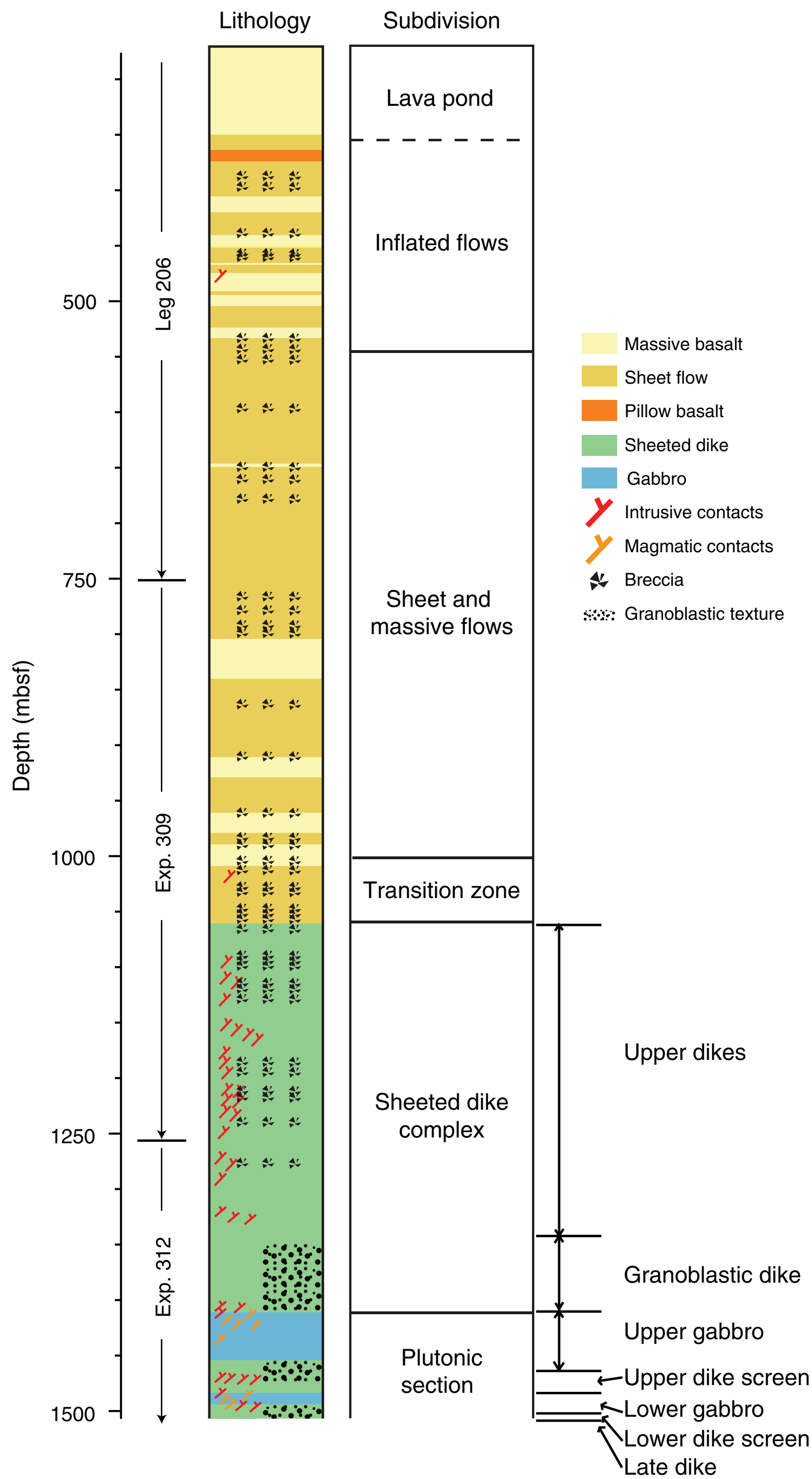

Figure F3. Comparison of inductively coupled plasma–mass spectrometry analyses of Sample 312-1256D-184R-1, 0–8 cm, dissolved by acid digestion and following alkali fusion. Zr, Hf, Th, and U values by acid digestion are lower than those by alkali fusion, indicating the presence of acid-resistant minerals.

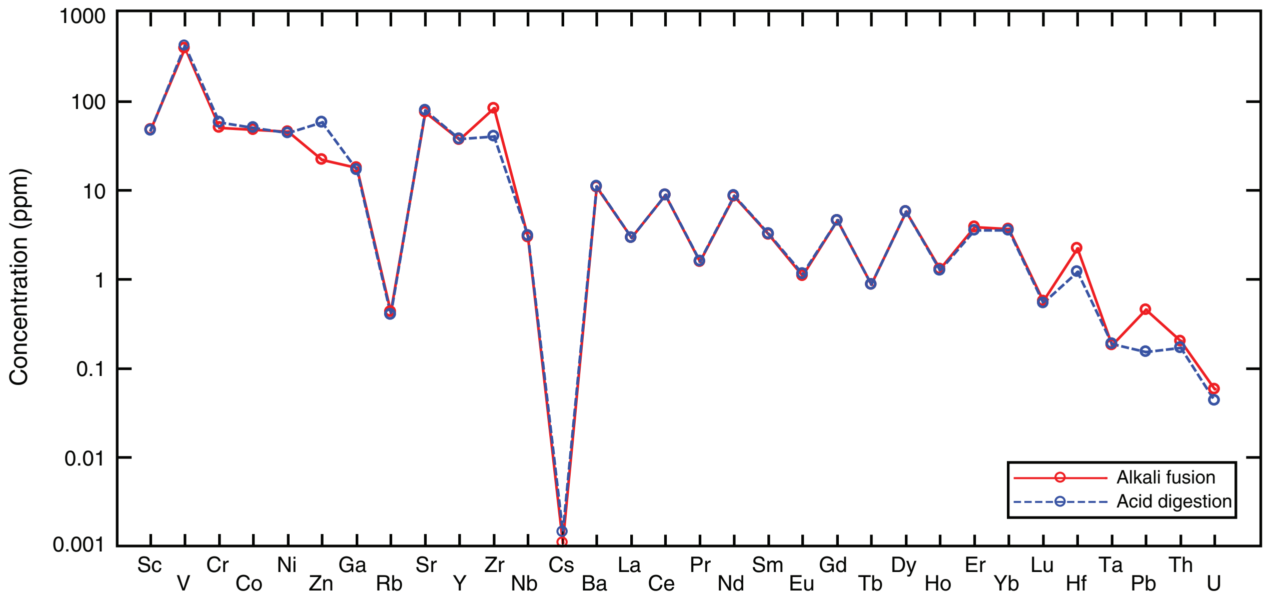

Figure F4. Downhole variations of Zr, Hf, Th, and U abundances of inductively coupled plasma–mass spectrometry analyses by acid digestion and alkali fusion. The discrepancy between the two dissolution methods becomes prominent in samples from deeper than ~1300 mbsf.

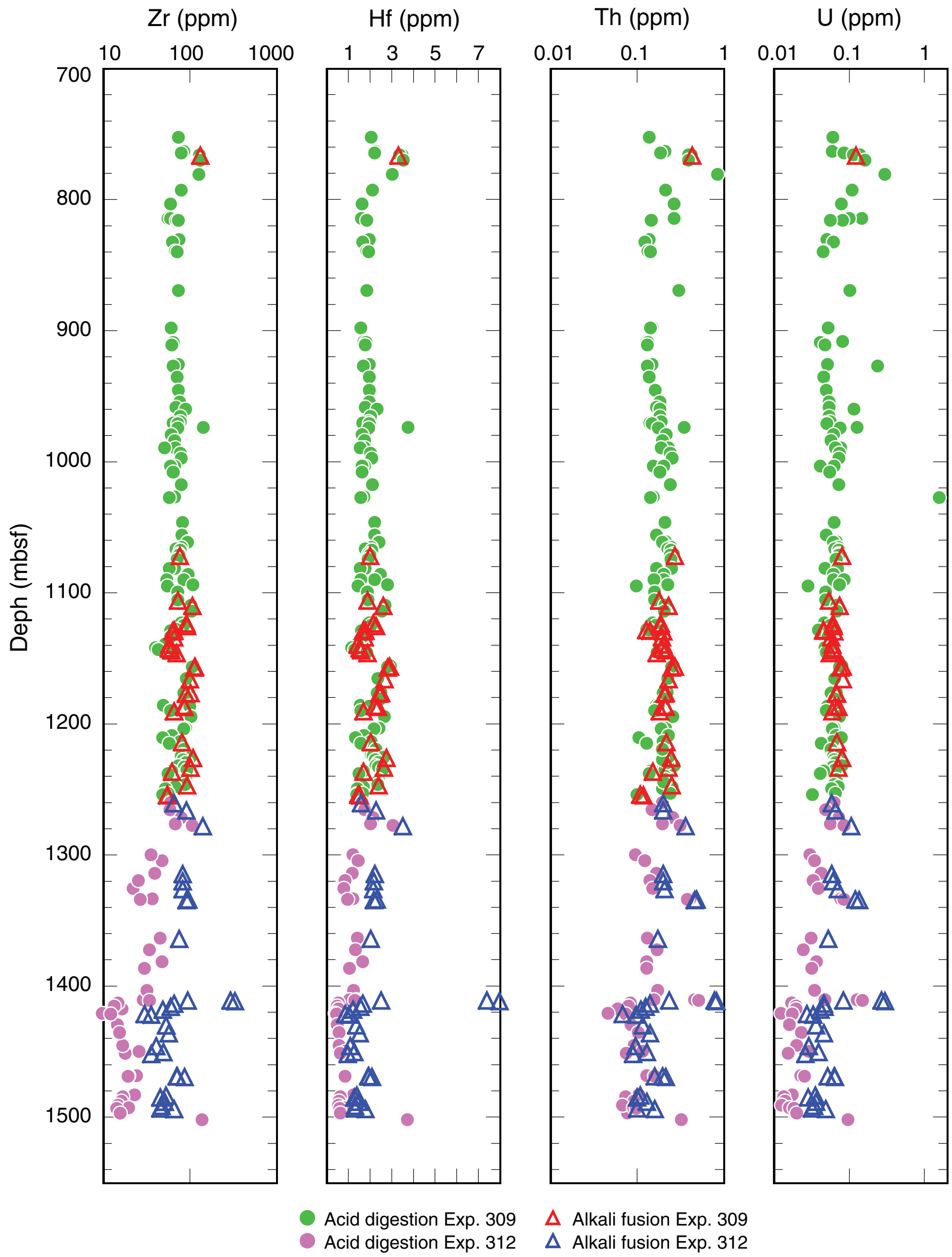

Figure F5. Plot of Zr values of inductively coupled plasma–mass spectrometry (ICP-MS) analyses by alkali fusion method vs. analyses of X-ray fluorescence (XRF) for the same samples. Zr values of ICP-MS analyses show higher concentrations than those of XRF analyses.

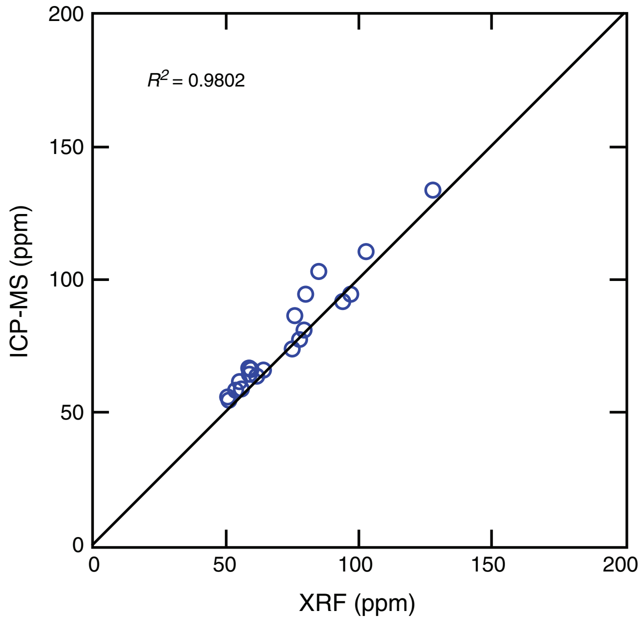

Figure F6. Downhole variation diagram of major elements of the pool sample contents by X-ray fluorescence analyses. Major element concentrations are recalculated on an anhydrous basis and total Fe as FeO. Blue bands = gabbro intervals. LOI = loss on ignition. Magnesium number (Mg#) = 100 × Mg/(Mg + Fe).

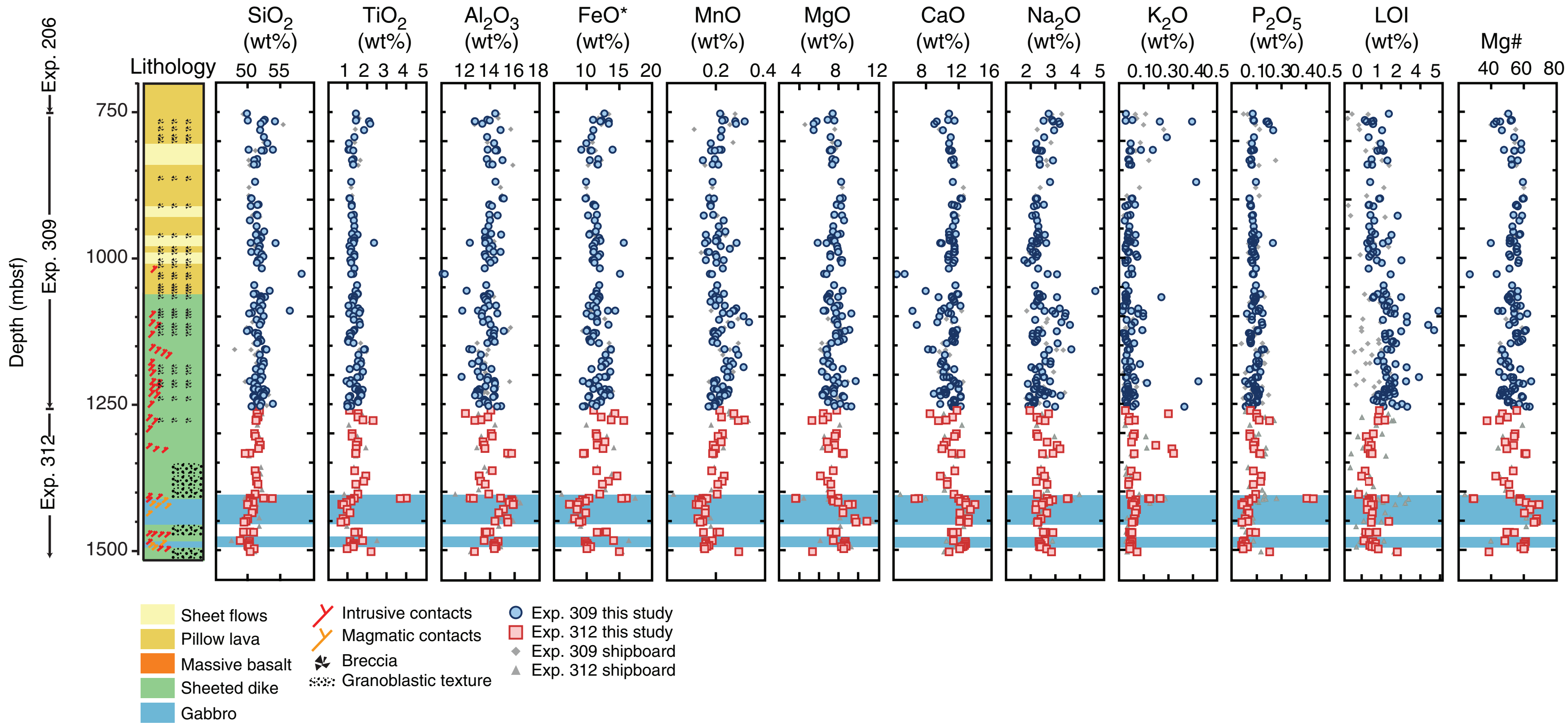

Figure F7. Downhole variation diagram of trace element abundances of the pool samples by inductively coupled plasma–mass spectrometry analyses of this study. Shipboard analyses data of Co, Zn, Sc, Cr, V, Zr, Y, Sr, Ba, and Ni abundances by inductively coupled plasma–atomic emission spectroscopy from Expedition 309/312 are also plotted. Blue bands = gabbro intervals. (**Continued on next page.**)

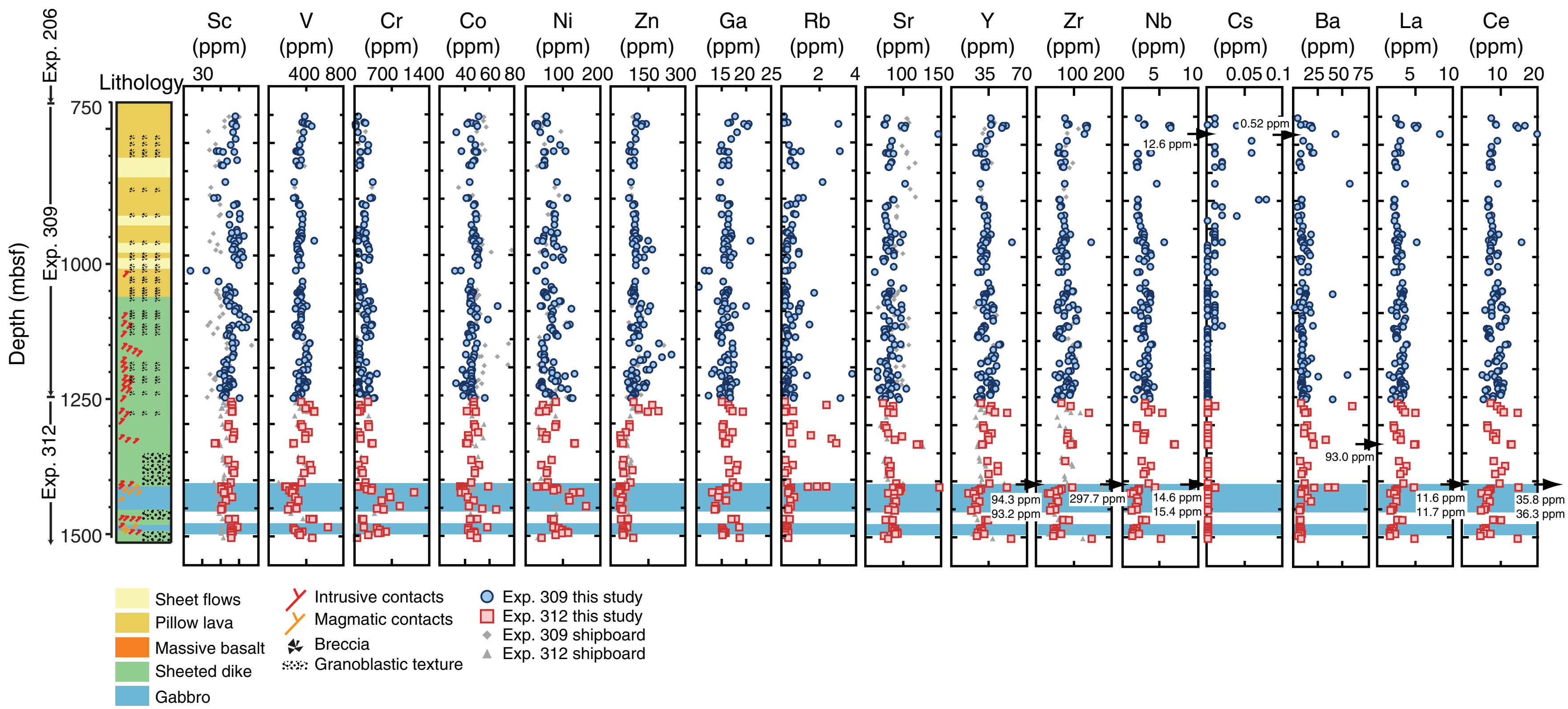

Figure F7 (continued).

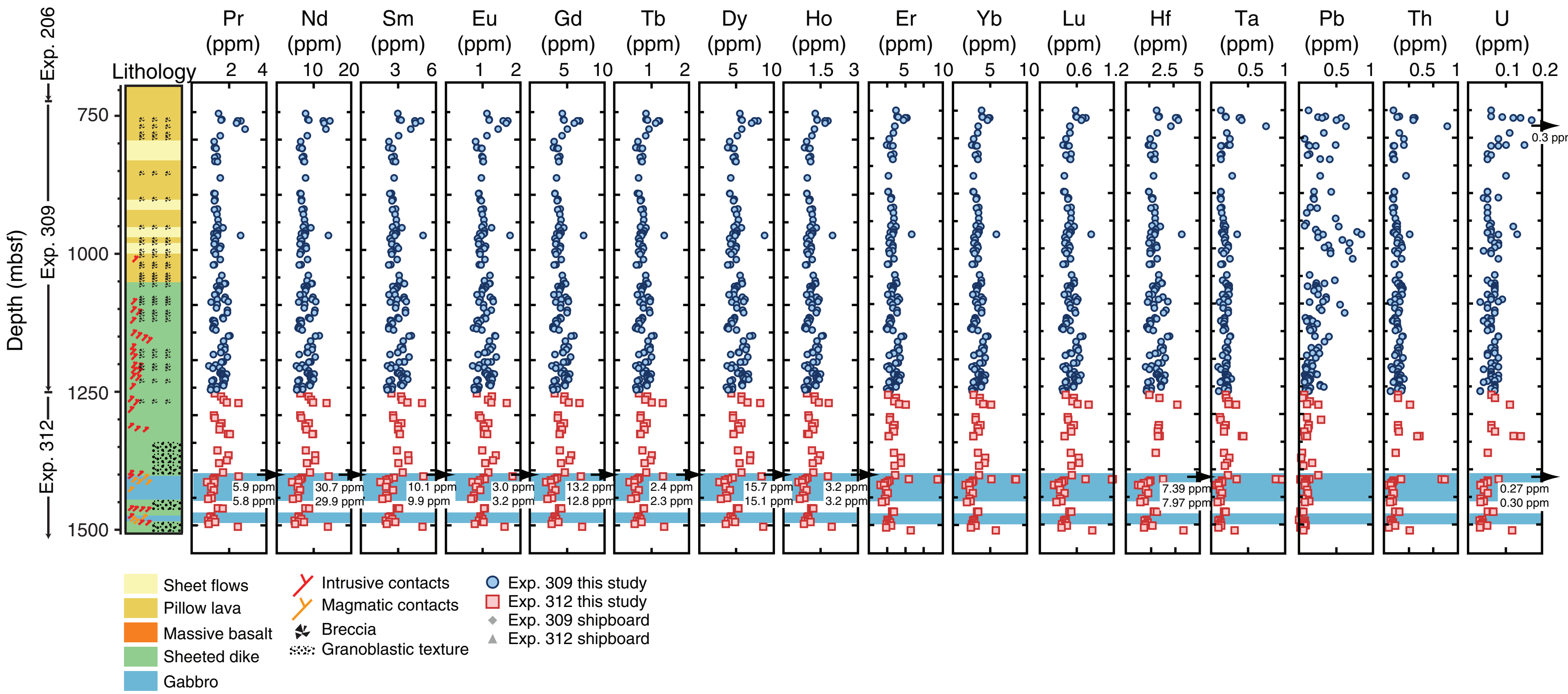

Figure F8. Chondrite (Sun and McDonough, 1989) normalized rare earth element (REE) abundances of the pool samples recovered from Expedition 309/312. REE patterns are shown for each sublithology. Almost all samples show normal mid-ocean-ridge basalt (N-MORB) REE patterns. However, one lava sample from the sheeted and massive flows and two samples from upper dikes show light rare earth element–enriched patterns. A late dike sample from the bottom of Hole 1256D has evolved values. Red lines = N-MORB pattern (Sun and McDonough, 1989), gray lines = REE abundances from 0°–10°N on the East Pacific Rise (PetDB).

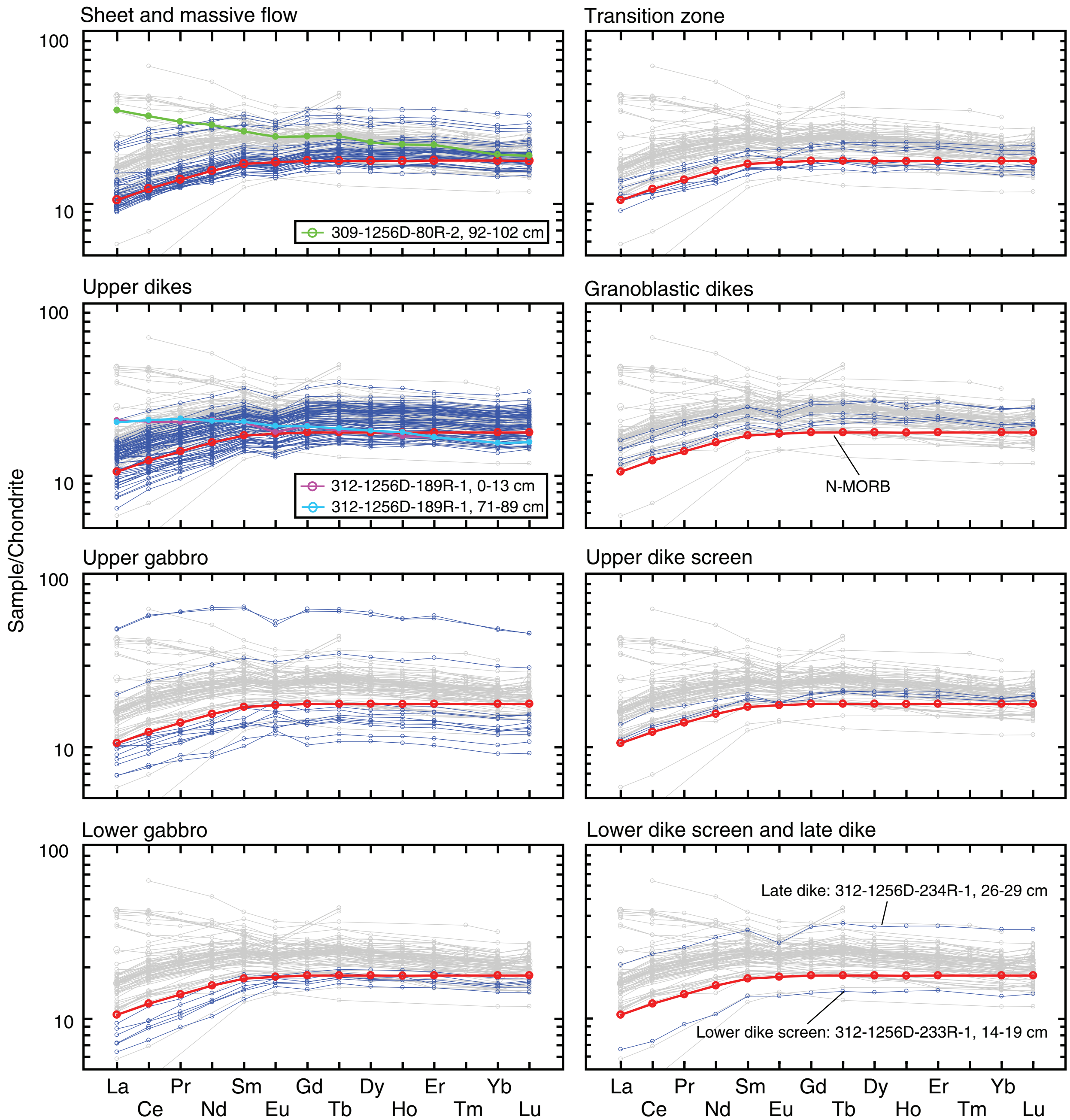

Table T1. Major element abundances. (See table note.) (Continued on next two pages.)

Core, section, interval (cm)	Depth (mbsf)	SiO_2 (wt%)	TiO_2 (wt%)	Al_2O_3 (wt%)	Fe_2O_3 (wt%)	MnO (wt%)	MgO (wt%)	CaO (wt%)	Na_2O (wt%)	K_2O (wt%)	P_2O_5 (wt%)	Total	LOI (wt%)	Mg#
309-1256D-														
75R-1, 116–123	753.05	49.58	1.44	14.34	14.09	0.22	7.36	10.77	2.73	0.04	0.11	100.67	1.69	50.8
78R-1, 42–50	763.95	52.42	1.45	13.74	12.20	0.24	6.89	10.70	2.87	0.07	0.11	100.69	0.21	52.8
78R-2, 20–33	764.97	49.55	1.43	13.85	13.60	0.23	7.52	11.42	2.52	0.03	0.11	100.25	0.74	52.2
78R-3, 63–76	766.55	54.14	2.12	12.76	13.44	0.28	5.72	9.35	2.92	0.21	0.18	101.13	0.62	45.7
78R-3, 63–76	766.55	52.50	2.11	12.83	14.93	0.32	5.77	9.38	3.15	0.37	0.18	101.55	0.33	43.3
79R-1, 98–107	770.72	52.00	2.17	13.38	14.93	0.28	5.47	9.08	3.19	0.66	0.19	101.34	0.73	42.0
80R-2, 92–102	781.47	51.88	1.86	14.85	12.30	0.23	5.49	10.09	2.97	1.12	0.21	100.99	1.27	46.9
82R-2, 10–20	793.77	52.04	1.36	13.65	11.88	0.22	7.14	10.98	2.54	0.24	0.11	100.15	0.46	54.3
84R-2, 61–70	803.78	52.51	1.08	14.21	11.02	0.18	7.87	10.77	2.22	0.06	0.10	100.01	1.18	58.6
85R-2, 124–136	814.97	49.50	1.06	13.65	15.33	0.22	7.16	10.70	2.19	0.17	0.11	100.08	1.31	48.0
85R-2, 124–136	814.97	53.40	1.12	14.45	10.18	0.21	7.28	10.90	2.26	0.11	0.11	100.01	1.14	58.6
85R-4, 83–92	816.46	51.63	1.29	14.35	11.61	0.18	7.00	10.76	2.42	0.06	0.10	99.40	1.35	54.4
85R-5, 0–21	816.83	51.32	1.28	14.23	11.79	0.20	7.14	11.03	2.36	0.05	0.10	99.49	0.99	54.5
87R-1, 22–35	831.06	51.12	1.32	13.66	13.06	0.20	7.33	11.35	2.34	0.05	0.10	100.52	0.63	52.6
87R-2, 83–90	832.90	50.44	1.23	14.87	11.59	0.15	7.58	11.02	2.89	0.05	0.09	99.90	1.59	56.4
88R-1, 10–21	840.41	51.19	1.29	13.88	12.90	0.19	7.34	11.40	2.37	0.05	0.10	100.71	0.38	52.9
88R-1, 56–64	840.68	50.67	1.31	14.15	12.98	0.21	7.35	11.41	2.36	0.06	0.10	100.61	0.66	52.8
92R-1, 102–109	869.83	50.85	1.21	14.40	10.98	0.19	8.22	11.26	2.78	0.39	0.12	100.38	0.54	59.7
97R-1, 61–70	898.37	50.12	1.11	14.91	10.94	0.17	8.37	12.14	2.26	0.07	0.09	100.16	1.15	60.2
97R-1, 102–109	898.69	49.93	1.11	14.93	10.83	0.19	8.04	12.27	2.19	0.06	0.09	99.64	1.09	59.5
99R-2, 29–37	908.97	51.33	1.22	13.86	12.21	0.18	7.77	11.12	2.53	0.08	0.10	100.38	0.49	55.7
99R-2, 101–120	909.63	50.86	1.22	13.78	12.35	0.18	7.74	11.35	2.23	0.05	0.09	99.84	0.46	55.3
100R-1, 136–144	911.71	49.93	1.22	14.03	12.47	0.18	8.18	11.75	2.12	0.03	0.10	99.99	0.74	56.5
102R-1, 17–29	926.86	50.77	1.33	13.79	12.70	0.19	7.51	11.26	2.19	0.06	0.11	99.90	0.56	53.9
102R-1, 128–137	927.63	50.88	1.21	14.45	11.26	0.15	8.26	11.35	2.05	0.05	0.10	99.75	2.21	59.2
103R-1, 20–28	936.21	49.99	1.33	13.90	12.44	0.23	8.51	11.55	2.26	0.03	0.11	100.36	0.79	57.5
105R-1, 35–46	945.99	50.96	1.36	13.78	12.91	0.21	7.43	11.24	2.30	0.05	0.11	100.36	0.49	53.3
107R-1, 9–17	955.33	52.13	1.34	13.52	12.56	0.24	7.38	10.75	2.30	0.05	0.11	100.38	0.64	53.8
108R-1, 38–48	959.21	50.76	1.24	13.93	11.57	0.21	8.13	11.52	2.25	0.05	0.10	99.76	0.84	58.2
108R-2, 52–61	960.51	50.83	1.52	14.79	11.48	0.16	7.84	10.75	2.56	0.08	0.13	100.15	1.84	57.5
109R-1, 117–129	965.93	51.34	1.34	13.42	13.09	0.20	7.12	10.77	2.28	0.04	0.11	99.72	0.55	51.8
110R-1, 26–32	969.91	51.05	1.36	13.47	13.28	0.21	7.20	10.78	2.33	0.05	0.12	99.82	0.55	51.7
110R-1, 130–144	970.89	50.83	1.19	13.46	13.24	0.17	7.34	11.04	2.03	0.05	0.10	99.44	1.65	52.3
110R-2, 76–88	971.71	50.96	1.33	13.80	12.62	0.20	7.55	11.30	2.23	0.06	0.11	100.15	0.53	54.2
111R-1, 26–32	974.68	50.09	2.35	12.27	17.32	0.28	5.86	9.71	2.62	0.08	0.21	100.78	0.36	40.1
111R-1, 48–55	974.92	53.34	1.31	13.40	12.32	0.16	6.67	9.79	2.25	0.04	0.11	99.39	1.33	51.7
112R-1, 113–122	980.26	51.23	1.10	14.02	11.98	0.22	7.76	11.38	2.00	0.03	0.10	99.82	0.73	56.2
113R-1, 43–53	984.58	51.17	1.20	13.80	12.25	0.26	7.84	11.39	1.97	0.03	0.10	100.01	0.45	55.9
114R-1, 117–122	989.87	50.15	1.21	14.75	12.20	0.17	7.95	11.48	2.20	0.05	0.11	100.26	0.73	56.3
114R-1, 127–142	990.04	50.83	1.16	14.13	12.16	0.17	7.88	11.26	2.06	0.05	0.10	99.80	0.96	56.2
115R-1, 40–50	994.01	51.46	1.35	13.41	13.26	0.20	7.07	10.72	2.25	0.09	0.12	99.93	0.60	51.3
116R-1, 0–15	998.40	51.75	1.36	13.48	12.98	0.20	7.09	10.62	2.22	0.09	0.12	99.91	0.49	51.9
117R-1, 56–67	1003.85	51.23	1.22	13.83	12.04	0.23	8.16	11.44	2.05	0.03	0.10	100.33	0.96	57.3
117R-1, 97–107	1004.17	51.05	1.15	14.12	12.22	0.16	8.23	10.61	1.72	0.04	0.10	99.40	2.45	57.1
118R-1, 48–56	1008.63	51.09	1.20	13.97	12.41	0.20	8.27	11.27	1.87	0.03	0.10	100.42	1.26	56.9
120R-1, 95–105	1018.42	51.45	1.36	13.39	13.18	0.23	7.06	10.68	2.28	0.06	0.12	99.81	0.46	51.4
122R-1, 28–33	1027.55	55.63	1.26	9.71	16.05	0.17	6.25	5.18	2.58	0.07	0.10	96.99	5.87	43.5
122R-1, 67–79	1027.97	39.32	1.15	9.87	34.55	0.18	6.49	4.28	2.95	0.05	0.11	98.94	1.80	27.1
126R-1, 39–47	1046.95	49.93	1.47	13.41	12.97	0.20	7.40	11.39	2.13	0.03	0.12	99.05	1.37	53.0
128R-1, 80–91	1056.77	53.21	1.43	12.07	12.78	0.20	8.39	7.97	4.63	0.05	0.11	100.85	1.38	56.5
129R-1, 34–51	1061.51	50.78	1.54	13.78	12.60	0.23	7.06	11.73	2.26	0.03	0.14	100.15	1.01	52.6
129R-1, 125–139	1062.26	50.06	1.51	13.78	12.66	0.18	6.97	11.81	2.32	0.03	0.14	99.47	1.53	52.1
130R-1, 14–22	1065.84	50.81	1.32	13.20	12.95	0.20	6.79	10.95	2.45	0.04	0.12	98.82	0.77	50.9
130R-2, 21–34	1067.28	51.89	1.22	13.62	12.02	0.20	7.86	9.43	3.04	0.21	0.11	99.58	2.44	56.4
130R-2, 79–88	1067.78	51.26	1.34	13.34	13.10	0.21	6.74	11.02	2.34	0.03	0.12	99.50	0.72	50.5
131R-1, 65–79	1071.24	51.48	1.32	13.58	12.99	0.20	6.82	11.29	2.29	0.04	0.12	100.11	1.30	51.0
131R-1, 137–147	1071.86	51.44	1.32	13.48	12.94	0.21	6.88	11.24	2.27	0.04	0.11	99.93	1.28	51.3
132R-1, 0–18	1075.30	51.15	1.29	13.64	12.63	0.18	7.08	11.37	2.23	0.04	0.11	99.71	1.72	52.6
133R-1, 42–52	1082.15	50.82	1.25	14.47	11.44	0.24	8.07	12.20	2.14	0.02	0.10	100.74	1.42	58.3
133R-1, 141–148	1082.41	51.65	1.06	13.78	12.07	0.20	7.77	10.84	2.37	0.03	0.10	99.87	1.57	56.0
134R-2, 40–52	1086.54	51.87	1.58	13.61	12.78	0.29	7.63	10.26	3.20	0.10	0.14	101.45	2.04	54.2
135R-1, 54–64	1090.56	51.71	1.66	12.96	14.69	0.28	6.65	9.85	2.87	0.06	0.14	100.86	1.55	47.3
135R-1, 121–127	1090.86	55.49	1.38	11.55	15.74	0.27	6.38	6.27	2.53	0.02	0.12	99.75	4.71	44.5
136R-1, 11–16	1094.65	50.69	1.63	13.36	12.99	0.23	7.78	10.79	3.43	0.12	0.16	101.18	1.79	54.2
136R-1, 82–90	1095.36	50.33	1.11	14.62	11.18	0.26	9.34	11.10	3.00	0.10	0.08	101.12	2.04	62.3
137R-1, 92–99	1100.11	52.88	1.33	13.44	12.08	0.32	8.42	9.73	3.43	0.13	0.10	101.86	2.79	58.0
138R-2, 32–41	1105.89	50.89	1.32	13.77	12.73	0.21	7.56	11.39	2.16	0.04	0.10	100.18	1.33	54.0
139R-1, 93–99	1109.83	52.05	1.62	13.44	12.92	0.34	7.87	9.41	3.26	0.08	0.15	101.12	2.79	54.7

Table T1 (continued). (Continued on next page.)

Core, section, interval (cm)	Depth (mbsf)	SiO_2 (wt%)	TiO_2 (wt%)	Al_2O_3 (wt%)	Fe_2O_3 (wt%)	MnO (wt%)	MgO (wt%)	CaO (wt%)	Na_2O (wt%)	K_2O (wt%)	P_2O_5 (wt%)	Total	LOI (wt%)	Mg#
140R-1, 55–65	1114.72	51.62	1.64	13.99	14.82	0.26	7.87	6.90	3.58	0.06	0.16	100.91	4.09	51.2
142R-1, 38–48	1123.75	49.98	1.37	14.32	11.19	0.22	9.06	11.74	2.32	0.12	0.13	100.45	4.45	61.6
142R-2, 40–55	1125.34	49.75	1.33	15.10	11.14	0.20	8.62	11.28	3.06	0.06	0.13	100.67	2.43	60.5
143R-1, 72–82	1128.71	50.63	1.16	13.87	12.29	0.19	8.04	11.17	2.45	0.02	0.09	99.90	1.73	56.4
143R-1, 122–125	1129.23	50.37	1.21	13.79	12.56	0.19	7.87	11.24	2.24	0.02	0.09	99.58	1.75	55.4
143R-2, 40–49	1129.64	50.93	1.12	14.14	12.13	0.21	7.65	11.43	2.07	0.03	0.10	99.80	1.45	55.5
144R-2, 39–56	1134.38	50.92	1.15	14.13	12.14	0.20	7.65	11.45	2.06	0.03	0.10	99.82	1.46	55.5
145R-2, 73–89	1139.63	51.37	1.06	14.00	11.46	0.20	8.46	11.08	2.25	0.03	0.09	100.00	1.51	59.4
146R-1, 30–54	1142.50	51.52	1.03	14.04	11.53	0.19	8.06	11.20	2.19	0.04	0.09	99.89	1.95	58.1
146R-2, 80–88	1143.86	50.75	1.05	14.13	11.71	0.19	7.81	11.37	2.14	0.04	0.10	99.30	1.87	56.9
147R-1, 40–48	1145.98	50.92	1.31	13.64	13.09	0.21	7.22	10.46	3.07	0.08	0.10	100.09	2.13	52.2
149R-1, 57–63	1156.66	52.49	1.90	12.27	15.17	0.24	6.81	8.27	3.65	0.06	0.16	101.03	1.58	47.0
149R-1, 138–145	1157.33	52.59	1.85	12.48	15.15	0.28	6.73	8.82	2.73	0.05	0.15	100.83	1.83	46.8
151R-1, 119–125	1166.43	51.75	1.58	13.26	14.35	0.29	6.85	10.32	2.56	0.04	0.13	101.11	1.23	48.6
153R-2, 36–47	1176.70	51.50	1.68	13.02	14.80	0.24	6.41	10.03	2.58	0.03	0.14	100.43	0.98	46.2
153R-2, 103–115	1177.28	52.02	1.54	12.98	13.61	0.26	7.11	9.94	2.80	0.06	0.12	100.44	1.37	50.8
154R-2, 30–52	1181.45	52.13	1.68	12.48	14.26	0.27	6.94	9.80	2.80	0.11	0.13	100.60	2.10	49.1
155R-2, 60–80	1186.47	51.34	1.47	13.32	13.65	0.25	7.31	10.29	2.35	0.07	0.12	100.17	1.39	51.5
155R-3, 0–10	1187.12	51.80	1.49	13.35	13.51	0.31	7.37	10.43	2.02	0.04	0.12	100.44	2.77	51.9
156R-1, 90–100	1190.51	50.87	1.13	14.02	11.91	0.23	8.34	11.41	2.17	0.05	0.09	100.22	1.60	58.1
157R-1, 111–125	1195.29	51.52	1.78	12.90	15.00	0.25	6.25	10.07	2.46	0.04	0.14	100.41	1.49	45.2
159R-1, 3–13	1203.83	51.39	1.61	13.07	14.38	0.25	6.79	10.09	2.53	0.04	0.13	100.27	1.54	48.3
159R-1, 60–70	1204.40	52.01	1.64	11.65	14.13	0.26	7.84	10.50	2.52	0.07	0.13	100.75	3.52	52.3
159R-1, 98–110	1204.63	50.79	1.51	13.74	13.20	0.25	7.76	10.86	2.25	0.04	0.12	100.51	2.04	53.8
160R-1, 85–100	1209.69	51.27	1.16	13.60	12.54	0.20	7.41	11.24	2.19	0.08	0.10	99.80	1.80	53.9
161R-1, 105–113	1211.15	50.44	0.98	14.39	10.52	0.19	9.77	11.50	2.80	0.41	0.07	101.07	2.74	64.8
162R-1, 37–45	1213.95	50.51	1.32	14.22	11.59	0.19	7.90	11.53	2.22	0.14	0.11	99.71	2.03	57.4
162R-2, 89–106	1215.60	50.53	1.12	14.29	11.41	0.19	8.59	11.93	1.88	0.04	0.08	100.05	1.73	59.8
163R-2, 55–63	1219.91	50.84	1.49	13.49	12.99	0.23	7.56	10.89	2.23	0.05	0.12	99.87	1.86	53.5
164R-1, 27–50	1223.80	50.31	1.40	14.21	12.12	0.19	7.43	11.89	2.15	0.05	0.11	99.85	1.71	54.8
164R-2, 5–15	1224.49	50.58	1.40	14.18	12.18	0.20	7.37	11.92	2.12	0.03	0.11	100.09	1.43	54.5
164R-2, 101–107	1225.18	51.88	1.59	13.00	14.10	0.21	6.65	10.22	2.40	0.05	0.12	100.23	1.54	48.3
164R-3, 36–44	1225.86	51.37	1.77	13.09	14.86	0.25	6.59	10.16	2.45	0.03	0.14	100.72	1.54	46.7
165R-1, 23–33	1228.12	52.32	1.56	12.83	13.41	0.25	7.49	9.62	2.57	0.05	0.12	100.22	1.99	52.5
165R-2, 71–91	1230.17	51.21	1.61	12.90	14.38	0.23	6.51	10.11	2.37	0.04	0.13	99.49	1.42	47.3
165R-3, 19–30	1230.19	51.94	1.63	12.90	13.56	0.23	6.65	10.42	2.70	0.07	0.13	100.23	1.64	49.2
166R-1, 15–27	1232.87	51.81	1.64	12.69	14.12	0.24	7.43	8.89	2.85	0.06	0.14	99.85	2.04	51.0
166R-1, 126–132	1233.74	51.01	1.69	12.79	14.68	0.24	6.26	10.26	2.32	0.04	0.13	99.42	1.05	45.7
166R-2, 88–99	1235.57	51.26	1.64	12.88	13.89	0.21	6.38	9.63	3.16	0.07	0.13	99.25	1.32	47.6
166R-3, 49–65	1235.75	50.93	1.67	12.43	14.74	0.23	6.23	9.53	2.50	0.08	0.13	98.46	1.72	45.5
167R-1, 12–23	1236.68	50.18	1.15	14.20	11.42	0.18	8.32	12.12	1.94	0.04	0.09	99.63	1.00	59.0
167R-2, 50–70	1238.63	50.31	1.08	14.06	11.29	0.18	8.47	12.12	1.91	0.06	0.08	99.56	1.42	59.7
168R-1, 58–72	1243.18	50.56	1.54	13.31	13.37	0.21	6.87	11.24	2.14	0.03	0.12	99.39	0.75	50.4
168R-3, 23–32	1245.16	50.80	1.52	13.52	13.13	0.21	7.04	11.46	2.15	0.04	0.12	99.97	0.95	51.5
168R-4, 78–90	1247.03	50.89	1.55	13.40	13.40	0.21	6.86	11.37	2.08	0.04	0.13	99.92	1.30	50.3
169R-2, 40–54	1248.75	51.59	1.18	13.69	12.71	0.20	7.45	10.99	2.13	0.04	0.11	100.08	1.89	53.7
169R-3, 18–37	1249.88	53.19	1.01	12.95	11.91	0.19	8.09	9.65	2.63	0.08	0.08	99.78	2.49	57.3
170R-2, 40–48	1253.50	51.29	1.19	13.74	12.61	0.19	7.53	11.35	1.89	0.04	0.11	99.95	2.19	54.2
170R-2, 130–144	1254.31	50.22	1.04	14.79	10.77	0.17	8.76	12.19	2.00	0.07	0.07	100.10	1.35	61.7
170R-3, 22–40	1254.68	50.37	1.01	14.52	10.44	0.17	9.28	11.25	2.99	0.33	0.07	100.43	2.81	63.8
312-1256D-														
173R-1, 0–10	1260.60	51.27	1.10	13.93	12.15	0.21	7.71	11.68	1.94	0.03	0.09	100.11	1.09	55.7
174R-1, 73–79	1266.13	51.47	1.55	12.01	14.36	0.27	6.44	8.52	2.73	0.25	0.12	97.71	1.33	47.0
175R-1, 75–83	1272.05	51.19	1.53	13.73	13.48	0.22	6.82	11.18	2.24	0.05	0.13	100.56	1.04	50.0
176R-1, 116–122	1277.27	50.54	1.76	13.07	15.06	0.31	6.30	10.32	2.36	0.08	0.14	99.94	1.42	45.3
176R-2, 42–55	1278.03	50.22	2.26	12.50	17.03	0.29	5.16	9.33	2.54	0.05	0.19	99.55	1.00	37.5
181R-1, 51–56	1300.61	50.02	1.22	13.81	12.47	0.22	7.61	11.50	2.20	0.08	0.09	99.21	0.73	54.7
182R-1, 18–25	1305.09	50.60	1.22	14.03	12.67	0.21	7.55	11.37	2.26	0.07	0.09	100.06	0.28	54.1
184R-1, 0–8	1314.50	51.02	1.52	13.23	14.03	0.22	6.71	10.37	2.64	0.06	0.12	99.91	0.45	48.6
186R-1, 12–20	1320.10	51.26	1.43	13.33	12.74	0.19	7.50	10.09	3.04	0.18	0.11	99.85	0.59	53.8
187R-2, 21–31	1325.88	50.79	1.42	13.37	13.67	0.20	6.84	9.78	3.14	0.26	0.11	99.57	0.39	49.8
189R-1, 0–13	1333.90	49.71	1.40	15.22	10.63	0.19	8.25	11.03	2.87	0.27	0.14	99.70	0.53	60.6
189R-1, 71–89	1334.61	49.00	1.41	15.57	10.43	0.19	8.39	12.12	2.45	0.08	0.14	99.77	0.64	61.4
196R-1, 16–20	1363.86	50.84	1.37	14.10	12.71	0.18	7.41	11.47	2.41	0.06	0.11	100.65	0.22	53.6
202R-1, 25–37	1373.05	50.25	1.90	12.85	15.90	0.23	6.01	9.56	2.50	0.09	0.14	99.42	0.00	42.8
205R-1, 0–4	1382.10	50.48	1.81	13.03	14.57	0.22	6.78	10.44	2.19	0.05	0.14	99.69	0.43	47.9
206R-1, 8–12	1386.98	50.79	1.41	13.41	13.57	0.21	7.11	10.46	2.63	0.05	0.11	99.73	0.00	50.9
212R-1, 4–7	1404.14	50.01	1.50	13.60	13.03	0.20	7.06	11.19	2.23	0.06	0.12	98.99	-0.17	51.7
214R-1, 26–35	1411.16	51.46	3.93	12.16	17.51	0.15	3.61	6.97	3.46	0.21	0.37	99.82	0.57	29.0

Table T1 (continued).

Core, section, interval (cm)	Depth (mbsf)	SiO_2 (wt%)	TiO_2 (wt%)	Al_2O_3 (wt%)	Fe_2O_3 (wt%)	MnO (wt%)	MgO (wt%)	CaO (wt%)	Na_2O (wt%)	K_2O (wt%)	P_2O_5 (wt%)	Total	LOI (wt%)	Mg#
214R-1, 26–35	1411.16	49.81	1.34	14.68	11.38	0.16	7.82	11.86	2.65	0.15	0.11	99.95	0.66	57.6
214R-1, 52–58	1411.42	52.58	3.60	12.35	16.67	0.16	3.53	6.50	3.41	0.15	0.40	99.36	1.43	29.6
214R-2, 119–129	1413.55	49.49	1.15	15.49	10.24	0.13	7.22	12.48	2.85	0.08	0.08	99.21	0.46	58.2
215R-1, 43–49	1416.13	49.70	1.18	15.59	10.74	0.14	7.38	12.03	2.70	0.07	0.08	99.60	0.47	57.6
216R-1, 49–58	1418.39	50.24	0.94	15.39	9.81	0.14	7.87	12.72	2.49	0.08	0.06	99.76	0.34	61.4
217R-1, 17–21	1421.77	49.42	0.70	15.68	8.08	0.12	9.23	13.78	2.20	0.06	0.05	99.31	0.71	69.3
217R-1, 29–33	1421.89	49.13	0.80	15.62	9.47	0.13	8.85	12.68	2.41	0.07	0.05	99.20	0.60	64.9
219R-1, 25–32	1430.26	50.48	0.98	14.96	9.40	0.16	8.37	13.33	2.19	0.09	0.08	100.02	0.34	63.8
220R-1, 92–100	1435.92	49.82	1.11	14.46	10.76	0.16	8.30	11.95	2.61	0.08	0.08	99.33	0.67	60.4
222R-2, 25–35	1446.37	48.99	0.76	15.07	8.88	0.13	9.45	12.94	2.37	0.07	0.07	98.72	0.61	67.8
223R-1, 137–144	1450.68	48.72	0.89	14.11	10.11	0.15	10.65	11.85	2.26	0.07	0.08	98.88	1.66	67.6
223R-3, 12–24	1452.40	48.22	0.65	15.07	9.59	0.13	9.52	12.86	2.22	0.06	0.05	98.38	0.60	66.3
227R-1, 50–61	1469.00	49.44	1.41	13.36	14.09	0.20	7.49	10.92	2.54	0.05	0.10	99.59	0.25	51.3
227R-1, 80–86	1469.30	48.74	1.55	13.83	14.32	0.21	7.13	11.69	2.48	0.06	0.09	100.11	0.93	49.6
227R-1, 113–126	1469.63	50.19	1.36	13.52	12.67	0.15	7.64	11.16	2.87	0.07	0.12	99.73	0.45	54.4
230R-1, 72–83	1483.72	47.45	1.72	13.12	15.21	0.18	7.23	11.04	2.50	0.06	0.06	98.56	0.15	48.5
230R-2, 49–61	1484.99	49.47	1.12	14.43	10.69	0.16	8.52	12.60	2.29	0.07	0.06	99.39	0.68	61.2
231R-1, 90–100	1488.80	49.14	1.30	14.06	10.94	0.16	8.36	12.57	2.34	0.06	0.07	98.99	0.86	60.2
231R-3, 80–98	1491.36	49.39	1.29	14.10	11.15	0.17	8.59	12.56	2.40	0.06	0.05	99.75	0.51	60.4
232R-1, 66–81	1493.56	49.43	1.17	14.31	11.17	0.16	8.64	12.35	2.33	0.06	0.06	99.67	0.62	60.5
232R-2, 35–50	1494.33	48.90	1.26	14.01	11.46	0.15	8.05	11.99	2.34	0.05	0.08	98.28	0.84	58.2
233R-1, 14–19	1497.64	50.31	0.97	14.15	11.03	0.15	8.41	11.94	2.61	0.05	0.06	99.68	1.03	60.2
234R-1, 26–29	1502.76	49.46	2.17	12.49	16.35	0.29	5.26	10.61	2.79	0.09	0.19	99.70	2.19	38.9

Note: LOI = loss on ignition, Mg# = 100 × Mg/(Mg + Fe).

Table T2. Measured major element contents and recommended values for reference samples. (**See table notes.**)

Element oxide (wt%)	JB-1b			JB-2			JB-3		
	RV (wt%)	This study (wt%)	RD (%)	RV (wt%)	This study (wt%)	RD (%)	RV (wt%)	This study (wt%)	RD (%)
SiO_2	52.23	52.26	0.07	52.96	53.02	0.12	50.71	50.62	–0.18
TiO_2	1.29	1.29	0.13	1.18	1.17	–0.80	1.44	1.45	0.28
Al_2O_3	14.69	14.51	–1.27	14.56	14.50	–0.38	17.16	17.10	–0.41
Fe_2O_3	9.22	9.18	–0.42	14.17	14.11	–0.41	11.81	11.82	0.07
MnO	0.15	0.15	–3.09	0.22	0.21	–1.54	0.18	0.18	–0.76
MgO	8.32	8.37	0.67	4.59	4.61	0.36	5.14	4.98	–3.24
CaO	9.81	9.81	–0.00	9.77	9.78	0.10	9.76	9.72	–0.43
Na_2O	2.69	2.65	–1.28	2.03	1.99	–1.72	2.69	2.71	0.76
K_2O	1.35	1.35	0.08	0.42	0.41	–0.90	0.79	0.78	–2.01
P_2O_5	0.26	0.27	1.38	0.10	0.10	–4.67	0.30	0.30	–1.42
Total:	100.00	100.96		100.00	101.07		100.00	100.93	

Notes: Recommended values (RV) for Geological Survey of Japan reference samples. Relative deviation (RD) values, an estimate of accuracy, are calculated between RV and values from this study. RV of JB-1b from Terashima et al. (1998), RV of JB-2 and JB-3 from Imai et al. (1995).

Table T3. Measured trace element abundances and recommended values for reference samples. (See table notes.)

Element	W–2 RV (ppm)	W–2 This study (ppm)	W–2 RSD (%)	W–2 RD (%)	BAS–206 This study (ppm)	BAS–206 RSD (%)	BAS–312 This study (ppm)	BAS–312 RSD (%)
Sc	36.2	33.7	12.2	–6.8	51.7	4.7	45.8	1.6
V	270	272	2.5	0.7	465	6.3	321	4.3
Cr	92	91.3	3.1	–0.7	84.6	9.1	252	6.2
Co	46	43.2	6.8	–6.1	55.1	2.4	46.7	1.8
Ni	74	75.0	6.5	1.4	50.7	3.8	88.9	5.2
Zn	77	74.6	3.2	–3.2	133	2.4	89.3	2.2
Ga	17.4	16.7	3.9	–3.9	19.2	2.5	16.5	1.4
Rb	20.1	19.7	3.4	–2.2	2.0	4.0	0.47	1.5
Sr	191.8	188.0	3.4	–2.0	102	1.4	101	1.2
Y	22.8	22.8	2.3	–0.01	50.2	1.7	30.8	1.5
Zr	92.0	93.0	2.4	1.1	128	1.2	79.2	2.1
Zr*		101	2.4	10.1				
Nb	7.76	7.67	2.2	–1.2	4.7	1.4	3.33	1.2
Cs	0.916	0.913	3.2	–0.3	0.1	4.4	0.02	5.7
Ba	171	169	1.7	–1.2	42.2	5.5	12.2	3.0
La	10.59	10.4	1.4	–1.5	4.7	1.0	3.03	1.0
Ce	23.08	22.8	1.5	–1.1	13.9	1.6	8.63	1.4
Pr	3.03	3.02	1.6	–0.3	2.4	1.6	1.44	2.4
Nd	12.95	12.9	2.4	–0.0	13.2	1.3	7.83	2.9
Sm	3.31	3.24	2.8	–2.2	4.7	2.2	2.80	2.8
Eu	1.093	1.05	4.5	–3.8	1.6	0.8	1.03	3.4
Gd	3.69	3.65	2.6	–1.1	6.5	1.7	3.90	2.0
Tb	0.622	0.61	3.0	–1.4	1.2	2.3	0.71	2.3
Dy	3.79	3.77	3.1	–0.6	7.9	1.0	4.81	0.8
Ho	0.798	0.78	2.1	–2.6	1.8	1.9	1.06	2.9
Er	2.26	2.22	3.6	–1.6	5.2	1.3	3.11	2.1
Yb	2.03	2.04	2.9	0.3	4.7	1.5	3.07	2.2
Lu	0.299	0.304	3.8	1.8	0.71	1.1	0.47	1.3
Hf	2.30	2.33	2.3	1.3	3.3	2.5	2.02	1.7
Hf*		2.43	4.0	5.7				
Ta	0.483	0.47	4.0	–3.4	0.5	1.1	0.28	1.2
Pb	7.81	7.63	9.2	–2.3	0.6	25.2	0.23	4.4
Th	2.21	2.28	3.2	3.2	0.3	3.6	0.23	1.7
Th*		2.24	4.6	1.32				
U	0.497	0.509	5.4	2.4	0.316	3.4	0.101	1.6
U*		0.502	2.7	0.92				

Notes: Recommended values (RV) of W–2 standard are from Eggins et al. (1997). Abundances of Zr, Hr, Th, and U of W–2 following alkali fusion are also shown. Relative deviation (RD) values calculated between RV, values from this study, and relative standard deviation (RSD) values, an estimate of precision. For all reference samples $n = 5$ except where denoted by *, where $n = 8$.

Table T4. Trace element abundances. (See table notes.) (Continued on next four pages.)

Core, section, interval (cm)	Depth (mbsf)	Sc (ppm)	V (ppm)	Cr (ppm)	Co (ppm)	Ni (ppm)	Zn (ppm)	Ga (ppm)	Rb (ppm)	Sr (ppm)	Y (ppm)	Zr (ppm)	Nb (ppm)	Cs (ppm)	Ba (ppm)	La (ppm)	Ce (ppm)
309-1256D-																	
75R-1, 116–123	753.05	48.2	388	72.6	51.4	56.0	106	17.8	0.09	78.4	37.5	76.5	2.25	0.006	5.05	2.40	7.54
78R-1, 42–50	763.95	47.8	360	186	43.5	54.8	102	16.8	0.29	74.8	38.3	87.1	3.08	0.013	12.7	2.84	8.74
78R-2, 20–33	764.97	47.6	385	206	46.4	58.6	101	16.4	0.09	75.6	37.8	82.1	2.97	0.000	8.14	3.12	8.91
78R-3, 63–76	766.55	47.5	415	27.8	42.1	25.9	143	20.6	3.05	103	52.2	138	6.60	0.045	18.8	5.38	16.7
78R-3, 63–76	766.55	46.5	430	17.0	49.3	32.4	126	19.6	6.55	98.2	49.1	134	6.36	0.115	17.1	4.94	14.3
79R-1, 98–107	770.72	48.7	465	24.5	50.4	31.6	123	20.3	12.72	102	48.1	135	6.60	0.270	19.6	5.16	14.8
80R-2, 92–102	781.47	47.0	376	67.4	33.3	39.5	96.5	18.2	23.47	148	37.1	129	12.6	0.525	43.6	8.40	20.0
82R-2, 10–20	793.77	48.4	360	151	45.1	67.4	100	17.0	5.11	85.2	33.9	81.8	3.53	0.060	10.6	3.00	9.22
84R-2, 61–70	803.78	45.7	330	260	48.7	93.6	79.0	15.0	0.36	82.8	27.7	61.2	3.95	0.007	17.3	2.71	7.59
85R-2, 124–136	814.97	38.1	296	241	37.4	75.5	73.1	14.7	3.13	77.0	27.1	57.5	3.80	0.062	19.8	3.09	7.88
85R-2, 124–136	814.97	39.4	308	253	47.7	108	83.7	15.6	1.00	80.1	23.4	61.2	3.93	0.006	21.1	2.61	7.28
85R-4, 83–92	816.46	41.5	323	108	50.6	53.5	83.3	16.2	0.52	81.2	29.0	72.1	2.11	0.014	8.05	2.27	7.19
85R-5, 0–21	816.83	47.6	344	114	49.2	49.6	96.2	16.5	0.61	87.2	31.5	75.7	2.16	0.015	8.19	2.29	7.19
87R-1, 22–35	831.06	49.2	350	113	48.3	51.0	93.1	16.5	0.45	85.0	33.7	77.0	2.20	0.021	7.06	2.33	7.52
87R-2, 83–90	832.90	43.7	296	97.9	47.1	52.0	77.4	15.5	0.44	84.0	31.2	65.2	1.93	0.021	6.47	2.30	7.08
88R-1, 10–21	840.41	40.7	322	112	43.7	51.6	89.4	15.2	0.71	80.6	31.3	69.9	2.03	0.019	8.29	2.41	7.12
88R-1, 56–64	840.68	41.5	334	97.9	45.5	46.1	93.0	16.5	0.66	81.2	33.1	73.2	2.10	0.014	8.55	2.55	7.74
92R-1, 102–109	869.83	42.7	275	348	44.1	85.4	80.4	14.8	2.19	103	27.6	76.3	4.73	0.007	57.9	3.65	9.35
97R-1, 61–70	898.37	38.5	287	334	43.1	113	74.4	14.6	1.12	86.7	26.7	61.2	2.16	0.077	8.68	2.17	6.67
97R-1, 102–109	898.69	36.6	269	299	41.4	113	72.2	15.2	0.87	87.7	26.9	63.0	2.12	0.071	9.26	2.25	6.81
99R-2, 29–37	908.97	49.0	325	145	48.1	64.6	94.1	16.7	0.73	79.5	31.1	66.2	2.13	0.013	8.93	2.15	6.98
99R-2, 101–120	909.63	48.6	321	156	48.2	67.0	95.3	16.3	0.42	79.7	31.0	66.8	2.13	0.013	7.59	2.22	6.73
100R-1, 136–144	911.71	47.4	333	214	47.2	74.5	89.3	16.3	0.28	76.7	31.2	63.9	2.07	0.019	4.68	2.12	6.59
102R-1, 17–29	926.86	50.7	367	178	48.8	77.2	98.6	16.5	0.62	75.6	34.5	75.3	2.28	0.024	8.72	2.42	7.63
102R-1, 128–137	927.63	45.0	333	198	49.2	80.4	91.8	15.1	0.74	75.8	31.5	65.8	2.03	0.038	5.35	2.31	7.00
103R-1, 20–28	936.21	50.6	364	203	49.5	78.6	99.3	16.5	0.13	77.3	34.3	73.8	2.32	0.002	6.82	2.21	7.50
105R-1, 35–46	945.99	45.0	361	180	45.4	77.9	96.4	16.3	0.55	78.7	34.2	76.0	2.52	0.015	10.4	2.55	7.94
107R-1, 9–17	955.33	49.0	357	78.1	47.6	54.4	99.2	16.4	0.45	82.7	34.1	79.0	2.86	0.013	9.09	2.73	7.91
108R-1, 38–48	959.21	49.2	327	163	47.1	69.0	91.5	15.8	0.21	89.7	30.7	70.4	2.70	0.007	7.77	2.60	7.43
108R-2, 52–61	960.51	46.2	353	220	46.3	86.4	97.2	17.0	0.31	100	37.7	91.5	2.99	0.009	18.5	3.27	9.58
109R-1, 117–129	965.93	52.8	357	69.1	49.2	49.4	100	17.1	0.47	83.8	34.8	79.7	2.97	0.012	10.3	2.84	8.35
110R-1, 26–32	969.91	50.1	351	74.0	48.5	48.2	114	16.8	0.42	83.1	34.6	79.9	2.91	0.011	10.4	2.83	8.23
110R-1, 130–144	970.89	45.8	324	205	46.0	75.9	87.8	15.6	0.46	76.8	30.4	65.7	2.06	0.015	7.97	2.28	6.86
110R-2, 76–88	971.71	45.4	349	186	47.8	75.5	106	16.6	0.58	78.7	34.2	74.1	2.39	0.010	9.08	2.44	7.62
111R-1, 26–32	974.68	50.0	492	28.3	52.0	32.8	150	20.9	0.58	96.3	57.7	148	5.74	0.023	17.7	5.24	15.7
111R-1, 48–55	974.92	47.3	330	69.7	46.8	46.8	97.6	16.1	0.27	82.6	32.8	75.0	2.77	0.009	9.48	2.74	8.06
112R-1, 113–122	980.26	48.2	306	228	49.2	77.1	88.2	15.6	0.23	77.7	28.0	62.5	3.22	0.005	11.3	2.57	7.32
113R-1, 43–53	984.58	47.5	307	261	48.6	83.9	103	16.3	0.27	77.4	30.4	68.6	3.11	0.005	10.9	2.67	7.38
114R-1, 117–122	989.87	48.4	319	276	51.5	258	168	16.2	0.19	85.6	29.5	69.1	3.36	0.005	14.2	2.60	7.53
114R-1, 127–142	990.04	46.5	308	274	51.4	103	140	15.4	0.27	80.5	27.9	52.6	3.13	0.005	14.5	2.58	7.19
115R-1, 40–50	994.01	51.7	331	75.7	50.5	51.3	99.8	16.7	0.89	87.8	33.8	79.8	3.88	0.013	16.6	3.17	9.42
116R-1, 0–15	998.40	50.8	341	76.1	50.3	54.0	99.3	17.5	0.89	87.8	33.4	81.8	3.97	0.011	17.7	3.24	9.08
117R-1, 56–67	1003.85	52.5	323	194	50.5	74.2	134	17.0	0.26	76.1	31.9	68.2	2.34	0.003	6.48	2.38	6.88
117R-1, 97–107	1004.17	47.6	315	287	48.7	96.0	114	15.6	0.27	73.2	28.0	61.7	3.34	0.005	9.32	2.70	7.08
118R-1, 48–56	1008.63	49.3	322	270	51.4	101	101	15.6	0.20	74.4	29.9	66.4	2.99	0.005	8.11	2.47	7.23
120R-1, 95–105	1018.42	50.3	354	81.5	50.6	51.9	99.6	16.7	0.57	87.6	33.5	81.9	3.85	0.005	15.6	3.20	9.36
122R-1, 28–33	1027.55	32.4	290	95.0	36.8	28.7	18,140	11.6	0.29	61.7	28.5	68.9	2.39	0.005	15.5	2.57	7.09
122R-1, 67–79	1027.97	23.8		68.5	32.2	30.6	142	12.5	0.15	36.4	25.2	59.2	2.07	0.003	9.69	2.17	6.68
126R-1, 39–47	1046.95	39.1	365	63.0	45.0	53.1	97.6	15.4	0.11	83.8	35.2	84.6	3.19	0.002	9.67	3.29	9.35
128R-1, 80–91	1056.77	44.8	361	164	44.4	70.1	93.1	10.4	0.26	101	37.1	83.5	2.44	0.002	13.2	2.95	8.62
129R-1, 34–51	1061.51	43.6	336	174	43.6	73.3	88.2	16.5	0.15	84.8	37.9	99.0	3.26	0.004	7.44	3.49	10.6
129R-1, 125–139	1062.26	43.1	339	185	43.0	76.5	94.4	16.1	0.14	81.2	37.4	97.6	3.15	0.004	7.20	3.48	10.4
130R-1, 14–22	1065.84	47.6	334	75.1	47.0	50.5	92.8	16.4	0.17	80.5	33.5	82.1	3.85	0.003	13.6	3.34	9.21
130R-2, 21–34	1067.28	48.0	308	81.3	45.3	54.4	81.0	15.4	1.73	75.3	30.9	71.4	3.42	0.006	40.7	3.01	8.13
130R-2, 79–88	1067.78	45.5	327	74.4	46.4	48.8	91.7	16.0	0.20	81.0	33.1	80.1	3.80	0.004	12.4	3.30	9.24
131R-1, 65–79	1071.24	43.0	337	93.1	44.9	52.8	96.9	15.8	0.15	80.0	31.8	77.7	3.86	0.004	12.3	3.33	9.08
131R-1, 137–147	1071.86	44.2	353	97.4	45.7	55.5	98.1	16.0	0.23	78.6	31.9	77.5	3.85	0.003	12.4	3.23	8.88
132R-1, 0–18	1075.30	45.2	347	111	44.8	58.3	95.4	15.7	0.15	78.0	31.5	73.1	3.74	0.004	11.6	3.20	8.45
133R-1, 42–52	1082.15	43.3	315	301	44.5	95.4	90.3	15.7	0.10	76.3	30.5	68.3	2.53	0.003	7.01	2.53	7.72
133R-1, 141–148	1082.41	43.7	309	257	45.8	90.8	83.9	14.2	0.17	80.1	26.3	59.3	3.85	0.002	10.3	2.83	7.43
134R-2, 40–52	1086.54	45.8	369	195	44.3	78.0	122	15.7	1.01	98.1	38.1	98.2	3.29	0.010	17.1	3.41	10.5
135R-1, 54–64	1090.56	47.8	409	66.6	47.3	44.5	159	17.4	0.41	82.3	40.4	87.1	3.29	0.008	8.35	3.37	10.1
135R-1, 121–127	1090.86	44.9	347	64.6	66.8	40.1	311	20.1	0.12	17.1	33.8	55.6	2.81	0.002	1.73	2.54	7.71
136R-1, 11–16	1094.65	50.1	368	233	47.5	70.1	115	15.3	0.90	98.7	40.0	112	3.60	0.005	16.5	3.61	11.7
136R-1, 82–90	1095.36	48.8	287	356	50.1	125	119	16.2	0.91	86.1	30.5	56.7	1.72	0.007	13.3	1.85	5.87
137R-1, 92–99	1100.11	48.0	351	255	44.8	74.2	150	15.0	0.90	92.9	33.7	75.0	2.49	0.006	18.1	2.46	7.68
138R-2, 32–41	1105.89	50.7	347	182	48.4	70.5	110	17.8	0.33	74.5	34.0	74.4	2.56	0.004	9.20	2.54	7.71
139R-1, 93–99	1109.83	53.6	348	224	49.9	69.5	1,342	16.2	0.68	97.6	39.6	106	3.50	0.006	9.97	3.69	11.5

Table T4 (continued). (Continued on next page.)

Core, section, interval (cm)	Depth (mbsf)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)	Dy (ppm)	Ho (ppm)	Er (ppm)	Yb (ppm)	Lu (ppm)	Hf (ppm)	Ta (ppm)	Pb (ppm)	Th (ppm)	U (ppm)
309-1256D-																	
75R-1, 116–123	753.05	1.44	7.90	3.01	1.13	4.40	0.86	5.58	1.30	3.82	3.76	0.58	2.10	0.13	0.15	0.14	0.062
78R-1, 42–50	763.95	1.62	8.54	3.14	1.19	4.54	0.86	5.75	1.36	3.93	3.83	0.59	2.27	0.19	0.38	0.22	0.061
78R-2, 20–33	764.97	1.58	8.80	3.28	1.19	4.64	0.90	5.86	1.38	4.12	3.88	0.60	2.24	0.20	0.28	0.19	0.089
78R-3, 63–76	766.55	2.68	14.5	4.88	1.71	6.80	1.23	8.07	1.82	5.26	4.87	0.75	3.51	0.40	0.34	0.43	0.144
78R-3, 63–76	766.55	2.49	12.7	4.42	1.58	6.45	1.19	7.59	1.71	5.04	4.71	0.70	3.40	0.38	0.59	0.41	0.116
79R-1, 98–107	770.72	2.42	13.0	4.47	1.66	6.04	1.12	7.22	1.71	4.82	4.53	0.68	3.58	0.41	0.53	0.41	0.165
80R-2, 92–102	781.47	2.89	13.5	4.07	1.44	5.10	0.94	5.84	1.26	3.67	3.30	0.49	3.07	0.74	0.66	0.87	0.307
82R-2, 10–20	793.77	1.53	8.33	3.08	1.13	4.36	0.85	5.22	1.16	3.44	3.24	0.49	2.14	0.21	0.36	0.22	0.111
84R-2, 61–70	803.78	1.20	6.56	2.28	0.82	3.26	0.64	4.16	0.94	2.90	2.70	0.43	1.67	0.25	0.10	0.28	0.081
85R-2, 124–136	814.97	1.28	6.77	2.33	0.87	3.41	0.63	4.05	0.95	2.76	2.63	0.40	1.56	0.23	0.15	0.28	0.151
85R-2, 124–136	814.97	1.21	6.22	2.25	0.85	3.19	0.58	3.90	0.85	2.53	2.45	0.38	1.66	0.25	0.52	0.28	0.103
85R-4, 83–92	816.46	1.30	6.95	2.57	0.97	3.63	0.70	4.64	1.03	3.04	2.95	0.45	1.89	0.14	0.17	0.14	0.085
85R-5, 0–21	816.83	1.30	6.90	2.57	0.99	3.84	0.76	4.78	1.08	3.37	3.14	0.48	1.90	0.13	0.25	0.15	0.058
87R-1, 22–35	831.06	1.37	7.39	2.70	0.99	4.06	0.77	4.94	1.11	3.48	3.26	0.51	2.00	0.14	0.17	0.14	0.052
87R-2, 83–90	832.90	1.23	7.03	2.50	1.02	3.78	0.70	4.68	1.04	3.10	2.92	0.43	1.71	0.12	0.14	0.13	0.064
88R-1, 10–21	840.41	1.25	7.36	2.63	1.02	3.94	0.73	4.93	1.11	3.33	3.22	0.49	1.88	0.13	0.31	0.14	0.048
88R-1, 56–64	840.68	1.38	7.58	2.81	1.03	3.91	0.75	5.04	1.11	3.38	3.26	0.50	1.99	0.13	0.44	0.15	0.046
92R-1, 102–109	869.83	1.54	7.86	2.71	0.98	3.61	0.65	4.32	0.97	2.78	2.66	0.40	1.89	0.28	0.31	0.31	0.105
97R-1, 61–70	898.37	1.19	6.39	2.49	0.91	3.40	0.62	4.18	0.95	2.78	2.63	0.39	1.58	0.13	0.23	0.15	0.052
97R-1, 102–109	898.69	1.24	6.59	2.35	0.90	3.39	0.67	4.21	0.95	2.74	2.68	0.41	1.60	0.13	0.46	0.15	0.055
99R-2, 29–37	908.97	1.24	6.76	2.61	0.94	3.82	0.71	4.83	1.08	3.19	3.10	0.46	1.77	0.12	0.22	0.13	0.085
99R-2, 101–120	909.63	1.25	6.86	2.54	0.95	3.77	0.73	4.79	1.05	3.14	3.11	0.47	1.85	0.13	0.22	0.14	0.043
100R-1, 136–144	911.71	1.22	6.79	2.52	0.98	3.69	0.71	4.70	1.05	3.11	3.03	0.46	1.81	0.13	0.23	0.14	0.049
102R-1, 17–29	926.86	1.38	7.47	2.83	1.03	4.08	0.78	5.33	1.18	3.45	3.39	0.51	2.00	0.14	0.18	0.15	0.053
102R-1, 128–137	927.63	1.22	6.89	2.58	0.97	3.76	0.72	4.86	1.10	3.11	3.08	0.45	1.73	0.12	0.27	0.13	0.243
103R-1, 20–28	936.21	1.36	7.29	2.78	1.00	4.07	0.79	5.13	1.17	3.45	3.35	0.51	2.00	0.14	0.13	0.14	0.047
105R-1, 35–46	945.99	1.42	7.64	2.89	1.05	4.21	0.80	5.40	1.21	3.53	3.37	0.51	2.02	0.16	0.52	0.17	0.052
107R-1, 9–17	955.33	1.43	7.73	2.87	1.05	4.12	0.77	5.15	1.18	3.42	3.33	0.50	2.02	0.17	0.12	0.19	0.055
108R-1, 38–48	959.21	1.32	7.26	2.58	0.99	3.87	0.71	4.77	1.09	3.12	3.04	0.46	1.81	0.16	0.10	0.17	0.056
108R-2, 52–61	960.51	1.68	9.35	3.34	1.26	4.58	0.86	5.82	1.34	3.82	3.67	0.56	2.36	0.19	0.56	0.19	0.119
109R-1, 117–129	965.93	1.41	7.94	2.82	1.06	4.18	0.81	5.21	1.20	3.51	3.42	0.51	2.06	0.18	0.25	0.19	0.056
110R-1, 26–32	969.91	1.38	7.92	2.90	1.06	4.20	0.78	5.17	1.20	3.51	3.43	0.51	1.99	0.18	0.81	0.19	0.058
110R-1, 130–144	970.89	1.18	6.78	2.59	0.93	3.62	0.70	4.63	1.05	3.06	3.00	0.44	1.72	0.14	1.21	0.14	0.050
110R-2, 76–88	971.71	1.30	7.63	2.81	1.05	4.00	0.75	4.98	1.16	3.43	3.33	0.49	2.01	0.15	0.28	0.15	0.052
111R-1, 26–32	974.68	2.65	14.2	5.11	1.77	7.34	1.36	8.99	2.02	5.91	5.76	0.84	3.81	0.35	0.87	0.36	0.132
111R-1, 48–55	974.92	1.38	7.65	2.75	0.98	4.00	0.74	4.92	1.12	3.34	3.22	0.48	1.97	0.16	0.35	0.18	0.078
112R-1, 113–122	980.26	1.18	6.46	2.37	0.87	3.40	0.65	4.17	0.94	2.85	2.73	0.41	1.67	0.19	0.28	0.22	0.064
113R-1, 43–53	984.58	1.27	6.84	2.51	0.91	3.59	0.69	4.61	1.05	3.14	2.91	0.44	1.79	0.18	0.61	0.20	0.059
114R-1, 117–122	989.87	1.27	6.82	2.56	0.97	3.66	0.69	4.50	1.00	3.10	2.93	0.43	1.80	0.19	1.18	0.24	0.080
114R-1, 127–142	990.04	1.20	6.40	2.51	0.90	3.51	0.66	4.31	0.95	2.88	2.73	0.41	1.60	0.19	0.71	0.19	0.068
115R-1, 40–50	994.01	1.56	8.04	2.92	1.09	4.13	0.77	5.08	1.13	3.37	3.19	0.48	2.08	0.23	0.42	0.25	0.076
116R-1, 0–15	998.40	1.50	8.12	3.05	1.06	4.12	0.79	5.04	1.14	3.38	3.28	0.49	2.12	0.23	0.37	0.26	0.075
117R-1, 56–67	1003.85	1.23	6.80	2.59	0.92	3.81	0.74	4.79	1.09	3.36	3.05	0.47	1.78	0.14	0.70	0.16	0.043
117R-1, 97–107	1004.17	1.18	6.50	2.47	0.95	3.40	0.65	4.12	0.95	2.84	2.66	0.41	1.66	0.20	0.45	0.21	0.065
118R-1, 48–56	1008.63	1.27	6.37	2.51	0.94	3.55	0.70	4.40	1.00	2.93	2.81	0.44	1.67	0.17	0.45	0.19	0.056
120R-1, 95–105	1018.42	1.53	8.40	2.95	1.08	4.26	0.79	5.09	1.17	3.52	3.30	0.50	2.15	0.25	0.75	0.25	0.075
122R-1, 28–33	1027.55	1.22	6.69	2.44	0.92	3.53	0.66	4.28	0.95	2.82	2.80	0.42	1.76	0.15	7.39	0.16	2.705
122R-1, 67–79	1027.97	1.15	6.15	2.25	0.97	3.27	0.59	3.90	0.90	2.65	2.51	0.38	1.61	0.13	11.0	0.15	1.603
126R-1, 39–47	1046.95	1.62	8.65	3.13	1.21	4.42	0.85	5.59	1.22	3.62	3.50	0.52	2.26	0.21	0.17	0.22	0.065
128R-1, 80–91	1056.77	1.49	8.25	3.17	1.06	4.56	0.86	5.83	1.30	3.78	3.71	0.56	2.26	0.15	0.51	0.17	0.051
129R-1, 34–51	1061.51	1.82	9.76	3.53	1.21	4.71	0.89	5.94	1.32	3.80	3.73	0.56	2.48	0.20	0.26	0.22	0.069
129R-1, 125–139	1062.26	1.76	9.47	3.55	1.20	4.87	0.91	5.87	1.31	3.90	3.72	0.56	2.45	0.20	0.37	0.20	0.064
130R-1, 14–22	1065.84	1.50	8.33	2.96	1.09	4.29	0.80	5.20	1.18	3.48	3.34	0.51	2.10	0.24	0.25	0.25	0.073
130R-2, 21–34	1067.28	1.33	7.54	2.59	1.03	3.81	0.70	4.84	1.08	3.08	2.99	0.45	1.84	0.22	0.14	0.23	0.066
130R-2, 79–88	1067.78	1.53	8.16	2.97	1.10	4.22	0.78	5.19	1.17	3.41	3.28	0.50	2.12	0.23	0.27	0.25	0.075
131R-1, 65–79	1071.24	1.44	7.91	2.86	1.06	4.07	0.75	4.97	1.13	3.42	3.17	0.49	1.99	0.24	0.28	0.27	0.074
131R-1, 137–147	1071.86	1.47	7.96	2.79	1.00	4.11	0.75	4.94	1.13	3.33	3.18	0.49	2.04	0.24	0.29	0.25	0.075
132R-1, 0–18	1075.30	1.46	7.94	2.64	1.00	4.03	0.74	4.80	1.10	3.27	3.12	0.47	1.96	0.23	0.23	0.25	0.069
133R-1, 42–52	1082.15	1.30	7.31	2.77	0.98	3.90	0.72	4.76	1.11	3.20	3.05	0.46	1.83	0.15	0.28	0.17	0.049
133R-1, 141–148	1082.41	1.23	6.42	2.28	0.86	3.22	0.62	4.09	0.94	2.71	2.57	0.40	1.59	0.24	0.28	0.26	0.072
134R-2, 40–52	1086.54	1.81	9.92	3.53	1.22	4.84	0.91	5.90	1.35	4.03	3.73	0.58	2.52	0.20	0.39	0.21	0.064
135R-1, 54–64	1090.56	1.78	9.75	3.56	1.29	5.18	0.98	6.28	1.45	4.25	3.99	0.62	2.24	0.21	0.39	0.21	0.063
135R-1, 121–127	1090.86	1.37	7.73	2.95	0.94	4.25	0.78	5.00	1.13	3.27	3.11	0.48	1.61	0.17	1.36	0.16	0.087
136R-1, 11–16	1094.65	1.97	10.7	3.71	1.30	5.24	0.97	6.10	1.41	4.00	3.87	0.60	2.86	0.23	0.35	0.23	0.076
136R-1, 82–90	1095.36	1.04	5.96	2.39	0.91	3.50	0.69	4.48	1.04	3.04	2.97	0.46	1.50	0.11	0.17	0.10	0.029
137R-1, 92–99	1100.11	1.37	7.71	2.86	1.04	4.16	0.78	5.12	1.17	3.36	3.24	0.49	1.92	0.16	0.58	0.16	0.051
138R-2, 32–41	1105.89	1.32	7.51	2.81	1.04	4.15	0.79	5.15	1.16	3.37	3.26	0.50	1.95	0.16	0.30	0.16	0.051
139R-1, 93–99	1109.83	1.92	10.5	3.65	1.25	5.09	0.95	5.96	1.38	3.97	3.75	0.57	2.73	0.23	0.33	0.22	0.070

Table T4 (continued). (Continued on next page.)

Core, section, interval (cm)	Depth (mbsf)	Sc (ppm)	V (ppm)	Cr (ppm)	Co (ppm)	Ni (ppm)	Zn (ppm)	Ga (ppm)	Rb (ppm)	Sr (ppm)	Y (ppm)	Zr (ppm)	Nb (ppm)	Cs (ppm)	Ba (ppm)	La (ppm)	Ce (ppm)
140R-1, 55–65	1114.72	55.3	349	233	58.8	72.4	118	15.4	0.46	81.5	39.9	108	3.53	0.007	9.46	3.53	11.3
142R-1, 38–48	1123.75	50.2	296	334	44.9	120	134	14.5	1.48	89.3	31.0	81.5	2.86	0.016	20.7	3.16	9.68
142R-2, 40–55	1125.34	46.5	284	318	46.1	113	104	16.7	0.56	99.0	32.2	86.3	2.93	0.009	7.70	3.37	10.2
143R-1, 72–82	1128.71	54.1	330	194	49.0	69.5	80.9	16.1	0.14	79.8	30.0	71.7	2.01	0.003	5.59	2.15	6.30
143R-1, 122–125	1129.23	51.8	341	198	48.6	71.2	85.2	16.8	0.13	77.9	31.1	64.1	2.12	0.003	5.95	2.24	6.82
143R-2, 40–49	1129.64	44.8	314	194	45.7	66.1	92.3	15.5	0.18	74.6	28.6	61.6	2.87	0.005	8.72	2.50	6.96
144R-2, 39–56	1134.38	45.0	327	199	45.9	73.8	109	15.0	0.23	76.0	28.7	62.3	2.87	0.004	10.3	2.59	7.19
145R-2, 73–89	1139.63	44.5	299	276	42.9	82.2	106	14.4	0.27	77.9	25.4	53.4	3.00	0.004	9.44	2.44	6.85
146R-1, 30–54	1142.50	43.5	292	303	43.6	83.0	109	14.3	0.33	74.3	24.9	*58.1	2.95	0.004	9.48	2.39	6.73
146R-2, 80–88	1143.86	45.3	304	302	46.8	87.2	115	14.6	0.32	75.0	25.9	*61.5	3.10	0.002	10.4	2.65	7.09
147R-1, 40–48	1145.98	46.6	363	223	43.9	57.8	92.7	15.2	0.72	84.8	32.8	68.7	2.58	0.005	10.8	2.49	7.47
149R-1, 57–63	1156.66	48.5	444	77.2	41.6	45.1	74.2	15.0	0.21	97.1	46.8	112	4.08	0.003	11.0	3.90	12.0
149R-1, 138–145	1157.33	46.5	440	94.8	50.1	44.1	195	17.3	0.20	88.8	45.2	110	3.88	0.005	9.79	3.78	11.4
151R-1, 119–125	1166.43	47.0	399	84.4	48.7	50.3	111	17.3	0.10	82.6	39.8	94.0	3.52	0.002	9.37	3.38	9.89
153R-2, 36–47	1176.70	47.4	414	75.7	47.8	41.1	148	17.6	0.11	83.5	41.7	94.7	3.44	0.002	8.29	3.46	10.2
153R-2, 103–115	1177.28	47.2	399	110	41.0	50.7	245	16.4	0.34	85.9	38.1	87.2	3.10	0.002	9.88	2.95	9.16
154R-2, 30–52	1181.45	46.6	431	95.3	47.3	50.0	207	15.7	0.91	94.7	40.6	95.8	3.50	0.004	18.8	3.32	9.82
155R-2, 60–80	1186.47	43.6	388	102	45.3	54.4	131	16.2	0.56	77.2	33.9	*86.1	3.12	0.003	15.2	2.95	8.59
155R-3, 0–10	1187.12	43.9	387	99.3	46.0	51.1	118	16.4	0.11	69.4	34.8	102	3.09	0.003	8.21	2.93	9.04
156R-1, 90–100	1190.51	42.0	327	222	44.7	75.5	91.7	14.9	0.35	76.1	28.2	61.3	2.42	0.004	11.8	2.26	6.68
157R-1, 111–125	1195.29	43.4	424	68.9	45.9	44.5	171	17.6	0.19	79.1	42.9	106	3.67	0.002	9.90	3.65	11.0
159R-1, 3–13	1203.83	43.2	409	85.0	46.1	46.3	144	17.2	0.16	81.2	39.4	90.9	3.25	0.004	9.48	3.18	9.74
159R-1, 60–70	1204.40	46.1	418	81.9	38.3	49.9	156	13.6	0.56	65.5	39.4	92.5	3.31	0.004	11.2	3.07	9.50
159R-1, 98–110	1204.63	42.3	371	163	45.0	71.2	84.2	16.3	0.16	79.2	35.8	86.7	3.07	0.003	8.19	3.04	9.21
160R-1, 85–100	1209.69	42.0	332	127	45.5	72.1	104	14.7	0.64	77.9	28.6	63.7	3.50	0.001	15.0	2.81	7.64
161R-1, 105–113	1211.15	39.9	295	426	41.3	132	63.4	13.1	3.79	93.2	25.2	50.5	1.56	0.004	55.9	1.52	5.10
162R-1, 37–45	1213.95	42.3	337	284	41.7	85.8	88.0	15.7	1.33	83.8	32.3	80.1	3.02	0.002	25.8	2.89	8.51
162R-2, 89–106	1215.60	42.1	328	295	45.5	107	82.1	15.1	0.34	65.7	28.0	59.5	2.10	0.002	9.37	2.07	6.38
163R-2, 55–63	1219.91	45.2	372	185	45.8	71.5	106	16.7	0.23	80.3	37.0	86.7	3.11	0.003	9.02	3.18	9.52
164R-1, 27–50	1223.80	43.1	342	278	44.1	88.3	82.8	16.1	0.31	84.6	33.6	83.8	3.19	0.002	9.84	2.98	9.14
164R-2, 5–15	1224.49	46.2	328	260	46.6	80.5	92.0	16.8	0.13	83.5	34.0	84.8	3.25	0.003	7.96	3.15	9.22
164R-2, 101–107	1225.18	46.7	383	77.7	46.7	44.0	77.6	16.9	0.31	81.8	39.1	80.9	3.28	0.004	9.36	3.32	9.74
164R-3, 36–44	1225.86	45.1	418	75.5	45.9	42.3	67.8	18.1	0.08	83.6	42.8	104	3.67	0.003	9.03	3.59	10.9
165R-1, 23–33	1228.12	46.6	395	78.4	33.0	41.9	143	16.0	0.25	85.8	38.0	85.3	3.13	0.002	9.39	3.02	9.17
165R-2, 71–91	1230.17	45.2	394	72.6	45.2	43.8	132	17.2	0.15	79.8	39.6	92.0	3.31	0.002	8.62	3.26	9.80
165R-3, 19–30	1230.19	47.1	396	59.4	39.4	40.7	93.9	16.1	0.13	87.1	40.1	94.0	3.34	0.002	9.53	3.12	9.78
166R-1, 15–27	1232.87	44.8	373	42.0	38.4	37.5	96.9	16.1	0.25	91.4	38.8	76.7	4.32	0.002	10.5	3.74	10.6
166R-1, 126–132	1233.74	42.6	376	63.5	41.7	43.4	138	15.8	0.13	71.9	38.4	89.0	3.09	0.002	8.40	3.15	9.58
166R-2, 88–99	1235.57	44.8	399	86.5	38.4	44.5	113	16.1	0.29	105	40.1	97.2	3.34	0.002	12.4	3.00	9.36
166R-3, 49–65	1235.75	44.3	397	66.9	45.4	46.3	136	16.8	0.63	84.5	41.9	95.4	3.40	0.002	16.1	3.51	10.7
167R-1, 12–23	1236.68	39.8	321	271	40.2	96.4	75.5	15.1	0.34	67.8	28.8	63.4	2.21	0.002	10.9	2.13	6.48
167R-2, 50–70	1238.63	43.3	320	291	45.2	115	78.3	14.7	0.45	69.1	27.5	57.7	2.02	0.001	11.4	1.99	5.93
168R-1, 58–72	1243.18	43.0	355	107	45.9	58.6	97.9	16.7	0.15	81.1	37.6	92.2	3.50	0.002	9.95	3.46	10.3
168R-3, 23–32	1245.16	42.7	353	119	44.2	65.4	95.1	16.4	0.21	81.3	36.3	88.7	3.43	0.001	10.0	3.34	9.75
168R-4, 78–90	1247.03	43.2	355	101	45.6	54.2	98.5	16.7	0.21	82.9	37.3	90.3	3.52	0.002	9.68	3.41	10.1
169R-2, 40–54	1248.75	43.0	316	214	46.6	71.2	90.1	14.8	0.18	76.2	29.0	69.4	3.73	0.002	10.7	2.96	8.02
169R-3, 18–37	1249.88	41.4	289	231	38.8	76.4	88.6	12.4	0.65	93.3	24.3	53.6	3.01	0.005	14.3	2.33	6.40
170R-2, 40–48	1253.50	42.6	323	253	45.3	78.8	84.7	15.0	0.16	71.2	28.9	57.1	3.77	0.003	9.73	3.05	7.97
170R-2, 130–144	1254.31	61.2	289	382	56.3	122	87.7	16.8	0.61	76.1	28.2	52.5	1.67	0.002	13.4	1.78	5.53
170R-3, 22–40	1254.68	50.5	265	365	48.0	128	80.6	15.3	3.15	95.2	26.5	49.9	1.64	0.003	40.7	1.76	5.42
312-1256D-																	
173R-1, 0–10	1260.60	45.7	346	251	47.1	81.0	89.6	15.1	0.13	72.6	28.0	66.3	3.11	0.003	7.92	2.56	7.27
174R-1, 73–79	1266.13	46.4	435	76.9	47.4	46.3	166	16.4	2.39	86.4	37.8	91.4	3.02	0.005	60.3	3.09	9.01
175R-1, 75–83	1272.05	46.3	395	128	47.0	60.4	110	16.7	0.21	82.2	36.5		3.91	0.003	11.0	3.30	9.97
176R-1, 116–122	1277.27	46.5	484	95.5	41.7	55.1	191	17.2	0.56	80.1	41.2		3.53	0.004	14.5	3.61	10.8
176R-2, 42–55	1278.03	46.2	488	55.4	48.9	36.2	148	19.3	0.11	86.9	52.7	141	5.41	0.001	12.2	5.03	14.6
181R-1, 51–56	1300.61	44.5	345	255	47.2	81.9	73.0	15.4	0.61	74.7	29.8		2.00	0.002	14.3	2.06	6.35
182R-1, 18–25	1305.09	44.3	359	267	48.2	79.8	74.1	15.2	0.40	77.3	30.5		1.95	0.001	11.3	2.15	6.46
184R-1, 0–8	1314.50	47.3	427	58.0	50.7	44.0	58.5	17.2	0.40	79.7	37.9	83.2	3.09	0.001	11.1	2.95	8.84
186R-1, 12–20	1320.10	47.3	392	103	42.5	56.5	37.0	15.3	1.53	98.8	34.5	83.0	2.90	0.001	19.4	2.46	7.96
187R-2, 21–31	1325.88	46.7	393	105	43.3	53.6	38.1	16.5	2.67	88.7	35.0	82.4	2.85	0.001	33.4	3.04	8.73
189R-1, 0–13	1333.90	37.5	261	320	41.1	131	39.2	15.7	2.92	122	29.6	96.7	7.03	0.003	93.0	4.99	12.7
189R-1, 71–89	1334.61	36.8	263	332	42.0	133	46.9	15.9	0.52	119	29.0	91.9	7.13	0.002	21.0	4.87	13.0
196R-1, 16–20	1363.86	44.2	346	179	45.3	70.2	48.7	16.4	0.15	79.6	33.9	76.7	2.61	0.001	7.32	2.77	8.10
202R-1, 25–37	1373.05	47.6	443	70.2	51.4	41.6	45.6	18.2	0.54	82.9	43.9		3.88	0.002	14.4	3.82	11.2
205R-1, 0–4	1382.10	46.4	458	131	48.0	57.6	85.3	18.0	0.27	80.8	43.8		3.15	0.003	10.2	3.41	10.2
206R-1, 8–12	1386.98	47.4	381	148	48.0	55.9	48.7	16.6	0.13	82.7	34.9		2.87	0.003	8.54	2.95	8.52
212R-1, 4–7	1404.14	45.5	352	202	45.0	59.4	77.6	17.3	0.24	90.5	35.9		3.56	0.003	11.7	3.39	9.72
214R-1, 26–35	1411.16	40.5	277	88.1	36.1	38.9	33.0	18.3	1.86	97.1	94.3	298	14.6	0.005	35.7	11.6	35.8

Table T4 (continued). (Continued on next page.)

Core, section, interval (cm)	Depth (mbsf)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)	Dy (ppm)	Ho (ppm)	Er (ppm)	Yb (ppm)	Lu (ppm)	Hf (ppm)	Ta (ppm)	Pb (ppm)	Th (ppm)	U (ppm)
140R-1, 55–65	1114.72	1.93	10.3	3.64	1.13	5.05	0.96	6.12	1.34	3.95	3.76	0.58	2.59	0.23	0.64	0.21	0.070
142R-1, 38–48	1123.75	1.67	8.69	3.01	1.05	4.12	0.76	4.84	1.05	3.03	2.87	0.44	2.00	0.18	0.11	0.16	0.048
142R-2, 40–55	1125.34	1.70	9.14	3.09	1.09	4.22	0.77	4.84	1.10	3.10	2.96	0.46	2.11	0.18	0.17	0.17	0.057
143R-1, 72–82	1128.71	1.12	6.21	2.40	0.89	3.56	0.68	4.47	1.01	3.00	2.90	0.45	1.63	0.13	0.16	0.13	0.040
143R-1, 122–125	1129.23	1.17	6.72	2.49	0.96	3.81	0.73	4.76	1.07	3.18	3.10	0.49	1.75	0.13	0.21	0.14	0.040
143R-2, 40–49	1129.64	1.22	6.59	2.44	0.86	3.49	0.66	4.40	0.97	2.90	2.75	0.43	1.66	0.18	0.13	0.19	0.055
144R-2, 39–56	1134.38	1.24	6.77	2.57	0.90	3.60	0.68	4.51	1.00	3.06	2.81	0.44	1.70	0.17	0.27	0.19	0.055
145R-2, 73–89	1139.63	1.16	6.04	2.28	0.86	3.13	0.60	3.96	0.89	2.70	2.47	0.38	1.45	0.18	0.21	0.20	0.055
146R-1, 30–54	1142.50	1.13	5.89	2.26	0.76	3.12	0.57	3.83	0.87	2.50	2.31	0.36	*1.53	0.18	0.17	*0.20	*0.06
146R-2, 80–88	1143.86	1.16	6.27	2.25	0.84	3.27	0.63	4.02	0.92	2.64	2.52	0.38	*1.57	0.19	0.22	*0.21	*0.06
147R-1, 40–48	1145.98	1.29	7.03	2.67	0.99	3.96	0.74	5.13	1.17	3.40	3.28	0.50	1.88	0.16	0.18	0.17	0.051
149R-1, 57–63	1156.66	2.06	11.7	4.12	1.35	5.98	1.08	7.31	1.63	4.83	4.61	0.70	2.98	0.26	0.24	0.27	0.083
149R-1, 138–145	1157.33	1.98	10.7	3.93	1.37	5.60	1.01	6.94	1.56	4.51	4.34	0.66	2.85	0.25	0.43	0.26	0.077
151R-1, 119–125	1166.43	1.72	9.27	3.45	1.20	4.81	0.91	6.07	1.37	4.03	3.93	0.59	2.41	0.22	0.37	0.23	0.067
153R-2, 36–47	1176.70	1.79	9.82	3.39	1.28	5.22	0.97	6.48	1.43	4.18	4.08	0.62	2.55	0.21	0.29	0.23	0.068
153R-2, 103–115	1177.28	1.57	8.55	3.23	1.16	4.63	0.91	5.97	1.32	4.02	3.81	0.59	2.37	0.19	0.19	0.20	0.058
154R-2, 30–52	1181.45	1.79	9.72	3.43	1.23	4.98	0.97	6.40	1.41	4.20	4.07	0.63	2.53	0.22	0.26	0.21	0.066
155R-2, 60–80	1186.47	1.59	8.31	2.99	1.14	4.44	0.82	5.38	1.16	3.41	3.40	0.49	*2.21	0.20	0.21	*0.21	*0.07
155R-3, 0–10	1187.12	1.56	8.49	3.02	1.07	4.51	0.80	5.46	1.21	3.54	3.49	0.52	2.01	0.19	0.30	0.18	0.053
156R-1, 90–100	1190.51	1.15	6.18	2.37	0.89	3.40	0.66	4.31	0.97	2.87	2.76	0.42	1.63	0.15	0.13	0.16	0.051
157R-1, 111–125	1195.29	1.93	10.5	3.93	1.39	5.53	1.01	6.65	1.46	4.36	4.24	0.65	2.70	0.22	0.25	0.27	0.076
159R-1, 3–13	1203.83	1.71	9.32	3.48	1.25	5.11	0.90	6.08	1.36	4.10	3.94	0.59	2.45	0.20	0.18	0.22	0.068
159R-1, 60–70	1204.40	1.63	8.99	3.56	1.06	4.89	0.92	6.27	1.36	4.06	3.89	0.60	2.47	0.21	0.14	0.21	0.065
159R-1, 98–110	1204.63	1.59	8.83	3.13	1.15	4.53	0.84	5.64	1.22	3.76	3.55	0.55	2.23	0.19	0.20	0.19	0.061
160R-1, 85–100	1209.69	1.28	6.99	2.47	0.92	3.52	0.67	4.50	0.98	2.85	2.85	0.43	1.76	0.21	0.21	0.24	0.068
161R-1, 105–113	1211.15	0.91	5.38	2.17	0.74	2.97	0.58	3.85	0.86	2.56	2.47	0.38	1.37	0.09	0.11	0.11	0.081
162R-1, 37–45	1213.95	1.49	7.86	2.85	1.06	4.08	0.76	4.98	1.11	3.35	3.14	0.48	2.09	0.19	0.12	0.21	0.062
162R-2, 89–106	1215.60	1.12	6.22	2.41	0.89	3.51	0.65	4.35	1.00	2.90	2.81	0.42	1.62	0.13	0.12	0.13	0.044
163R-2, 55–63	1219.91	1.63	8.75	3.23	1.16	4.61	0.86	5.73	1.27	3.88	3.63	0.56	2.30	0.19	0.20	0.20	0.059
164R-1, 27–50	1223.80	1.51	8.35	2.98	1.08	4.23	0.78	5.27	1.19	3.50	3.30	0.49	2.14	0.19	0.25	0.21	0.064
164R-2, 5–15	1224.49	1.61	8.54	3.10	1.10	4.25	0.78	5.31	1.18	3.54	3.30	0.51	2.09	0.20	0.27	0.21	0.063
164R-2, 101–107	1225.18	1.65	9.23	3.45	1.27	4.93	0.91	6.01	1.37	4.06	3.78	0.59	2.20	0.19	0.10	0.21	0.064
164R-3, 36–44	1225.86	1.88	10.3	3.77	1.33	5.43	1.00	6.74	1.52	4.47	4.29	0.67	2.68	0.23	0.18	0.24	0.075
165R-1, 23–33	1228.12	1.63	9.01	3.26	1.13	4.71	0.89	5.88	1.32	4.04	3.76	0.57	2.29	0.20	0.11	0.20	0.065
165R-2, 71–91	1230.17	1.70	9.36	3.41	1.24	5.06	0.92	6.11	1.39	4.15	3.94	0.60	2.39	0.21	0.13	0.23	0.066
165R-3, 19–30	1230.19	1.67	9.18	3.42	1.21	5.05	0.95	6.47	1.40	4.20	4.04	0.61	2.44	0.22	0.15	0.22	0.069
166R-1, 15–27	1232.87	1.81	9.67	3.54	1.26	4.94	0.91	6.09	1.35	3.96	3.73	0.57	2.32	0.27	0.14	0.28	0.082
166R-1, 126–132	1233.74	1.69	9.28	3.36	1.18	4.72	0.89	6.05	1.34	3.95	3.85	0.58	2.42	0.20	0.18	0.21	0.062
166R-2, 88–99	1235.57	1.69	9.64	3.52	1.22	5.08	0.93	6.33	1.40	4.16	4.04	0.61	2.63	0.22	0.17	0.23	0.066
166R-3, 49–65	1235.75	1.80	10.1	3.82	1.27	5.26	0.98	6.77	1.47	4.27	4.19	0.64	2.61	0.21	0.15	0.22	0.068
167R-1, 12–23	1236.68	1.17	6.26	2.48	0.89	3.57	0.68	4.57	1.01	3.00	2.91	0.44	1.73	0.14	0.10	0.15	0.047
167R-2, 50–70	1238.63	1.08	5.78	2.30	0.85	3.26	0.62	4.23	0.96	2.85	2.67	0.42	1.52	0.12	0.10	0.14	0.042
168R-1, 58–72	1243.18	1.75	9.31	3.50	1.25	4.81	0.89	5.93	1.32	3.85	3.74	0.56	2.42	0.21	0.31	0.22	0.070
168R-3, 23–32	1245.16	1.64	8.88	3.24	1.18	4.66	0.86	5.83	1.26	3.77	3.59	0.54	2.38	0.22	0.31	0.21	0.071
168R-4, 78–90	1247.03	1.72	9.08	3.37	1.23	4.77	0.89	5.90	1.33	3.78	3.71	0.55	2.40	0.22	0.36	0.22	0.065
169R-2, 40–54	1248.75	1.34	7.13	2.57	0.91	3.69	0.68	4.53	1.03	3.00	2.88	0.43	1.74	0.23	0.18	0.26	0.074
169R-3, 18–37	1249.88	1.04	5.53	2.09	0.78	3.02	0.58	3.71	0.84	2.53	2.43	0.37	1.45	0.18	0.11	0.20	0.060
170R-2, 40–48	1253.50	1.33	7.14	2.52	0.89	3.71	0.69	4.53	0.98	2.99	2.82	0.43	1.72	0.23	0.11	0.25	0.068
170R-2, 130–144	1254.31	1.00	5.70	2.23	0.84	3.21	0.61	4.14	0.93	2.79	2.56	0.40	1.43	0.10	0.16	0.10	0.034
170R-3, 22–40	1254.68	1.00	5.51	2.15	0.79	3.14	0.59	3.95	0.88	2.72	2.52	0.38	1.42	0.10	0.15	0.10	0.033
312-1256D-																	
173R-1, 0–10	1260.60	1.22	6.36	2.45	0.84	3.31	0.65	4.36	0.94	2.71	2.67	0.42	1.60	0.19	0.09	0.20	0.059
174R-1, 73–79	1266.13	1.56	8.68	3.25	1.26	4.65	0.89	5.77	1.26	3.77	3.50	0.55	2.27	0.20	0.07	0.20	0.067
175R-1, 75–83	1272.05	1.71	9.30	3.33	1.15	4.59	0.83	5.75	1.26	3.55	3.45	0.53		0.23	0.17		
176R-1, 116–122	1277.27	1.89	9.87	3.78	1.24	5.25	1.01	6.61	1.43	4.16	3.94	0.61		0.23	0.13		
176R-2, 42–55	1278.03	2.52	13.5	4.97	1.67	6.72	1.31	8.33	1.84	5.09	5.03	0.79	3.50	0.33	0.28	0.36	0.107
181R-1, 51–56	1300.61	1.17	6.37	2.60	0.90	3.75	0.71	4.60	1.01	2.97	2.92	0.45		0.11	0.13		
182R-1, 18–25	1305.09	1.22	6.63	2.61	0.95	3.72	0.70	4.61	1.03	2.94	2.92	0.46		0.12	0.32		
184R-1, 0–8	1314.50	1.60	8.71	3.29	1.16	4.59	0.87	5.77	1.26	3.57	3.57	0.55	2.24	0.19	0.15	0.20	0.059
186R-1, 12–20	1320.10	1.49	7.73	2.99	1.03	4.12	0.79	5.32	1.15	3.32	3.19	0.50	2.20	0.17	0.14	0.20	0.061
187R-2, 21–31	1325.88	1.47	8.04	2.99	1.08	4.31	0.81	5.50	1.21	3.48	3.33	0.51	2.17	0.17	0.09	0.21	0.071
189R-1, 0–13	1333.90	1.95	9.86	3.14	1.04	4.04	0.69	4.68	0.96	2.79	2.63	0.40	2.30	0.41	0.10	0.49	0.122
189R-1, 71–89	1334.61	2.05	9.75	3.16	1.13	4.00	0.71	4.65	1.02	2.78	2.64	0.40	2.18	0.43	0.13	0.46	0.137
196R-1, 16–20	1363.86	1.37	7.90	2.91	0.99	4.03	0.75	5.26	1.15	3.50	3.22	0.50	2.03	0.17	0.06	0.17	0.053
202R-1, 25–37	1373.05	1.97	10.5	3.84	1.37	5.57	1.01	6.97	1.48	4.44	4.21	0.63		0.24	0.05		
205R-1, 0–4	1382.10	1.89	10.4	3.86	1.29	5.34	0.98	6.92	1.40	4.44	4.13	0.64		0.21	0.20		
206R-1, 8–12	1386.98	1.45	8.21	3.04	1.08	4.18	0.81	5.49	1.18	3.58	3.39	0.51		0.18	0.08		
212R-1, 4–7	1404.14	1.67	9.01	3.39	1.16	4.70	0.86	5.76	1.21	3.66	3.38	0.52		0.22	0.28		
214R-1, 26–35	1411.16	5.89	30.7	10.1	3.00	13.2	2.39	15.7	3.20	9.75	8.27	1.18	7.39	0.87	0.05	0.79	0.269

Table T4 (continued).

Core, section, interval (cm)	Depth (mbsf)	Sc (ppm)	V (ppm)	Cr (ppm)	Co (ppm)	Ni (ppm)	Zn (ppm)	Ga (ppm)	Rb (ppm)	Sr (ppm)	Y (ppm)	Zr (ppm)	Nb (ppm)	Cs (ppm)	Ba (ppm)	La (ppm)	Ce (ppm)
214R-1, 26–35	1411.16	72.8	175	196	58.8	53.1	56.9	25.6	2.37	149	52.5	95.3	4.45	0.006	42.6	4.80	14.9
214R-1, 52–58	1411.42	43.5	186	49.5	38.5	29.9	40.8	18.1	1.37	86.6	93.2	336	15.4	0.007	21.3	11.7	36.3
214R-2, 119–129	1413.55	42.1	276	325	37.1	82.3	34.1	15.9	0.46	94.1	27.9	66.7	2.24	0.002	10.1	2.52	7.32
215R-1, 43–49	1416.13	40.5	260	227	38.3	85.5	36.4	15.9	0.34	95.5	26.1	60.1	2.18	0.003	9.02	2.30	6.89
216R-1, 49–58	1418.39	44.4	219	313	38.7	75.4	34.4	14.6	0.38	94.3	22.5	49.0	1.59	0.002	11.9	2.39	6.30
217R-1, 17–21	1421.77	42.3	244	1126	36.7	147	25.6	13.1	0.32	79.6	16.0	29.9	1.04	0.000	8.38	1.61	4.78
217R-1, 29–33	1421.89	41.9	251	652	40.4	127	30.4	14.5	0.30	88.2	20.8	36.0	1.44	0.001	8.15	2.13	6.60
219R-1, 25–32	1430.26	46.2	283	672	42.3	117	45.6	14.3	0.63	87.5	22.8	53.5	2.00	0.003	14.7	2.42	6.24
220R-1, 92–100	1435.92	42.9	318	508	47.1	118	38.9	15.9	0.41	90.2	26.3	56.9	2.14	0.000	18.1	2.43	7.06
222R-2, 25–35	1446.37	40.9	231	856	43.2	163	34.4	13.7	0.45	86.7	22.2	41.1	1.84	0.001	7.72	2.01	5.97
223R-1, 137–144	1450.68	41.0	295	418	54.1	233	38.7	13.9	0.29	79.9	24.0	49.5	1.94	0.001	7.21	1.88	5.60
223R-3, 12–24	1452.40	40.4	203	549	65.6	389	44.6	13.6	0.32	88.8	18.7	35.8	1.27	0.002	6.55	1.62	4.68
227R-1, 50–61	1469.00	45.0	481	136	46.3	68.1	64.3	17.1	0.17	80.5	32.0	70.4	2.73	0.002	6.69	2.65	8.13
227R-1, 80–86	1469.30	47.7	438	152	50.2	69.1	66.7	17.9	0.12	76.4	33.9	72.1	2.67	0.003	6.71	2.54	7.96
227R-1, 113–126	1469.63	44.5	471	162	44.1	75.0	38.4	17.0	0.38	85.6	34.5	86.3	3.18	0.001	7.44	3.22	10.1
230R-1, 72–83	1483.72	49.1	637	172	58.2	74.3	64.5	18.6	0.22	85.5	28.4	53.1	1.92	0.001	6.46	2.07	5.91
230R-2, 49–61	1484.99	45.7	262	419	42.7	88.9	47.2	15.1	0.27	89.2	27.0	45.4	1.52	0.003	7.86	1.69	5.38
231R-1, 90–100	1488.80	46.6	281	472	42.6	98.6	46.2	15.2	0.18	87.9	28.9	52.1	1.79	0.001	7.12	1.91	5.96
231R-3, 80–98	1491.36	46.5	359	588	47.1	109	50.9	15.4	0.24	91.7	24.9	47.2	1.40	0.002	7.38	1.51	4.57
232R-1, 66–81	1493.56	45.4	329	487	48.0	115	52.0	15.8	0.31	92.3	27.9	45.4	1.57	0.003	8.94	1.71	5.51
232R-2, 35–50	1494.33	45.5	315	450	44.6	97.5	44.6	15.5	0.15	89.6	31.0	65.5	2.25	0.002	7.39	2.23	7.23
233R-1, 14–19	1497.64	45.9	335	254	44.6	80.7	46.6	15.2	0.16	74.0	23.9	43.8	1.34	0.004	5.24	1.57	4.50
234R-1, 26–29	1502.76	45.8	467	47	49.8	42.2	88.4	18.7	0.30	79.7	56.6	149.1	5.22	0.002	8.08	4.91	14.6

Notes: Most elements analyzed by ICP-MS using acid digestion. Zr, Hf, Th, and U abundances of three samples from Expedition 309 (*) and all samples from Expedition 312 were analyzed using the alkali fusion method.

Core, section, interval (cm)	Depth (mbsf)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)	Dy (ppm)	Ho (ppm)	Er (ppm)	Yb (ppm)	Lu (ppm)	Hf (ppm)	Ta (ppm)	Pb (ppm)	Th (ppm)	U (ppm)
214R-1, 26–35	1411.16	2.53	14.2	5.09	1.83	6.90	1.32	8.54	1.81	5.52	5.05	0.74	2.53	0.34	0.16	0.24	0.084
214R-1, 52–58	1411.42	5.84	29.9	9.91	3.17	12.8	2.33	15.1	3.19	9.40	8.37	1.17	7.97	0.95	0.04	0.83	0.298
214R-2, 119–129	1413.55	1.22	6.83	2.66	1.03	3.65	0.67	4.57	0.97	2.87	2.61	0.39	1.68	0.14	0.12	0.14	0.047
215R-1, 43–49	1416.13	1.16	6.47	2.26	1.07	3.34	0.62	3.93	0.89	2.63	2.49	0.36	1.55	0.14	0.10	0.13	0.047
216R-1, 49–58	1418.39	1.12	5.76	2.03	0.93	2.79	0.54	3.49	0.77	2.26	2.15	0.31	1.21	0.10	0.10	0.11	0.042
217R-1, 17–21	1421.77	0.80	4.11	1.54	0.73	2.12	0.40	2.75	0.60	1.69	1.55	0.23	0.85	0.06	0.10	0.07	0.027
217R-1, 29–33	1421.89	1.20	5.92	2.09	0.88	2.77	0.53	3.41	0.74	2.15	2.01	0.30	1.02	0.09	0.10	0.10	0.034
219R-1, 25–32	1430.26	1.02	5.61	2.02	0.82	2.95	0.54	3.61	0.81	2.38	2.13	0.33	1.37	0.11	0.13	0.12	0.036
220R-1, 92–100	1435.92	1.17	6.31	2.59	0.94	3.42	0.65	4.18	0.93	2.66	2.53	0.40	1.53	0.14	0.14	0.14	0.047
222R-2, 25–35	1446.37	1.00	5.77	2.03	0.77	2.84	0.56	3.64	0.77	2.27	2.10	0.33	1.09	0.12	0.07	0.10	0.029
223R-1, 137–144	1450.68	1.05	5.68	2.14	0.75	2.95	0.58	3.81	0.84	2.35	2.24	0.35	1.29	0.12	0.16	0.13	0.039
223R-3, 12–24	1452.40	0.85	4.33	1.71	0.69	2.32	0.44	2.94	0.65	1.86	1.75	0.27	0.98	0.08	0.10	0.09	0.026
227R-1, 50–61	1469.00	1.42	7.95	2.89	1.05	3.92	0.78	5.12	1.12	3.22	3.13	0.48	1.90	0.18	0.04	0.20	0.052
227R-1, 80–86	1469.30	1.38	7.73	2.97	1.07	4.19	0.79	5.34	1.16	3.34	3.25	0.51	1.93	0.17	0.05	0.16	0.064
227R-1, 113–126	1469.63	1.66	8.78	3.10	1.05	4.24	0.80	5.35	1.21	3.51	3.28	0.51	2.11	0.19	0.08	0.22	0.065
230R-1, 72–83	1483.72	1.04	5.98	2.39	0.95	3.40	0.65	4.37	1.00	2.64	2.73	0.42	1.40	0.11	0.02	0.11	0.035
230R-2, 49–61	1484.99	0.96	5.83	2.24	0.94	3.27	0.64	4.25	0.95	2.74	2.58	0.39	1.28	0.09	0.10	0.10	0.028
231R-1, 90–100	1488.80	1.15	6.59	2.52	0.99	3.52	0.70	4.56	1.02	2.97	2.69	0.42	1.48	0.12	0.08	0.13	0.037
231R-3, 80–98	1491.36	0.85	4.80	1.98	0.90	3.05	0.60	3.92	0.86	2.51	2.43	0.36	1.31	0.09	0.08	0.10	0.034
232R-1, 66–81	1493.56	1.01	5.88	2.27	1.00	3.37	0.66	4.32	0.97	2.80	2.63	0.41	1.31	0.10	0.11	0.10	0.032
232R-2, 35–50	1494.33	1.25	7.37	2.77	1.03	3.85	0.73	4.91	1.09	3.12	2.94	0.44	1.80	0.13	0.09	0.16	0.049
233R-1, 14–19	1497.64	0.88	4.96	2.07	0.79	2.90	0.54	3.61	0.82	2.42	2.30	0.35	1.23	0.09	0.04	0.07	0.029
234R-1, 26–29	1502.76	2.48	13.9	5.04	1.61	7.09	1.35	8.77	1.97	5.78	5.67	0.85	3.91	0.31	0.08	0.36	0.116

Table T5. Comparisons of trace element abundances. (**See table note.**)

	BAS-206		BAS-312	
	Expedition 312 (avg.)	This study (avg.)	Expedition 312 (avg.)	This study (avg.)
Element oxide (wt%):				
SiO_2	49.35	49.24	49.86	49.5
TiO_2	2.09	2.10	1.33	1.336
Al_2O_3	13.87	13.86	15.41	15.445
Fe_2O_3	14.58	14.73	10.77	10.877
MnO	0.26	0.26	0.18	0.184
MgO	6.73	6.71	7.79	7.752
CaO	9.92	9.79	11.89	11.819
Na_2O	2.83	2.71	2.44	2.351
K_2O	0.18	0.20	0.05	0.077
P_2O_5	0.19	0.17	0.09	0.11
Total:	100.00	99.76	99.83	99.45
Element (ppm):				
Sc	42.59	51.7	39.99	45.8
V	421.96	465.1	295.38	321.3
Cr	73.28	84.6	259.03	252.2
Co	50.78	55.1	44.27	46.7
Ni	45.50	50.7	88.12	88.9
Zn	99.29	133.0	82.75	89.3
Sr	99.16	101.9	98.85	101.1
Y	34.14	50.2	24.65	30.8
Zr	111.19	128.5	71.43	79.2
Ba	42.75	42.2	9.54	12.2

Note: Average (avg.) values from Expedition 312 from Teagle et al. (2006).