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8. Mineral Chemistry, Whole-Rock Compositions, and Petrogenesis of Leg 176 Gabbros: Data and Discussion[1]

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ABSTRACT

We report mineral chemistry, whole-rock major element compositions, and trace element analyses on Hole 735B samples drilled and selected during Leg 176. We discuss these data, together with Leg 176 shipboard data and Leg 118 sample data from the literature, in terms of primary igneous petrogenesis. Despite mineral compositional variation in a given sample, major constituent minerals in Hole 735B gabbroic rocks display good chemical equilibrium as shown by significant correlations among Mg# (= Mg/[Mg+Fe^{2+}]) of olivine, clinopyroxene, and orthopyroxene and An (=Ca/[Ca+Na]) of plagioclase. This indicates that the mineral assemblages olivine + plagioclase in troctolite, plagioclase + clinopyroxene in gabbro, plagioclases + clinopyroxene + olivine in olivine gabbro, and plagioclase + clinopyroxene + olivine + orthopyroxene in gabbronorite, and so on, have all coprecipitated from their respective parental melts. Fe-Ti oxides (ilmenite and titanomagnetite), which are ubiquitous in most of these rocks, are not in chemical equilibrium with olivine, clinopyroxene, and plagioclase, but precipitated later at lower temperatures. Disseminated oxides in some samples may have precipitated from trapped Fe-Ti–rich melts. Oxides that concentrate along shear bands/zones may mark zones of melt coalescence/transport expelled from the cumulate sequence as a result of compaction or filter pressing. Bulk Hole 735B is of cumulate composition. The most primitive olivine, with Fo = 0.842, in Hole 735B suggests that the most primitive melt parental to Hole 735B lithologies must have Mg# ≤ 0.637, which is significantly less than Mg# = 0.714 of bulk Hole 735B. This

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suggests that a significant mass fraction of more evolved products is needed to balance the high Mg# of the bulk hole. Calculations show that 25%–45% of average Eastern Atlantis II Fracture Zone basalt is needed to combine with 55%–75% of bulk Hole 735B rocks to give a melt of Mg# ≤ 0.637, parental to the most primitive Hole 735B cumulate. On the other hand, the parental melt with Mg# ≤ 0.637 is far too evolved to be in equilibrium with residual mantle olivine of Fo > 0.89. Therefore, a significant mass fraction of more primitive cumulate (e.g., high Mg# dunite and troctolite) is yet to be sampled. This hidden cumulate could well be deep in the lower crust or simply in the mantle section. We favor the latter because of the thickened cold thermal boundary layer atop the mantle beneath slow-spreading ridges, where cooling and crystallization of ascending mantle melts is inevitable. These observations and data interpretation require reconsideration of the popular concept of primary mantle melts and relationships among the extent of mantle melting, melt production, and the composition and thickness of igneous crust.

INTRODUCTION

The ocean crust, which covers ~70% of the Earth's surface, is the net product of the magmatic, tectonic, and hydrothermal processes taking place along the world ocean ridges. Although this concept is well conceived, important details of these processes and the structure and composition of the bulk ocean crust remains poorly understood because of the inaccessibility of lower ocean crust. This incomplete knowledge of ocean crust not only hinders our understanding of ocean crust accretion at ridges, but also leaves models of some fundamental geodynamic problems unconstrained. For example, the nature and composition of primary mantle melts parental to mid-ocean-ridge basalt (MORB) has been in debate for over three decades (e.g., O'Hara, 1968; Elthon, 1989). Whereas this debate is now less acute, considering the polybaric (vs. isobaric) melting processes beneath ocean ridges (e.g., Klein and Langmuir, 1987; McKenzie and Bickle, 1988; Niu and Batiza, 1991), it remains unknown what primary mantle melt should look like until the bulk composition of the entire ocean crust is obtained. Furthermore, ocean crust is widely accepted to be an important geochemical reservoir. Popular models of chemical geodynamics use average composition of MORB as proxy for ocean crust (e.g., Hofmann, 1988), but this use neglects the fact that MORB is only a compositional end-member and constitutes no more than ~10%–15% of the total crustal mass (e.g., Niu, 1997). Therefore, characterization of the actual composition of lower ocean crust is needed.

Ocean Drilling Program (ODP) Hole 735B, Southwest Indian Ridge, drilled during Leg 118 (Robinson, Von Herzen, et al., 1989; Dick et al., 1991) and Leg 176 (Dick, Natland, Miller, et al., 1999) provides an unprecedented opportunity to study in detail the mineralogy, lithology, and composition of lower ocean crust formed at slow-spreading ridges. Hole 735B may not yet provide solutions to the above problems but has yielded important observations toward addressing these problems, as already well demonstrated by Dick, Natland, Miller, et al. (1999). In this paper, we report mineral chemistry, whole-rock major element compositions, and trace element analyses of samples selected during Leg 176. We discuss these data, together with Leg 176 shipboard data and data from Leg 118 samples found in the literature, in terms of primary igneous petrogenesis.

SAMPLES

Table T1 lists in detail the samples taken during Leg 176 and studied using various methods at The University of Queensland. For all but one sample, two polished thin sections each were made for detailed petrography. A total of 100 samples were analyzed for whole-rock major and trace elements. Of these, 79 samples were analyzed for mineral major element compositions and 48 samples were analyzed for trace elements on mineral separates. Fifteen felsic vein samples were analyzed for Sr and O isotopes on primary and secondary plagioclase.

T1. Downhole positions and analytical work, p. 29.

Sample identification abbreviations in Table T1 specify the purpose of a particular aspect of the study. Samples with prefix BN were fresh (F) and altered (A) sample pairs taken in spatial proximity in the same core section to study the chemical consequences of low-temperature alteration in lower ocean crust. The work is presented elsewhere by Bach et al. (2001). Samples with prefix FV are felsic veins/veinlets taken to study the mineralogy, geochemistry, and petrogenesis of felsic vein lithologies. This work will be presented separately (J.H. Natland et al., unpubl. data). Samples with prefix MS are taken to characterize trace element systematics of the whole-rock gabbroic samples and the constituent minerals. This work will also be presented separately (Y. Niu et al., unpubl. data). Samples with prefix GS are olivine gabbros with microgabbroic "veins/veinlets" taken to study the nature and origin of the microgabbros. As their mineral compositions are essentially the same as those of the coarse-grained host (see Tables T2, T3, T4, T5), no further analytical work is necessary.

T2. Microprobe analyses of olivine, p. 31.

T3. Microprobe analyses of plagioclase, p. 36.

T4. Microprobe analyses of clinopyroxene, p. 43.

T5. Microprobe analyses of orthopyroxene, p. 49.

DATA

Detailed petrographic descriptions including modal analyses on MS and FV samples are documented by Mackie (2000) and Gilmore (2000) in their University of Queensland honors theses, which are available in electronic form upon request. Here, we present and discuss mineral major element compositional data on MS, GS, and FV samples and whole-rock major element and selected trace element data on MS, BN, and FV samples.

Mineral Compositional Data

Major and minor element compositions (Si, Ti, Al, Fe, Mn, Mg, Ca, Na, K, P, Cr, and Ni) of olivine, plagioclase, clinopyroxene, orthopyroxene, amphibole, and Fe-Ti oxides were analyzed on polished thin sections using a JEOL Superprobe JXA-8800L at The University of Queensland. Analytical conditions were optimized for standard silicates and oxides at 15-kV accelerating voltage with a 20-nA focused electron beam for all the elements, with the exception of Na and K, for which a broader beam (10 µm) was used. Routine analyses were obtained by counting for 30 s at peak and 5 s on background. Repeated analysis of natural and synthetic mineral standards yielded precisions better than 2% for all the major element oxides analyzed. For the minerals in Hole 735B samples analyzed, the precisions are better than 2% for SiO_2, TiO_2,

Al_2O_3, FeO, MgO, and CaO; 5% for MnO, Na_2O, Cr_2O_3, and NiO; and 10% for K_2O and P_2O_5, depending on mineral types and elemental abundances. Instrumental drift was minimal over an analytical session of 2–3 days but corrected for when present by repeatedly analyzing standards as unknowns during the run. The analytical data are given in Tables T2 (olivine), T3 (plagioclase), T4 (clinopyroxene), T5 (orthopyroxene), T6 (Fe-Ti oxides), and T7 (amphiboles).

T6. Microprobe analyses of Fe-Ti oxides, p. 50.

T7. Microprobe analyses of amphiboles, p. 52.

Whole-Rock Major, Minor, and Trace Element Data

All MS, BN, and FV samples for whole-rock compositional analysis involved a thorough cleaning procedure. The pen marks, saw marks, sticker residues, and other suspicious surface contaminants were ground off all samples that were collected on board. The samples were then reduced to 1- to 2-cm size using a percussion mill with minimal power production. These centimeter-sized rock pieces were then ultrasonically cleaned in Mili-Q water, dried, and powdered in a thoroughly cleaned agate mill.

Major element oxides (SiO_2, TiO_2, Al_2O_3, FeOt, MnO, MgO, CaO, Na_2O, K_2O, and P_2O_5) for MS and BN samples were analyzed using a Varian Liberty 200 inductively coupled plasma–atomic emission spectrometer (ICP-AES) at Queensland University of Technology, following the procedure of Kwiecien (1990). Precision (1 σ) for most elements based on U.S. Geological Survey (USGS) standards (BCR-1, BIR-1, AGV-1, and G2) is better than 1% with the exception of TiO_2 (~1.5%) and P_2O_5 (~2.0%). Loss on ignition (LOI) was determined by placing 1 g of sample in a furnace at 1000°C for several hours, cooling in desiccator, and reweighing. These same major element oxides were analyzed for FV samples using a Perkin Elmer Optima 3300 DV inductively coupled plasma–optical emission spectrometer (ICP-OES) at The University of Queensland with the analytical precisions similar to the above. No LOI was determined for the FV samples because of small sample size. The analytical data along with calculated CIPW norms are given in Table T8.

T8. Whole-rock major trace elements in gabbro, p. 54.

Minor and trace element (Li, Sc, V, Cr, Co, Ni, Cu, Zn, Ga, Rb, Sr, Y, Zr, and Nb) abundances in these same samples were analyzed on a Fisons $PQ2^+$ inductively coupled plasma–mass spectrometer (ICP-MS) at The University of Queensland with the analytical conditions and procedures following Niu and Batiza (1997) and Eggins et al. (1997) except for sample digestion, which was done using high pressure bombs to ensure complete digestion/dissolution of ilmenite, zircon, and other refractory phases in gabbroic rocks (vs. basalts). Precisions (1 σ) are better than 1%–2% for Li, Ga, Sr, Y, Zr, and Nb and are better than 2%–4% for Sc, V, Cr, Co, Ni, Cu, Zn, and Rb based on repeated analyses of highly depleted basaltic samples like USGS reference rock standard BIR-1. The analytical data are given in Table T8.

DISCUSSION

In this section we discuss the major implications of the data in terms of igneous pathogenesis under several headings, each of which pertains to a particular question. We agree with previous workers (e.g., Hébert et al., 1991; Bloomer et al., 1991; Ozawa et al., 1991; Natland et al., 1991; Dick et al., 1991, Dick, Natland, Miller, et al., 1999) on major aspects of

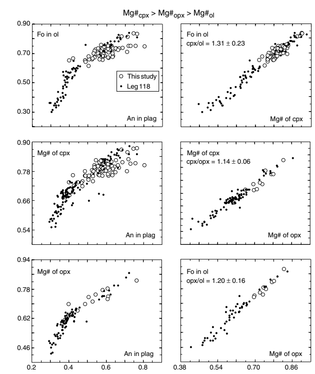
Hole 735B petrology. We offer additional interpretations with demonstrations.

Attainment of Phase Equilibrium

Figure F1 shows the correlated variations of An content in plagioclase and Mg# in olivine, clinopyroxene, and orthopyroxene of the Hole 735B gabbroic rocks. Whereas the scatter exceeds the analytical error, the significant correlations demonstrate that these minerals are, to a first order, in chemical equilibrium. Such first-order equilibrium could be achieved under subsolidus conditions, but the slowness of solid-state diffusion and the very young age (~11.5 Ma) of the system argue strongly that the observed equilibrium was largely achieved under magmatic conditions. In other words, the bulk of the coexisting minerals (plagioclase, olivine, clinopyroxene, and orthopyroxene) in each sample were coprecipitated from a common liquid undergoing cooling. For example, the compositional range of these minerals corresponds to liquidus temperatures from ~1190°C for high Mg# and An samples to ~1070°C for low Mg# and An samples (see below). The relationship $Mg\#_{cpx} > Mg\#_{opx} > Mg\#_{ol}$ is consistent with experimental results (e.g., Grove et al., 1992), although the differences are larger, perhaps due to subsolidus reequilibration(?).

It is important to note, however, that Fe-Ti oxides exist in many of these samples, and their compositions do not in any manner (not shown) correlate with the compositions of olivine, plagioclase, clinopyroxene, and othopyroxene. A simple argument is that these oxides were not in equilibrium with the major silicate minerals and thus were not precipitated from the same melt at the same conditions. This is an important observation (see below). We also must not dismiss the fact that the scatter in Figure F1 is greater than analytical error. In some cases, the mineral compositional variation in a given crystal is as large as within-sample variation. It is possible that such compositional heterogeneity could be due to kinetics, but it could well be caused by reequilibration of mineral phases with entrapped late-stage melt (Natland et al., 1991; Natland and Dick, 1996; Coogan et al., 2001).

F1. Covariation plots of Mg# of olivine, clinopyroxene, orthopyroxene, and anthorite of plagioclase, p. 18.



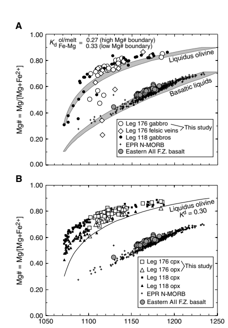
Physical Conditions of Crystallization

Assuming that the gabbros were indeed emplaced at lower crustal level, then their crystallization pressures must be ~1–1.5 kbar. Their crystallization temperatures can be precisely calculated from experimentally established basalt phase equilibria (e.g., Roeder and Emslie, 1970; Bender et al., 1978; Walker et al., 1979; Langmuir and Hanson, 1981; Nielsen and Dungan, 1983; Weaver and Langmuir, 1990), which states that the liquidus temperature of basaltic melt is proportional to the MgO content in the melt, and also to the Fo content of olivine that is in equilibrium with the melt. The relationship between the two parameters is characterized by the well-known Fe-Mg exchange relationship of Roeder and Emslie, 1970:

$$K_d = (X_{Mg}^{L}/X_{Fe^{2+}}^{L})/(X_{Mg}^{ol}/X_{Fe^{2+}}^{ol}) = 0.3 \pm 0.03.$$

Figure F2A shows the relationship between Mg# of a basaltic melt (lower shaded band) and Mg# (or Fo content) of olivine (upper shaded band) in equilibrium with the melt as a function of liquidus tempera-

F2. Plots of Mg# of minerals, basaltic melt, and whole-rock gabbroic samples vs. liquidus temperatures, p. 19.



ture. Also plotted in Figure **F2A** are whole-rock Legs 118 and 176 samples with olivine analyses available. Typical normal-type MORB (N-MORB) samples from the East Pacific Rise (EPR) and MORB samples from the eastern wall of the Atlantis II Fracture Zone (AII F.Z.) basalts are plotted for comparison.

Note that although many Leg 118 samples were studied for mineral chemistry and whole-rock compositions, not many have both mineral and whole-rock data available. In any case, most whole-rock gabbros are plotted onto or above the band defined by the liquidus olivine (Fig. **F2B**), which corroborates the above interpretation that the bulk of the coexisting minerals (plagioclase, olivine, clinopyroxene, and orthopyroxene) in each sample are in equilibrium and were coprecipitated from a common liquid undergoing cooling. The few samples with low Mg# plotted way below the olivine liquidus band are samples with significant amounts of excess Fe-Ti oxides, which also corroborates the above interpretation that these excess oxides were not in equilibrium with, but extraneous to, the major silicate minerals in these rocks. Most of these samples plot above the olivine liquidus because whole-rock samples contain pyroxenes that have higher Mg# than Fo in olivine (Fig. **F2B;** also see Fig. **F1**).

The most important conclusion from Figure **F2** is that the bulk of Hole 735B gabbros were formed from evolved melts. The olivine $Fo_{84.2}$ in the most primitive troctolite (Ozawa et al., 1991) corresponds to a parental liquid of Mg# ≤ 0.637 (0.590–0.637, for K_d = 0.27–0.33) with a liquidus temperature of 1190° ± 10°C. This is not surprising because of the simple fact that clinopyroxene appears on the tholeiite liquidus at temperatures no higher than ~1180°C at lower pressures (<2 kbar) and that the bulk of Hole 735B lithology is gabbroic with 40%–50% modal clinopyroxene.

Liquid vs. Cumulate and Bulk Hole Composition

Bowen (1928) first suggested that gabbros were formed by crystal sorting and accumulation from cooling basaltic melts. Four decades later, Wager and Brown (1968) illustrated in great detail various types of cumulate textures developed during the formation of gabbros in response to cooling of basaltic magmas. Perhaps most, if not all, modern igneous petrologists would accept the concept by Bowen and the conclusions by Wager and Brown, but ironically, some modern igneous petrology textbooks maintain "gabbroic rocks are intrusive/compositional equivalents of basalts but have phaneritic grain size" (e.g., Best, 1995), implying that the slow cooling, and thus greater grain size, is the sole difference between gabbros and basalts. A simple conceptual argument is that if gabbros are indeed the product of fractional (vs. equilibrium) crystallization, then we cannot avoid the conclusion that gabbros are cumulate, not melt, equivalents, although gabbros could trap a significant amount of interstitial melt (e.g., Coogan et al., 2001). Natland et al. (1991) and Natland and Dick (1996) argue for the cumulate nature of Hole 735B gabbros drilled during Leg 118 and gabbros drilled from Hess Deep during Leg 147. Casey (1997) and Ross and Elthon (1997) also demonstrated the cumulate nature of gabbros drilled at the Mid-Atlantic Ridge Kane Fracture Zone (MARK) area during Leg 153. However, Hart et al. (1999) used compositions of strip samples from Leg 118 and Dick et al. (2000) used reconstructed major element compositions of bulk Hole 735B to interpret that the Hole 735B gabbros are meltlike.

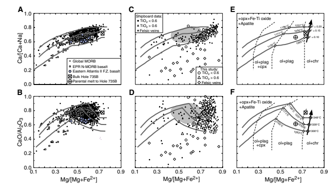
Figure F3 compares Hole 735B gabbroic samples with MORB melts and model melt compositions on Ca# – Mg# and CaO/Al_2O_3 – Mg# plots. Note that AII F.Z. basalts are plotted at the low-Ca# and low-CaO/Al_2O_3 end of the global MORB data array, which is consistent with the interpretation that these melts result from the lowest extent of melting associated with slowest spreading rate (Niu and Hékinian, 1997). The major conclusions from this comparison are as follows:

1. Gabbroic samples with high TiO_2 (e.g., >0.6 wt%) may resemble some evolved basaltic melts.
2. Felsic veins/veinlets are melts, but they are no longer "basaltic," not only because of the high SiO_2 but also because of the too-low Ca# and CaO/Al_2O_3 ratio. The Mg# of felsic veins/veinlets is largely determined by traces of mafic mineral inclusions (including secondary clinopyroxene, amphiboles, and chlorite) and, hence, is no longer a useful petrological parameter.
3. Gabbroic samples with low TiO_2 do not resemble melts but are typical cumulates with the bulk compositions determined largely by modal proportions of clinopyroxene and plagioclase. They have too high a Mg# and too large a range in CaO/Al_2O_3. A number of samples have $CaO/Al_2O_3 > 1$ (not shown in Fig. F3D), which cannot at all be meltlike.

The most relevant question here is whether the bulk hole composition resembles a basaltic melt. Hart et al. (1999) conclude that the bulk composition of the upper 500 m of core is in fact meltlike and interpret that the large downhole modal compositional variations result from "local separation of melt and solids, but no large scale removal of melts." Dick et al. (2000) conclude "a feature of the bulk [hole] compositions is that they are all close to those of various primitive to moderately differentiated basalts. Thus, the interpretation of most Hole 735B gabbros as cumulates is based on trace rather than major elements." This conclusion can be tested by a simple phase equilibrium analysis. The bulk hole composition reconstructed by Dick et al. (2000) has FeOt = 7.31 wt% and MgO = 9.21 wt%, which gives Mg# = 0.714 (assuming 10% total Fe as Fe^{3+}). If this were indeed the Mg# of the parental melt, then the most primitive olivine in these rocks must have Fo ≥ 0.883 (0.883–0.893, for K_d = 0.33–0.27), but this is not observed. In fact, the most primitive olivine in Hole 735B has Fo = 0.842 (troctolite) (Sample 176-735B-83R-7, 77–81 cm) (Ozawa et al., 1991). The parental melt from which this olivine crystallized must have Mg# ≤ 0.637 (0.590–0.637, for K_d = 0.27–0.33). Using this Mg# value as a constraint and the AII F.Z. basalts as a reference, the melt parental to Hole 735B would have the composition (circle with plus in Fig. F3) that contrasts with the reconstructed bulk composition (square with cross in Fig. F3) of Hole 735B as shown in Table T9. These differences and the phase equilibrium constraints presented above argue strongly that bulk Hole 735B is not meltlike but is cumulate in nature: cumulate clinopyroxene and olivine give the high Mg#, cumulate plagioclase and clinopyroxene give the high Ca#, excess of clinopyroxene over plagioclase gives the high CaO/Al_2O_3 ratio, and the removal of Fe-Ti–rich melt gives the low FeOt and TiO_2 in the bulk Hole 735B composition.

If the above estimated parental melt is reasonable, then a significant amount of more differentiated products is needed to balance the high Mg# (0.714) of the bulk hole composition. The AII F.Z. basalts, which have an average Mg# = 0.561 ± 0.031, may be such more differentiated

F3. Plots of Ca# and CaO/Al_2O_3 vs. Mg#, p. 20.



T9. Comparison of primitive melt with bulk hole composition, p. 60.

products. Assuming this is the case, then 25%–45% of average AII F.Z. basalt is needed to combine with 55%–75% of bulk Hole 735B gabbros to give a melt (Mg# ≤ 0.637) parental to olivine of Fo = 0.842. It is noteworthy, however, that the most primitive AII F.Z. basalt has Mg# = 0.616, which in fact corresponds to the most primitive olivine of Fo = 0.842 ± 0.14 (for K_d = 0.30 ± 0.03) in the troctolite.

Parental and Primary Melts, Bulk Crust, and Thermal Boundary Layer atop the Mantle

The above deduced melt with Mg# ≤ 0.637 is parental to all the lithologies in Hole 735B including the volcanics. This parental melt is not the same as primary mantle melt (or primary magma) conceived by petrologists. The latter, which is considered to be in equilibrium with mantle residual olivine (Fo ≥ 0.89), must have Mg# ≥ 0.71. Assuming that the mantle melt passing the crustal/mantle boundary does have Mg# ≥ 0.71, then "a considerable thickness of primitive cumulates complementary to the lavas, dikes, and Hole 735B gabbros" (Dick et al., 2000) remains in the deep crust to be revealed. We suggest that the mantle melt passing the crustal/mantle boundary is already cooled and evolved. That is, the more primitive cumulates (i.e., chromitite/dunite, troctolite, etc.) may be found in the mantle. This is because below slow-spreading ridges, slow mantle upwelling allows conductive cooling to the surface to extend to a greater depth against the adiabat and hence leads to a thickened, cold thermal boundary layer atop the mantle (Niu and Hékinian, 1997; Niu, 1997). Melt ascending/migrating through this cold boundary layer must cool and crystallize out minerals on the liquidus, which in this case are mostly chromite/Cr spinel, forsteritic olivine, and plus anorthitic plagioclase (see Fig. **F3E, F3F**) before reaching the crust/mantle boundary (Niu, 1997; Niu et al., 1997). This latter process may also be termed high-pressure (vs. crustal level) fractionation (e.g., Bender et al., 1978; Elthon et al., 1982; Grove et al., 1992).

This suggests that bulk igneous crust is not equivalent to primary mantle melt in composition but is more evolved as the result of cooling/crystallization during ascent in the thermal boundary layer atop the mantle. We further add that the thin igneous crust at slow-spreading ridges (vs. thick crust at fast-spreading ridges) results from two actions: lower extent of melting (Niu and Hékinian, 1997) and the loss of melt mass during ascent through the thickened thermal boundary layer (Niu et al., 1997; Niu, 1997). This concept is not a speculation but a testable hypothesis, which is already supported by observations that exist in the literature (e.g., Cannat, 1996, and by Y. Niu's recent observations during the JR63 expedition at 15°20′N Mid-Atlantic Ridge.

Origin of Fe-Ti–Rich Melts

About 40% of rock types recovered from Hole 735B are named with "oxide" as modifier (e.g., oxide gabbro, oxide gabbronorite, oxide olivine gabbro, disseminated oxide gabbro, etc.) (Dick, Natland, Miller, et al., 1999; Dick et al., 2000). These oxide-rich or oxide-bearing rock types take up ~17 vol% of the bulk Hole 735B (Dick et al., 2000). The oxides are mineralogically dominated by ilmenite and ilmenite-hematite-magnetite solid solutions (Table **T6**); thus, they are undoubtedly magmatic products. Although most of these oxide-rich/bearing rocks are also cumulate (Dick et al., 2000), they are nevertheless genetically closely associated with Fe-Ti–rich melt as a natural consequence of tholeiitic magma evolution (Wager and Brown, 1968). As noted in **"Attainment of Phase Equilibrium,"** p. 5, what is important here is the disequilibrium coexistence of Fe-Ti oxides with clinopyroxene, plagioclase, and olivine in most of these gabbroic rocks.

F4. Plots of SiO_2 and TiO_2 of MORB samples, p. 21.

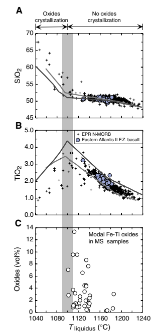


Figure **F4B** shows that during cooling and evolution of tholeiitic magmas, there is a significant Ti (also Fe) enrichment until the temperature of the system falls down to 1080°–1110°C (depending on fO_2 and H_2O content in the system), at which temperature Fe-Ti oxides appear on the liquidus and begin to crystallize. Therefore, production of Fe-Ti oxides is genetically associated with Fe-Ti–rich melt at relatively low temperatures. Figure **F4C** plots the modal abundances of Fe-Ti oxides in MS samples (see Table **T1**) against the liquidus temperatures calculated from olivine composition of these samples. As olivine is, to a first order, well in equilibrium with clinopyroxene, orthopyroxene, and plagioclase in these rocks (Fig. **F1**), it is these Fe-Ti oxides that are out of equilibrium. In other words, these oxides should not be in these rocks because the melts that produced olivine, plagioclase, and clinopyroxene were too hot to produce the oxides. This observation suggests that the Fe-Ti oxides in most of these rocks must be *physically* added to their host rocks below the liquidus temperatures of host minerals. As solid-state mass transport on such macroscopic scales is difficult, the oxide carrier must be silicate melt. There are two possibilities. One is that these oxides, particularly those in "disseminated" oxide-bearing rocks, represent crystallization of trapped Fe-Ti liquids that cooled and evolved in isolated pockets with the residual felsic liquid expelled during compaction and consumed locally during subsequent recrystallization. This could be the cause of mineral compositional variation (scatter) in a given crystal or between crystals of a given sample (see Fig. **F1** and **"Attainment of Phase Equilibrium,"** p. 5). The other possibility is that these oxide-rich rocks may represent a snapshot of melt migration (Dick et al., 2000). Fractional crystallization/crystal sorting results in residual melt enriched in Fe and Ti (Fig. **F4B**). These residual melts must be continuously expelled out of already formed crystal piles and transport/coalesce toward zones of low pressures. Continuous cooling during transport leaves oxides behind as traces of the passageways of melt transport. This latter interpretation is consistent with the observation that oxides are clearly enriched in shear zones of varying size, and synmagmatic deformation may play an important role (Dick et al., 2000)—a process envisaged as "differentiation by deformation" by Bowen (1928).

Origin of Felsic Veins/Veinlets

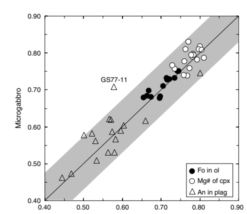
Within the bulk gabbroic rocks of Hole 735B are numerous small (a few millimeters to several centimeters thick) felsic veins (Dick, Natland, Miller, et al., 1999). Most veins are leucodiorite dominated by plagioclase plus some green amphiboles. Other lithologies include diorite, trodhjemite, and tonalite with variable amounts of amphibole, quartz, and biotite. Granitic veins were also recovered with up to 28% quartz and 24% alkali feldspars plus hornblende, biotite, pyroxene, Fe-Ti oxide, apatite, and zircon. Despite the small volume of these veins (~0.5% of the bulk of Hole 735B), their occurrence throughout the entire 1.5-km section of Hole 735B has important implications for processes of melt emplacement and evolution at slow-spreading ridges. While oxide-silicate liquid immiscibility (e.g., Natland et al., 1991) and Fe-Ti–

rich melt reaction with wall rock (e.g., Dick et al., 2000) may be invoked to interpret the origin of the felsic veins, we believe that simple fractional crystallization is adequate. Figure F4A and F4B demonstrates that SiO_2 enrichment in residual melt is the natural consequence of oxide removal/crystallization at a late stage of tholeiitic magma evolution. This is evident from the close association of oxides with felsic veins/veinlets throughout Hole 735B (Dick, Natland, Miller, et al., 1999).

Origin of Microgabbros

There are also fine-grained equigranular microgabbros that crosscut the coarse-grained gabbros/olivine-bearing gabbros throughout the core (Dick, Natland, Miller, et al., 1999). Many of these microgabbros are small in size (1–5 cm thick) but span nearly the full compositional range of the host gabbros (Dick et al., 2000). Whereas some of the microgabbros show intrusive contact with the host, gradational, or sutured, contacts dominate. Most microgabbros exhibit shallow to moderate dips, but some, particularly those near the base of the hole, occur as vertical to subvertical "veins" or "veinlets." Dick et al. (2000) interpret this latter type as representing channels of melt transport through the crystallizing intrusions. Whereas this interpretation is sensible, the question that remains is why these microgabbros are finer grained than their host. It is possible that the finer grain size may simply result from the "quench effect." That is, the hot melt migrates in an already cooled (>30°C cooler?) host. This interpretation would suggest a significant time difference between the solidification of the host gabbro and the intrusion of the microgabbros. This time difference would imply different parental melts with different cooling and evolution histories. If this interpretation is correct, then the microgabbros and their host should have different compositions in their respective mineralogy. This is not observed. Figure F5 shows that, although scattered, mineral compositions of the microgabbros are broadly similar to those of the host gabbros. Neither group is necessarily more primitive than the other (straddle about the 1:1 line in Fig. F5) with the exception of Sample GS77-11. This suggests that there is a fairly good degree of compositional equilibrium between microgabbros and their host. Subsolidus equilibration may be invoked to explain such compositional equilibrium, but this cannot explain why such compositional equilibration (diffusion controlled) is not accompanied by crystal growth (recrystallization). Alternatively, both the microgabbros and their host gabbros may be different products of the same parental melts. Microgabbros may represent zones of melt expelled from the host gabbros as a result of compaction or filter pressing. The expelled melt must therefore be in equilibrium with both the minerals in the host (already formed coarse crystals) and the minerals crystallizing out of the melt (currently forming fine crystals). We can imagine that the zones of the expelled melt (1) must be present as crystal mushes and (2) must migrate/move in response to continuous compaction and filter-pressing. This motion/stirring (vs. static growth of the host minerals) may not impede nucleation but can prevent crystal growth of the system. This latter process may also contribute to the finer grain size of the microgabbros.

F5. Mineral compositions of microgabbros and coarse-grained host gabbros, p. 22.



Modal Control on Bulk Rock Compositions

The foregoing discussion indicates that whereas trapped melt may be present, the bulk gabbroic rocks are not meltlike but are crystal cumulates. This is further demonstrated by modal and compositional control of minerals on bulk rock composition, particularly for compatible and less incompatible elements that prefer to stay in minerals over possible interstitial melts, if any. Figure F6, for example, shows that Sc abundance in whole-rock gabbros is largely controlled by clinopyroxene and plagioclase, the two major constituent minerals of gabbros. The deviation of the data trend away from the mixing lines in Figure F6A and F6B result from dilution of CaO- and Al_2O_3-poor phases (i.e., olivine, oxides, and, perhaps, orthopyroxene) in the rocks. This deviation disappears when CaO/Al_2O_3 (Fig. F6C) is used because these CaO- and Al_2O_3-poor phases (1) have low Sc and (2) do not affect bulk rock CaO/Al_2O_3 ratio. The hyperbolic curve in Figure F6C is a typical mixing line involving ratios. This mixing curve can be used to calculate relative mass proportions of clinopyroxene (i.e., cpx# = cpx/[cpx+plag]) and plagioclase (1 – cpx#) in the bulk rock from whole-rock CaO/Al_2O_3 ratio ($R_{C/A}$) and Sc abundance as illustrated in Figure F6D. As bulk rock Sc abundance could be affected by ilmenite, $R_{C/A}$ would be a more reliable parameter for calculating cpx# and for estimating whole-rock clinopyroxene mass proportion for rocks without significant amounts of oxides, olivine, and orthopyroxene: cpx# = [1.3835 $R_{C/A}$ – 0.5163]/[1.2571 $R_{C/A}$+0.4587]. As plagioclase takes essentially no Mg and Fe, whole-rock Mg# would be an efficient measure for the composition of mafic minerals (clinopyroxene, olivine, and orthopyroxene), and thus the liquidus temperatures of the parental melt, provided that the whole-rock samples do not have excess cumulate oxides.

F6. Sc vs. CaO, Al_2O_3, and CaO/Al_2O_3, p. 23.

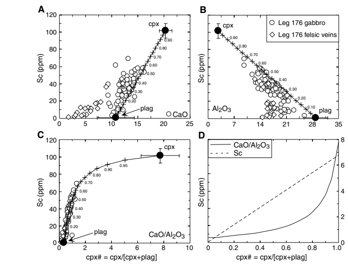


Figure F7A shows that there is no correlation between Mg# and cpx# even excluding samples with excess oxides (i.e., those with TiO_2 > 0.6 wt%). This is expected, as Mg# reflects liquidus composition and temperature of the parental melt, but cpx# reflects modal heterogeneity on sampling scales. Whereas Ca# should be proportional to the liquidus temperature, as might be inferred from the correlation of An in plagioclase with Fo in olivine (Fig. F1), the weak correlation in Figure F7B demonstrates that Ca# in the whole rock is also controlled by mineral modes because Ca in the whole rock is dominated by clinopyroxene, whereas Na is dominated by plagioclase. The relationships among several compositional parameters in Figures F6 and F7 are important for understanding the abundances and distributions of trace elements in gabbroic lower crust. Figure F8 gives some examples, but a full discussion and account of the topic will be addressed elsewhere (Y. Niu et al., unpubl. data).

F7. Mineral mass proportions, p. 24.

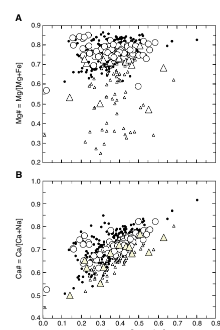
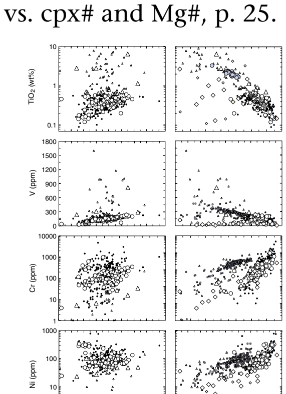


Figure F8 plots the abundances of representative elements against cpx# (left) and Mg# (right) (where both felsic veins/veinlets and N-MORB data are plotted for comparison). For gabbroic samples, for example, TiO_2, V, and, to some extent, Y are controlled by both modes (cpx#) and mineral compositions (Mg#). Sr is largely controlled by cpx#. Highly compatible elements like Ni and Cr are controlled by mineral compositions (Mg#). Incompatible elements like Zr and Nb are not controlled by cpx# but are determined by the amount of excess Fe-Ti oxides in the rock (samples with TiO_2 > 0.6 wt%), which is consistent with the fact that Fe-Ti oxides are genetically associated with trapped melt or late-stage Fe-Ti basaltic melts (Fig. F4).

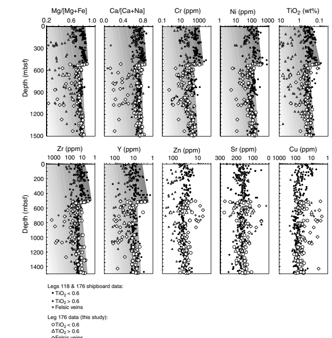
F8. TiO_2, V, Cr, Ni, Sr, Y, Zr, and Nb vs. cpx# and Mg#, p. 25.



Downhole Compositional Profile

As noted by Dick et al. (2000), there is no systematic downhole compositional change, as would be expected if the stratigraphic sequence resulted from differentiation of a single large magma body, nor is there a simple evolutionary sequence, as seen in layered intrusions like the Skaergaard. In fact, the igneous stratigraphy of Hole 735B is characterized by extremely small-scale chemical and textural variability with products of highly evolved melts (e.g., Fe-Ti oxides, ferrogabbro, felsic veins, etc.) occurring throughout the hole as enclaves of variable size within the less-evolved gabbroic lithologies (Fig. F9). Such a "composite" sequence cannot be fully explained by simple models of magma chamber processes (Sinton and Detrick, 1992) but requires processes of multiple melt injection on highly localized scales (e.g., as sills) and in situ cooling and crystallization (Dick et al., 2000; Kelemen et al., 1997; MacLeod and Yaouancq, 2000).

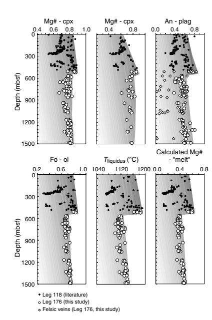
F9. Downhole whole-rock composition, p. 27.



Dick et al. (2000) divided the Hole 735B stratigraphy into 12 polygenetic units considering detailed changes in principal lithologies and intrusive events. We show in Figure F9 downhole whole-rock compositional variations. Except for felsic veins/veinlets and rocks with excess Fe-Ti oxides (TiO_2 > 0.6 wt%), the bulk Hole 735B shows two major units below and above the ~550-meters below seafloor (mbsf) discontinuity reflected by many compositional parameters such as Mg# (= Mg/[Mg+Fe]), Ca/[Ca+Na], Cr, Ni, TiO_2, Zr, Y, and Zn. This discontinuity, which is coincident with a shear zone (Dick, Natland, Miller, et al., 1999), may in fact be a fault contact separating the two units. It is possible that the upper 550-m and the lower kilometer sections may be genetically unrelated. As these parameters largely reflect mineral compositional control (see Fig. F8 and discussion above), they thus record the temperature and compositions of liquids parental to the cumulate sequence. The melts parental to the upper ~550 m (excluding oxide-rich zones) are clearly more primitive and hotter than melts parental to the lower kilometer.

Using Mg#, Dick et al. (2000) separated the upper ~550 m into two chemical units and the lower ~1000 m into three chemical units, each being characterized by an upward trend of decreasing Mg#, with a sharp increase in Mg# at the beginning of each overlying unit, as representing some form of cyclic intrusion. Such cycles are not so obvious for the lower kilometer but are better developed for the upper ~550 m (Fig. F9). What is clear is the small but systematic upward decrease in Mg# (i.e., the liquidus temperature) and the corresponding changes of other parameters for units both above and below the ~550-m discontinuity. Note that Sr and Cu do not show such systematics because these two elements are not controlled by mineral compositions but by mineral modes (e.g., Sr is proportional to the plagioclase/clinopyroxene ratio and Cu is largely controlled by sulfide globules). Such downhole liquidus temperature variation is better reflected by the mineral compositional data as shown in Figure F10. In Figure F10, the liquidus temperature is calculated from olivine composition and represents the maximum values. It is obvious that the melts parental to Hole 735B cumulate sequence are rather evolved. To further illustrate this point, the Mg# of the parental melts in equilibrium with olivine is shown. The simple implication is that the parental melt to the bulk of Hole 735B is too evolved to be in equilibrium with residual mantle mineral assemblages. A significant amount of more refractory cumulate must be hidden as discussed above and by Dick et al. (2000).

F10. Downhole mineral composition, p. 28.



SUMMARY

The major conclusions of this study are as follows:

1. Despite mineral compositional variation in a given sample, major constituent minerals in Hole 735B gabbroic rocks are, to a first order, in chemical equilibrium. That is, olivine + plagioclase in troctolite, plagioclase + clinopyroxene in gabbro, plagioclase + clinopyroxene + olivine in olivine gabbro, plagioclase + clinopyroxene + olivine + orthopyroxene in gabbronorite, and so on, have all coprecipitated from their respective parental melts (Fig. **F1**).
2. Fe-Ti oxides could be in equilibrium with major silicate minerals in ferrogabbros and gabbronorites. However, these oxides in gabbros, olivine gabbros, and troctolitic gabbros are not in chemical equilibrium with silicate minerals but must have formed or been added to the rocks at temperatures below the liquidus of the silicate mineral assemblages (Figs. **F3, F4**). Disseminated oxides in some rocks may have precipitated from trapped Fe-Ti–rich melts. Oxides that concentrate along bands/zones of shearing probably mark zones of low pressures into which expelled interstitial melt transport/coalesce. Continuous cooling during transport leaves oxides behind tracing the passageways of melt transport.
3. Although oxide-silicate liquid immiscibility and Fe-Ti–rich melt reaction with wall rock may be invoked to interpret the origin of the felsic veins, we believe that simple fractional crystallization is adequate. SiO_2 enrichment in residual melt is the natural consequence of oxide removal/crystallization at a late stage of tholeiitic magma evolution (Fig. **F4**).
4. The mineral compositional similarity between fine-grained microgabbros and their coarse-grained gabbroic host (Fig. **F5**) suggests that most of these microgabbros are, to a first order, in chemical equilibrium with their coarse-grained host. We interpret that the microgabbros represent zones of melt expelled from the host gabbros. This melt must therefore be in equilibrium with minerals in the host (already formed coarse crystals) and minerals crystallizing out of the melt (currently forming fine crystals).
5. Whereas felsic veins, ferrogabbros, and some microgabbros have meltlike compositions, the bulk composition of Hole 735B is not meltlike, but is rather a cumulate composition. The most primitive olivine in Hole 735B has Fo = 0.842. The melt that is parental to this olivine would have Mg# ≤ 0.637 (0.590–0.637, for K_d = 0.27–0.33), which is significantly less than Mg# = 0.714 of bulk Hole 735B. This suggests that a significant mass fraction of more evolved products is needed to balance the high Mg# of the bulk cumulate. A simple calculation shows that in terms of Mg#, 25%–45% of average eastern AII F.Z. basalt is needed to combine with 55%–75% of bulk Hole 735B gabbros to give a melt parental to olivine of Fo = 0.842. This result is not unexpected.
6. The inferred melt with Mg# ≤ 0.637 parental to the most primitive olivine in Hole 735B is still rather evolved to be in equilibrium with residual mantle olivine of Fo > 0.89. This suggests that a significant mass fraction of more primitive cumulate (i.e., high-Mg# dunite and troctolite, etc.) is yet to be sampled.

This hidden cumulate could well be deep in the lower crust or simply in the mantle section. We favor the latter because of the thickened thermal boundary layer atop the mantle beneath slow-spreading ridges. It is inevitable that mantle melts that migrate through this cold thermal boundary layer will cool and crystallize whatever minerals on the liquidus, which in this case are chromite/Cr spinel, forsteritic olivine, and anorthitic plagioclase.

7. Whole-rock compositions of cumulate rocks are controlled by both compositions and modes of the constituent minerals. Abundances of all elements, and particularly highly compatible elements (e.g., Ni and Cr), are controlled by mineral compositions, but slightly compatible elements (Sc, Sr, V, Ti, and Y, etc.) are also controlled by mineral modes. Incompatible and highly incompatible elements (i.e., Zr and Nb) are largely determined by the presence of trapped melt or cumulates of late-stage highly evolved melt (i.e., Fe-Ti oxides). Whole-rock CaO/Al_2O_3 ratio can effectively describe modal systematics of coarse-grained gabbroic rocks, particularly when the abundances of olivine, orthopyroxene, and Fe-Ti are low in abundance, and thus can be used to evaluate modal controls on trace element systematics.

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Figure F1. Covariation plots of Mg# (= Mg/[Mg+Fe^{2+}]) of olivine (ol), clinopyroxene (cpx), orthopyroxene (opx), and anthorite (An) (= Ca/[Ca+Na+K]) of plagioclase of Hole 735B minerals. Open circles are data from Leg 176 samples collected in this study. Solid symbols are data from the literature (e.g., Hébert et al., 1991; Bloomer et al., 1991; Ozawa et al., 1991; Natland et al., 1991). The significant correlations suggest that these minerals in the same rocks are in compositional equilibrium and thus must have coprecipitated form their respective parental melts. The relationship $Mg\#_{cpx} > Mg\#_{opx} > Mg\#_{ol}$ is consistent with experimental data (e.g., Grove et al., 1992), although the differences are larger.

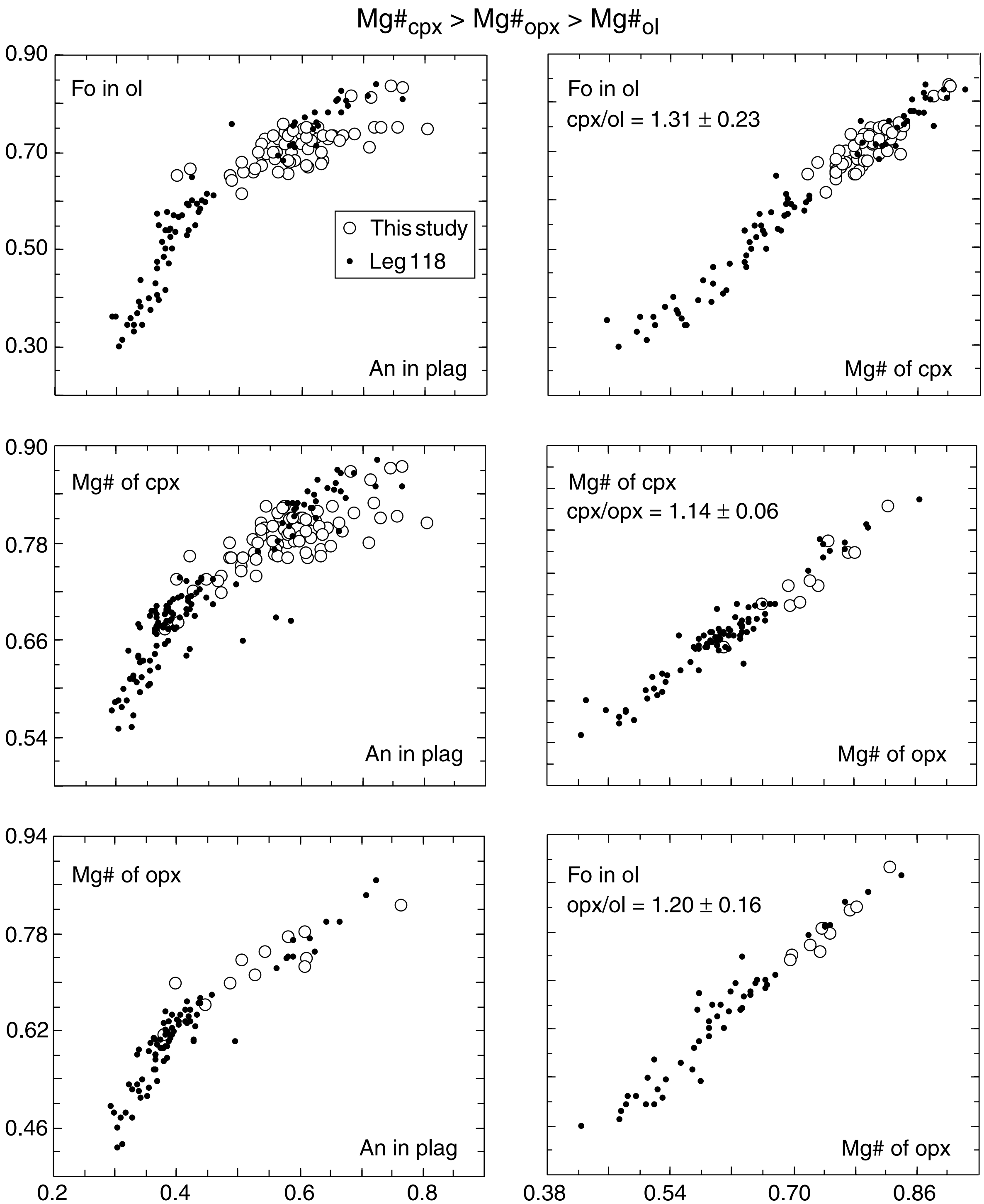

Figure F2. Plots of Mg# of minerals (olivine [ol], clinopyroxene [cpx], and orthopyroxene [opx]), basaltic melt, and whole-rock gabbroic samples against liquidus temperatures. The relationships of the composition and liquidus temperatures of olivine and basaltic melts are derived from well-established experimental results and phase equilibrium analyses (e.g., Roeder and Emslie, 1970; Bender et al., 1978; Walker et al., 1979; Langmuir and Hanson, 1981; Nielsen and Dungan, 1983; Weaver and Langmuir, 1990; Grove et al., 1992): T_{liquidus} (°C) = $1026e^{[0.01894\text{MgO (wt\%)}]}$, or T_{liquidus} (°C) = 1066 + 12.067 Mg# + 312.3 $(\text{Mg\#})^2$. The liquidus temperature of olivine is derived from the second equation, with Mg# calculated from olivine using Mg# (melt) = $1/([1/\text{Fo}-1]/K_d+1)$, where $K_d = 0.30 \pm 0.03$. **A.** The range of Mg# values is calculated to consider the range of K_d values from 0.27 to 0.33. Plotted are whole-rock samples of which olivine analyses are available for calculating the liquidus temperatures. Normal mid-ocean-ridge basalt (N-MORB) samples from the East Pacific Rise (Langmuir et al., 1986; Sinton et al., 1991; Niu and Batiza, 1997; Regelous et al., 1999) and Atlantis II Fracture Zone (AII F.Z.) basalts (Johnson and Dick, 1992) are plotted for comparison. **B.** Clinopyroxene and orthopyroxene compositions are plotted against liquidus temperatures of the corresponding samples derived from olivine compositions.

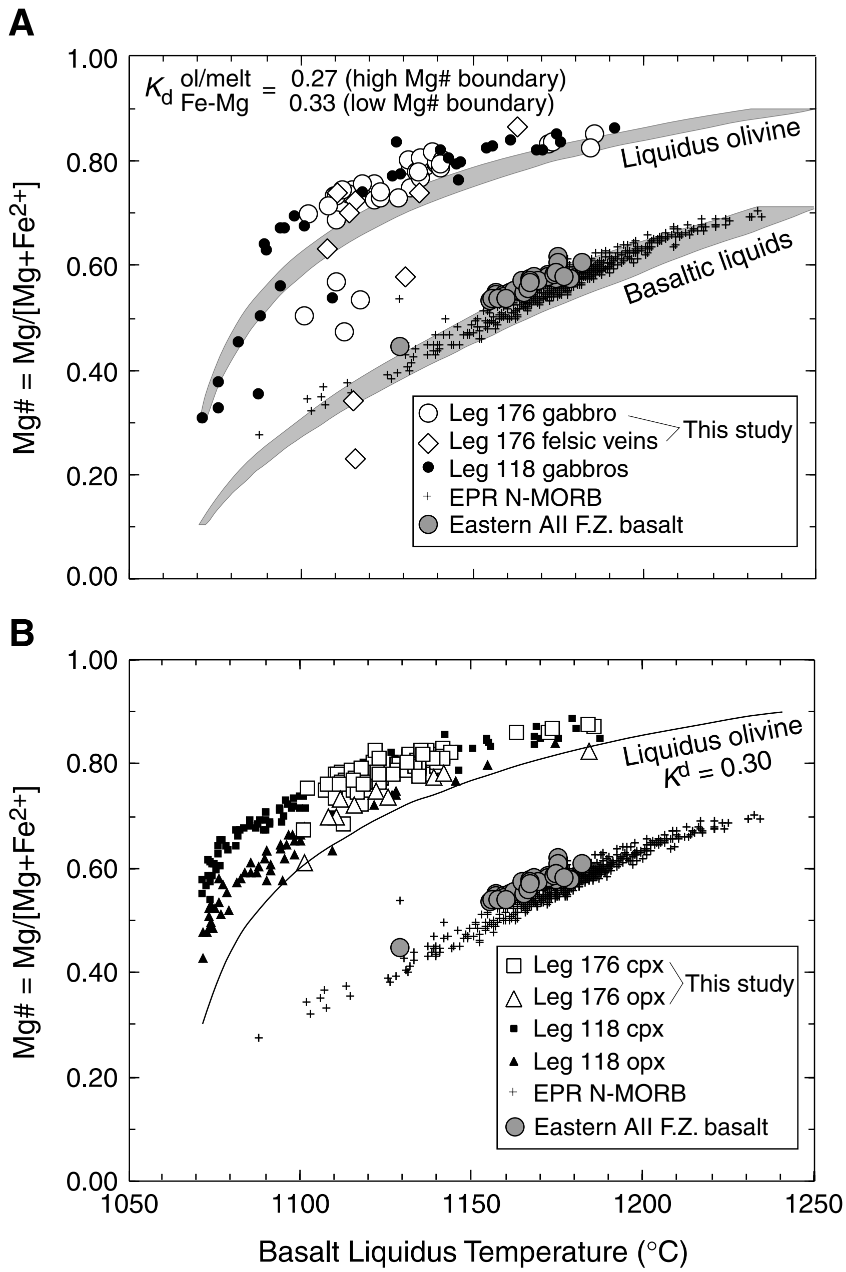

Figure F3. Plots of Ca# and CaO/Al_2O_3 vs. Mg# to compare Hole 735B gabbroic rocks with mid-ocean-ridge basalt (MORB) samples and model melt compositions. **A, B.** Global MORB data are Niu and Batiza (1993) compilation. **C, D.** The shaded areas are MORB fields defined by >90% of global MORB data in A and B. **E, F.** The solid arrows are compositions of model melts produced by decompression melting initiated at 25 kbar. The small circles with pluses are three such melts extracted, respectively, at different depths corresponding to 10%, 15%, and 20% melting (Niu and Batiza, 1991; Niu, 1997). The thick shaded curves are liquid lines of descent (Weaver and Langmuir, 1990) from these three model melts at 1-kbar pressure. Note that Atlantis II Fracture Zone (AII F.Z.) basalts plot at the low-Ca# and low-CaO/Al_2O_3 end of the global MORB data array, which is consistent with the interpretation that these melts result from the lowest extent of melting at the slowest spreading ridge (Bown and White, 1994; Muller et al., 1997; Niu and Hékinian, 1997). Note that a number of samples with CaO/Al_2O_3 > 1 are not shown in D. Note the differences between bulk Hole 735B average (large square with cross) and primitive melt (large circle with plus) parental to the most primitive olivine found in Hole 735B. References for East Pacific Rise (EPR) and AII F.Z. MORB are given in Figure F2, p. 19. opx = orthopyroxene, ol = olivine, plag = plagioclase, cpx = clinopyroxene, chr = chromite.

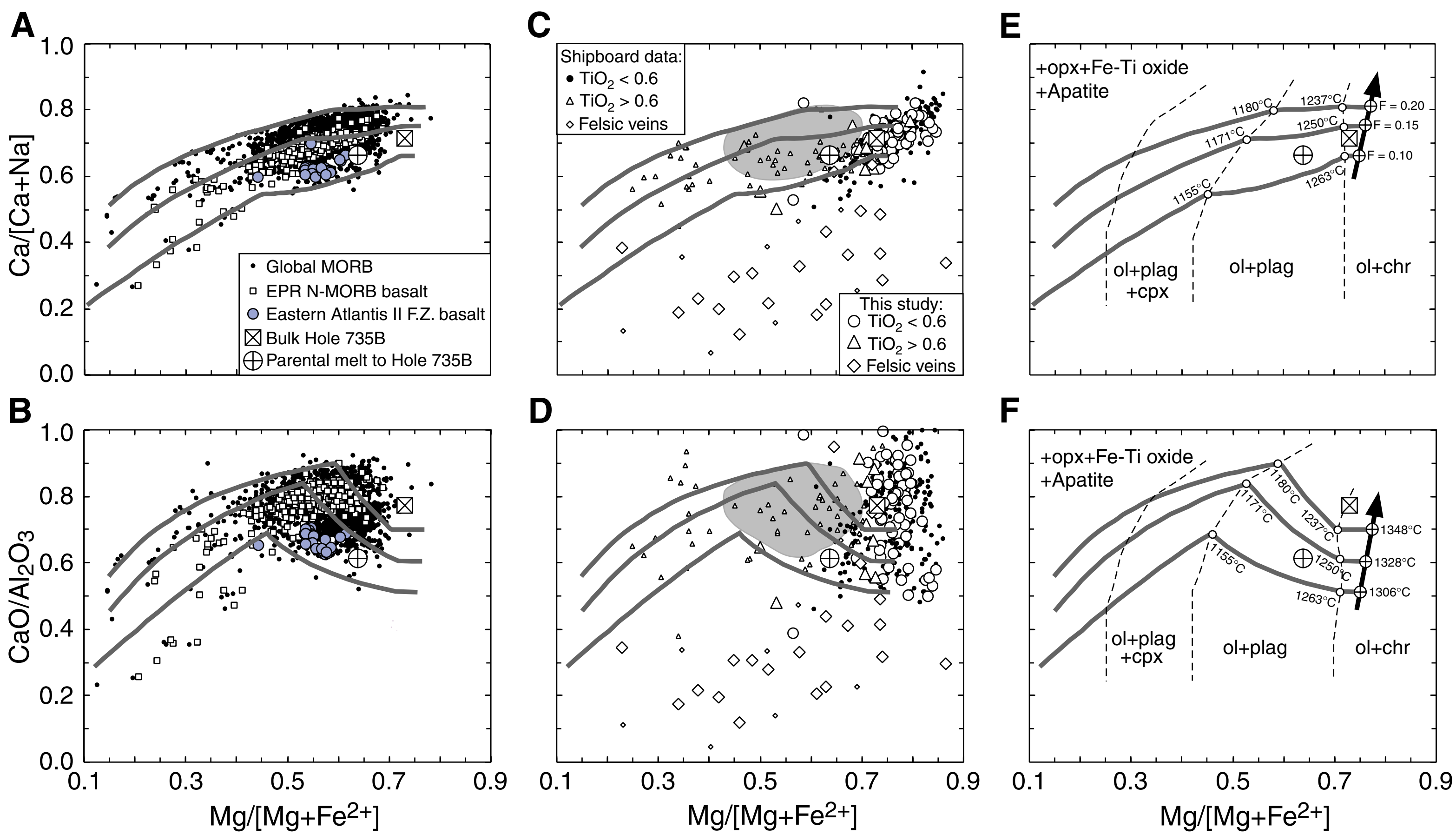

Figure F4. Plots of (**A**) SiO_2 and (**B**) TiO_2 of MORB samples and model liquid lines of descent as a function of liquidus temperature to show that Ti and Fe (not shown) enrichment, thus the derivation of high Fe-Ti basalt liquid, is a natural consequence of tholeiitic magma evolution. This Fe-Ti enrichment reaches a maximum at temperatures of ~1100°C (depending on fO_2 of the system), where Fe-Ti oxides begin to appear on the liquidus. Crystallization of Fe-Ti oxides (ilmenite and titanomagnetite) results in SiO_2 enrichment in the residual liquids, which we interpret to be the origin of felsic veins/veinlets in Hole 735B. The liquid lines of descent are derived from model parental melts in Figure F3, p. 20, for F = 10% (dark line) and F = 15% (light line), respectively, using the algorithms of Danyushevsky (1998). Plotted in (**C**) are modal (vol%) oxides in MS samples against liquidus temperatures (calculated from olivine as in Fig. F2, p. 19) of parental liquids that produced olivine, clinopyroxene, and plagioclase in these rocks. Obviously, the melts parental to the mineral assemblages of most gabbros and olivine gabbros were too hot to produce the Fe-Ti oxides in these rocks. Therefore, these oxides must have been "added" to these rocks subsequently at lower temperatures. References for East Pacific Rise (EPR) and Atlantis II Fracture Zone (AII F.Z.) mid-ocean-ridge basalts (MORB) are given in Figure F2, p. 19.

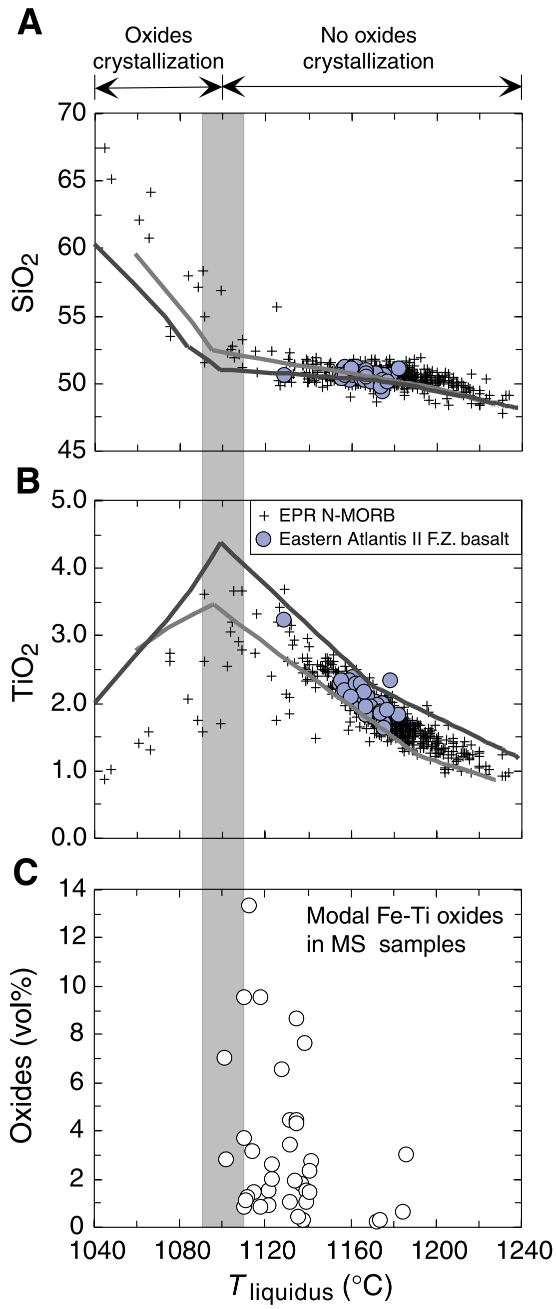

Figure F5. Comparison of mineral compositions between microgabbros and coarse-grained host gabbros. Except for plagioclase in Sample GS77-11, the compositions of the same minerals in the two groups are broadly similar, suggesting that there is a fairly good degree of compositional equilibrium between the two. Fo = fosterite, ol = olivine, cpx = clinopyroxene, An = anthorite.

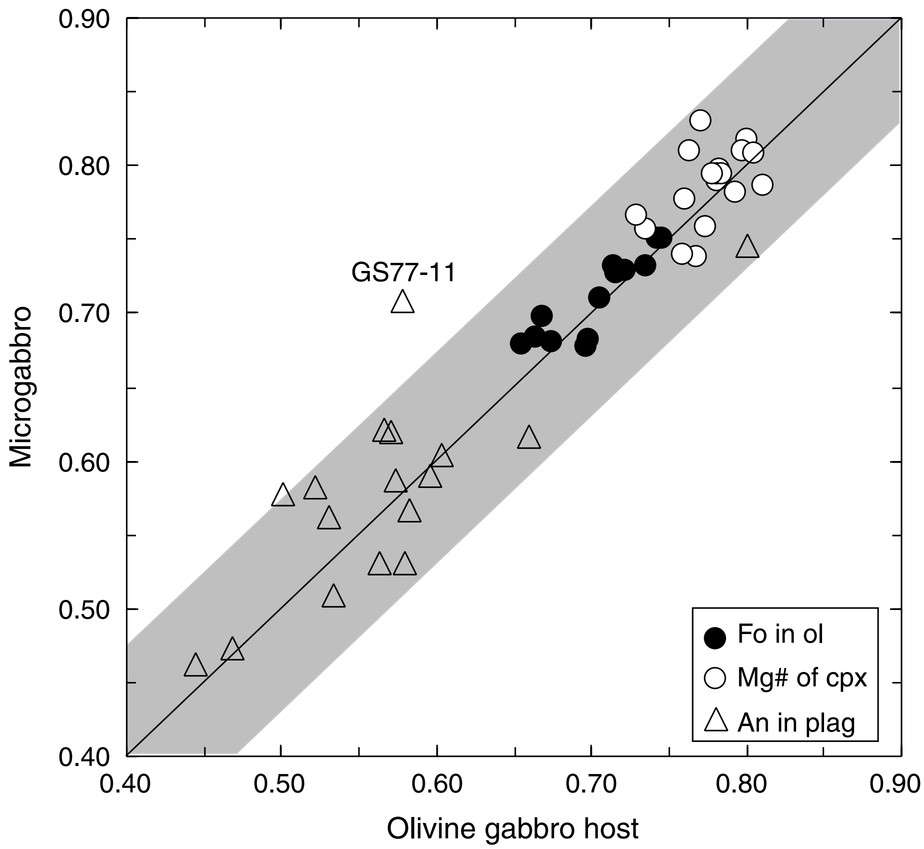

Figure F6. Plots of Sc, which is highly compatible in clinopyroxene (cpx) and incompatible in plagioclase (Plag), vs. CaO, Al_2O_3, and CaO/Al_2O_3. These compositional parameters in bulk gabbroic rocks are largely controlled by the relative modal proportions of clinopyroxene and plagioclase, the two dominant minerals. (**A**, **B**) bulk-rock Sc abundances lie on a mixing line defined by average plagioclase and clinopyroxene composition. The deviation from the mixing lines results from dilution effect of CaO- and Al_2O_3-poor minerals (i.e., olivine, orthopyroxene, ilmenite, titanomagnetite, etc.) in the rock. (**C**) this dilution effect is removed when CaO/Al_2O_3 is used. (**D**) both Sc and CaO/Al_2O_3 ($R_{C/A}$) can be used precisely for estimating relative mass proportions of clinopyroxene (i.e., cpx# = cpx/[cpx+plag]) and plagioclase (1 – cpx#): cpx# = [1.3835 $R_{C/A}$ – 0.5163]/[1.2571 $R_{C/A}$+0.4587] (also shown in part C). Average Sc abundances in plagioclase and clinopyroxene are from Y. Niu (unpubl. data). The numbers and tick marks along the mixing lines are cpx#. Data for FV samples are plotted for comparison.

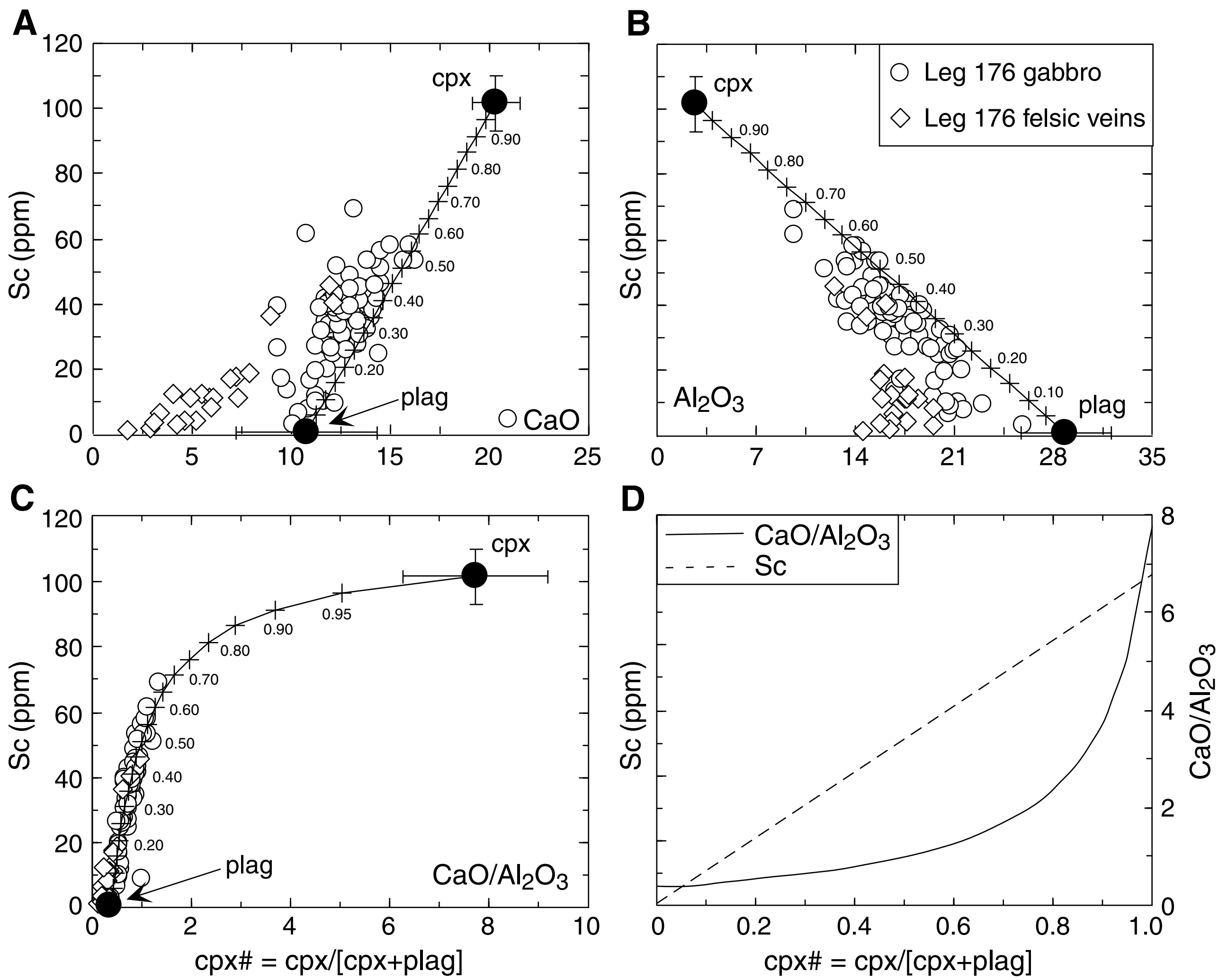

Figure F7. A. Mineral mass proportions (e.g., represented by cpx#) do not correlate with mineral compositions (e.g., represented by whole-rock Mg#) in gabbroic rocks. **B.** The apparent correlation of whole-rock Ca#, which is often used to reflect mineral compositional variation only (e.g., as in plagioclase), with cpx# is in fact also controlled by mineral modes because Ca is dominated by clinopyroxene (cpx), whereas Na is dominated by plagioclase (plag) in the whole rock. Symbols are as in Figure F3, p. 20.

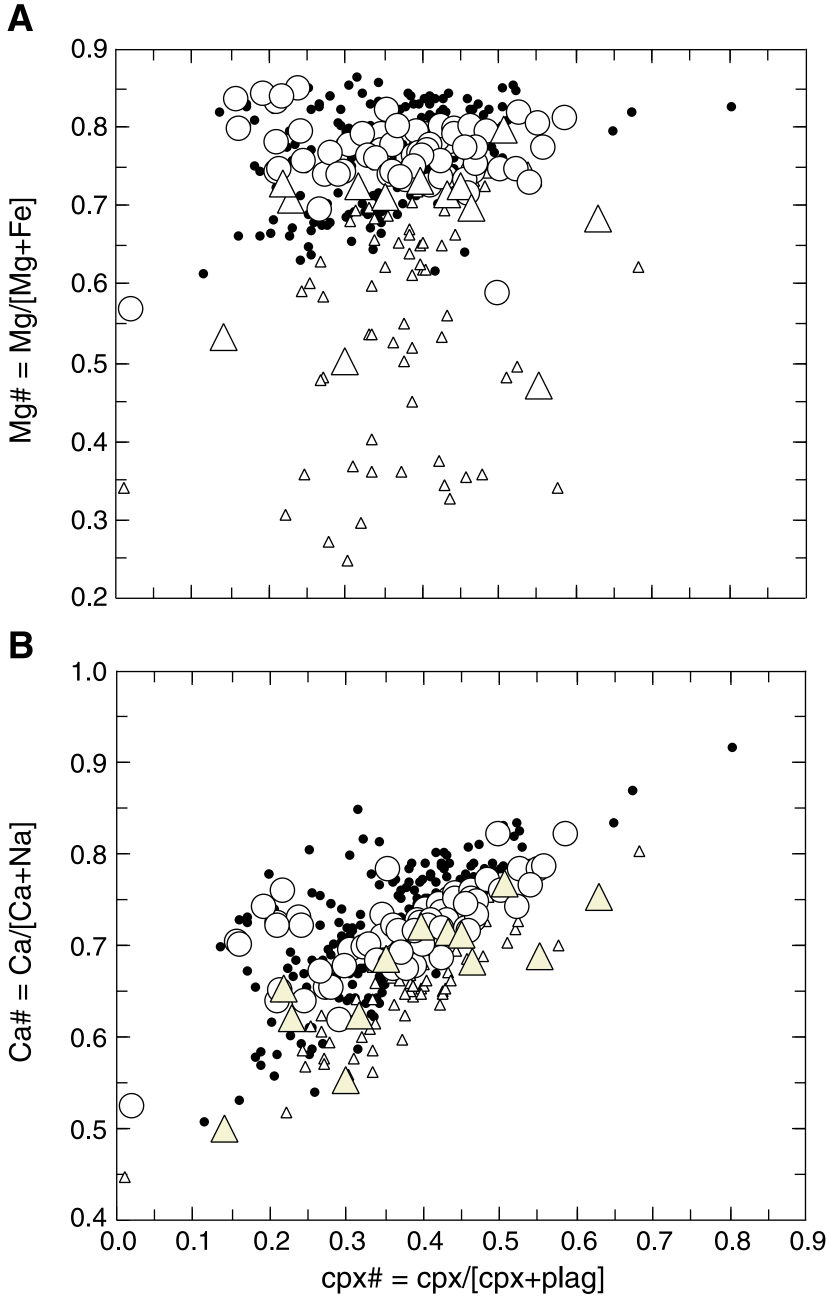

Figure F8. Plots of TiO_2, V, Cr, Ni, Sr, Y, Zr, and Nb in whole-rock samples against cpx# and Mg# to illustrate relative controls (modal vs. mineral compositional) on the abundances and distribution of these elements in gabbroic rocks. East Pacific Rise and Atlantis II Fracture Zone mid-ocean-ridge basalt data (references given in Fig. F2, p. 19) are shown in Mg# plots for comparison. Symbols are as in Figures F3, p. 20, and F7, p. 24. cpx = clinopyroxene, plag = plagioclase. (Continued on next page.)

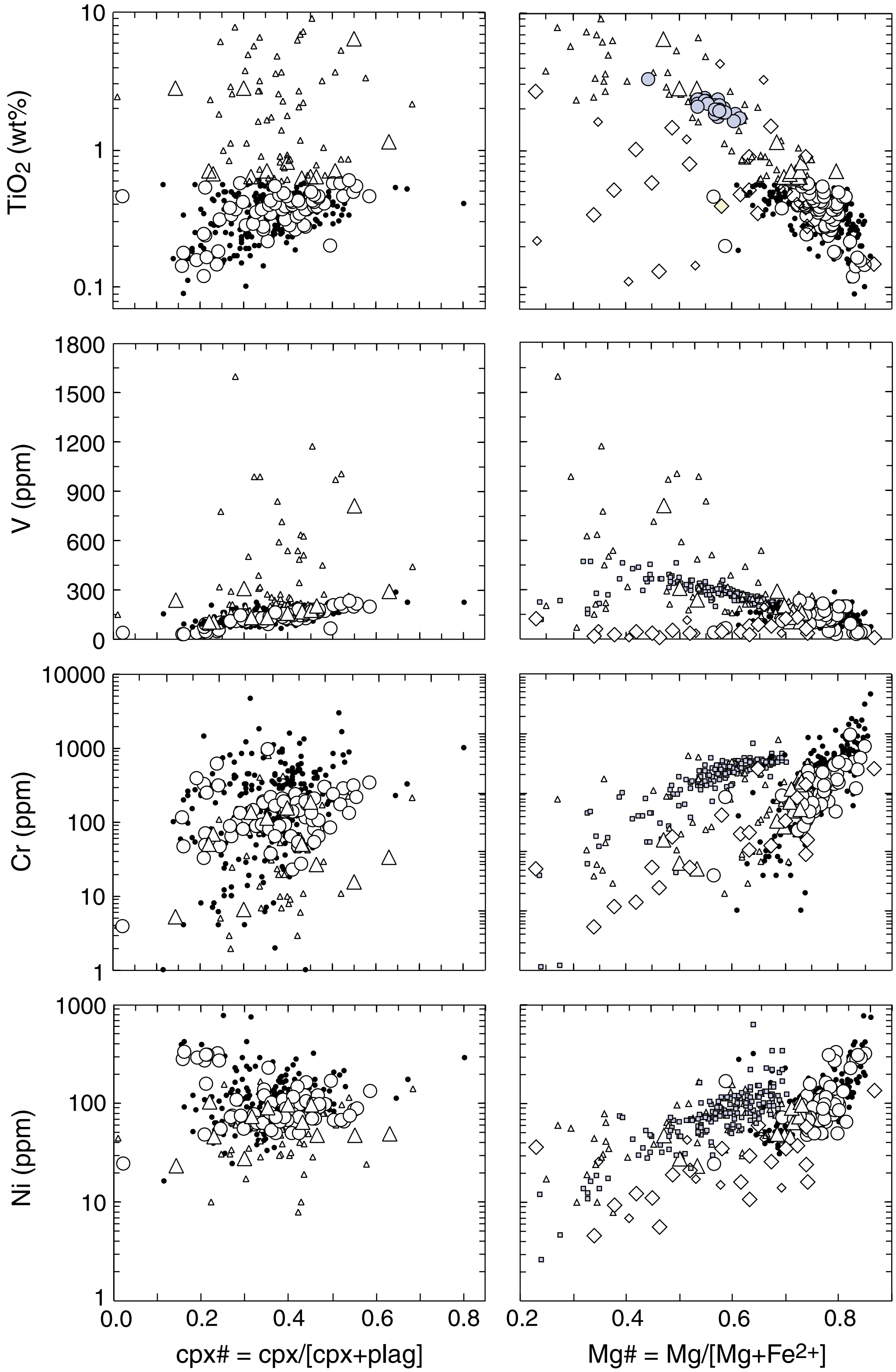

Figure F8 (continued).

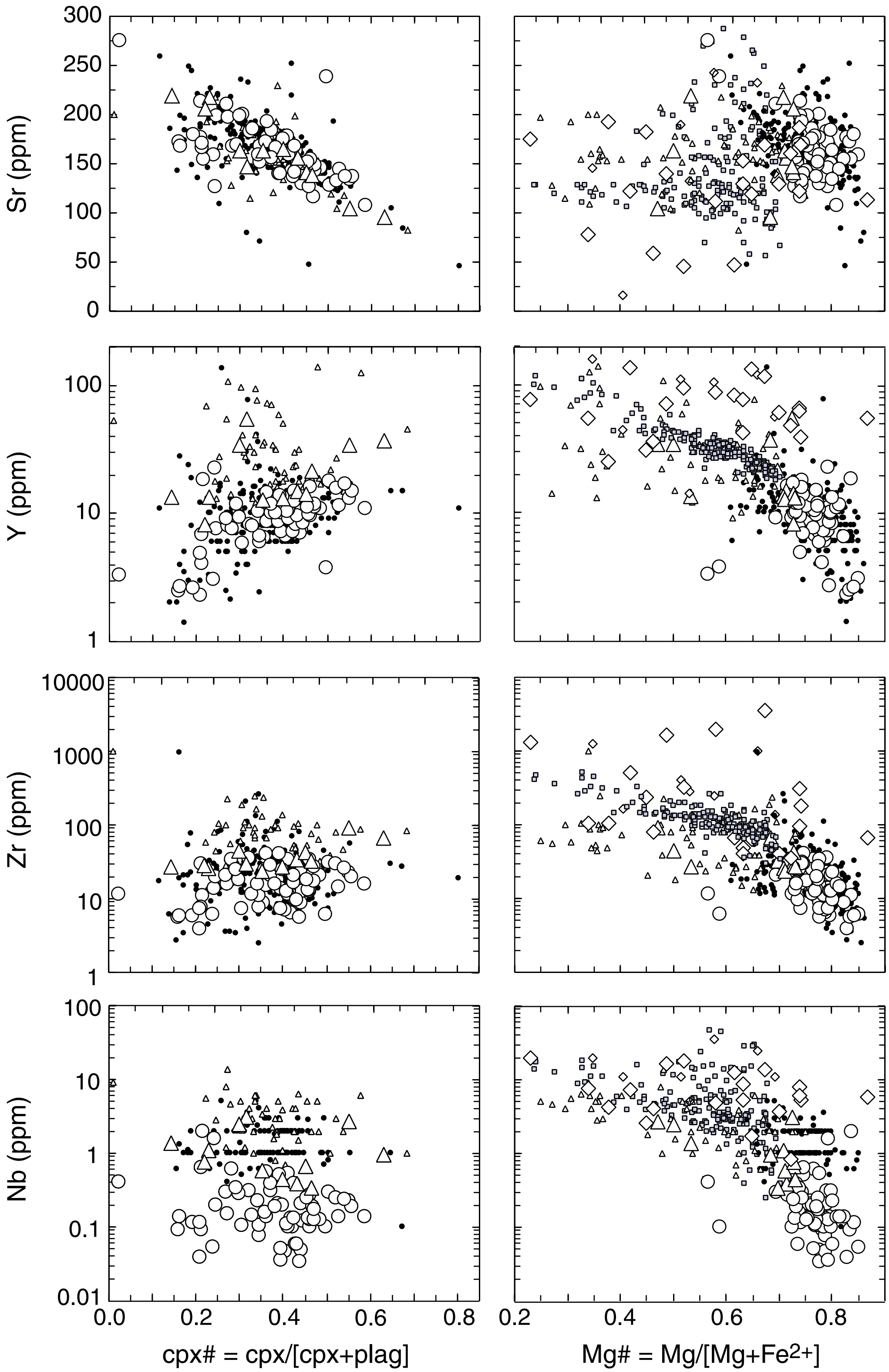

Figure F9. Downhole whole-rock compositional variation. Note that except for felsic veins/veinlets and samples with excess TiO_2 (>0.6 wt%), similar downhole profiles exist for whole-rock Mg#, Ca#, Cr, Ni, TiO_2, Zr, Y, and Zn, largely due to mineral compositional variation, which in turn is controlled by the temperature and cooling history of their parental melts. The lack of such a pattern for Sr and Cu is due to modal control. For example, Sr in the whole rock is proportional to the plagioclase/clinopyroxene ratio, whereas Cu is largely controlled by the distribution of sulfide globules.

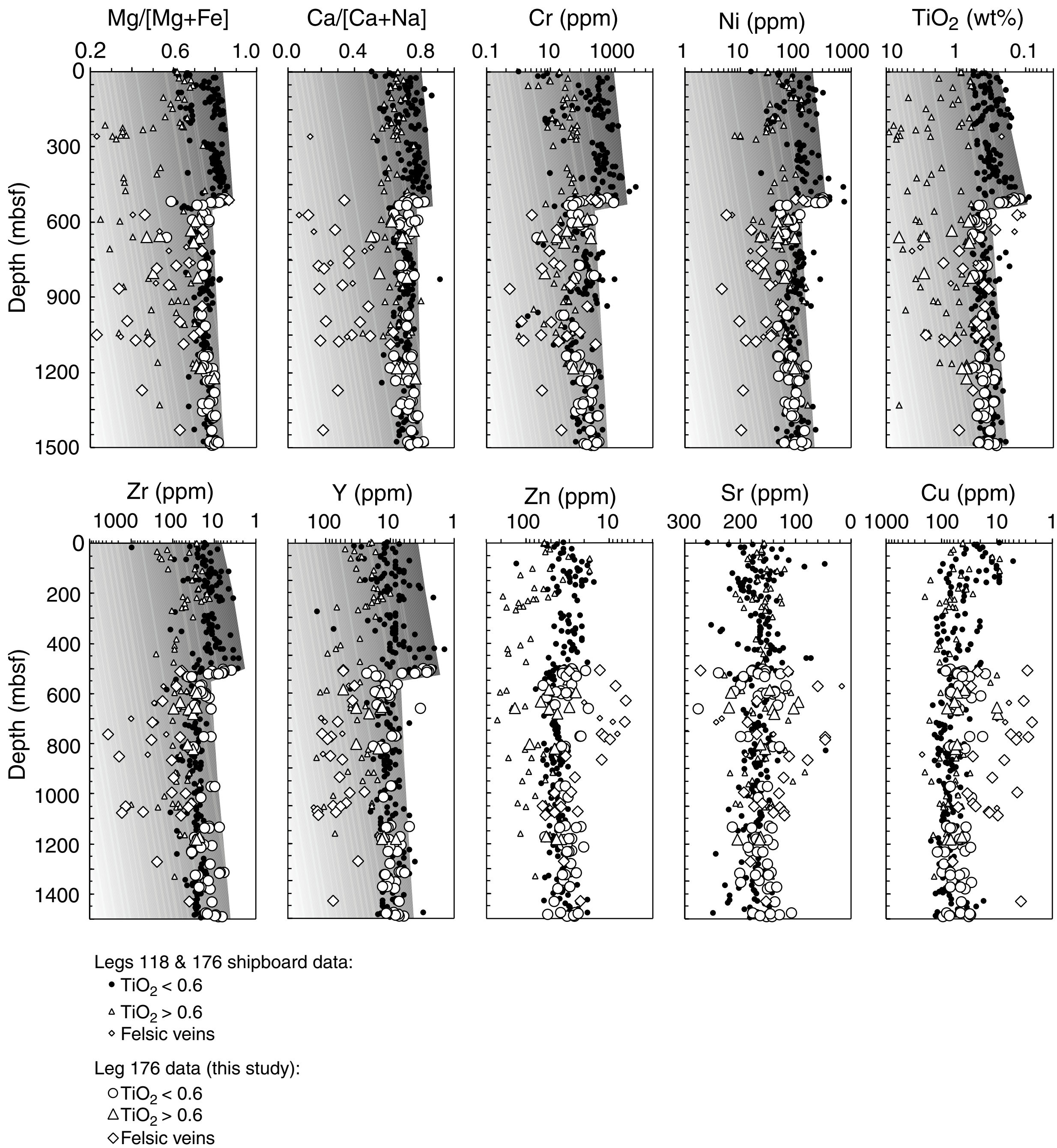

Figure F10. Downhole mineral compositional variation showing the same pattern as in Figure F9, p. 27. The calculated compositions and liquidus temperatures of melts parental to the gabbroic rocks are also shown. Obviously, the bulk hole, in particular the lower kilometer, is rather evolved, as seen in Figure F2, p. 19, and discussed in the text. cpx = clinopyroxene, opx = orthopyroxene, An = anthorite, plag = plagioclase, Fo = fosterite, ol = olivine.

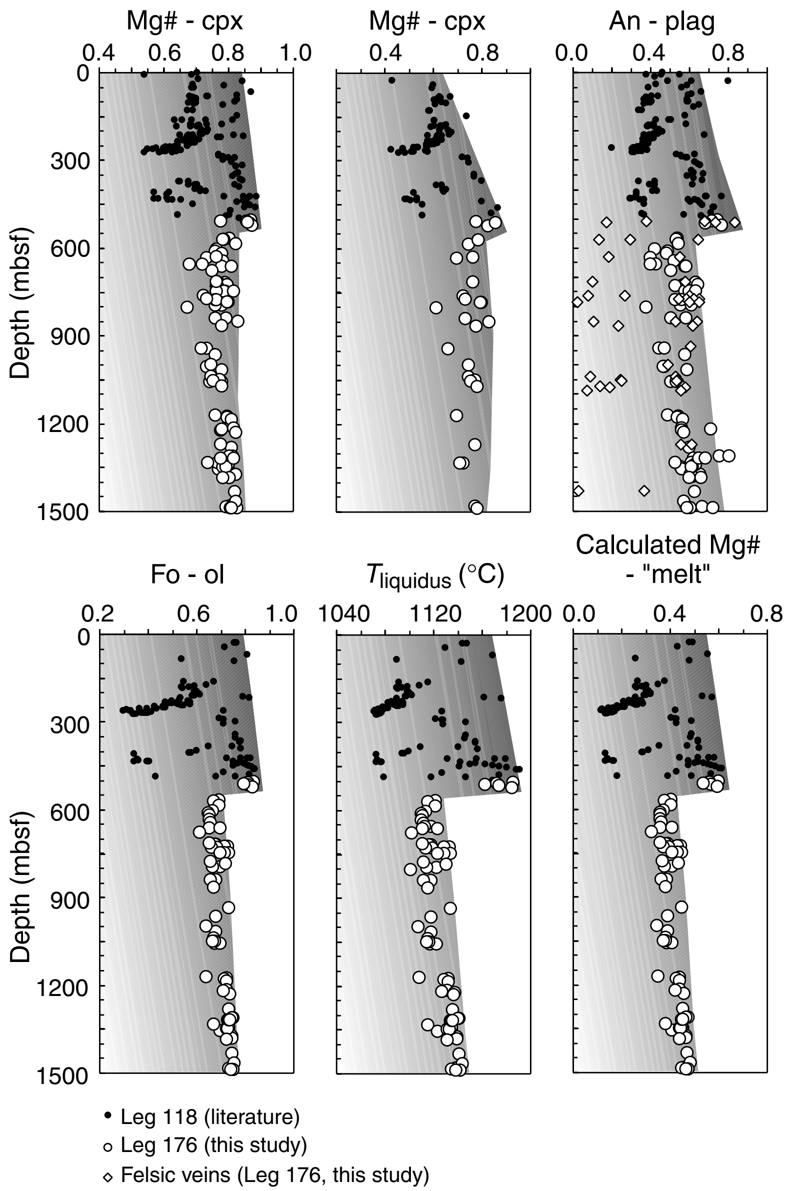

Table T1. Downhole positions and analytical work done on selected Leg 176 samples. (See table notes. Continued on next page.)

Core, section, piece, interval (cm)	Depth (mbsf)	Sample ID	Rock types	Whole-rock major element data	Whole-rock trace element data	Mineral major element data	Mineral trace element data	Isotopes
176-735B-								
89R-1 (Piece 4A, 46–52)	505.26	MS1-1	TrG	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
90R-2 (Piece 1A, 1–9)	509.31	MS3-2	TrG	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
90R-6 (Piece 5B, 118–122)	515.69	MS6-3	TrG	Done	Done	Ol, plag, cpx, ox, am	Cpx, plag	NA
91R-4 (Piece 6B, 80–87)	522.18	MS9-4	OG	Done	Done	Ol, plag, cpx, opx	Cpx, plag	NA
99R-2 (Piece 4G, 133–137)	568.64	MS11-5	DOxOG	Done	Done	Ol, plag, cpx, ox, am	Cpx, plag	NA
99R-4 (Piece 2A, 37–42)	570.39	MS12-6	DOxG	Done	Done	Ol, plag, cpx, ox	Cpx, plag	NA
101R-1 (Piece 7, 114–121)	586.24	MS14-7	OG	Done	Done	Ol, plag, cpx, opx, am	Cpx, plag	NA
104R-1 (Piece 14, 93–98)	605.23	MS18-8	OxG	Done	Done	Ol, plag, cpx, ox	Cpx, plag	NA
105R-3 (Piece 7, 107–112)	612.76	MS19-9	OxOGN	Done	Done	Ol, plag, cpx, ox	Cpx, plag	NA
106R-4 (Piece 8A, 117–124)	619.26	MS20-10	OxG	Done	Done	Ol, plag, cpx, ox	Cpx, plag	NA
109R-4 (Piece 1C, 57–62)	633.15	MS22-11	OxG	Done	Done	Ol, plag, cpx, opx, ox, am	Cpx, plag	NA
112R-4 (Piece 1B, 47–55)	646.64	MS23-12	DOxG	Done	Done	Ol, plag, cpx, ox	Cpx, plag	NA
114R-4 (Piece 1A, 10–15)	656.81	MS24-13	OxG	Done	Done	Plag, cpx, ox, am	Cpx, plag	NA
114R-4 (Piece 3A, 83–88)	657.54	MS25-14	OxG	Done	Done	Plag, cpx, ox, am	Cpx, plag	NA
115R-1 (Piece 4, 27–34)	662.27	MS26-15	DOxGN	Done	Done	Ol, plag, cpx, ox	Cpx, plag	NA
115R-2 (Piece 1A, 6–11)	663.56	MS27-16	OxOG	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
116R-6 (Piece 8, 130–135)	679.92	MS28-17	OxGN	Done	Done	Ol, plag, cpx, am	Cpx, plag	NA
131-1 (Piece 1B, 16–23)	803.66	MS41-18	OxOG	Done	Done	Plag, cpx, opx, ox, am	Cpx, plag	NA
155-3 (Piece 1C, 52–58)	1018.45	MS60-19	OGN	Done	Done	Ol, plag, cpx, ox, am	Cpx, plag	NA
172-4 (Piece 1B, 21–27)	1173.02	MS70-20	OGN	Done	Done	Ol, plag, cpx, opx, ox	Cpx, plag	NA
172-6 (Piece 1, 11–18)	1175.65	MS71-21	OxOG	Done	Done	Ol, plag, cpx, ox	Cpx, plag	NA
173-2 (Piece 4, 128–134)	1181.18	MS72-22	OxOGN	Done	Done	Ol, plag, cpx, ox, am	Cpx, plag	NA
173-6 (Piece 8A, 70–77)	1186.23	MS74-23	OxOG	Done	Done	Ol, plag, cpx, ox	Cpx, plag	NA
178-4 (Piece 5A, 105–111)	1216.26	MS76-24	GN	Done	Done	Ol, plag, cpx, ox	Cpx, plag	NA
179-2 (Piece 3B, 80–88)	1222.9	MS78-25	OxG	Done	NA	Plag, cpx, ox	Cpx, plag	NA
180-1 (Piece 3, 50–57)	1231	MS79-26	DOxOGN	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
185-3 (Piece 1, 87–95)	1281.93	MS82-27	OxG	Done	Done	Ol, plag, cpx, ox	Cpx, plag	NA
189-2 (Piece 3, 127–135)	1319.02	MS84-28	DOxOG	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
192-5 (Piece 1, 0–8)	1350.35	MS89-29	OxOG	Done	Done	Ol, plag, cpx, am	Cpx, plag	NA
193-1 (Piece 3A, 33–40)	1355.33	MS90-30	OxOG	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
196-2 (Piece 1, 13–18)	1374.88	MS91-31	DOxOG	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
196-3 (Piece 1, 7–13)	1375.78	MS92-32	OxOG	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
196-7 (Piece 12, 109–115)	1382.71	MS93-33	OG	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
203-3 (Piece 3, 108–115)	1434.21	MS95-34	DOxG	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
208-4 (Piece 2, 36–43)	1483	MS97-35	OxOG	Done	Done	Ol, plag, cpx, opx	Cpx, plag	NA
208-5 (Piece 3A, 72–79)	1484.86	MS98-36	OxGN	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
209-1 (Piece 2, 15–24)	1488.85	MS99-37	OxGN	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
210-5 (Piece 2A, 88–95)	1504.63	MS101-38	OxOGN	Done	Done	Ol, plag, cpx,	Cpx, plag	NA
91R-3 (Piece 2, 125–130)	521.2	BN1(F)	OG	Done	Done	NA	NA	NA
91R-2 (Piece 1E, 111–116)	519.86	BN2(F)	DOxOG	Done	Done	NA	NA	NA
93R-1 (Piece 5, 75–81)	532.85	BN3(F)	OxOG	Done	Done	NA	NA	NA
103R-2 (Piece 3F, 120–125)	597.39	BN4(F)	OxOG	Done	Done	NA	NA	NA
102R-3 (Piece 1, 8–14)	592.86	BN5(F)	OG	Done	Done	NA	NA	NA
103R-4 (Piece 4A, 36–45)	599.51	BN6(F)	OG	Done	Done	NA	NA	NA
90R-3 (Piece 2C, 115–120)	511.92	BN7(F)	OG	Done	Done	NA	NA	NA
127-5 (Piece 3, 22–28)	770.75	BN8(F)	OG	Done	Done	NA	NA	NA
132-1 (Piece 11B, 94–99)	814.14	BN9(F)	OG	Done	Done	NA	NA	NA
132-8 (Piece 7B, 112–118)	823.29	BN10(F)	OG	Done	Done	NA	NA	NA
150-3 (Piece 3, 77–83)	973.33	BN11(F)	DOxOG	Done	Done	NA	NA	NA
168-7 (Piece 3, 36–41)	1139.01	BN12(F)	DOxOG	Done	Done	NA	NA	NA
168-3 (Piece 2, 10–15)	1132.99	BN13(F)	OG	Done	Done	NA	NA	NA
173-4 (Piece 4B, 94–100)	1183.58	BN14(F)	OG	Done	Done	NA	NA	NA
177-5 (Piece 1A, 34–40)	1207.38	BN15(F)	OG	Done	Done	NA	NA	NA
180-4 (Piece 8, 93–100)	1235.71	BN16(F)	OG	Done	Done	NA	NA	NA
188-7 (Piece 1C, 61–68)	1315.96	BN17(F)	OG	Done	Done	NA	NA	NA
190-2 (Piece 1E, 69–75)	1327.92	BN18(F)	OG	Done	Done	NA	NA	NA
207-6 (Piece 1, 32–38)	1476.24	BN19(F)	OG	Done	Done	NA	NA	NA
209-5 (Piece 2B, 63–71)	1494.43	BN20(F)	OG	Done	Done	NA	NA	NA
91-2 (Piece 1E, 92–97)	519.67	BN1(A)	Altered	Done	Done	NA	NA	NA
91-3 (Piece 1E, 100–105)	520.95	BN2(Ah)	Altered	Done	Done	NA	NA	NA
91-3 (Piece 1D, 90–95)	520.85	BN2(Am)	Altered	Done	Done	NA	NA	NA
93-1 (Piece 2, 86–91)	532.96	NB3(A)	Altered	Done	Done	NA	NA	NA
103-2 (Piece 4, 139–142)	597.58	BN4(A)	Altered	Done	Done	NA	NA	NA
102-3 (Piece 1, 1–8)	592.79	BN5(A)	Altered	Done	Done	NA	NA	NA
103-4 (Piece 3, 18–22)	599.33	BN6(A)	Altered	Done	Done	NA	NA	NA
90-3 (Piece 2C, 97–100)	511.74	BN7(A)	Altered	Done	Done	NA	NA	NA

Table T1 (continued).

Core, section, piece, interval (cm)	Depth (mbsf)	Sample ID	Rock types	Whole-rock major element data	Whole-rock trace element data	Mineral major element data	Mineral trace element data	Isotopes
127-5 (Piece 2, 12–20)	770.65	BN8(A)	Altered	Done	Done	NA	NA	NA
132-1 (Piece 11A, 70–78)	813.9	BN9(A)	Altered	Done	Done	NA	NA	NA
132-8 (Piece 7B, 103–109)	823.2	BN10(A)	Altered	Done	Done	NA	NA	NA
150-3 (Piece 2B, 65–69)	973.21	BN11(A)	Altered	Done	Done	NA	NA	NA
168-7 (Piece 2A, 7–13)	1138.72	BN12(A)	Altered	Done	Done	NA	NA	NA
168-3 (Piece 3, 71–76)	1133.6	BN13(A)	Altered	Done	Done	NA	NA	NA
173-4 (Piece 4B, 105–113)	1183.69	BN14(A1)	Altered	Done	Done	NA	NA	NA
177-4 (Piece 2, 50–56)	1206.37	BN15(A)	Altered	Done	Done	NA	NA	NA
180-4 (Piece 9C, 109–119)	1235.87	BN16(A)	Altered	Done	Done	NA	NA	NA
188-7 (Piece 3A, 101–107)	1316.36	BN17(A)	Altered	Done	Done	NA	NA	NA
190-2 (Piece 2A, 97–103)	1328.2	BN18(A)	Altered	Done	Done	NA	NA	NA
207-6 (Piece 1, 1–7)	1475.93	BN19(A)	Altered	Done	Done	NA	NA	NA
209-4 (Piece 2B, 103–111)	1493.63	BN20(A)	Altered	Done	Done	NA	NA	NA
121-1 (Piece 2C, 22–28)	719.92	GS30-1	OG/MOG	NA	NA	Ol, plag, cpx, ox	NA	NA
121-4 (Piece 4B, 125–131)	725.37	GS31-2	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
122-2 (Piece 2, 37–45)	731.07	GS32-3	OG/MOG	NA	NA	Ol, plag, cpx, ox, am	NA	NA
123-6 (Piece 4C, 128–135)	746.99	GS33-4	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
123-7 (Piece 1A, 15–23)	747.34	GS34-5	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
130-3 (Piece 11, 99–107)	797.63	GS40-6	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
128-3 (Piece 14, 132–139)	778.73	GS38-7	OG/MOG	NA	NA	Cpx	NA	NA
134-7 (Piece 1B, 52–61)	841.3	GS44-8	OG/MOG	NA	NA	Ol, plag, cpx, opx	NA	NA
154-1 (Piece 2A, 4–11)	1005.34	GS59-9	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
159-2 (Piece 8B, 91–98)	1055.91	GS64-10	OG/MOG	NA	NA	Ol, plag, cpx, ox	NA	NA
178-7 (Piece 1B, 21–29)	1219.66	GS77-11	OG/MOG	NA	NA	Ol, plag, cpx, opx, ox	NA	NA
188-3 (Piece 1D, 105–112)	1310.89	GS83-12	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
190-7 (Piece 1B, 19–25)	1334.34	GS86-13	OG/MOG	NA	NA	Ol, plag, cpx, opx	NA	NA
191-4 (Piece 1B, 13–21)	1340.14	GS87-14	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
192-2 (Piece 3, 98–105)	1347.78	GS88-15	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
206-7 (Piece 3, 42–48)	1468.27	GS96-16	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
209-2 (Piece 1B, 37–44)	1490.11	GS100-17	OG/MOG	NA	NA	Ol, plag, cpx, opx	NA	NA
147-3 (Piece 1B, 39–42)	944.37	GS51-18	OG/MOG	NA	NA	Plag, cpx, opx, ox	NA	NA
149-5 (Piece 1, 5–13)	965.67	GS55-19	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
189-3 (Piece 2, 131–138)	1320.54	GS85-20	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
197-2 (Piece 8, 65–73)	1385.45	GS102-21	OG/MOG	NA	NA	Ol, plag, cpx,	NA	NA
90R-1 (Piece 1C, 45–48)	508.25	FV2-1	Felsic veins	NA	Done	Plag, cpx, am	Plag	Sr, O on plag
90R-3 (Piece 2B, 50–55)	511.27	FV5-2	Felsic veins	Done	Done	Ol, plag, cpx, am	NA	NA
99R-4 (Piece 5B, 97–102)	570.99	FV13-3	Felsic veins	Done	Done	Plag, cpx, ox, am	Plag	Sr, O on plag
109R-1 (Piece 2B, 17–22)	628.87	FV21-4	Felsic veins	Done	Done	Plag, cpx, ox	Plag	Sr, O on plag
120-4 (Piece 4, 34–41)	714.72	FV29-5	Felsic veins	Done	Done	Ol, plag, cpx, ox	NA	NA
126-5 (Piece 2A, 75–81)	761.57	FV35-6	Felsic veins	Done	Done	Plag, cpx, am	NA	NA
128-1 (Piece 5, 75–80)	775.25	FV37-7	Felsic veins	Done	Done	Plag, cpx, am	NA	Sr, O on plag
129-1 (Piece 7A, 53–56)	784.73	FV39-8	Felsic veins	Done	Done	Plag, cpx, am	NA	Sr, O on plag
136-4 (Piece 2A, 37–42)	851.25	FV45-9	Felsic veins	Done	Done	Ol, plag, cpx, am	Plag	Sr, O on plag
138-4 (Piece 3, 40–42)	865.8	FV47-10	Felsic veins	Done	Done	Plag, cpx, ox, am	Plag	Sr, O on plag
146-5 (Piece 4, 69–73)	937.28	FV50-11	Felsic veins	Done	Done	Ol, plag,	NA	Sr, O on plag
153-1 (Piece 3A, 30–33)	996	FV57-12	Felsic veins	Done	Done	NA	NA	NA
153-3 (Piece 3, 99–105)	999.37	FV58-13	Felsic veins	Done	Done	Ol, plag, cpx	NA	NA
157-5 (Piece 1, 1–8)	1040.28	FV61-14	Felsic veins	Done	Done	Ol, plag, cpx	Plag	Sr, O on plag
158-6 (Piece 3, 26–32)	1051.15	FV62-15	Felsic veins	Done	Done	Ol, plag, cpx	Plag	Sr, O on plag
158-8 (Piece 2A, 37–44)	1053.88	FV63-16	Felsic veins	Done	Done	Ol, plag, cpx	NA	Sr, O on plag
160-6 (Piece 3A, 120–124)	1071.75	FV65-17	Felsic veins	Done	Done	Plag, cpx	NA	Sr on plag
161-2 (Piece 4B, 106–113)	1075.45	FV66-18	Felsic veins	Done	Done	Plag,	Plag	Sr, O on plag
162-4 (Piece 4A, 105–110)	1087.41	FV67-19	Felsic veins	Done	Done	Plag	Plag	Sr, O on plag
184-2 (Piece 2, 18–21)	1270.88	FV81-20	Felsic veins	Done	Done	Plag, cpx	NA	NA
202-7 (Piece 2, 84–87)	1430.15	FV94-21	Felsic veins	Done	Done	Plag	Plag	Sr, O on plag

Notes: Working sample IDs were used throughout. OG = olivine gabbro, TrG = troctolitic gabbro, OxG = oxide gabbro, DOxG = disseminated oxide gabbro, DOxOG = disseminated oxide olivine gabbro, OxGN = oxide gabbronorite, altered = variably altered olivine gabbro and oxide gabbros, OG/MOG = olivine/oxide gabbro with fine-grained microgabbro "veins." ol = olivine, plag = plagioclase, cpx = clinopyroxene, opx = orthopyroxene, ox = titanomagnetite or ilmenite, am = amphibole. Sample powders were prepared by exclusive use of cleaned agate mills. Whole-rock major elements were analyzed by ICP-AES at Queensland University of Technology and ICP-OES at The University of Queensland. Whole-rock trace elements were analyzed by ICP-MS at The University of Queensland. Sr and O isotopes on selected felsic vein plagioclase (both primary and secondary) were analyzed at The University of Queensland. This paper focuses on whole-rock major element and selected trace element data on MS samples and mineral probe data on all the samples analyzed. Petrogenesis and geochemistry BN samples (fresh and altered sample pairs) are discussed elsewhere by Bach et al. (2001). Petrogenesis and geochemistry of FV (felsic vein) samples will be presented elsewhere by J.H. Natland et al. (unpubl. data). Trace element data on whole-rock samples and mineral separates will be discussed elsewhere by Y. Niu et al. (unpubl. data). NA = not analyzed.

Table T2. Microprobe analyses of olivine in Leg 176 gabbros. (Continued on next four pages.)

Sample:*	MS1-1	MS3-2	MS6-3	MS9-4	MS11-5	MS12-6	MS14-7	MS18-8	MS19-9	MS20-10	MS22-11	MS23-12	MS26-15	MS27-16	MS28-17	MS60-19	MS70-20
N:	5	15	13	10	6	5	5	5	4	5	10	5	5	3	4	5	8
Major element oxides (wt%):																	
SiO_2	39.86	39.56	39.55	40.04	37.60	37.28	37.63	37.25	37.02	37.06	37.07	37.14	37.22	37.95	36.54	37.50	36.91
TiO_2	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.02	0.01	0.02	0.01	0.01	0.00	0.00	0.01	0.01	0.01
Al_2O_3	0.03	0.01	0.01	0.02	0.02	0.01	0.01	0.00	0.01	0.07	0.00	0.04	0.01	0.00	0.00	0.00	0.01
FeO	15.42	17.39	17.11	15.91	27.11	28.83	26.98	29.28	30.42	30.31	30.41	29.83	30.70	27.31	33.18	28.03	31.13
MnO	0.24	0.26	0.27	0.24	0.39	0.45	0.45	0.45	0.46	0.47	0.54	0.46	0.47	0.42	0.56	0.46	0.50
MgO	44.62	43.29	43.28	45.40	34.89	33.45	34.97	33.29	32.30	32.42	32.46	32.80	32.95	36.12	30.17	34.36	31.78
CaO	0.01	0.03	0.03	0.04	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.01	0.03	0.03	0.03	0.02
NiO	0.15	0.14	0.15	0.18	0.05	0.06	0.05	0.05	0.04	0.03	0.03	0.03	0.06	0.05	0.04	0.04	0.05
Cr_2O_3	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Total:	100.38	100.72	100.42	101.86	100.11	100.11	100.13	100.39	100.30	100.43	100.59	100.38	101.46	101.92	100.54	100.47	100.43
Calculated cation proportions:																	
Si	1.0000	0.9982	0.9997	0.9923	1.0012	1.0013	1.0012	0.9999	1.0003	0.9996	0.9992	0.9999	0.9950	0.9925	0.9994	0.9996	0.9999
Ti	0.0001	0.0002	0.0002	0.0001	0.0002	0.0001	0.0001	0.0004	0.0002	0.0003	0.0002	0.0002	0.0001	0.0001	0.0001	0.0002	0.0002
Al	0.0007	0.0004	0.0002	0.0005	0.0006	0.0002	0.0003	0.0001	0.0004	0.0022	0.0001	0.0013	0.0003	0.0001	0.0000	0.0001	0.0002
Fe	0.3229	0.3664	0.3610	0.3292	0.6027	0.6465	0.5995	0.6562	0.6863	0.6825	0.6843	0.6705	0.6853	0.5963	0.7576	0.6237	0.7042
Mn	0.0051	0.0056	0.0058	0.0050	0.0088	0.0102	0.0100	0.0103	0.0106	0.0107	0.0124	0.0104	0.0106	0.0094	0.0129	0.0105	0.0115
Mg	1.6673	1.6271	1.6293	1.6757	1.3835	1.3386	1.3860	1.3313	1.3001	1.3026	1.3032	1.3154	1.3121	1.4072	1.2289	1.3642	1.2823
Ca	0.0004	0.0008	0.0008	0.0012	0.0002	0.0002	0.0003	0.0002	0.0005	0.0006	0.0005	0.0009	0.0003	0.0008	0.0008	0.0008	0.0006
Ni	0.0030	0.0028	0.0029	0.0035	0.0011	0.0013	0.0011	0.0011	0.0009	0.0007	0.0007	0.0006	0.0012	0.0011	0.0008	0.0009	0.0011
Total:	2.9995	3.0014	2.9999	3.0074	2.9983	2.9984	2.9985	2.9996	2.9993	2.9990	3.0006	2.9993	3.0048	3.0074	3.0005	3.0001	2.9999
Fo	83.4	81.2	81.5	83.2	69.3	67.0	69.4	66.6	65.1	65.2	65.1	65.8	65.3	69.8	61.4	68.2	64.1
1 σ	0.29	0.41	0.43	0.21	1.1	0.30	0.96	0.43	0.39	0.66	0.79	0.26	0.67	0.09	0.19	0.51	0.17

Notes: * = ODP sample designations for the sample IDs can be found in Table T1, p. 29. *N* = averages of a number of point analyses on more than one crystal in a thin section are reported. The analyses were done on a JXA-8800L Superprobe at The University of Queensland. See text for analytical details. F (fine) and C (coarse) in GS samples refer to fine-grained microgabbro "bands" or "veins" entrued or enclosed within coarse-grained gabbro host. Note the compositional similarity between F and C portions of the same samples. Fo = forsterite.

Table T2 (continued).

Sample:*	MS71-21	MS72-22	MS74-23	MS76-24	MS79-26	MS82-27	MS8428	MS89-29	MS90-30	MS91-31	MS92-32	MS93-33	MS95-34	MS97-35	MS98-36	MS-99-37	MS101-38
N:	3	3	3	6	3	3	3	3	6	3	3	3	6	3	5	5	5
Major element oxides (wt%):																	
SiO_2	38.08	37.90	38.06	38.07	38.47	38.47	38.28	38.45	37.96	38.56	38.21	38.43	38.46	38.36	38.21	38.48	38.42
TiO_2	0.01	0.00	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.00
Al_2O_3	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
FeO	24.52	25.36	24.53	24.54	23.84	24.25	24.38	24.43	27.24	23.28	23.87	22.91	22.64	23.08	23.99	22.48	22.61
MnO	0.37	0.38	0.37	0.38	0.37	0.37	0.38	0.37	0.41	0.36	0.36	0.34	0.35	0.35	0.37	0.36	0.33
MgO	36.92	36.20	36.89	36.87	38.48	38.44	37.74	38.34	36.17	38.91	37.52	38.41	38.58	38.14	37.48	38.66	38.43
CaO	0.04	0.03	0.03	0.04	0.03	0.05	0.03	0.05	0.01	0.04	0.01	0.02	0.03	0.04	0.04	0.02	0.03
NiO	0.07	0.04	0.06	0.06	0.05	0.08	0.07	0.07	0.07	0.08	0.07	0.09	0.07	0.06	0.07	0.09	0.07
Cr_2O_3	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00
Total:	100.05	99.96	99.97	100.01	101.31	101.70	100.89	101.75	101.93	101.25	100.10	100.26	100.18	100.08	100.21	100.14	99.93
Calculated cation proportions:																	
Si	1.0016	1.0020	1.0018	1.0018	0.9954	0.9932	0.9972	0.9932	0.9926	0.9955	1.0013	1.0007	1.0010	1.0015	1.0009	1.0012	1.0022
Ti	0.0002	0.0001	0.0002	0.0003	0.0004	0.0004	0.0002	0.0001	0.0002	0.0003	0.0003	0.0002	0.0002	0.0003	0.0001	0.0002	0.0001
Al	0.0001	0.0001	0.0002	0.0002	0.0001	0.0002	0.0002	0.0003	0.0003	0.0001	0.0003	0.0002	0.0002	0.0001	0.0002	0.0004	0.0002
Fe	0.5386	0.5597	0.5390	0.5391	0.5150	0.5227	0.5302	0.5268	0.5946	0.5018	0.5223	0.4981	0.4919	0.5030	0.5246	0.4883	0.4924
Mn	0.0083	0.0086	0.0083	0.0085	0.0081	0.0081	0.0083	0.0080	0.0090	0.0078	0.0079	0.0074	0.0076	0.0077	0.0082	0.0079	0.0072
Mg	1.4468	1.4256	1.4464	1.4452	1.4833	1.4784	1.4643	1.4752	1.4087	1.4961	1.4643	1.4900	1.4956	1.4832	1.4623	1.4981	1.4933
Ca	0.0013	0.0010	0.0007	0.0013	0.0009	0.0015	0.0007	0.0013	0.0003	0.0010	0.0003	0.0006	0.0008	0.0011	0.0011	0.0006	0.0008
Ni	0.0013	0.0009	0.0013	0.0012	0.0010	0.0017	0.0015	0.0015	0.0015	0.0017	0.0015	0.0018	0.0015	0.0013	0.0015	0.0017	0.0014
Total:	2.9982	2.9978	2.9979	2.9977	3.0041	3.0062	3.0025	3.0065	3.0071	3.0042	2.9982	2.9990	2.9988	2.9981	2.9989	2.9984	2.9976
Fo	72.5	71.4	72.5	72.4	73.9	73.5	73.0	73.3	69.9	74.5	73.4	74.6	74.9	74.3	73.2	75.0	74.8
1 σ	0.17	0.09	0.18	0.15	0.07	0.16	0.30	0.13	0.69	0.52	0.62	0.21	0.33	0.34	0.48	0.34	0.19

Table T2 (continued).

Sample:*	GS30-1	GS30-1	GS31-2	GS31-2	GS32-3	GS33-3	GS33-4	GS33-4	GS34-5	GS40-6	GS40-6	GS40-6	GS44-8	GS44-8	GS64-10	GS64-10	GS77-11
N:	5	5	3	3	3	3	3	3	3	3	3	3	3	3	5	5	5
	F	C	F	C	C	F	F	C	C	C	F		F	C	F	C	C
Major element oxides (wt%):																	
SiO_2	37.38	37.31	38.12	37.90	37.08	37.33	38.05	37.79	37.58	37.15	37.59	37.11	37.46	37.13	37.25	37.54	37.67
TiO_2	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.00	0.02	0.01	0.01	0.02	0.01	0.01	0.01
Al_2O_3	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00
FeO	27.89	28.32	24.29	25.16	28.99	27.38	23.68	25.06	26.40	28.74	26.57	29.71	28.25	30.10	28.04	26.36	25.84
MnO	0.43	0.44	0.37	0.38	0.45	0.40	0.37	0.38	0.41	0.42	0.41	0.42	0.44	0.46	0.42	0.44	0.40
MgO	33.94	33.61	37.08	36.18	32.71	33.83	36.90	35.83	34.88	33.03	34.88	32.73	34.20	32.72	33.48	34.72	35.26
CaO	0.04	0.04	0.04	0.02	0.04	0.02	0.01	0.02	0.01	0.04	0.02	0.00	0.03	0.01	0.01	0.03	0.03
NiO	0.08	0.06	0.07	0.07	0.05	0.06	0.08	0.02	0.06	0.05	0.06	0.06	0.05	0.05	0.06	0.05	0.05
Cr_2O_3	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
Total:	99.80	99.85	100.03	99.75	99.39	99.07	99.15	99.13	99.39	99.46	99.57	100.09	100.45	100.54	99.28	99.17	99.28
Calculated cation proportions:																	
Si	1.0029	1.0028	1.0018	1.0031	1.0051	1.0065	1.0064	1.0061	1.0050	1.0045	1.0040	1.0015	0.9995	0.9993	1.0053	1.0060	1.0054
Ti	0.0002	0.0003	0.0003	0.0003	0.0004	0.0001	0.0002	0.0001	0.0002	0.0001	0.0005	0.0003	0.0001	0.0004	0.0003	0.0002	0.0002
Al	0.0001	0.0001	0.0001	0.0002	0.0000	0.0002	0.0001	0.0000	0.0002	0.0002	0.0001	0.0001	0.0000	0.0003	0.0002	0.0001	0.0000
Fe	0.6246	0.6354	0.5330	0.5560	0.6561	0.6164	0.5228	0.5571	0.5895	0.6487	0.5924	0.6694	0.6293	0.6763	0.6319	0.5897	0.5759
Mn	0.0098	0.0101	0.0083	0.0086	0.0104	0.0091	0.0083	0.0086	0.0093	0.0096	0.0092	0.0097	0.0100	0.0104	0.0096	0.0099	0.0090
Mg	1.3563	1.3455	1.4517	1.4265	1.3204	1.3590	1.4536	1.4209	1.3892	1.3303	1.3877	1.3158	1.3595	1.3118	1.3459	1.3859	1.4021
Ca	0.0013	0.0012	0.0012	0.0006	0.0011	0.0007	0.0003	0.0006	0.0002	0.0010	0.0005	0.0001	0.0009	0.0004	0.0002	0.0009	0.0008
Ni	0.0016	0.0014	0.0015	0.0014	0.0010	0.0014	0.0017	0.0004	0.0013	0.0010	0.0012	0.0012	0.0010	0.0011	0.0012	0.0011	0.0010
Total:	2.9968	2.9968	2.9979	2.9965	2.9946	2.9933	2.9934	2.9938	2.9948	2.9954	2.9955	2.9981	3.0004	3.0001	2.9944	2.9938	2.9944
Fo	68.0	67.5	72.7	71.6	66.4	68.4	73.2	71.5	69.8	66.8	69.7	65.9	67.9	65.6	67.7	69.7	70.5
1 σ	0.28	0.32	0.53	0.31	0.66	0.20	0.27	0.21	0.07	0.26	0.31	0.33	0.37	0.27	0.17	0.57	0.10

Table T2 (continued).

Sample:*	GS77-11	GS83-12	GS83-12	GS86-13	GS87-14	GS88-15	GS88-15	GS96-16	GS100-17	GS100-17	GS55-19	GS85-20	GS85-20	GS102-21	FV5-2	FV29-5	FV45-9
N:	5	5	5	5	3	2	3	3	2	3	4	3	3	5	4	3	6
	F	F	C	F	C	C	F		F	C		F	C	F			
Major element oxides (wt%):																	
SiO_2	37.72	38.34	38.33	37.23	38.10	37.95	38.04	38.47	38.41	38.28	37.51	38.10	38.21	37.96	39.08	36.91	37.91
TiO_2	0.02	0.00	0.01	0.02	0.01	0.00	0.03	0.01	0.01	0.01	0.01	0.03	0.01	0.04	0.01	0.01	0.02
Al_2O_3	0.01	0.01	0.01	0.02	0.12	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.00
FeO	25.33	22.28	22.67	28.46	23.69	24.56	23.98	21.83	22.30	22.88	28.13	23.70	23.56	24.47	18.42	29.91	24.66
MnO	0.39	0.33	0.34	0.40	0.33	0.34	0.36	0.31	0.31	0.33	0.44	0.35	0.36	0.36	0.29	0.48	0.38
MgO	35.50	38.14	38.06	33.35	37.02	36.46	36.81	38.71	38.40	37.89	34.41	37.07	37.52	36.46	41.27	32.01	36.29
CaO	0.03	0.01	0.03	0.01	0.03	0.01	0.01	0.01	0.02	0.04	0.02	0.03	0.05	0.03	0.03	0.03	0.02
NiO	0.06	0.08	0.07	0.08	0.11	0.08	0.08	0.09	0.10	0.07	0.05	0.07	0.09	0.06	0.13	0.02	0.05
Cr_2O_3	0.01	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.01
Total:	99.10	99.22	99.57	99.59	99.44	99.46	99.35	99.46	99.58	99.52	100.60	99.41	99.82	99.40	99.27	99.37	99.35
Calculated cation proportions:																	
Si	1.0064	1.0058	1.0041	1.0038	1.0044	1.0047	1.0053	1.0045	1.0040	1.0042	0.9989	1.0049	1.0028	1.0047	1.0059	1.0048	1.0051
Ti	0.0003	0.0001	0.0002	0.0004	0.0002	0.0000	0.0006	0.0002	0.0001	0.0003	0.0002	0.0006	0.0002	0.0008	0.0001	0.0001	0.0004
Al	0.0004	0.0003	0.0003	0.0005	0.0036	0.0001	0.0000	0.0004	0.0003	0.0001	0.0002	0.0001	0.0003	0.0002	0.0000	0.0000	0.0000
Fe	0.5642	0.4881	0.4958	0.6405	0.5213	0.5429	0.5291	0.4757	0.4867	0.5011	0.6253	0.5220	0.5162	0.5407	0.3962	0.6799	0.5459
Mn	0.0088	0.0073	0.0075	0.0091	0.0074	0.0076	0.0080	0.0069	0.0068	0.0073	0.0098	0.0078	0.0079	0.0081	0.0064	0.0110	0.0085
Mg	1.4108	1.4906	1.4851	1.3395	1.4537	1.4378	1.4493	1.5053	1.4953	1.4803	1.3649	1.4566	1.4666	1.4376	1.5818	1.2980	1.4331
Ca	0.0010	0.0002	0.0010	0.0002	0.0007	0.0004	0.0002	0.0004	0.0006	0.0010	0.0006	0.0009	0.0013	0.0008	0.0008	0.0007	0.0005
Ni	0.0013	0.0016	0.0015	0.0016	0.0023	0.0017	0.0017	0.0018	0.0020	0.0014	0.0010	0.0015	0.0018	0.0013	0.0027	0.0005	0.0010
Total:	2.9931	2.9939	2.9955	2.9956	2.9936	2.9952	2.9941	2.9951	2.9958	2.9955	3.0008	2.9944	2.9969	2.9944	2.9940	2.9950	2.9945
Fo	71.0	75.0	74.6	67.3	73.2	72.2	72.9	75.6	75.1	74.3	68.2	73.2	73.6	72.3	79.6	65.2	72.1
1 σ	0.55	0.46	0.23	0.14	0.16	0.15	0.09	0.20	0.05	0.32	0.55	0.27	0.11	0.10	2.11	0.12	0.82

Table T2 (continued).

Sample:*	FV47-10	FV50-11	FV58-13	FV61-14	FV62-15	FV63-16
N:	6	3	6	6	3	3
Major element oxides (wt%):						
SiO_2	37.14	38.25	36.87	37.38	37.49	37.35
TiO_2	0.01	0.00	0.01	0.02	0.00	0.01
Al_2O_3	0.00	0.02	0.01	0.00	0.01	0.06
FeO	28.28	24.16	31.35	28.95	29.09	29.37
MnO	0.47	0.36	0.52	0.43	0.45	0.45
MgO	33.00	37.61	31.60	33.80	34.21	33.59
CaO	0.01	0.01	0.02	0.03	0.01	0.03
NiO	0.06	0.07	0.05	0.03	0.02	0.07
Cr_2O_3	0.01	0.02	0.00	0.01	0.01	0.00
Total:	99.04	100.56	100.48	100.73	101.31	100.97
Calculated cation proportions:						
Si	1.0070	0.9993	0.9997	0.9987	0.9954	0.9971
Ti	0.0002	0.0001	0.0003	0.0004	0.0001	0.0002
Al	0.0000	0.0006	0.0004	0.0000	0.0004	0.0019
Fe	0.6402	0.5270	0.7097	0.6457	0.6447	0.6546
Mn	0.0108	0.0080	0.0119	0.0097	0.0100	0.0102
Mg	1.3329	1.4635	1.2762	1.3451	1.3529	1.3355
Ca	0.0003	0.0003	0.0005	0.0007	0.0004	0.0007
Ni	0.0012	0.0015	0.0011	0.0006	0.0005	0.0015
Total:	2.9927	3.0003	2.9998	3.0009	3.0044	3.0018
Fo	67.1	73.2	63.8	67.2	67.4	66.7
1 σ	1.4	0.51	0.54	0.46	0.11	0.21

Table T3. Microprobe analyses of plagioclase in Leg 176 gabbros. (Continued on next six pages).

Sample:*	MS1-1	MS3-2	MS6-3	MS9-4	MS11-5	MS12-6	MS14-7	MS18-8	MS19-9	MS20-10	MS22-11	MS23-12	MS24-13	MS25-14	MS26-15	MS27-16	MS28-17	MS41-18
N:	10	15	11	10	7	5	5	5	5	5	10	5	3	3	6	3	5	10
Major element oxides (wt%):																		
SiO_2	49.98	50.50	51.40	49.18	55.15	54.98	55.19	58.13	55.94	56.31	58.82	55.63	57.83	57.66	53.35	53.64	55.23	59.19
TiO_2	0.02	0.03	0.05	0.02	0.05	0.06	0.04	0.04	0.07	0.07	0.05	0.04	0.07	0.08	0.06	0.05	0.05	0.04
Al_2O_3	32.82	32.52	31.59	33.40	28.66	28.88	28.89	26.54	28.48	28.36	26.59	28.46	27.33	26.25	29.68	30.29	28.85	25.89
FeOt	0.06	0.19	0.11	0.13	0.17	0.14	0.10	0.13	0.15	0.19	0.38	0.19	0.20	0.19	0.20	0.19	0.18	0.17
MnO	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.01	0.00
MgO	0.09	0.03	0.03	0.04	0.04	0.01	0.01	0.01	0.01	0.02	0.21	0.02	0.01	0.02	0.02	0.03	0.02	0.01
CaO	15.30	14.62	14.02	15.65	11.09	11.07	11.32	8.72	10.03	10.02	8.00	10.88	8.77	8.24	11.86	12.03	10.34	7.91
Na_2O	2.87	3.23	3.58	2.51	5.18	5.18	5.14	6.51	5.82	5.82	6.93	5.32	6.55	6.73	4.82	4.72	5.63	6.96
K_2O	0.01	0.03	0.03	0.02	0.04	0.07	0.05	0.09	0.05	0.10	0.18	0.08	0.12	0.14	0.06	0.06	0.10	0.10
P_2O_5	0.01	0.02	0.01	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.01	0.03	0.01	0.01	0.01	0.01	0.00	0.02
Total:	101.19	101.20	100.84	100.96	100.40	100.40	100.76	100.20	100.58	100.93	101.20	100.68	100.94	99.37	100.07	101.04	100.43	100.29
Calculated cation proportions:																		
Si	2.2543	2.2752	2.3185	2.2252	2.4767	2.4691	2.4704	2.5963	2.5019	2.5099	2.6029	2.4908	2.5691	2.5989	2.4133	2.4026	2.4777	2.6360
Ti	0.0008	0.0012	0.0018	0.0007	0.0017	0.0019	0.0012	0.0012	0.0023	0.0024	0.0016	0.0015	0.0024	0.0027	0.0020	0.0017	0.0018	0.0015
Al	1.7442	1.7266	1.6791	1.7810	1.5162	1.5282	1.5235	1.3981	1.5010	1.4896	1.3872	1.5012	1.4306	1.3946	1.5819	1.5989	1.5251	1.3587
Fe^{3+}	0.0039	0.0012	0.0038	0.0000	0.0055	0.0033	0.0058	0.0046	0.0000	0.0018	0.0110	0.0072	0.0000	0.0038	0.0053	0.0000	0.0000	0.0044
Ca	0.7392	0.7057	0.6771	0.7584	0.5331	0.5323	0.5427	0.4182	0.4802	0.4785	0.3800	0.5215	0.4170	0.3980	0.5746	0.5772	0.4968	0.3772
Fe^{2+}	0.0016	0.0066	0.0023	0.0050	0.0016	0.0022	0.0006	0.0008	0.0055	0.0057	0.0055	0.0014	0.0075	0.0036	0.0031	0.0069	0.0068	0.0023
Mg	0.0060	0.0022	0.0019	0.0029	0.0026	0.0008	0.0006	0.0006	0.0008	0.0013	0.0136	0.0014	0.0009	0.0011	0.0012	0.0018	0.0016	0.0007
Na	0.2505	0.2822	0.3129	0.2197	0.4506	0.4507	0.4459	0.5631	0.5040	0.5023	0.5940	0.4617	0.5642	0.5880	0.4221	0.4098	0.4897	0.6002
K	0.0007	0.0020	0.0019	0.0009	0.0024	0.0038	0.0026	0.0050	0.0028	0.0059	0.0103	0.0047	0.0066	0.0081	0.0032	0.0033	0.0057	0.0056
Total:	5.0012	5.0029	4.9994	4.9938	4.9904	4.9924	4.9934	4.9879	4.9985	4.9974	5.0062	4.9913	4.9984	4.9988	5.0067	5.0023	5.0054	4.9865
Ca#	74.7	71.4	68.4	77.5	54.2	54.2	54.9	42.6	48.8	48.8	39.0	53.0	42.5	40.4	57.7	58.5	50.4	38.6
1 σ	4.1	3.4	3.7	2.1	2.0	2.2	2.5	9.7	1.4	3.4	11	3.6	1.1	1.1	2.1	0.34	0.16	1.0
An	74.6	71.3	68.3	77.5	54.1	53.9	54.8	42.4	48.7	48.5	38.6	52.8	42.2	40.0	57.5	58.3	50.1	38.4
Ab	25.3	28.5	31.5	22.4	45.7	45.7	45.0	57.1	51.1	50.9	60.3	46.7	57.1	59.1	42.2	41.4	49.4	61.1
Or	0.07	0.20	0.19	0.09	0.24	0.39	0.27	0.51	0.28	0.60	1.05	0.47	0.67	0.82	0.32	0.33	0.58	0.57

Notes: * = ODP sample designations for sample IDs can be found in Table T1, p. 29. *N* = averages of a number of point analyses on more than one crystal in a thin section are reported. The analyses were done on a JXA-8800L Superprobe at The University of Queensland. See text for analytical details. P and S in felsic vein samples refer to primary (mostly in host gabbro) and secondary (vein mineral), respectively. F (fine) and C (coarse) in GS samples refer to fine-grained microgabbro "bands" or "veins" entrued or enclosed within coarse-grained gabbro host. Note the compositional similarity between F and C portions of the same samples. An = anorthite, Ab = albite, Or = orthoclase.

Table T3 (continued).

Sample:*	MS60-19	MS70-20	MS71-21	MS72-22	MS74-23	MS76-24	MS78-25	MS79-26	MS82-27	MS84-28	MS89-29	MS90-30	MS91-31	MS92-32	MS93-33	MS95-34	MS97-35	MS98-36
N:	5	3	3	3	6	3	6	3	3	3	3	3	3	3	3	3	3	5
Major element oxides (wt%):																		
SiO_2	54.16	57.00	55.56	55.24	54.84	54.68	53.77	53.99	52.84	53.48	54.00	54.25	52.54	52.90	52.98	53.39	53.97	51.82
TiO_2	0.06	0.08	0.10	0.07	0.07	0.06	0.06	0.07	0.05	0.08	0.08	0.08	0.07	0.08	0.08	0.05	0.07	0.09
Al_2O_3	30.08	27.60	28.81	29.04	29.86	29.25	28.89	30.02	30.34	30.61	29.86	29.56	30.63	31.13	30.72	30.83	30.17	31.02
FeOt	0.26	0.28	0.29	0.24	0.29	0.25	0.32	0.24	0.35	0.29	0.26	0.29	0.26	0.35	0.27	0.28	0.27	0.48
MnO	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.02
MgO	0.03	0.04	0.04	0.04	0.03	0.02	0.03	0.03	0.05	0.03	0.03	0.03	0.05	0.04	0.03	0.04	0.05	0.20
CaO	12.17	10.18	11.23	11.05	11.68	11.62	11.42	11.73	12.14	13.08	11.31	11.56	12.21	13.70	12.67	13.05	11.99	13.57
Na_2O	4.33	5.71	5.02	5.21	4.91	4.86	4.94	4.86	4.67	4.75	5.06	5.30	4.61	4.51	4.54	4.61	4.90	4.21
K_2O	0.07	0.13	0.09	0.08	0.08	0.06	0.09	0.07	0.06	0.05	0.07	0.10	0.06	0.06	0.06	0.05	0.05	0.08
P_2O_5	0.01	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.00	0.01	0.03	0.03	0.00	0.01	0.00	0.00	0.02	0.02
Total:	101.19	101.03	101.15	101.02	101.79	100.82	99.57	101.03	100.51	102.44	100.70	101.22	100.44	102.78	101.37	102.32	101.49	101.51
Calculated cation proportions:																		
Si	2.4188	2.5374	2.4771	2.4673	2.4351	2.4497	2.4426	2.4168	2.3837	2.3751	2.4237	2.4278	2.3720	2.3463	2.3724	2.3715	2.4081	2.3291
Ti	0.0022	0.0026	0.0034	0.0024	0.0024	0.0019	0.0022	0.0022	0.0017	0.0028	0.0025	0.0027	0.0023	0.0027	0.0026	0.0017	0.0024	0.0029
Al	1.5830	1.4479	1.5134	1.5285	1.5623	1.5437	1.5467	1.5837	1.6135	1.6016	1.5798	1.5590	1.6297	1.6270	1.6209	1.6134	1.5865	1.6434
Fe^{3+}	0.0020	0.0120	0.0068	0.0038	0.0014	0.0047	0.0088	0.0000	0.0013	0.0205	0.0000	0.0125	0.0000	0.0241	0.0061	0.0142	0.0063	0.0246
Ca	0.5818	0.4853	0.5361	0.5287	0.5554	0.5572	0.5558	0.5623	0.5866	0.6220	0.5436	0.5541	0.5903	0.6505	0.6077	0.6204	0.5729	0.6533
Fe^{2+}	0.0077	0.0000	0.0042	0.0058	0.0094	0.0047	0.0042	0.0091	0.0120	0.0000	0.0099	0.0035	0.0098	0.0000	0.0068	0.0038	0.0067	0.0020
Mg	0.0021	0.0025	0.0025	0.0024	0.0020	0.0015	0.0022	0.0020	0.0031	0.0021	0.0023	0.0020	0.0032	0.0029	0.0017	0.0028	0.0031	0.0132
Na	0.3748	0.4926	0.4333	0.4506	0.4221	0.4223	0.4346	0.4214	0.4084	0.4086	0.4398	0.4600	0.4033	0.3871	0.3940	0.3966	0.4236	0.3667
K	0.0042	0.0072	0.0049	0.0047	0.0045	0.0031	0.0053	0.0040	0.0032	0.0030	0.0040	0.0059	0.0035	0.0033	0.0032	0.0029	0.0030	0.0044
Total:	4.9764	4.9876	4.9818	4.9942	4.9946	4.9889	5.0023	5.0015	5.0135	5.0358	5.0056	5.0276	5.0142	5.0438	5.0156	5.0272	5.0126	5.0396
Ca#	60.9	49.6	55.3	54.0	56.8	56.9	56.1	57.2	58.9	60.3	55.3	54.6	59.4	62.7	60.6	61.0	57.4	64.1
1 σ	3.5	0.76	1.7	1.0	3.5	4.8	3.5	0.47	2.2	0.90	0.80	3.1	1.9	0.50	2.2	2.8	3.8	1.1
An	60.6	49.3	55.0	53.7	56.6	56.7	55.8	56.9	58.8	60.2	55.1	54.3	59.2	62.5	60.5	60.8	57.3	63.8
Ab	39.0	50.0	44.5	45.8	43.0	43.0	43.6	42.7	40.9	39.5	44.5	45.1	40.4	37.2	39.2	38.9	42.4	35.8
Or	0.43	0.73	0.50	0.48	0.46	0.32	0.53	0.40	0.32	0.29	0.40	0.58	0.35	0.32	0.32	0.29	0.30	0.43

Table T3 (continued).

Sample:*	MS99-37	MS101-38	GS30-1	GS30-1	GS31-2	GS31-2	GS32-3	GS32-3	GS33-4	GS33-4	GS33-4	GS34-5	GS40-6	GS40-6	GS40-6	GS40-6	GS44-8	GS44-8
N:	5	5	5	5	3	3	3	3	3	3	3	3	3	3	3	4	3	3
			F	C	F	C	C	F	F	Needle	C	C	C	F	C	F	F	C
Major element oxides (wt%):																		
SiO_2	50.39	50.00	51.95	52.01	52.76	54.51	55.65	54.19	54.22	54.27	53.05	52.00	52.91	54.66	54.94	55.70	53.64	55.31
TiO_2	0.04	0.06	0.09	0.07	0.06	0.06	0.10	0.03	0.04	0.06	0.07	0.06	0.07	0.08	0.06	0.04	0.06	0.03
Al_2O_3	31.94	31.94	30.60	30.56	30.91	29.92	29.27	30.04	30.21	30.17	30.29	30.56	30.27	30.07	30.12	29.40	30.32	28.83
FeOt	0.30	0.27	0.26	0.25	0.24	0.21	0.22	0.08	0.22	0.25	0.31	0.30	0.28	0.18	0.25	0.17	0.22	0.24
MnO	0.00	0.01	0.02	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.02	0.00	0.01	0.01	0.01	0.00	0.01	0.00
MgO	0.05	0.19	0.03	0.04	0.03	0.03	0.03	0.02	0.06	0.03	0.03	0.03	0.04	0.01	0.03	0.01	0.02	0.02
CaO	14.64	14.64	13.07	13.02	13.43	11.96	10.94	11.59	11.97	11.86	12.40	13.02	12.69	11.53	11.65	11.00	11.92	10.37
Na_2O	3.15	3.27	4.68	4.69	4.50	5.00	5.31	4.94	5.03	4.85	4.89	4.83	5.05	5.01	4.97	5.34	4.78	5.65
K_2O	0.05	0.06	0.09	0.08	0.05	0.08	0.08	0.08	0.05	0.05	0.05	0.06	0.07	0.04	0.06	0.05	0.06	0.09
P_2O_5	0.01	0.02	0.00	0.01	0.00	0.02	0.00	0.01	0.01	0.01	0.03	0.02	0.01	0.01	0.00	0.03	0.01	0.02
Total:	100.59	100.46	100.80	100.74	102.00	101.80	101.64	100.97	101.83	101.54	101.17	100.90	101.40	101.64	102.11	101.74	101.03	100.57
Calculated cation proportions:																		
Si	2.2854	2.2734	2.3483	2.3514	2.3544	2.4239	2.4687	2.4238	2.4106	2.4168	2.3827	2.3493	2.3747	2.4295	2.4311	2.4678	2.4024	2.4789
Ti	0.0015	0.0021	0.0029	0.0023	0.0020	0.0021	0.0034	0.0009	0.0014	0.0020	0.0025	0.0022	0.0022	0.0025	0.0019	0.0014	0.0020	0.0009
Al	1.7070	1.7115	1.6300	1.6281	1.6255	1.5675	1.5302	1.5834	1.5830	1.5831	1.6030	1.6267	1.6011	1.5746	1.5705	1.5347	1.6007	1.5230
Fe^{3+}	0.0061	0.0130	0.0188	0.0183	0.0181	0.0101	0.0037	0.0000	0.0060	0.0000	0.0132	0.0218	0.0220	0.0000	0.0000	0.0000	0.0000	0.0000
Ca	0.7111	0.7131	0.6329	0.6306	0.6421	0.5694	0.5196	0.5550	0.5703	0.5657	0.5965	0.6301	0.6099	0.5487	0.5520	0.5217	0.5717	0.4977
Fe^{2+}	0.0054	0.0039	0.0008	0.0000	0.0000	0.0026	0.0057	0.0029	0.0060	0.0092	0.0033	0.0000	0.0000	0.0068	0.0094	0.0065	0.0082	0.0089
Mg	0.0032	0.0125	0.0018	0.0025	0.0018	0.0017	0.0017	0.0013	0.0041	0.0021	0.0019	0.0023	0.0025	0.0009	0.0018	0.0006	0.0011	0.0016
Na	0.2764	0.2878	0.4096	0.4106	0.3894	0.4306	0.4562	0.4280	0.4337	0.4182	0.4254	0.4227	0.4394	0.4319	0.4263	0.4584	0.4146	0.4903
K	0.0031	0.0032	0.0053	0.0049	0.0030	0.0044	0.0048	0.0043	0.0031	0.0029	0.0030	0.0035	0.0038	0.0025	0.0031	0.0027	0.0034	0.0052
Total:	4.9993	5.0205	5.0504	5.0485	5.0363	5.0123	4.9939	4.9996	5.0181	4.9999	5.0315	5.0587	5.0555	4.9975	4.9961	4.9939	5.0041	5.0065
Ca#	72.0	71.3	60.8	60.6	62.2	56.9	53.2	56.5	56.8	57.5	58.3	59.8	58.1	56.0	56.4	53.2	58.0	50.4
1 σ	2.3	3.9	3.6	3.5	2.1	3.8	3.0	1.6	2.9	0.46	2.5	2.2	0.78	1.9	0.68	0.49	1.3	2.9
An	71.8	71.0	60.4	60.3	62.1	56.7	53.0	56.2	56.6	57.3	58.2	59.7	57.9	55.8	56.2	53.1	57.8	50.1
Ab	27.9	28.7	39.1	39.3	37.6	42.9	46.5	43.3	43.1	42.4	41.5	40.0	41.7	43.9	43.4	46.6	41.9	49.4
Or	0.32	0.32	0.51	0.47	0.29	0.44	0.49	0.44	0.30	0.29	0.29	0.33	0.36	0.26	0.32	0.28	0.34	0.52

Table T3 (continued).

Sample:*	GS59-9	GS59-9	GS64-10	GS64-10	GS77-11	GS77-11	GS83-12	GS83-12	GS86-13	GS86-13	GS87-14	GS88-15	GS88-15	GS96-16	GS100-17	GS100-17	GS51-18	GS51-18
N:	3	3	5	5	5	5	5	5	5	5	3	6	3	3	3	3	3	3
	F	C	F	C	C	F	F	C	F	C	F	C	F	C	F	C	C	F
Major element oxides (wt%):																		
SiO_2	57.79	58.01	56.69	55.57	52.49	50.24	49.07	47.97	52.59	55.51	53.05	52.67	52.91	54.22	52.99	54.13	57.46	55.64
TiO_2	0.02	0.06	0.04	0.05	0.06	0.10	0.05	0.05	0.04	0.07	0.06	0.06	0.04	0.08	0.07	0.08	0.06	0.05
Al_2O_3	28.33	28.30	29.19	29.49	30.27	31.77	32.60	33.37	30.17	29.11	30.65	30.55	30.41	30.21	30.40	30.17	27.75	28.30
FeOt	0.21	0.25	0.16	0.20	0.27	0.22	0.20	0.31	0.22	0.29	0.22	0.23	0.22	0.25	0.25	0.28	0.17	0.14
MnO	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00
MgO	0.02	0.03	0.02	0.02	0.04	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.01	0.01
CaO	9.87	9.72	10.53	11.03	12.59	14.44	15.41	16.32	12.57	10.95	13.13	13.01	12.55	11.76	12.53	12.25	9.25	9.64
Na_2O	6.02	6.05	5.60	5.29	5.01	3.26	2.88	2.21	4.93	5.47	4.58	4.85	4.79	4.91	4.84	5.00	6.30	6.12
K_2O	0.10	0.09	0.04	0.06	0.08	0.05	0.04	0.05	0.09	0.11	0.06	0.07	0.05	0.05	0.06	0.06	0.12	0.12
P_2O_5	0.01	0.01	0.01	0.01	0.03	0.02	0.01	0.01	0.03	0.02	0.01	0.03	0.04	0.02	0.01	0.04	0.02	0.03
Total:	102.40	102.53	102.29	101.75	100.86	100.14	100.31	100.33	100.67	101.58	101.80	101.50	101.05	101.54	101.22	102.06	101.15	100.07
Calculated cation proportions:																		
Si	2.5352	2.5400	2.4929	2.4627	2.3690	2.2879	2.2382	2.1935	2.3758	2.4672	2.3693	2.3626	2.3780	2.4153	2.3780	2.4061	2.5496	2.5027
Ti	0.0008	0.0020	0.0012	0.0016	0.0022	0.0035	0.0016	0.0016	0.0014	0.0024	0.0020	0.0019	0.0013	0.0028	0.0024	0.0027	0.0019	0.0016
Al	1.4644	1.4599	1.5125	1.5399	1.6097	1.7050	1.7527	1.7982	1.6062	1.5252	1.6132	1.6150	1.6112	1.5856	1.6082	1.5801	1.4507	1.5003
Fe^{3+}	0.0001	0.0000	0.0000	0.0000	0.0191	0.0037	0.0075	0.0066	0.0166	0.0087	0.0156	0.0205	0.0112	0.0000	0.0126	0.0125	0.0000	0.0000
Ca	0.4636	0.4557	0.4959	0.5235	0.6083	0.7045	0.7534	0.7993	0.6081	0.5217	0.6281	0.6251	0.6045	0.5608	0.6028	0.5829	0.4394	0.4643
Fe^{2+}	0.0075	0.0091	0.0060	0.0074	0.0009	0.0048	0.0029	0.0051	0.0010	0.0039	0.0000	0.0000	0.0029	0.0092	0.0032	0.0035	0.0064	0.0053
Mg	0.0012	0.0017	0.0011	0.0015	0.0029	0.0014	0.0016	0.0020	0.0014	0.0016	0.0014	0.0016	0.0014	0.0018	0.0022	0.0018	0.0008	0.0010
Na	0.5120	0.5130	0.4772	0.4538	0.4384	0.2875	0.2543	0.1958	0.4315	0.4711	0.3967	0.4212	0.4169	0.4237	0.4213	0.4306	0.5414	0.5339
K	0.0053	0.0051	0.0024	0.0036	0.0046	0.0030	0.0024	0.0027	0.0051	0.0060	0.0033	0.0040	0.0030	0.0027	0.0037	0.0036	0.0068	0.0066
Total:	4.9901	4.9866	4.9893	4.9941	5.0551	5.0011	5.0145	5.0049	5.0471	5.0079	5.0295	5.0520	5.0305	5.0019	5.0344	5.0238	4.9971	5.0158
Ca#	47.5	47.0	51.0	53.6	58.1	71.0	74.9	80.3	58.6	52.5	61.3	59.7	59.1	57.0	58.8	57.5	44.8	46.5
1 σ	0.56	0.14	0.39	1.7	3.8	4.2	7.8	4.5	2.0	3.0	1.1	1.9	3.8	0.41	3.0	2.1	0.65	0.59
An	47.3	46.8	50.8	53.4	57.9	70.8	74.6	80.1	58.2	52.2	61.1	59.5	59.0	56.8	58.6	57.3	44.5	46.2
Ab	52.2	52.7	48.9	46.3	41.7	28.9	25.2	19.6	41.3	47.2	38.6	40.1	40.7	42.9	41.0	42.3	54.8	53.1
Or	0.54	0.52	0.25	0.37	0.43	0.30	0.24	0.27	0.48	0.60	0.32	0.39	0.30	0.27	0.36	0.36	0.69	0.66

Table T3 (continued).

Sample:*	GS55-19	GS85-20	GS85-20	GS102-21	GS102-21	FV2-1	FV2-1	FV5-2	FV5-2	FV5-2	FV13-3	FV13-3	FV13-3	FV21-4	FV21-4	FV19-5	FV19-5	FV29-5
N:	3	3	2	4	3	5	6	3	3	9	3	6	6	3	3	3	9	6
	?	F	C	F	C	P	S	P1	P2	S	P	S1	S2	P	S	P	S	P
Major element oxides (wt%):																		
SiO_2	53.01	52.01	50.80	51.23	52.84	51.44	59.19	47.61	50.93	64.29	51.82	61.40	66.00	54.14	64.40	55.47	66.89	54.11
TiO_2	0.07	0.04	0.07	0.07	0.07	0.04	0.00	0.02	0.05	0.02	0.08	0.02	0.02	0.07	0.02	0.06	0.01	0.07
Al_2O_3	29.63	30.95	31.38	31.08	30.00	32.06	26.20	34.09	32.55	21.93	30.68	25.01	21.86	29.14	22.62	29.82	21.14	29.97
FeOt	0.22	0.23	0.32	0.24	0.27	0.14	0.04	0.16	0.11	0.06	0.21	0.23	0.13	0.25	0.17	0.24	0.21	0.25
MnO	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.00
MgO	0.02	0.02	0.06	0.02	0.03	0.02	0.00	0.00	0.03	0.00	0.02	0.02	0.01	0.01	0.00	0.03	0.00	0.04
CaO	11.94	13.49	13.98	13.63	12.37	14.03	7.86	17.16	15.35	3.64	13.17	6.01	2.72	11.37	3.82	11.60	1.35	11.96
Na_2O	5.50	4.61	3.96	4.59	5.09	3.77	7.12	2.51	3.54	9.44	4.30	8.10	10.04	5.40	9.57	4.86	10.81	5.05
K_2O	0.06	0.05	0.04	0.04	0.06	0.02	0.02	0.00	0.03	0.18	0.06	0.26	0.13	0.14	0.13	0.07	0.05	0.08
P_2O_5	0.01	0.01	0.03	0.01	0.02	0.00	0.00	0.01	0.01	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.01	0.01
Total:	100.47	101.43	100.65	100.93	100.77	101.55	100.47	101.59	102.61	99.57	100.37	101.08	100.92	100.54	100.76	102.18	100.49	101.56
Calculated cation proportions:																		
Si	2.3974	2.3378	2.3043	2.3181	2.3841	2.3060	2.6300	2.1581	2.2699	2.8479	2.3490	2.7030	2.8773	2.4386	2.8244	2.4494	2.9191	2.4135
Ti	0.0024	0.0014	0.0025	0.0024	0.0024	0.0015	0.0000	0.0008	0.0016	0.0005	0.0026	0.0007	0.0006	0.0024	0.0007	0.0020	0.0003	0.0022
Al	1.5796	1.6398	1.6772	1.6570	1.5952	1.6934	1.3712	1.8215	1.7094	1.1452	1.6387	1.2977	1.1227	1.5470	1.1689	1.5518	1.0875	1.5759
Fe^{3+}	0.0205	0.0210	0.0161	0.0226	0.0184	0.0037	0.0027	0.0195	0.0191	0.0068	0.0096	0.0011	0.0005	0.0121	0.0060	0.0035	0.0006	0.0101
Ca	0.5785	0.6493	0.6793	0.6606	0.5978	0.6736	0.3739	0.8334	0.7329	0.1728	0.6392	0.2833	0.1270	0.5484	0.1795	0.5486	0.0635	0.5716
Fe^{2+}	0.0000	0.0000	0.0029	0.0000	0.0000	0.0042	0.0012	0.0000	0.0000	0.0003	0.0029	0.0073	0.0043	0.0035	0.0034	0.0056	0.0071	0.0047
Mg	0.0013	0.0015	0.0039	0.0015	0.0018	0.0015	0.0001	0.0000	0.0021	0.0002	0.0011	0.0012	0.0004	0.0004	0.0001	0.0019	0.0001	0.0029
Na	0.4819	0.4019	0.3480	0.4020	0.4451	0.3273	0.6132	0.2203	0.3059	0.8103	0.3776	0.6910	0.8485	0.4708	0.8135	0.4157	0.9137	0.4369
K	0.0035	0.0026	0.0025	0.0022	0.0035	0.0012	0.0012	0.0001	0.0017	0.0102	0.0035	0.0145	0.0071	0.0080	0.0070	0.0040	0.0030	0.0046
Total:	5.0652	5.0554	5.0365	5.0664	5.0483	5.0123	4.9936	5.0539	5.0425	4.9942	5.0243	4.9999	4.9884	5.0311	5.0035	4.9826	4.9949	5.0224
Ca#	54.5	61.8	66.2	62.2	57.3	67.3	37.9	79.1	70.6	17.6	62.9	29.1	13.0	53.9	18.1	56.8	6.6	56.7
1 σ	1.3	1.2	1.1	1.4	0.83	3.6	7.1	1.5	0.48	4.5	1.4	3.5	1.1	2.4	0.35	3.1	7.4	2.9
An	54.4	61.6	66.0	62.0	57.1	67.2	37.8	79.1	70.4	17.4	62.6	28.7	12.9	53.4	18.0	56.7	6.5	56.4
Ab	45.3	38.1	33.8	37.8	42.5	32.7	62.0	20.9	29.4	81.6	37.0	69.9	86.4	45.8	81.3	42.9	93.2	43.1
Or	0.33	0.25	0.24	0.21	0.34	0.12	0.12	0.01	0.16	1.03	0.35	1.47	0.72	0.78	0.70	0.42	0.30	0.46

Table T3 (continued).

Sample:*	FV29-5	FV35-6	FV35-6	FV35-6	FV37-7	FV37-7	FV37-7	FV37-7	FV39-8	FV39-8	FV45-9a	FV45-9a	FV45-9b	FV45-9b	FV47-10	FV47-10	FV50-11	FV58-13
N:	7	3	7	3	3	3	4	5	6	6	3	6	3	5	3	3	21	7
	S	P	S1	S2	P1	P2	P3	P4	P	S	P	S	P	S	S	P	P	S
Major element oxides (wt%):																		
SiO_2	66.44	52.82	62.08	66.74	51.42	52.31	53.23	55.10	53.49	67.83	51.60	65.70	51.86	55.23	62.94	52.48	53.40	56.14
TiO_2	0.03	0.06	0.01	0.00	0.06	0.07	0.06	0.06	0.07	0.01	0.04	0.01	0.03	0.12	0.01	0.06	0.05	0.08
Al_2O_3	21.25	30.01	23.83	20.73	30.83	30.35	29.74	29.91	30.48	20.15	30.83	21.54	30.66	29.36	23.63	30.24	30.24	28.21
FeOt	0.16	0.29	0.19	0.15	0.20	0.21	0.21	0.20	0.24	0.12	0.17	0.09	0.15	0.19	0.22	0.15	0.23	0.24
MnO	0.01	0.02	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.01	0.00	0.01	0.01	0.01
MgO	0.01	0.02	0.00	0.00	0.02	0.03	0.02	0.02	0.02	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.01
CaO	1.98	12.38	5.53	1.57	13.34	12.78	12.07	11.34	12.45	0.33	13.34	2.25	13.14	10.98	4.77	12.65	12.51	10.10
Na_2O	10.38	5.10	8.26	10.35	4.67	4.88	5.27	5.09	4.69	11.29	4.58	10.11	4.74	5.37	8.76	4.60	4.50	5.80
K_2O	0.13	0.08	0.10	0.11	0.06	0.09	0.08	0.06	0.04	0.04	0.05	0.25	0.06	0.11	0.35	0.12	0.06	0.09
P_2O_5	0.00	0.00	0.01	0.00	0.01	0.03	0.01	0.01	0.02	0.02	0.00	0.00	0.00	0.02	0.01	0.02	0.02	0.01
Total:	100.39	100.81	100.04	99.67	100.62	100.77	100.72	101.80	101.50	99.81	100.63	99.96	100.68	101.41	100.69	100.35	101.05	100.70
Calculated cation proportions:																		
Si	2.9063	2.3830	2.7520	2.9331	2.3311	2.3633	2.4001	2.4426	2.3893	2.9698	2.3366	2.8894	2.3464	2.4581	2.7717	2.3757	2.3951	2.5094
Ti	0.0008	0.0021	0.0004	0.0002	0.0022	0.0023	0.0020	0.0019	0.0023	0.0003	0.0012	0.0004	0.0012	0.0039	0.0002	0.0021	0.0016	0.0028
Al	1.0953	1.5955	1.2448	1.0735	1.6466	1.6158	1.5805	1.5624	1.6043	1.0396	1.6450	1.1159	1.6344	1.5398	1.2265	1.6134	1.5988	1.4856
Fe^{3+}	0.0020	0.0195	0.0041	0.0004	0.0201	0.0186	0.0175	0.0000	0.0081	0.0005	0.0171	0.0044	0.0180	0.0038	0.0044	0.0089	0.0047	0.0033
Ca	0.0929	0.5983	0.2628	0.0740	0.6474	0.6185	0.5829	0.5382	0.5958	0.0156	0.6470	0.1056	0.6366	0.5234	0.2250	0.6137	0.6013	0.4835
Fe^{2+}	0.0050	0.0000	0.0040	0.0052	0.0000	0.0000	0.0000	0.0075	0.0040	0.0040	0.0000	0.0012	0.0000	0.0054	0.0062	0.0021	0.0040	0.0055
Mg	0.0004	0.0015	0.0001	0.0000	0.0015	0.0023	0.0013	0.0012	0.0014	0.0001	0.0009	0.0002	0.0009	0.0006	0.0003	0.0000	0.0009	0.0008
Na	0.8798	0.4458	0.7098	0.8808	0.4102	0.4271	0.4609	0.4373	0.4057	0.9581	0.4018	0.8611	0.4156	0.4629	0.7472	0.4027	0.3913	0.5024
K	0.0070	0.0048	0.0057	0.0064	0.0035	0.0049	0.0048	0.0036	0.0022	0.0021	0.0027	0.0137	0.0033	0.0064	0.0196	0.0071	0.0033	0.0050
Total:	4.9896	5.0505	4.9838	4.9736	5.0626	5.0528	5.0499	4.9947	5.0131	4.9900	5.0525	4.9918	5.0565	5.0043	5.0010	5.0256	5.0009	4.9984
Ca#	9.6	57.3	27.0	7.8	61.2	59.1	55.8	55.2	59.5	1.6	61.7	10.9	60.5	53.0	23.4	60.6	60.6	49.0
1 σ	4.7	2.6	3.5	3.5	0.67	1.1	0.46	1.8	2.6	2.0	0.16	6.1	2.1	6.6	12.0	5.5	3.8	3.3
An	9.5	57.0	26.9	7.7	61.0	58.9	55.6	55.0	59.4	1.6	61.5	10.8	60.3	52.7	22.7	60.0	60.4	48.8
Ab	89.8	42.5	72.6	91.6	38.7	40.7	44.0	44.7	40.4	98.2	38.2	87.8	39.4	46.6	75.3	39.4	39.3	50.7
Or	0.72	0.46	0.59	0.66	0.33	0.47	0.46	0.36	0.22	0.22	0.26	1.40	0.31	0.64	2.0	0.69	0.33	0.51

Table T3 (continued).

Sample:*	FV61-14	FV61-14	FV62-15	FV62-15	FV63-16	FV63-16	FV65-17	FV65-17	FV66-18	FV66-18	FV67-19	FV67-19	FV81-20	FV81-20	FV94-21
N:	11	17	6	3	4	3	5	6	7	3	3	7	2	2	4
		S	P	S	P	S	P	S	P	S	P	S	P1	P2	S1
Major element oxides (wt%):															
SiO_2	55.06	66.88	54.95	62.77	54.31	62.74	54.15	66.06	54.04	64.79	54.20	67.31	52.48	54.01	59.26
TiO_2	0.05	0.01	0.05	0.03	0.09	0.02	0.03	0.01	0.06	0.01	0.05	0.00	0.09	0.07	0.04
Al_2O_3	28.58	21.37	28.82	23.91	28.64	23.90	29.64	22.38	29.71	23.02	29.28	21.41	29.87	29.20	25.81
FeOt	0.19	0.04	0.22	0.17	0.23	0.24	0.19	0.13	0.21	0.22	0.18	0.04	0.24	0.24	0.32
MnO	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01
MgO	0.01	0.00	0.02	0.01	0.01	0.01	0.02	0.00	0.01	0.01	0.00	0.00	0.02	0.02	0.01
CaO	10.89	1.83	11.19	5.13	10.91	5.22	11.79	2.88	11.92	3.83	11.52	1.50	12.47	11.45	7.52
Na_2O	5.42	10.44	5.44	8.74	5.47	8.45	5.03	9.93	4.89	9.05	5.23	10.63	4.60	5.09	7.11
K_2O	0.08	0.16	0.07	0.23	0.08	0.47	0.06	0.21	0.08	0.67	0.05	0.08	0.09	0.08	0.25
P_2O_5	0.03	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.04	0.00	0.02	0.01	0.03
Total:	100.33	100.77	100.82	101.02	99.79	101.12	100.95	101.66	100.98	101.63	100.56	100.99	99.90	100.18	100.34
Calculated cation proportions:															
Si	2.4766	2.9113	2.4638	2.7575	2.4600	2.7567	2.4274	2.8612	2.4229	2.8194	2.4382	2.9191	2.3857	2.4383	2.6400
Ti	0.0015	0.0003	0.0016	0.0008	0.0031	0.0007	0.0011	0.0004	0.0019	0.0005	0.0016	0.0001	0.0029	0.0025	0.0012
Al	1.5150	1.0964	1.5224	1.2377	1.5286	1.2378	1.5655	1.1433	1.5695	1.1815	1.5523	1.0942	1.6000	1.5531	1.3549
Fe^{3+}	0.0069	0.0000	0.0121	0.0039	0.0083	0.0048	0.0059	0.0012	0.0057	0.0011	0.0079	0.0000	0.0114	0.0062	0.0039
Ca	0.5246	0.0854	0.5373	0.2413	0.5291	0.2457	0.5661	0.1344	0.5725	0.1794	0.5551	0.0699	0.6068	0.5537	0.3587
Fe^{2+}	0.0017	0.0016	0.0004	0.0023	0.0020	0.0042	0.0014	0.0035	0.0027	0.0068	0.0014	0.0014	0.0004	0.0027	0.0079
Mg	0.0010	0.0001	0.0012	0.0004	0.0007	0.0007	0.0011	0.0002	0.0006	0.0005	0.0001	0.0000	0.0013	0.0016	0.0006
Na	0.4719	0.8808	0.4728	0.7438	0.4798	0.7191	0.4370	0.8332	0.4251	0.7626	0.4563	0.8930	0.4053	0.4448	0.6137
K	0.0043	0.0088	0.0039	0.0129	0.0049	0.0264	0.0033	0.0116	0.0044	0.0371	0.0030	0.0043	0.0051	0.0044	0.0140
Total:	5.0034	4.9847	5.0155	5.0007	5.0164	4.9961	5.0090	4.9889	5.0054	4.9889	5.0158	4.9819	5.0189	5.0073	4.9949
Ca#	52.6	8.8	53.2	24.5	52.4	25.4	56.4	13.8	57.4	18.8	54.9	7.2	60.0	55.4	36.9
1 σ	3.5	4.0	2.5	0.6	1.6	3.3	1.3	10.3	2.7	9.4	0.3	3.1	1.2	3.8	2.1
An	52.4	8.8	53.0	24.2	52.2	24.8	56.2	13.7	57.1	18.3	54.7	7.2	59.7	55.2	36.4
Ab	47.2	90.3	46.6	74.5	47.3	72.5	43.4	85.1	42.4	77.9	45.0	92.3	39.8	44.3	62.2
Or	0.43	0.90	0.38	1.3	0.48	2.7	0.33	1.2	0.44	3.79	0.29	0.44	0.50	0.44	1.42

Table T4. Microprobe analyses of clinopyroxene in Leg 176 gabbros. (Continued on next five pages.)

Sample:*	MS1-1	MS3-2	MS6-3	MS9-4	MS11-5	MS12-6	MS14-7	MS18-8	MS19-9	MS20-10	MS22-11	MS23-12	MS24-13	MS25-14	MS26-15	MS27-16	MS28-17	MS41-18
N:	8	15	10	8	14	12	9	17	17	11	5	9	3	6	8	7	14	14
Major element oxides (wt%):																		
SiO_2	52.40	52.16	51.42	50.31	52.64	52.99	52.96	52.29	51.89	52.02	51.93	52.47	51.00	50.19	50.24	51.10	51.70	51.90
TiO_2	0.58	0.49	0.68	0.43	0.65	0.59	0.68	0.85	0.78	0.80	0.68	0.79	0.88	0.70	0.78	0.75	0.81	0.60
Al_2O_3	4.03	3.32	3.37	3.98	2.94	2.40	3.23	2.66	3.21	2.99	2.46	2.71	2.42	2.16	2.65	2.85	2.61	2.36
FeOt	4.66	5.25	4.60	4.40	7.01	7.98	6.20	8.39	8.61	8.01	9.41	7.58	9.77	11.43	8.66	6.97	9.14	12.13
MnO	0.13	0.15	0.13	0.12	0.19	0.23	0.18	0.25	0.23	0.22	0.30	0.22	0.28	0.35	0.22	0.19	0.25	0.34
MgO	17.60	17.66	16.73	16.95	16.07	16.60	16.34	15.18	15.44	15.80	14.57	15.34	14.09	13.70	17.20	16.72	15.46	14.02
CaO	19.26	20.28	21.91	21.81	20.54	19.44	20.90	20.31	19.38	19.90	19.60	21.14	21.42	20.64	18.78	20.14	19.66	17.73
Na_2O	0.52	0.32	0.37	0.48	0.52	0.35	0.51	0.51	0.72	0.51	0.57	0.43	0.52	0.52	0.39	0.39	0.43	0.58
K_2O	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.03	0.00	0.00	0.01	0.06
P_2O_5	0.02	0.02	0.01	0.00	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01
NiO	0.03	0.03	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.02	0.03	0.03	0.02	0.01	0.01	0.01
Cr_2O_3	0.99	0.63	0.49	1.07	0.03	0.03	0.07	0.02	0.03	0.03	0.01	0.06	0.00	0.02	0.03	0.09	0.02	0.00
Total:	100.22	100.32	99.75	99.57	100.65	100.66	101.13	100.50	100.33	100.32	99.57	100.78	100.42	99.78	98.97	99.23	100.09	99.74
Calculated cation proportions:																		
Si	1.9019	1.9021	1.8913	1.8587	1.9264	1.9398	1.9223	1.9287	1.9157	1.9174	1.9399	1.9265	1.9076	1.9041	1.8851	1.9007	1.9198	1.9491
Ti	0.0158	0.0136	0.0188	0.0118	0.0179	0.0163	0.0186	0.0235	0.0216	0.0222	0.0192	0.0219	0.0246	0.0200	0.0219	0.0210	0.0225	0.0169
Al	0.1722	0.1428	0.1464	0.1730	0.1267	0.1037	0.1384	0.1157	0.1398	0.1300	0.1086	0.1174	0.1068	0.0966	0.1171	0.1247	0.1141	0.1044
Cr	0.0284	0.0181	0.0142	0.0314	0.0008	0.0009	0.0021	0.0006	0.0009	0.0008	0.0002	0.0018	0.0001	0.0005	0.0010	0.0027	0.0005	0.0001
Fe	0.1414	0.1600	0.1412	0.1357	0.2141	0.2438	0.1879	0.2582	0.2656	0.2466	0.2937	0.2323	0.3049	0.3619	0.2713	0.2170	0.2833	0.3801
Mn	0.0040	0.0047	0.0041	0.0037	0.0060	0.0072	0.0056	0.0077	0.0072	0.0069	0.0096	0.0068	0.0088	0.0111	0.0071	0.0059	0.0078	0.0109
Mg	0.9513	0.9592	0.9166	0.9322	0.8755	0.9052	0.8834	0.8342	0.8493	0.8673	0.8107	0.8387	0.7848	0.7745	0.9608	0.9262	0.8551	0.7842
Ca	0.7487	0.7920	0.8636	0.8638	0.8059	0.7621	0.8122	0.8026	0.7662	0.7854	0.7838	0.8312	0.8578	0.8386	0.7553	0.8022	0.7820	0.7137
Na	0.0363	0.0223	0.0266	0.0341	0.0369	0.0248	0.0361	0.0367	0.0514	0.0366	0.0413	0.0306	0.0373	0.0381	0.0284	0.0282	0.0306	0.0421
K	0.0002	0.0003	0.0002	0.0001	0.0006	0.0003	0.0003	0.0003	0.0007	0.0001	0.0005	0.0001	0.0003	0.0013	0.0000	0.0002	0.0003	0.0029
Total:	4.0002	4.0152	4.0230	4.0444	4.0107	4.0041	4.0070	4.0082	4.0184	4.0133	4.0075	4.0073	4.0331	4.0470	4.0482	4.0288	4.0158	4.0043
Mg#	87.2	88.1	90.7	95.4	82.0	79.5	83.6	77.6	78.8	79.9	74.5	79.4	76.7	74.4	85.0	85.5	77.3	67.9
1 σ	2.0	1.3	4.5	3.8	2.6	3.5	1.7	1.5	1.7	2.8	1.9	1.9	3.2	4.6	4.8	3.9	2.4	2.5
Wo	34.1	36.3	39.5	36.0	39.0	37.1	39.3	39.6	38.0	38.1	38.8	40.8	40.8	38.0	32.2	37.1	38.5	35.1
En	57.4	56.1	54.9	61.1	50.0	49.9	50.7	46.8	48.8	49.4	45.5	47.0	45.5	46.1	57.4	53.7	47.6	43.9
Fs	8.5	7.6	5.6	3.0	11.0	13.0	10.0	13.6	13.2	12.5	15.7	12.2	13.8	15.9	10.3	9.2	14.0	21.0

Notes: * = ODP designations for sample IDs are found in Table T1, p. 29. *N* = averages of a number of point analyses on more than one crystal in a thin section are reported. The analyses were done on a JXA-8800L Superprobe at The university of Queensland. See text for analytical details. F (fine) and C (coarse) in GS samples refer to fine-grained microgabbro “bands” or “veins” entrued or enclosed within coarse-grained gabbro host. Note that nonsystematic compositional differences exist between averaged F and C portions of the same samples, but these differences are within the expected within sample variations. Wo = wollastonite, En = enstatite, Fs = ferrosilite.

Table T4 (continued).

Sample:*	MS60-19	MS70-20	MS71-21	MS72-22	MS74-23	MS76-24	MS78-25	MS79-26	MS82-27	MS84-28	MS89-29	MS90-30	MS91-31	MS92-32	MS93-33	MS95-34	MS97-35	MS98-36
N:	5	6	6	5	9	5	9	6	9	6	3	6	6	6	8	3	3	9
Major element oxides (wt%):																		
SiO_2	52.76	53.33	52.61	52.73	52.61	52.84	50.66	51.43	51.54	51.82	50.90	49.99	51.89	51.91	51.82	52.13	52.35	51.81
TiO_2	0.58	0.59	0.84	0.72	0.75	0.74	0.68	0.58	0.75	0.61	0.82	0.99	0.56	0.68	0.77	0.53	0.64	0.76
Al_2O_3	2.37	1.99	2.75	2.38	3.13	2.94	2.75	3.00	3.04	2.75	2.64	2.84	2.84	2.75	2.61	2.91	2.75	2.56
FeOt	9.36	8.55	6.98	7.28	6.75	6.39	7.79	6.27	7.14	7.20	7.36	8.59	6.94	6.01	7.51	6.82	7.03	7.46
MnO	0.24	0.27	0.20	0.21	0.19	0.18	0.21	0.16	0.19	0.20	0.20	0.24	0.19	0.17	0.22	0.18	0.20	0.23
MgO	18.78	15.25	15.39	15.97	16.31	15.80	15.24	16.47	17.01	16.86	16.45	16.21	16.65	15.82	16.29	17.27	16.58	16.01
CaO	15.43	20.02	21.51	20.73	20.44	21.45	21.43	21.25	19.72	19.24	19.78	20.23	19.59	21.74	19.56	19.22	19.70	20.04
Na_2O	0.31	0.42	0.45	0.37	0.47	0.45	0.58	0.45	0.40	0.36	0.38	0.50	0.38	0.42	0.37	0.36	0.36	0.38
K_2O	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00
P_2O_5	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.00	0.01
NiO	0.02	0.01	0.02	0.02	0.01	0.02	0.03	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.02
Cr_2O_3	0.02	0.02	0.06	0.06	0.07	0.06	0.07	0.09	0.06	0.07	0.03	0.04	0.10	0.05	0.05	0.08	0.07	0.05
Total:	99.88	100.47	100.83	100.49	100.74	100.87	99.46	99.72	99.87	99.14	98.59	99.66	99.18	99.58	99.23	99.53	99.72	99.33
Calculated cation proportions:																		
Si	1.9369	1.9626	1.9270	1.9362	1.9201	1.9276	1.8975	1.9018	1.9013	1.9221	1.9074	1.8724	1.9233	1.9203	1.9255	1.9213	1.9294	1.9254
Ti	0.0161	0.0165	0.0230	0.0197	0.0205	0.0203	0.0191	0.0161	0.0209	0.0171	0.0231	0.0279	0.0155	0.0190	0.0215	0.0146	0.0178	0.0212
Al	0.1026	0.0864	0.1186	0.1029	0.1347	0.1263	0.1216	0.1308	0.1321	0.1200	0.1167	0.1252	0.1240	0.1198	0.1141	0.1264	0.1196	0.1120
Cr	0.0007	0.0006	0.0018	0.0018	0.0019	0.0017	0.0019	0.0027	0.0018	0.0021	0.0007	0.0011	0.0031	0.0016	0.0014	0.0024	0.0021	0.0015
Fe	0.2866	0.2628	0.2135	0.2232	0.2055	0.1947	0.2438	0.1936	0.2199	0.2231	0.2304	0.2686	0.2148	0.1858	0.2329	0.2097	0.2162	0.2314
Mn	0.0073	0.0085	0.0063	0.0064	0.0060	0.0054	0.0068	0.0049	0.0058	0.0062	0.0062	0.0076	0.0061	0.0053	0.0069	0.0057	0.0062	0.0071
Mg	1.0268	0.8356	0.8397	0.8731	0.8861	0.8584	0.8502	0.9073	0.9347	0.9313	0.9187	0.9045	0.9190	0.8720	0.9013	0.9473	0.9099	0.8863
Ca	0.6073	0.7893	0.8439	0.8152	0.7996	0.8380	0.8595	0.8420	0.7800	0.7648	0.7934	0.8110	0.7779	0.8613	0.7783	0.7593	0.7778	0.7977
Na	0.0218	0.0297	0.0318	0.0262	0.0333	0.0315	0.0421	0.0321	0.0283	0.0259	0.0277	0.0361	0.0276	0.0298	0.0265	0.0260	0.0261	0.0276
K	0.0003	0.0006	0.0001	0.0002	0.0002	0.0002	0.0003	0.0000	0.0000	0.0004	0.0004	0.0002	0.0001	0.0000	0.0003	0.0004	0.0002	0.0002
Total:	4.0063	3.9926	4.0057	4.0050	4.0079	4.0039	4.0428	4.0314	4.0249	4.0129	4.0248	4.0547	4.0115	4.0149	4.0087	4.0130	4.0052	4.0106
Mg#	79.1	75.1	80.6	80.4	82.4	82.1	84.4	87.6	84.7	82.5	83.5	85.2	82.8	84.9	80.9	84.0	81.5	80.9
1 σ	2.2	2.5	0.78	1.3	1.9	1.2	5.7	4.9	4.9	1.4	3.5	2.7	3.2	2.6	2.3	2.4	0.56	2.5
Wo	29.3	37.9	41.4	40.0	38.8	40.7	39.4	37.7	35.6	36.9	37.0	35.1	36.9	42.2	38.0	36.6	37.6	39.0
En	55.8	46.6	47.2	48.2	50.4	48.7	51.2	54.6	54.7	52.0	52.7	55.2	52.2	49.1	50.0	53.1	50.8	49.3
Fs	14.9	15.5	11.4	11.8	10.8	10.6	9.3	7.7	9.7	11.0	10.3	9.7	10.9	8.8	12.0	10.3	11.5	11.7

Table T4 (continued).

Sample:*	MS99-37	MS101-38	GS30-1	GS30-1	GS31-2	GS31-2	GS32-3	GS32-3	GS33-4	GS33-4	GS34-5	GS34-5	GS40-6	GS40-6	GS38-7	GS38-7	GS44-8	GS44-8
N:	10	15	5	5	3	6	6	3	3	3	3	3	6	3	6	5	3	3
			F	C	F	C	C	F	F	C	C	F	C	F	C	F	F	C
Major element oxides (wt%):																		
SiO_2	51.96	52.05	52.26	51.94	51.81	52.35	51.26	51.81	52.41	52.63	51.58	52.81	52.27	52.35	50.93	51.49	50.75	51.69
TiO_2	0.61	0.59	0.67	0.72	0.72	0.63	0.92	0.66	0.68	0.65	1.04	0.65	0.82	0.81	0.83	0.76	0.70	0.61
Al_2O_3	2.75	2.50	2.44	2.51	2.72	2.62	2.98	3.12	2.66	2.50	2.86	2.71	2.61	2.80	2.67	2.48	2.59	2.73
FeOt	5.97	6.88	7.40	8.24	7.34	7.33	7.92	8.39	7.60	7.50	7.82	6.41	8.14	7.41	8.64	8.78	7.17	8.84
MnO	0.19	0.19	0.21	0.22	0.21	0.21	0.23	0.23	0.22	0.22	0.22	0.17	0.24	0.20	0.25	0.24	0.22	0.23
MgO	16.03	16.46	15.52	15.59	16.22	16.09	14.59	15.24	15.90	15.61	14.17	16.01	14.53	14.83	15.51	15.48	15.29	15.75
CaO	21.02	19.86	20.72	20.02	20.14	19.95	20.55	19.03	19.78	20.28	21.17	20.57	20.99	21.11	19.65	19.97	21.31	18.74
Na_2O	0.41	0.37	0.41	0.36	0.37	0.37	0.45	0.42	0.39	0.35	0.48	0.40	0.44	0.43	0.46	0.38	0.39	0.40
K_2O	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
P_2O_5	0.01	0.01	0.03	0.02	0.02	0.01	0.03	0.03	0.02	0.00	0.02	0.00	0.02	0.01	0.01	0.01	0.01	0.02
NiO	0.02	0.01	0.02	0.02	0.01	0.01	0.02	0.03	0.03	0.02	0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02
Cr_2O_3	0.06	0.05	0.10	0.05	0.08	0.12	0.03	0.31	0.06	0.05	0.03	0.04	0.04	0.25	0.02	0.02	0.05	0.05
Total:	99.05	98.97	99.77	99.70	99.64	99.68	98.99	99.29	99.75	99.82	99.41	99.78	100.10	100.25	98.98	99.63	98.51	99.09
Calculated cation proportions:																		
Si	1.9278	1.9337	1.9353	1.9292	1.9188	1.9342	1.9198	1.9284	1.9364	1.9436	1.9248	1.9414	1.9361	1.9312	1.9113	1.9201	1.9108	1.9296
Ti	0.0171	0.0164	0.0187	0.0202	0.0201	0.0175	0.0261	0.0186	0.0189	0.0180	0.0292	0.0181	0.0228	0.0225	0.0236	0.0214	0.0199	0.0172
Al	0.1203	0.1092	0.1066	0.1098	0.1187	0.1139	0.1315	0.1371	0.1160	0.1090	0.1258	0.1175	0.1140	0.1217	0.1179	0.1092	0.1149	0.1203
Cr	0.0019	0.0014	0.0028	0.0015	0.0024	0.0036	0.0010	0.0091	0.0017	0.0013	0.0010	0.0013	0.0012	0.0072	0.0007	0.0005	0.0016	0.0016
Fe	0.1848	0.2135	0.2288	0.2556	0.2268	0.2261	0.2477	0.2607	0.2343	0.2313	0.2436	0.1967	0.2517	0.2282	0.2709	0.2735	0.2254	0.2756
Mn	0.0059	0.0061	0.0064	0.0069	0.0064	0.0064	0.0073	0.0074	0.0068	0.0069	0.0068	0.0053	0.0076	0.0063	0.0080	0.0076	0.0070	0.0074
Mg	0.8861	0.9108	0.8561	0.8626	0.8950	0.8848	0.8135	0.8448	0.8750	0.8584	0.7877	0.8766	0.8015	0.8151	0.8668	0.8600	0.8578	0.8761
Ca	0.8353	0.7901	0.8218	0.7962	0.7990	0.7897	0.8247	0.7586	0.7827	0.8021	0.8462	0.8099	0.8328	0.8342	0.7897	0.7976	0.8592	0.7500
Na	0.0297	0.0267	0.0291	0.0258	0.0265	0.0263	0.0328	0.0305	0.0280	0.0253	0.0350	0.0285	0.0314	0.0306	0.0336	0.0275	0.0284	0.0286
K	0.0000	0.0001	0.0003	0.0001	0.0000	0.0003	0.0000	0.0003	0.0002	0.0002	0.0001	0.0000	0.0001	0.0002	0.0001	0.0000	0.0003	0.0002
Total:	4.0089	4.0080	4.0059	4.0079	4.0138	4.0028	4.0043	3.9954	4.0000	3.9960	4.0003	3.9954	3.9992	3.9972	4.0226	4.0174	4.0254	4.0066
Mg#	84.2	82.2	79.8	78.3	81.8	80.0	77.3	75.8	78.9	78.2	76.4	81.0	76.0	77.7	79.4	78.1	83.1	77.1
1 σ	1.5	2.5	0.90	1.9	0.46	1.4	1.7	0.53	0.27	0.39	0.22	0.79	0.52	1.3	1.5	2.3	2.7	4.7
Wo	40.6	38.4	40.3	39.1	39.1	38.2	40.3	35.7	37.8	38.7	41.5	38.9	40.6	40.2	38.4	37.3	40.7	34.6
En	50.0	50.6	47.6	47.7	49.8	49.4	46.2	48.7	49.0	48.0	44.7	49.5	45.1	46.4	48.9	49.1	49.3	50.4
Fs	9.4	11.0	12.1	13.3	11.1	12.3	13.6	15.6	13.1	13.4	13.8	11.6	14.3	13.3	12.7	13.6	10.0	15.0

Table T4 (continued).

Sample:*	GS59-9	GS59-9	GS64-10	GS64-10	GS77-11	GS83-12	GS83-12	GS86-13	GS86-13	GS87-14	GS87-14	GS88-15	GS88-15	GS96-16	GS100-17	GS100-17	GS51-18	GS51-18
N:	6	3	5	10	5	5	5	3	5	3	6	5	3	3	4	3	4	6
	C	F	F	C	C	F	C	F	C	F	C	C	F	C	F	C	C	F
Major element oxides (wt%):																		
SiO_2	52.42	51.25	52.60	52.94	52.29	53.09	52.84	52.60	52.37	52.74	52.57	52.44	52.48	52.88	52.67	52.93	51.38	51.02
TiO_2	0.85	0.86	0.83	0.71	0.93	0.62	0.66	0.76	0.93	0.66	0.91	0.63	0.74	0.56	0.67	0.61	0.70	0.68
Al_2O_3	2.33	2.54	2.45	2.64	2.64	2.33	2.32	2.38	2.71	2.57	2.68	2.73	2.60	2.89	2.61	2.77	2.25	2.22
FeOt	9.83	9.07	9.42	7.80	7.73	6.59	6.90	7.98	9.02	7.12	7.75	7.66	7.41	6.39	6.71	6.82	9.50	10.36
MnO	0.29	0.26	0.28	0.22	0.22	0.19	0.20	0.23	0.26	0.21	0.21	0.19	0.19	0.15	0.19	0.19	0.30	0.32
MgO	15.09	14.38	15.33	15.49	15.31	16.01	15.80	14.72	14.25	15.96	16.22	15.65	15.94	16.59	15.82	16.35	14.74	14.75
CaO	19.02	20.33	18.76	19.86	20.22	20.84	20.54	21.22	20.30	20.05	19.06	20.00	19.82	19.97	20.90	20.00	19.98	18.74
Na_2O	0.46	0.48	0.44	0.44	0.44	0.38	0.39	0.42	0.47	0.39	0.39	0.41	0.43	0.39	0.39	0.37	0.48	0.47
K_2O	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00
P_2O_5	0.01	0.01	0.02	0.01	0.00	0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.01	0.02	0.00	0.02	0.02	0.01
NiO	0.01	0.03	0.01	0.01	0.03	0.01	0.03	0.02	0.04	0.01	0.02	0.00	0.02	0.00	0.02	0.03	0.01	0.01
Cr_2O_3	0.01	0.01	0.02	0.04	0.31	0.08	0.06	0.06	0.07	0.17	0.10	0.07	0.19	0.10	0.10	0.05	0.05	0.06
Total:	100.33	99.23	100.15	100.19	100.11	100.16	99.76	100.40	100.46	99.90	99.93	99.81	99.83	99.95	100.09	100.13	99.40	98.66
Calculated cation proportions:																		
Si	1.9414	1.9247	1.9452	1.9469	1.9304	1.9478	1.9486	1.9418	1.9372	1.9417	1.9354	1.9370	1.9362	1.9373	1.9366	1.9400	1.9287	1.9316
Ti	0.0236	0.0244	0.0230	0.0198	0.0257	0.0172	0.0183	0.0211	0.0258	0.0183	0.0252	0.0174	0.0205	0.0155	0.0185	0.0167	0.0197	0.0195
Al	0.1017	0.1122	0.1067	0.1141	0.1147	0.1009	0.1007	0.1033	0.1183	0.1115	0.1162	0.1188	0.1130	0.1247	0.1133	0.1195	0.0997	0.0989
Cr	0.0003	0.0003	0.0007	0.0012	0.0089	0.0022	0.0019	0.0018	0.0021	0.0049	0.0029	0.0021	0.0054	0.0029	0.0030	0.0015	0.0015	0.0017
Fe	0.3039	0.2843	0.2907	0.2395	0.2382	0.2019	0.2125	0.2459	0.2785	0.2188	0.2381	0.2363	0.2283	0.1955	0.2061	0.2087	0.2977	0.3274
Mn	0.0092	0.0084	0.0087	0.0070	0.0068	0.0059	0.0063	0.0072	0.0081	0.0066	0.0067	0.0061	0.0061	0.0048	0.0060	0.0059	0.0094	0.0103
Mg	0.8321	0.8048	0.8443	0.8480	0.8417	0.8752	0.8682	0.8094	0.7854	0.8755	0.8897	0.8613	0.8759	0.9053	0.8664	0.8926	0.8236	0.8320
Ca	0.7549	0.8179	0.7432	0.7833	0.7997	0.8189	0.8112	0.8390	0.8042	0.7905	0.7516	0.7914	0.7834	0.7836	0.8230	0.7849	0.8032	0.7598
Na	0.0333	0.0352	0.0315	0.0315	0.0316	0.0273	0.0281	0.0299	0.0340	0.0280	0.0280	0.0295	0.0311	0.0275	0.0274	0.0262	0.0348	0.0345
K	0.0004	0.0001	0.0001	0.0005	0.0002	0.0000	0.0001	0.0003	0.0001	0.0001	0.0002	0.0003	0.0000	0.0003	0.0003	0.0001	0.0003	0.0002
Total:	4.0009	4.0122	3.9940	3.9918	3.9979	3.9972	3.9959	3.9996	3.9938	3.9959	3.9939	4.0001	3.9997	3.9973	4.0006	3.9960	4.0186	4.0160
Mg#	73.5	75.6	73.8	76.8	77.7	80.9	79.7	76.6	73.0	79.4	78.1	78.5	79.3	81.8	80.9	80.5	76.0	74.0
1 σ	2.6	2.2	2.4	1.2	1.3	1.1	0.72	0.54	0.76	0.24	1.9	0.35	1.1	0.28	1.0	0.35	5.9	2.7
Wo	37.0	40.0	36.1	37.6	38.9	39.8	39.4	41.1	39.0	38.0	35.7	38.2	38.0	37.3	39.9	37.5	38.9	37.7
En	46.2	45.4	47.0	47.9	47.5	48.7	48.3	45.1	44.5	49.2	50.2	48.5	49.2	51.3	48.6	50.3	46.5	46.0
Fs	16.8	14.6	16.9	14.5	13.7	11.5	12.3	13.8	16.5	12.8	14.1	13.3	12.8	11.4	11.5	12.2	14.6	16.3

Table T4 (continued).

Sample:*	GS55-19	GS85-20	GS85-20	GS102-21	GS102-21	FV2-1	FV5-2	FV13-3	FV21-4	FV29-5	FV29-5	FV35-6	FV37-7	FV35-6	FV37-7	FV39-8	FV45-9a	FV45-9b
N:	5	3	3	4	5	8	3	3	9	13	2	4	3	2	2	3	7	6
	C	F	C	F	C													
Major element oxides (wt%):																		
SiO_2	50.80	51.69	53.12	52.99	52.73	53.34	51.87	52.30	52.44	52.87	53.28	52.91	51.47	50.38	50.63	52.48	53.17	52.98
TiO_2	0.76	0.76	0.58	0.68	0.75	0.18	0.67	1.12	0.77	0.57	0.04	0.59	0.77	0.05	0.65	0.64	0.55	0.58
Al_2O_3	2.53	2.61	2.67	2.57	2.89	1.26	3.45	2.49	2.51	2.18	0.26	2.03	3.19	0.51	2.68	3.02	2.54	3.25
FeOt	8.62	7.93	6.64	6.71	7.79	7.19	4.82	7.80	8.07	8.20	6.16	9.32	9.41	10.66	6.67	6.52	7.27	6.18
MnO	0.25	0.23	0.19	0.19	0.21	0.19	0.15	0.25	0.25	0.23	0.08	0.33	0.25	0.15	0.19	0.19	0.22	0.16
MgO	15.38	15.35	16.54	15.31	15.66	13.97	16.49	15.96	14.57	14.77	14.28	13.71	14.56	12.39	16.08	14.60	16.05	16.86
CaO	19.96	20.19	20.08	21.39	19.96	23.01	20.21	18.88	20.44	20.56	24.39	20.52	19.37	24.73	21.66	21.70	20.05	18.77
Na_2O	0.41	0.41	0.37	0.41	0.44	0.32	0.39	0.48	0.68	0.58	0.51	0.73	0.44	0.82	0.45	0.69	0.37	0.55
K_2O	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.01
P_2O_5	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.03	0.00	0.01	0.02	0.00
NiO	0.01	0.00	0.00	0.02	0.02	0.02	0.03	0.00	0.01	0.02	0.01	0.00	0.04	0.06	0.04	0.01	0.01	0.03
Cr_2O_3	0.03	0.06	0.07	0.22	0.03	0.13	0.46	0.03	0.04	0.04	0.00	0.02	0.01	0.01	0.04	0.19	0.08	0.09
Total:	98.75	99.25	100.27	100.50	100.49	99.66	98.56	99.35	99.79	100.04	99.02	100.17	99.55	99.79	99.11	100.08	100.33	99.45
Calculated cation proportions:																		
Si	1.9131	1.9272	1.9421	1.9423	1.9345	1.9845	1.9195	1.9379	1.9457	1.9567	1.9957	1.9662	1.9214	1.9310	1.8943	1.9346	1.9484	1.9414
Ti	0.0214	0.0212	0.0159	0.0187	0.0207	0.0050	0.0185	0.0313	0.0214	0.0159	0.0010	0.0165	0.0217	0.0015	0.0183	0.0178	0.0151	0.0159
Al	0.1122	0.1147	0.1151	0.1112	0.1250	0.0550	0.1503	0.1087	0.1095	0.0950	0.0114	0.0886	0.1410	0.0230	0.1183	0.1313	0.1095	0.1404
Cr	0.0008	0.0018	0.0020	0.0064	0.0010	0.0037	0.0134	0.0009	0.0011	0.0012	0.0000	0.0005	0.0003	0.0002	0.0013	0.0056	0.0024	0.0026
Fe	0.2710	0.2473	0.2026	0.2053	0.2385	0.2240	0.1489	0.2413	0.2501	0.2534	0.1927	0.2893	0.2938	0.3418	0.2083	0.2007	0.2223	0.1890
Mn	0.0078	0.0074	0.0060	0.0060	0.0066	0.0061	0.0049	0.0080	0.0078	0.0072	0.0025	0.0104	0.0081	0.0049	0.0059	0.0060	0.0067	0.0050
Mg	0.8627	0.8530	0.9007	0.8358	0.8556	0.7731	0.9092	0.8806	0.8052	0.8138	0.7970	0.7587	0.8097	0.7072	0.8965	0.8017	0.8760	0.9206
Ca	0.8053	0.8061	0.7862	0.8397	0.7843	0.9173	0.8012	0.7498	0.8122	0.8150	0.9788	0.8164	0.7744	1.0152	0.8681	0.8568	0.7870	0.7366
Na	0.0296	0.0294	0.0259	0.0292	0.0315	0.0233	0.0281	0.0347	0.0491	0.0420	0.0365	0.0525	0.0315	0.0616	0.0328	0.0492	0.0262	0.0392
K	0.0000	0.0000	0.0001	0.0001	0.0001	0.0020	0.0006	0.0006	0.0003	0.0003	0.0001	0.0001	0.0004	0.0005	0.0002	0.0003	0.0002	0.0003
Total:	4.0239	4.0081	3.9965	3.9948	3.9977	3.9939	3.9945	3.9937	4.0024	4.0004	4.0158	3.9990	4.0022	4.0869	4.0441	4.0039	3.9937	3.9910
Mg#	79.5	78.7	81.1	79.5	77.9	76.1	85.0	77.5	76.6	76.4	83.2	72.3	73.7	80.7	88.4	80.6	78.9	81.7
1 σ	2.3	1.2	0.50	0.44	0.43	9.4	1.1	1.8	1.8	2.9	0.03	0.56	0.50	0.71	9.1	2.7	1.4	0.85
Wo	38.2	38.2	37.6	40.4	37.8	44.5	37.3	36.2	40.3	39.8	48.4	40.1	36.5	45.0	38.3	41.7	37.6	34.6
En	49.1	48.6	50.6	47.3	48.5	42.5	53.3	49.5	45.8	46.0	42.9	43.3	46.8	44.4	54.8	47.0	49.2	53.4
Fs	12.7	13.2	11.8	12.2	13.8	13.0	9.4	14.3	14.0	14.3	8.7	16.6	16.7	10.6	7.0	11.3	13.2	12.0

Table T4 (continued).

Sample:*	FV45-10	FV58-13	FV61-14	FV62-15	FV63-16	FV65-17	FV81-20
N:	6	7	12	9	5	5	2
Major element oxides (wt%):							
SiO_2	52.83	51.90	52.08	51.74	51.51	51.19	50.38
TiO_2	0.71	0.76	0.59	0.71	0.56	0.71	0.52
Al_2O_3	2.58	2.52	2.18	2.63	2.13	2.77	2.68
FeOt	7.91	9.05	8.90	8.08	8.26	7.77	7.68
MnO	0.22	0.27	0.28	0.22	0.30	0.24	0.24
MgO	15.60	15.06	14.74	15.53	14.24	15.49	14.85
CaO	19.29	20.29	21.13	21.05	22.08	20.52	21.46
Na_2O	0.55	0.45	0.49	0.49	0.61	0.52	0.73
K_2O	0.01	0.01	0.01	0.01	0.01	0.01	0.00
P_2O_5	0.01	0.02	0.02	0.01	0.02	0.03	0.02
NiO	0.03	0.02	0.02	0.01	0.03	0.01	0.02
Cr_2O_3	0.04	0.02	0.04	0.02	0.03	0.05	0.09
Total:	99.78	100.36	100.48	100.49	99.77	99.31	98.68
Calculated cation proportions:							
Si	1.9498	1.9246	1.9328	1.9127	1.9285	1.9116	1.9033
Ti	0.0197	0.0211	0.0165	0.0197	0.0158	0.0200	0.0149
Al	0.1122	0.1103	0.0953	0.1145	0.0940	0.1219	0.1194
Cr	0.0013	0.0005	0.0011	0.0006	0.0008	0.0016	0.0027
Fe	0.2437	0.2801	0.2757	0.2493	0.2582	0.2420	0.2423
Mn	0.0068	0.0083	0.0088	0.0068	0.0094	0.0077	0.0077
Mg	0.8577	0.8317	0.8144	0.8551	0.7941	0.8612	0.8357
Ca	0.7624	0.8057	0.8399	0.8336	0.8854	0.8218	0.8683
Na	0.0395	0.0326	0.0356	0.0349	0.0439	0.0374	0.0533
K	0.0007	0.0004	0.0004	0.0004	0.0005	0.0003	0.0001
Total:	3.9938	4.0153	4.0205	4.0277	4.0305	4.0255	4.0476
Mg#	77.0	76.9	77.6	81.6	80.1	81.9	85.0
1 σ	1.2	1.5	1.8	2.1	1.4	2.6	3.8
Wo	36.9	39.9	41.7	40.0	43.5	39.9	40.6
En	48.5	46.2	45.3	48.9	45.2	49.2	50.5
Fs	14.5	13.9	13.1	11.1	11.3	10.9	8.8

Table T5. Microprobe analyses of orthopyroxene in Leg 176 gabbros.

Sample:*	MS9-4	MS14-7	MS22-11	MS41-18	MS70-20	MS97-35	GS44-8	GS77-11	GS86-13	GS86-13	GS100-17	GS51-18
N:	1	1	9	7	8	5	3	5	2	5	3	3
							C	C	F	C	F	C
Major element oxides (wt%):												
SiO_2	52.45	55.51	53.72	52.50	53.39	54.44	52.53	55.15	54.87	54.47	55.61	50.93
TiO_2	0.12	0.33	0.44	0.38	0.40	0.33	0.24	0.36	0.31	0.48	0.31	0.44
Al_2O_3	2.57	2.35	1.15	0.84	1.19	1.43	1.07	1.28	1.19	1.15	1.30	1.03
FeOt	10.59	15.27	18.96	23.68	18.71	14.33	16.71	16.35	17.44	18.01	13.81	20.59
MnO	0.23	0.33	0.49	0.64	0.46	0.33	0.40	0.36	0.37	0.41	0.31	0.57
MgO	28.11	25.50	24.55	20.89	24.11	27.54	25.93	25.79	25.52	24.78	27.88	22.45
CaO	3.73	2.98	1.61	1.42	2.07	1.01	1.13	1.46	0.95	1.31	1.01	1.84
Na_2O	0.10	0.30	0.03	0.02	0.03	0.02	0.01	0.03	0.02	0.02	0.01	0.04
K_2O	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00
P_2O_5	0.00	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
NiO	0.06	0.00	0.02	0.01	0.02	0.02	0.03	0.03	0.00	0.02	0.04	0.01
Cr_2O_3	0.60	0.05	0.01	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.01
Total:	98.55	102.66	100.99	100.40	100.42	99.49	98.09	100.84	100.72	100.69	100.33	97.91
Calculated cation proportions:												
Si	1.9035	1.9565	1.9569	1.9683	1.9570	1.9641	1.9517	1.9805	1.9801	1.9754	1.9808	1.9404
Ti	0.0033	0.0087	0.0119	0.0107	0.0110	0.0091	0.0068	0.0097	0.0085	0.0131	0.0084	0.0126
Al	0.1100	0.0975	0.0493	0.0372	0.0516	0.0608	0.0470	0.0541	0.0508	0.0493	0.0548	0.0460
Cr	0.0171	0.0013	0.0003	0.0001	0.0004	0.0004	0.0006	0.0004	0.0008	0.0009	0.0008	0.0002
Fe	0.3208	0.4492	0.5767	0.7413	0.5727	0.4315	0.5183	0.4902	0.5253	0.5452	0.4108	0.6551
Mn	0.0070	0.0098	0.0151	0.0203	0.0143	0.0101	0.0124	0.0111	0.0112	0.0124	0.0093	0.0183
Mg	1.5196	1.3389	1.3323	1.1665	1.3165	1.4799	1.4352	1.3794	1.3716	1.3385	1.4791	1.2743
Ca	0.1448	0.1125	0.0628	0.0572	0.0812	0.0392	0.0450	0.0562	0.0368	0.0510	0.0385	0.0750
Na	0.0068	0.0207	0.0018	0.0012	0.0022	0.0017	0.0010	0.0018	0.0013	0.0012	0.0009	0.0033
K	0.0000	0.0008	0.0003	0.0001	0.0002	0.0004	0.0001	0.0002	0.0001	0.0001	0.0003	0.0000
Total:	4.0330	3.9961	4.0074	4.0030	4.0072	3.9972	4.0182	3.9835	3.9864	3.9871	3.9836	4.0254
Mg#	85.6	74.5	70.3	61.3	70.2	77.2	74.9	72.5	71.3	70.1	76.9	67.8
1 σ	NA	NA	0.81	0.40	0.58	1.1	0.72	0.36	0.08	1.0	0.38	1.2
Wo	10.4	9.4	5.5	5.5	7.0	3.1	3.8	4.7	3.2	4.4	3.0	6.9
En	76.7	67.5	66.5	58.0	65.3	74.8	72.0	69.1	69.0	67.0	74.6	63.2
Fs	12.9	23.1	28.0	36.5	27.7	22.1	24.2	26.2	27.8	28.6	22.4	29.9

Notes: * = ODP sample designations are found in Table **T1**, p. 29. *N* = averages of a number of point analyses on more than one crystal in a thin section are reported. NA = not analyzed. The analyses were done on a JXA-8800L Superprobe at The University of Queensland. See text for analytical details. F (fine) and C (coarse) in GS samples refer to fine-grained microgabbro "bands" or "veins" entrued or enclosed within coarse-grained gabbro host. Note that nonsystematic compositional differences exist between averaged F and C portions of the same samples, but these differences are within the expected within sample variations. Wo = wollastonite, En = enstatite, Fs = ferrosilite.

Table T6. Microprobe analyses of Fe-Ti oxides in Leg 176 gabbros. (Continued on next page.)

Sample:*	MS6-3	MS11-5	MS12-6	MS18-8	MS19-9	MS20-10	MS22-11	MS23-12	MS24-13	MS25-14	MS26-15	MS41-18	MS60-19	MS70-20	MS71-21	MS72-22	MS74-23	MS78-25
N:	3	5	5	3	5	4	10	5	3	9	3	6	7	8	3	3	3	2
Major element oxides (wt%):																		
SiO_2	0.01	0.04	0.01	0.01	0.09	0.00	0.04	0.01	0.00	0.06	0.02	0.12	0.47	0.01	0.01	0.01	0.01	0.02
TiO_2	52.50	51.45	52.84	50.45	50.35	48.20	32.54	50.48	50.40	38.11	50.32	49.42	38.08	48.10	49.52	49.50	48.40	48.48
Al_2O_3	0.05	0.03	0.02	0.02	0.04	0.40	1.70	0.03	0.03	1.31	0.03	0.18	0.40	0.08	0.09	0.04	0.21	0.02
FeOt	37.44	44.25	43.89	46.43	46.75	46.80	61.34	46.05	47.80	56.81	47.35	46.46	54.03	46.39	44.13	43.64	46.61	49.36
MnO	0.66	0.70	0.65	1.82	1.10	0.68	0.89	1.01	0.75	0.74	0.70	1.05	0.61	0.53	0.49	0.58	1.94	1.26
MgO	6.84	2.34	2.67	0.35	1.01	3.29	0.91	1.57	0.42	0.89	1.12	0.67	2.45	2.99	4.60	4.68	0.80	0.28
CaO	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.01	0.00	0.00	0.00	0.00	0.00
Na_2O	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.01	0.02	0.02	0.01
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
P_2O_5	0.00	0.02	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
NiO	0.03	0.00	0.02	0.02	0.00	0.02	0.03	0.03	0.03	0.01	0.01	0.01	0.05	0.02	0.00	0.01	0.04	0.00
Cr_2O_3	0.12	0.08	0.04	0.08	0.05	0.16	0.06	0.08	0.03	0.05	0.07	0.02	0.06	0.10	0.10	0.11	0.13	0.09
Total:	97.66	98.92	100.14	99.21	99.39	99.59	97.52	99.28	99.47	98.00	99.63	98.02	96.19	98.16	98.96	98.59	98.16	99.52
Calculated cation proportions:																		
Si	0.0004	0.0010	0.0002	0.0004	0.0022	0.0000	0.0013	0.0003	0.0001	0.0017	0.0004	0.0030	0.0140	0.0001	0.0003	0.0002	0.0003	0.0006
Ti	0.9762	0.9779	0.9868	0.9733	0.9663	0.9191	0.6488	0.9664	0.9705	0.7394	0.9644	0.9633	0.7512	0.9327	0.9391	0.9412	0.9480	0.9438
Al	0.0014	0.0009	0.0005	0.0006	0.0011	0.0124	0.0648	0.0010	0.0008	0.0468	0.0008	0.0054	0.0150	0.0024	0.0027	0.0011	0.0063	0.0005
Cr	0.0024	0.0015	0.0007	0.0015	0.0011	0.0034	0.0014	0.0016	0.0007	0.0014	0.0014	0.0003	0.0015	0.0020	0.0020	0.0022	0.0027	0.0017
Fe^{3+}	0.0648	0.0598	0.0372	0.0759	0.0913	0.2190	0.9441	0.0959	0.0859	0.7046	0.1023	0.0925	0.6787	0.1949	0.1747	0.1708	0.1417	0.1636
Fe^{2+}	0.7099	0.8755	0.8742	0.9202	0.9065	0.7794	0.5960	0.8846	0.9378	0.6892	0.9069	0.9144	0.6535	0.8059	0.7560	0.7522	0.8737	0.9057
Mn	0.0138	0.0150	0.0136	0.0395	0.0237	0.0146	0.0203	0.0218	0.0163	0.0164	0.0151	0.0230	0.0142	0.0115	0.0105	0.0125	0.0427	0.0277
Mg	0.2520	0.0881	0.0987	0.0133	0.0383	0.1247	0.0393	0.0596	0.0159	0.0352	0.0425	0.0259	0.0968	0.1151	0.1728	0.1766	0.0309	0.0110
Ca	0.0001	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0027	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000
Ni	0.0007	0.0001	0.0004	0.0004	0.0000	0.0005	0.0008	0.0007	0.0006	0.0003	0.0002	0.0003	0.0012	0.0004	0.0001	0.0002	0.0008	0.0000
Zn	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total:	2.0216	2.0199	2.0124	2.0253	2.0304	2.0730	2.3168	2.0320	2.0286	2.2349	2.0341	2.0308	2.2265	2.0650	2.0582	2.0569	2.0472	2.0545

Notes: * = ODP sample designations are listed in Table **T1**, p. 29. *N* = averages of a number of point analyses on more than one crystal in a thin section are reported. The analyses were done on a JXA-8800L Superprobe at The University of Queensland. See text for analytical details. F (fine) and C (coarse) in GS samples refer to fine-grained microgabbro "bands" or "veins" entrued or enclosed within coarse-grained gabbro host.

Table T6 (continued).

Sample:*	MS82-27	GS30-1	GS32-3	GS64-10	GS77-11	GS51-18	GS51-18	FV13-3	FV21-4	FV21-4	FV19-5	FV47-10	FV47-10
N:	3	5	3	5	5	8	6	4	2	2	3	5	2
Major element oxides (wt%):													
SiO_2	0.00	0.01	0.01	0.02	0.01	0.01	0.04	0.02	0.00	0.03	0.01	0.01	0.03
TiO_2	49.47	47.67	49.50	47.46	50.02	50.48	8.15	50.30	48.70	2.76	48.13	48.63	0.85
Al_2O_3	0.04	0.03	0.11	0.02	0.21	0.06	3.91	0.01	0.05	2.91	0.17	0.02	0.35
FeOt	42.59	46.69	44.19	45.46	44.66	44.58	78.62	48.41	48.84	84.20	47.69	46.60	88.82
MnO	0.68	1.96	0.51	0.59	0.63	0.69	0.33	1.13	0.85	0.14	0.62	1.08	0.06
MgO	5.51	0.23	3.85	2.81	3.16	2.60	0.97	0.03	0.38	0.53	0.46	1.49	0.27
CaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na_2O	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.02	0.02	0.01	0.01	0.01
K_2O	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
P_2O_5	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.03
NiO	0.02	0.03	0.04	0.01	0.03	0.01	0.03	0.01	0.00	0.05	0.02	0.02	0.01
Cr_2O_3	0.13	0.11	0.11	0.09	0.11	0.06	0.83	0.00	0.04	0.32	0.01	0.05	0.06
Total:	98.45	96.75	98.34	96.46	98.85	98.52	92.90	99.93	98.90	90.99	97.13	97.92	90.50
Calculated cation proportions:													
Si	0.0001	0.0002	0.0003	0.0004	0.0004	0.0004	0.0014	0.0005	0.0001	0.0013	0.0003	0.0002	0.0012
Ti	0.9374	0.9519	0.9466	0.9369	0.9530	0.9661	0.2087	0.9683	0.9511	0.0765	0.9539	0.9509	0.0250
Al	0.0012	0.0011	0.0034	0.0006	0.0062	0.0017	0.1574	0.0002	0.0015	0.1268	0.0054	0.0005	0.0160
Cr	0.0026	0.0023	0.0022	0.0019	0.0022	0.0013	0.0227	0.0001	0.0008	0.0095	0.0002	0.0011	0.0020
Fe^{3+}	0.1817	0.1389	0.1508	0.1842	0.1272	0.0962	2.0994	0.0932	0.1432	2.5623	0.1289	0.1443	2.8945
Fe^{2+}	0.7157	0.8981	0.7889	0.8139	0.8198	0.8527	0.1504	0.9432	0.9175	0.0424	0.9222	0.8691	0.0080
Mn	0.0145	0.0442	0.0111	0.0131	0.0136	0.0150	0.0096	0.0244	0.0187	0.0045	0.0138	0.0238	0.0020
Mg	0.2070	0.0092	0.1461	0.1101	0.1195	0.0986	0.0492	0.0010	0.0149	0.0293	0.0179	0.0578	0.0158
Ca	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ni	0.0004	0.0006	0.0008	0.0002	0.0005	0.0001	0.0009	0.0002	0.0001	0.0016	0.0003	0.0004	0.0004
Zn	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total:	2.0606	2.0463	2.0503	2.0614	2.0424	2.0321	2.6998	2.0311	2.0477	2.8541	2.0430	2.0481	2.9648

Table T7. Microprobe analyses of amphiboles in Leg 176 gabbros. (Continued on next page.)

Sample:*	MS6-3	MS11-5	MS14-7	MS22-11	MS22-11	MS24-13	MS25-14	MS25-14	MS28-17	MS41-18	MS41-18	MS41-18	MS60-19	MS72-22	MS89-29	GS32-3	FV2-1	FV5-2
N:	2	5	5	3	2	3	4	3	4	3	4	4	6	3	3	3	4	5
Major element oxides (wt%):																		
SiO_2	46.77	45.80	48.19	42.80	45.90	48.80	38.89	39.62	46.66	43.75	50.05	46.83	56.07	43.75	47.95	42.34	54.68	53.37
TiO_2	3.06	1.67	0.42	3.31	0.86	0.49	1.38	3.22	0.74	2.78	0.56	0.59	0.01	3.77	1.11	3.59	0.07	0.43
Al_2O_3	10.24	10.38	9.53	11.32	8.41	3.91	11.39	11.01	7.65	10.11	4.86	7.09	1.73	11.66	2.86	11.32	2.74	3.17
Cr_2O_3	0.68	0.01	0.00	0.02	0.00	0.01	0.01	0.01	0.11	0.00	0.01	0.00	0.00	0.07	0.03	0.06	0.00	0.31
FeOt	6.57	11.07	10.67	12.52	17.29	13.61	20.65	14.82	4.91	15.21	15.70	18.07	11.23	10.05	6.94	11.28	9.63	6.81
MnO	0.10	0.18	0.17	0.21	0.22	0.30	0.20	0.19	0.11	0.25	0.33	0.27	0.05	0.14	0.19	0.17	0.29	0.12
MgO	17.13	15.47	16.08	13.65	11.88	17.06	8.23	11.68	15.50	12.13	13.17	11.43	23.81	14.68	15.35	13.39	17.19	20.45
CaO	13.00	11.04	11.40	10.88	11.04	8.70	11.25	11.03	14.04	10.87	11.61	11.11	0.60	11.19	18.67	11.03	12.11	10.27
NiO	0.10	0.02	0.03	0.01	0.03	0.02	0.01	0.01	0.03	0.02	0.01	0.01	0.08	0.04	0.00	0.01	0.03	0.10
Na_2O	2.43	2.33	1.78	2.78	1.59	1.00	2.64	2.85	1.31	2.43	1.11	1.67	0.08	2.62	0.44	2.72	0.60	0.63
K_2O	0.01	0.22	0.30	0.27	0.38	0.06	0.42	0.31	0.00	0.35	0.10	0.37	0.08	0.20	0.00	0.26	0.03	0.07
P_2O_5	0.08	0.03	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.01	0.04	0.01	0.02
Total:	100.16	98.22	98.57	97.77	97.61	93.97	95.07	94.76	91.06	97.91	97.52	97.46	93.77	98.21	93.55	96.22	97.38	95.76
Calculated cation proportions:																		
Si	6.8260	6.9061	7.1835	6.5813	7.1575	7.6709	6.4533	6.4115	7.3825	6.7841	7.6909	7.3362	8.3622	6.6076	7.5766	6.5854	8.1103	7.9394
Ti	0.3352	0.1892	0.0467	0.3822	0.1005	0.0583	0.1717	0.3919	0.0879	0.3243	0.0654	0.0697	0.0011	0.4277	0.1315	0.4202	0.0074	0.0481
Al	1.7589	1.8451	1.6742	2.0506	1.5452	0.7251	2.2304	2.1013	1.4267	1.8470	0.8841	1.3093	0.3035	2.0754	0.5316	2.0749	0.4818	0.5514
Cr	0.0780	0.0014	0.0003	0.0018	0.0004	0.0010	0.0013	0.0007	0.0136	0.0006	0.0009	0.0005	0.0004	0.0079	0.0035	0.0070	0.0000	0.0365
Fe	0.7997	1.3933	1.3281	1.6068	2.2517	1.7934	2.8658	2.0035	0.6486	1.9691	2.0159	2.3640	1.3984	1.2677	0.9160	1.4650	1.1981	0.8496
Mn	0.0129	0.0227	0.0218	0.0270	0.0284	0.0402	0.0281	0.0261	0.0150	0.0326	0.0434	0.0353	0.0064	0.0184	0.0257	0.0225	0.0364	0.0154
Ni	0.0111	0.0029	0.0030	0.0015	0.0039	0.0028	0.0009	0.0018	0.0035	0.0023	0.0009	0.0015	0.0093	0.0049	0.0005	0.0014	0.0033	0.0121
Mg	3.7235	3.4753	3.5700	3.1260	2.7604	3.9973	2.0356	2.8168	3.6522	2.8027	3.0137	2.6665	5.2887	3.3015	3.6129	3.1034	3.7888	4.5444
Ca	2.0315	1.7836	1.8202	1.7925	1.8437	1.4600	2.0012	1.9124	2.3787	1.8054	1.9105	1.8649	0.0958	1.8101	3.1583	1.8372	1.9262	1.6245
Na	0.6842	0.6822	0.5133	0.8271	0.4794	0.3049	0.8517	0.8958	0.4015	0.7311	0.3321	0.5081	0.0236	0.7659	0.1352	0.8210	0.1729	0.1812
K	0.0027	0.0414	0.0564	0.0535	0.0758	0.0127	0.0899	0.0638	0.0000	0.0685	0.0190	0.0747	0.0144	0.0377	0.0004	0.0516	0.0057	0.0133
P	0.0093	0.0034	0.0010	0.0027	0.0016	0.0019	0.0000	0.0008	0.0013	0.0013	0.0018	0.0010	0.0043	0.0053	0.0018	0.0053	0.0012	0.0022
Total:	16.273	16.347	16.218	16.453	16.248	16.068	16.730	16.626	16.012	16.369	15.979	16.232	15.508	16.330	16.094	16.395	15.732	15.818
Mg#	82.3	71.4	72.9	66.0	55.0	69.2	41.6	58.4	84.9	58.8	59.9	53.0	79.1	72.3	79.8	67.9	75.5	84.2

Notes: * = ODP sample designations are listed in Table T1, p. 29. *N* = averages of a number of point analyses on more than one crystal in a thin section are reported. The analyses were done on a JXA-8800L Superprobe at The University of Queensland. See text for analytical details.

Table T7 (continued).

Sample:*	FV13-3	FV35-6	FV37-7	FV39-8	FV45-9a	FV45-9b	FV47-10
N:	2	3	4	9	3	3	3
Major element oxides (wt%):							
SiO_2	49.34	48.09	43.23	52.94	49.80	51.33	44.51
TiO_2	1.11	1.99	3.56	0.30	1.28	0.82	0.56
Al_2O_3	4.48	6.37	11.40	1.94	5.08	3.75	10.94
Cr_2O_3	0.01	0.01	0.07	0.01	0.00	0.01	0.01
FeOt	17.95	14.59	11.19	17.01	14.44	14.30	11.22
MnO	0.31	0.36	0.15	0.19	0.41	0.38	0.18
MgO	11.86	13.79	13.16	12.77	14.07	13.83	15.07
CaO	10.53	10.01	10.96	11.64	10.38	11.36	10.99
NiO	0.01	0.02	0.01	0.05	0.02	0.03	0.03
Na_2O	1.07	2.15	3.32	0.58	1.51	0.75	2.64
K_2O	0.30	0.22	0.29	0.10	0.22	0.27	0.26
P_2O_5	0.00	0.00	0.02	0.01	0.00	0.01	0.03
Total:	96.97	97.59	97.38	97.52	97.22	96.84	96.42
Calculated cation proportions:							
Si	7.7025	7.3750	6.6390	8.1275	7.6319	7.8705	6.8617
Ti	0.1306	0.2301	0.4106	0.0350	0.1471	0.0951	0.0649
Al	0.8255	1.1561	2.0636	0.3548	0.9179	0.6796	1.9873
Cr	0.0006	0.0010	0.0087	0.0006	0.0005	0.0017	0.0007
Fe	2.3403	1.8701	1.4349	2.1879	1.8478	1.8323	1.4445
Mn	0.0411	0.0465	0.0194	0.0243	0.0526	0.0489	0.0231
Ni	0.0012	0.0023	0.0017	0.0054	0.0021	0.0032	0.0033
Mg	2.7591	3.1478	3.0113	2.9145	3.2120	3.1580	3.4603
Ca	1.7603	1.6453	1.8025	1.9142	1.7040	1.8666	1.8140
Na	0.3244	0.6409	0.9882	0.1723	0.4488	0.2235	0.7879
K	0.0606	0.0431	0.0573	0.0191	0.0427	0.0522	0.0513
P	0.0000	0.0001	0.0030	0.0016	0.0005	0.0010	0.0037
Total:	15.946	16.158	16.440	15.757	16.008	15.833	16.503
Mg#	54.1	62.6	67.7	57.1	63.5	63.3	70.5

Table T8. Whole-rock major and selected trace element analyses of Leg 176 gabbroic samples. (Continued on next five pages.)

Sample:*	MS1-1	MS3-2	MS6-3	MS9-4	MS11-5	MS12-6	MS14-7	MS18-8	MSS19-9	MS20-10	MS22-11	MS23-12	MS24-13	MS25-14	MS26-15	MS27-16	MS28-17	MS41-18
Major element oxides (wt%):																		
SiO_2	47.21	47.91	47.11	47.67	51.72	49.22	52.54	51.30	50.88	49.32	51.22	50.84	52.49	44.26	52.63	49.76	52.58	51.64
TiO_2	0.14	0.12	0.14	0.21	0.31	0.39	0.63	0.42	0.46	0.42	1.14	0.57	2.84	6.52	0.45	0.63	0.64	2.84
Al_2O_3	19.58	21.25	21.73	19.92	20.67	12.76	17.11	14.92	16.59	13.35	9.67	13.30	19.34	9.68	25.89	13.84	13.50	14.40
FeOt	4.56	4.39	4.61	4.06	4.03	9.11	6.11	6.61	6.14	9.11	10.06	7.12	6.22	17.89	2.53	8.25	7.80	11.25
MnO	0.08	0.08	0.08	0.08	0.08	0.18	0.14	0.14	0.12	0.18	0.24	0.16	0.12	0.29	0.04	0.17	0.17	0.21
MgO	13.01	10.81	11.69	9.50	6.30	13.19	8.11	9.20	8.52	12.45	11.01	10.49	3.60	8.01	1.67	11.07	9.12	5.73
CaO	11.30	11.64	10.84	14.41	12.11	11.75	11.46	12.47	12.66	11.98	13.17	13.82	9.33	10.78	10.05	12.25	12.35	9.32
Na_2O	2.30	2.47	2.53	2.22	3.81	2.44	3.84	3.17	3.39	2.61	2.37	2.66	5.14	2.69	5.03	2.73	3.18	4.17
K_2O	0.05	0.02	0.08	0.00	0.03	0.10	0.09	0.06	0.04	0.07	0.06	0.06	0.08	0.04	0.08	0.04	0.05	0.15
P_2O_5	0.02	0.01	0.02	0.03	0.02	0.03	0.06	0.02	0.03	0.01	0.05	0.03	0.00	0.02	0.02	0.07	0.02	0.02
LOI	0.96	0.36	0.87	1.52	0.45	0.09	0.34	0.92	0.51	0.00	0.14	0.26	0.62	0.00	0.67	0.07	0.62	0.23
Total:	99.21	99.05	99.69	99.62	99.55	99.25	100.44	99.22	99.34	99.50	99.15	99.31	99.80	100.17	99.06	98.89	100.02	99.95
Mg#	0.85	0.83	0.83	0.82	0.76	0.74	0.72	0.73	0.73	0.73	0.68	0.74	0.53	0.47	0.57	0.73	0.70	0.50
Ca#	0.73	0.72	0.70	0.78	0.64	0.73	0.62	0.68	0.67	0.72	0.75	0.74	0.50	0.69	0.52	0.71	0.68	0.55
CIPW norms:																		
Q	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Or	0.27	0.13	0.46	—	0.19	0.61	0.53	0.34	0.25	0.40	0.34	0.34	0.46	0.21	0.46	0.26	0.28	0.90
Ab	18.60	20.88	19.75	15.25	31.65	20.65	32.52	26.84	26.69	21.16	20.07	22.53	43.53	22.04	42.14	23.10	26.92	35.30
An	42.95	46.86	47.72	44.37	39.21	23.55	29.16	26.30	29.96	24.53	15.58	24.16	29.46	14.26	47.87	25.37	22.41	20.11
Ne	0.49	—	0.89	1.93	0.32	—	—	—	1.06	0.49	—	—	—	0.37	0.21	—	—	—
Di	10.30	8.61	4.72	21.46	16.67	27.85	22.02	28.57	26.32	28.10	40.05	35.60	13.68	32.20	1.54	28.20	31.35	21.44
Hy	—	0.44	—	—	—	0.92	1.33	2.47	—	—	10.95	0.59	0.81	—	—	1.48	8.28	9.08
Ol	24.64	20.87	24.28	14.01	9.81	23.41	12.29	11.95	12.69	22.61	8.22	13.63	4.90	15.99	4.90	17.80	7.74	5.78
Mt	0.73	0.71	0.74	0.65	0.65	1.47	0.98	1.06	0.99	1.47	1.62	1.15	1.00	2.88	0.41	1.33	1.26	1.81
Il	0.27	0.23	0.27	0.40	0.58	0.73	1.20	0.80	0.88	0.81	2.17	1.08	5.39	12.37	0.86	1.20	1.21	5.39
Ap	0.05	0.02	0.04	0.06	0.05	0.06	0.14	0.05	0.07	0.03	0.12	0.06	0.01	0.05	0.04	0.17	0.05	0.05
Calculated cation proportions:																		
Li	2.51	3.53	4.76	2.98	4.45	5.09	4.29	2.38	1.42	4.19	2.59	3.35	1.21	1.37	2.82	5.43	1.64	1.95
Sc	11.5	9.7	7.5	24.8	24.3	41.3	38.6	42.6	37.6	40.7	69.1	53.3	26.2	61.4	3.0	42.7	51.4	39.5
V	42.0	33.1	28.0	88.5	95.9	157	136	165	150	152	287	208	243	816	34.0	176	207	311
Cr	601	322	116	955	47.0	76.3	136	47.1	88.4	104	33.4	175	5.32	15.9	3.85	185	26.7	6.57
Co	46.9	41.0	44.7	34.4	25.3	58.4	31.6	43.1	36.4	55.0	47.1	40.7	22.8	61.7	11.8	50.7	39.4	39.2
Ni	312	270	278	229	53.9	120	73.4	71.8	64.3	97.5	48.7	66.1	23.1	48.2	24.3	97.8	47.1	28.1
Cu	67.0	79.4	45.3	38.9	37.1	49.1	38.0	68.6	19.4	28.3	59.2	53.8	10.1	78.1	47.2	50.2	9.8	51.3
Zn	27.5	26.9	31.5	25.6	28.1	61.2	53.2	36.6	31.0	55.6	66.0	43.6	30.4	137	17.7	53.1	41.7	89.2
Ga	9.94	11.1	10.9	10.5	14.7	10.5	17.1	12.9	13.2	10.5	12.7	11.6	19.9	18.6	18.9	12.0	14.0	20.9
Rb	0.357	0.084	0.313	0.207	0.251	0.555	0.346	0.246	0.176	0.234	0.298	0.156	0.283	0.150	0.271	0.201	0.193	0.401
Sr	159	177	172	155	198	117	147	141	166	127	95.6	132	219	104	275	141	138	163
Y	3.03	2.28	2.48	6.42	7.55	11.6	54.3	15.0	10.2	9.91	37.4	15.6	13.3	34.4	3.26	14.2	21.2	34.1
Zr	5.98	3.84	5.55	8.77	19.3	21.0	29.0	16.4	15.6	12.9	67.2	29.4	26.8	92.7	11.6	41.6	31.7	44.0
Nb	0.054	0.038	0.091	0.140	0.200	0.184	3.065	0.391	0.187	0.132	0.960	0.251	1.355	2.688	0.399	0.665	0.343	2.444

Notes: * = ODP sample designations are listed in Table T1, p. 29. — = the normative mineral is absent. ND = not detected. Major element oxides were analyzed on a Varian Liberty 200 ICP-AES at Queensland University of Technology following the procedure of Kwiecien (1990). Precision (1 σ) for most elements based on USGS standards (BCR-1, BIR-1, and AGV-1) is <1% with the exception of TiO_2 (1.3%) and P_2O_5 (2.0%). Mg# = $Mg/[Mg+Fe^{2+}]$ with 10% of total Fe assumed to be Fe^{3+}. Trace elements were analyzed on a PQ2 ICP-MS at The University of Queensland with sample preparation procedure and instrumental conditions following Niu and Batiza (1997) and Eggins et al., (1997).

Table T8 (continued).

Sample:*	MS60-19	MS70-20	MS71-21	MS72 -22	MS74-23	MS76-24	MS78-25	MS79-26	MS82-27	MS84-28	MS89-29	MS90-30	MS91-31	MS92-32	MS93-33	MS95-34	MS97-35	MS98-36
Major element oxides (wt%):																		
SiO_2	52.39	50.69	48.51	50.41	51.09	52.63	52.20	51.29	51.72	51.80	52.33	51.94	51.65	51.11	50.50	48.69	51.62	48.46
TiO_2	0.43	0.71	0.53	0.71	0.37	0.40	0.70	0.29	0.38	0.28	0.38	0.33	0.40	0.50	0.36	0.33	0.46	0.27
Al_2O_3	16.33	16.04	17.22	20.26	15.86	18.85	15.04	18.61	15.85	20.29	16.63	19.09	15.15	14.00	16.06	14.36	15.43	13.45
FeOt	5.19	7.54	8.16	5.54	5.47	3.51	4.58	4.45	4.83	3.90	5.52	5.29	5.06	5.25	5.66	7.59	4.18	8.61
MnO	0.12	0.15	0.14	0.10	0.12	0.09	0.12	0.09	0.11	0.09	0.12	0.10	0.12	0.13	0.12	0.14	0.11	0.16
MgO	8.11	9.37	12.10	7.52	10.38	7.07	9.08	8.47	9.70	6.85	9.11	7.61	9.75	10.78	11.13	13.95	9.38	15.05
CaO	13.65	11.53	9.50	11.27	13.76	14.10	15.12	12.62	14.41	13.35	13.10	11.79	14.48	15.65	14.00	11.96	16.21	11.70
Na_2O	2.96	2.91	2.82	3.31	2.52	3.09	2.55	3.03	2.51	3.24	2.78	3.44	2.37	2.40	2.48	2.27	2.50	2.28
K_2O	0.04	0.10	0.07	0.05	0.04	0.05	0.02	0.03	0.03	0.00	0.00	0.02	0.02	0.04	0.02	0.03	0.06	0.00
P_2O_5	0.01	0.01	0.04	0.03	0.00	0.01	0.03	0.02	0.00	0.00	0.02	0.00	0.02	0.02	0.01	0.00	0.00	0.00
LOI	0.19	0.06	0.03	0.21	0.19	0.38	0.27	0.14	0.25	0.24	0.22	0.02	0.30	0.28	0.11	0.32	0.35	0.03
Total:	99.43	99.12	99.12	99.42	99.81	100.20	99.70	99.04	99.80	100.04	100.22	99.63	99.31	100.15	100.45	99.63	100.31	100.02
Mg#	0.76	0.71	0.75	0.73	0.79	0.80	0.80	0.79	0.80	0.78	0.77	0.74	0.79	0.80	0.80	0.78	0.82	0.78
Ca#	0.72	0.69	0.65	0.65	0.75	0.72	0.77	0.70	0.76	0.69	0.72	0.65	0.77	0.78	0.76	0.74	0.78	0.74
CIPW norms:																		
Q	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Or	0.24	0.60	0.40	0.31	0.23	0.32	0.09	0.15	0.18	—	0.02	0.12	0.12	0.23	0.11	0.16	0.37	—
Ab	25.07	24.66	23.87	28.00	21.36	26.16	21.54	25.65	21.27	27.43	23.52	29.14	20.03	18.48	20.51	19.22	19.21	17.74
An	31.15	30.40	34.11	40.29	31.82	37.41	29.55	37.10	31.89	40.80	32.89	36.57	30.64	27.30	32.63	28.91	30.70	26.45
Ne	—	—	—	—	—	—	—	—	—	—	—	—	—	1.00	0.26	—	1.05	0.85
Di	29.34	21.58	10.25	12.40	29.18	25.95	36.09	20.30	31.63	20.37	25.64	17.66	32.86	40.10	29.41	24.38	39.63	25.36
Hy	6.93	7.61	4.32	4.41	3.93	4.80	6.09	5.28	5.41	2.37	10.49	5.23	8.12	—	—	0.00	—	—
Ol	4.90	11.72	23.82	11.54	11.58	3.86	3.96	9.15	7.71	7.71	5.83	9.47	5.68	10.99	15.87	24.89	7.49	27.78
Mt	0.84	1.22	1.32	0.89	0.88	0.57	0.74	0.72	0.78	0.63	0.89	0.85	0.81	0.85	0.91	1.22	0.67	1.39
Il	0.81	1.34	1.00	1.35	0.70	0.77	1.33	0.55	0.73	0.53	0.73	0.63	0.76	0.94	0.69	0.62	0.88	0.52
Ap	0.02	0.03	0.10	0.08	—	0.02	0.08	0.06	—	—	0.06	—	0.04	0.04	0.01	—	0.00	—
Trace elements (ppm):																		
Li	2.25	3.15	4.31	5.20	4.64	2.27	ND	2.27	2.60	2.47	2.40	4.09	2.86	2.71	3.70	3.34	2.06	2.01
Sc	43.8	31.7	17.2	19.2	40.7	37.8	ND	30.4	45.7	27.6	39.6	26.7	46.3	53.0	41.7	33.4	53.5	34.3
V	174	131	86.4	103	152	143	ND	112	167	102	152	108	170	194	149	118	192	122
Cr	53.4	115	47.6	51.7	192	161	ND	144	203	108	91.6	62.6	292	311	174	178	283	112
Co	31.3	41.8	60.0	36.6	39.0	21.9	ND	32.5	34.6	27.4	37.4	36.1	36.4	34.3	40.6	58.9	26.4	66.1
Ni	48.5	90.8	156	103	103	49.3	ND	76.2	103	64.6	88.5	72.7	97.1	85.2	101	147	63.6	159
Cu	28.4	42.6	36.4	79.7	43.9	29.4	ND	36.2	89.2	38.1	62.0	28.0	69.3	45.4	37.3	42.8	30.0	29.6
Zn	30.5	57.1	59.0	37.6	34.6	20.2	ND	27.9	28.2	24.3	34.9	36.0	29.6	29.6	41.2	45.8	23.2	53.7
Ga	13.6	14.1	12.3	14.8	11.4	13.3	ND	12.7	11.4	13.6	12.5	14.8	11.3	11.1	11.2	10.0	11.4	10.0
Rb	0.115	0.137	0.151	0.199	0.125	0.163	ND	0.147	0.082	0.080	0.074	0.132	0.116	0.099	0.095	0.091	0.080	0.054
Sr	167	163	171	205	150	184	ND	182	150	200	165	198	145	134	150	137	145	129
Y	12.4	12.6	6.78	8.14	10.3	10.0	ND	8.23	9.84	5.84	10.1	8.07	11.0	12.9	8.46	7.16	11.4	7.43
Zr	20.6	23.2	29.0	28.7	22.7	20.3	ND	34.6	12.4	7.45	13.8	15.7	21.0	22.6	12.3	10.8	14.5	8.89
Nb	0.132	0.588	0.646	0.779	0.203	0.309	ND	0.306	0.102	0.105	0.051	0.152	0.124	0.228	0.120	0.101	0.137	0.048

Table T8 (continued).

Sample:*	MS99-37	MS101-38	BN3(F)	BN4(F)	BN5(F)	BN6(F)	BN7(F)	BN8(F)	BN9(F)	BN10(F)	BN11(F)	BN12(F)	BN13(F)	BN14(F)	BN15(F)	BN16(F)	BN17(F)	BN18(F)
Major element oxides (wt%):																		
SiO_2	50.39	50.69	51.94	53.30	51.23	51.57	46.80	51.43	49.48	51.26	51.24	49.60	51.18	50.04	49.08	51.09	51.34	50.61
TiO_2	0.34	0.31	0.43	0.67	0.37	0.49	0.16	0.41	0.56	0.62	0.40	0.45	0.41	0.81	0.27	0.41	0.28	0.46
Al_2O_3	16.91	17.83	18.18	21.26	20.98	15.75	23.07	20.75	14.57	15.31	15.01	14.27	15.29	16.43	16.82	16.02	16.55	14.57
FeOt	4.68	4.62	4.78	3.45	4.38	5.50	4.13	4.00	6.60	7.48	7.74	7.66	6.00	6.84	6.59	5.86	5.24	6.54
MnO	0.10	0.10	0.11	0.08	0.08	0.13	0.07	0.08	0.16	0.16	0.16	0.16	0.13	0.14	0.12	0.12	0.11	0.14
MgO	9.49	8.91	7.00	4.22	5.00	9.51	11.21	5.80	9.73	9.41	10.25	11.74	10.16	9.40	11.11	10.25	9.90	11.33
CaO	14.22	14.02	13.32	12.06	12.83	14.10	12.24	13.49	14.51	12.98	12.23	13.21	13.88	13.02	11.99	13.03	13.25	13.46
Na_2O	2.81	2.94	3.56	4.09	3.47	2.69	2.37	3.54	2.54	2.85	2.75	2.47	2.57	2.77	2.71	2.71	2.61	2.71
K_2O	0.00	0.02	0.06	0.10	0.08	0.13	0.02	0.06	0.05	0.04	0.04	0.03	0.04	0.04	0.02	0.03	0.01	0.04
P_2O_5	0.01	0.01	0.01	0.05	0.04	0.02	0.02	0.04	0.05	0.05	0.03	0.02	0.03	0.02	0.02	0.02	0.00	0.00
LOI	0.48	0.48	1.07	0.42	0.91	0.78	0.84	0.78	1.36	0.14	0.06	0.20	0.65	0.73	0.38	0.55	0.32	0.26
Total:	99.45	99.93	100.46	99.70	99.37	100.66	100.93	100.39	99.61	100.30	99.91	99.81	100.34	100.25	99.12	100.10	99.61	100.12
Mg#	0.80	0.79	0.74	0.71	0.69	0.77	0.84	0.74	0.74	0.71	0.72	0.75	0.77	0.73	0.77	0.78	0.79	0.77
Ca#	0.74	0.73	0.67	0.62	0.67	0.74	0.74	0.68	0.76	0.72	0.71	0.75	0.75	0.72	0.71	0.73	0.74	0.73
CIPW norms:																		
Q	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Or	0.01	0.11	0.33	0.60	0.45	0.77	0.14	0.38	0.32	0.26	0.24	0.21	0.25	0.24	0.13	0.19	0.04	0.26
Ab	21.44	22.63	28.41	34.63	29.37	22.79	15.43	27.77	18.89	24.11	23.27	19.88	21.74	23.46	22.48	22.89	22.11	21.67
An	33.50	35.41	33.43	39.34	41.44	30.49	52.27	40.54	28.21	28.84	28.48	27.74	30.07	32.28	33.65	31.48	33.40	27.43
Ne	1.28	1.20	0.95	—	—	—	2.49	1.19	1.39	—	—	0.56	—	—	0.27	—	—	0.70
Di	29.55	27.28	26.22	16.24	17.80	31.50	6.59	21.00	34.95	28.48	25.88	30.32	31.00	25.89	20.63	26.50	25.88	31.54
Hy	—	—	—	5.15	2.01	2.12	—	—	—	4.12	7.55	—	3.45	0.75	—	4.65	7.20	—
Ol	11.80	11.50	8.50	1.43	5.93	10.41	22.22	7.26	12.32	11.95	12.44	18.86	11.45	14.27	20.04	12.12	9.35	16.40
Mt	0.75	0.74	0.77	0.56	0.71	0.89	0.67	0.64	1.06	1.21	1.25	1.23	0.97	1.10	1.06	0.94	0.84	1.05
Il	0.65	0.59	0.81	1.27	0.71	0.93	0.29	0.78	1.06	1.18	0.76	0.85	0.79	1.55	0.51	0.79	0.53	0.87
Ap	0.03	0.02	0.02	0.12	0.09	0.05	0.05	0.10	0.12	0.11	0.06	0.04	0.06	0.06	0.05	0.05	—	—
Trace elements (ppm):																		
Li	1.65	3.37	3.54	2.74	8.35	4.69	3.41	3.38	4.66	3.18	2.46	3.76	3.45	6.26	3.88	5.15	3.95	3.18
Sc	39.1	35.5	34.3	26.4	25.9	53.3	9.40	30.3	56.0	44.2	38.6	43.2	44.7	39.2	26.9	37.4	35.4	45.0
V	142	127	127	109	107	168	35.3	118	200	169	157	166	164	159	106	140	123	173
Cr	143	137	37.6	69.8	86.7	132	387	80.6	233	50.7	22.2	64.7	81.5	158	179	136	159	104
Co	34.4	32.6	30.7	18.0	37.2	34.5	41.9	24.8	35.3	42.6	55.0	51.6	41.7	40.0	50.4	42.2	39.4	44.9
Ni	96.0	85.3	52.5	45.7	70.4	68.8	286.6	54.9	67.2	64.2	75.4	90.2	79.2	95.7	118	116	95.5	95.2
Cu	69.7	58.7	30.6	52.0	57.5	37.1	81.2	17.9	58.7	55.9	68.2	67.2	80.4	67.0	41.2	115.2	68.4	67.3
Zn	26.1	25.1	24.8	25.3	38.2	32.7	19.2	21.6	37.1	44.9	39.2	38.6	33.3	43.2	36.3	31.5	30.0	35.9
Ga	12.1	12.6	14.1	17.1	14.6	11.6	11.0	15.0	11.8	12.9	13.0	11.8	11.9	13.4	11.7	12.1	11.8	11.9
Rb	0.066	0.071	0.307	0.274	0.897	0.802	0.122	0.302	0.262	0.133	0.065	0.095	0.130	0.138	0.083	0.231	0.080	0.152
Sr	164	172	193	217	210	151	179	198	128	155	160	142	146	164	167	158	167	149
Y	8.18	7.16	14.5	13.6	9.17	11.2	2.60	9.30	18.0	15.0	9.14	11.2	9.67	13.1	6.62	10.7	6.70	11.8
Zr	9.61	7.33	40.9	26.4	20.4	18.4	5.7	17.6	30.8	33.1	11.6	16.9	13.2	26.4	11.1	34.5	6.84	27.6
Nb	0.058	0.035	0.564	1.080	0.295	0.243	0.117	0.282	0.294	0.389	0.102	0.127	0.125	0.443	0.105	0.522	0.046	0.169

Table T8 (continued).

Sample:*	BN19(F)	BN20(F)	BN1(AM)	BN2(A)	BN3(A)	BN4(A)	BN5(A)	BN6(A)	BN7(A)	BN8(A)	BN9(A)	BN10(A)	BN11(A)	BN12(A)	BN13(A)	BN14(A1)	BN14(A2)	BN15(A)
Major element oxides (wt%):																		
SiO_2	50.17	48.54	38.37	48.52	50.54	50.16	51.74	50.69	45.67	50.91	47.92	50.05	50.25	51.25	52.10	50.05	50.15	48.89
TiO_2	0.45	0.26	0.20	0.18	0.47	0.59	0.54	0.36	0.16	0.35	0.48	0.54	0.41	0.42	0.24	0.57	0.46	0.36
Al_2O_3	11.91	16.62	20.68	16.87	15.76	13.86	14.10	17.52	19.70	20.06	15.91	17.25	15.22	17.68	21.59	18.52	17.01	15.47
FeOt	6.84	6.23	4.93	6.64	6.22	6.66	5.40	5.32	5.00	4.13	6.73	5.93	6.97	4.40	3.58	4.72	4.81	6.16
MnO	0.15	0.12	0.08	0.12	0.14	0.16	0.14	0.11	0.10	0.10	0.14	0.13	0.15	0.11	0.07	0.09	0.11	0.13
MgO	14.68	11.76	3.57	12.97	7.90	9.04	9.21	8.50	12.95	6.72	10.05	8.26	9.82	7.42	5.20	6.76	7.84	9.93
CaO	14.51	11.84	20.37	9.79	14.24	15.02	15.96	12.38	10.93	13.83	12.41	12.91	12.97	14.30	11.82	11.82	13.50	12.00
Na_2O	1.77	2.41	2.48	2.10	3.12	2.54	2.41	3.18	1.92	3.29	2.72	3.19	2.69	3.08	3.70	4.02	3.18	3.18
K_2O	0.00	0.03	0.09	0.53	0.07	0.09	0.08	0.10	0.56	0.05	0.05	0.05	0.04	0.04	0.22	0.23	0.18	0.02
P_2O_5	0.00	0.03	0.20	0.02	0.05	0.01	0.02	0.05	0.02	0.02	0.03	0.06	0.01	0.00	0.02	0.03	0.03	0.00
LOI	0.40	1.40	9.45	2.28	1.61	1.52	0.96	2.63	2.96	1.28	2.92	1.69	1.74	1.23	2.04	2.94	3.33	3.48
Total:	100.87	99.23	100.42	100.03	100.12	99.66	100.55	100.85	99.98	100.74	99.35	100.07	100.28	99.91	100.57	99.74	100.59	99.62
Mg#	0.81	0.79	0.59	0.79	0.72	0.73	0.77	0.76	0.84	0.76	0.75	0.73	0.74	0.77	0.74	0.74	0.76	0.76
Ca#	0.82	0.73	0.82	0.72	0.72	0.77	0.79	0.68	0.76	0.70	0.72	0.69	0.73	0.72	0.64	0.62	0.70	0.68
CIPW norms:																		
Q	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Or	—	0.17	—	3.13	0.41	0.53	0.45	0.59	3.34	0.29	0.29	0.32	0.26	0.21	1.31	1.34	1.08	0.10
Ab	14.95	20.38	—	17.80	22.60	19.64	20.35	26.87	13.43	25.01	20.65	24.87	22.75	25.07	31.35	27.20	23.56	23.70
An	24.56	34.44	45.05	35.04	28.77	26.17	27.46	33.26	43.48	39.82	31.05	32.61	29.32	34.31	41.61	31.79	31.59	27.89
Ne	—	—	11.36	—	2.08	1.00	—	—	1.51	1.54	1.29	1.14	—	0.53	—	3.71	1.83	1.72
Di	37.85	19.32	13.72	10.71	33.55	38.94	41.40	22.36	8.47	23.04	24.40	25.03	28.16	29.35	13.60	21.47	28.27	25.43
Hy	2.29	2.82	—	9.87	—	—	0.80	1.11	—	—	—	—	2.69	—	4.19	—	—	—
Ol	18.94	19.20	7.08	19.81	9.15	9.72	7.26	12.42	25.69	8.43	16.77	12.36	13.50	7.75	5.45	9.45	9.29	15.69
Mt	1.10	1.00	0.79	1.07	1.00	1.07	0.87	0.86	0.81	0.67	1.08	0.96	1.12	0.71	0.58	0.76	0.77	0.99
Il	0.86	0.50	0.38	0.34	0.89	1.13	1.03	0.69	0.31	0.67	0.91	1.02	0.77	0.80	0.46	1.07	0.87	0.69
Ap	—	0.07	0.48	0.06	0.12	0.02	0.04	0.12	0.04	0.04	0.08	0.14	0.03	0.01	0.05	0.06	0.06	—
Trace elements (ppm):																		
Li	3.75	1.18	2.95	10.4	2.44	11.8	7.50	7.32	19.59	4.58	6.28	4.14	4.88	4.53	5.18	6.62	8.15	28.64
Sc	51.2	30.4	8.77	13.7	45.5	58.2	57.7	33.3	16.2	32.2	39.2	42.6	48.4	41.8	19.9	39.8	40.7	38.6
V	192	104	60.0	50.7	173	225	213	124	31.5	122	151	162	170	161	70.6	138	152	133
Cr	341	189	83.4	311	52.9	129	211	89.4	242.5	88.4	192	63.1	27.1	62.9	33.1	133	146	209
Co	53.1	49.4	41.5	48.5	36.8	34.0	48.1	32.3	45.5	27.2	37.0	37.7	48.5	28.2	26.2	29.4	27.3	43.3
Ni	130	136	167	268	69.7	74.3	86.9	62.7	309	61.5	70.9	70.2	70.7	49.4	47.5	73.9	66.3	107
Cu	43.9	90.9	37.8	15.5	41.1	66.3	68.3	55.8	39.8	30.3	70.9	36.8	69.1	63.5	36.1	46.5	41.6	60.4
Zn	37.5	31.5	29.4	36.2	32.4	42.7	49.4	29.0	35.1	22.3	33.4	34.1	33.6	24.4	21.4	30.3	27.5	31.5
Ga	8.8	11.2	11.7	11.7	13.1	12.0	11.3	12.5	11.3	14.2	12.3	13.7	12.9	14.2	15.0	12.7	12.6	11.6
Rb	0.060	0.148	0.720	3.169	0.415	0.387	0.771	0.415	5.42	0.218	0.244	0.230	0.148	0.121	0.818	0.929	0.790	0.410
Sr	107	151	238	126	154	136	136	159	154	185	140	156	150	178	213	170	175	139
Y	10.9	6.01	3.77	22.3	16.1	16.9	14.9	10.2	18.6	7.97	13.7	11.8	9.61	10.4	4.90	11.9	13.3	8.67
Zr	16.0	7.62	6.16	13.8	34.5	26.2	20.1	15.5	10.9	11.7	40.9	28.1	9.47	12.6	7.45	25.0	25.2	17.8
Nb	0.135	0.078	0.100	1.598	0.269	0.236	0.191	0.221	1.97	0.144	0.514	0.384	0.058	0.109	0.116	0.333	0.198	0.207

Table T8 (continued).

Sample:*	BN16(A)	BN17(A)	BN18(A)	BN20(A)	BN19(A)	FV2-1	FV5-2	FV13-3	FV21-4	FV29-5	FV35-6	FV37-7	FV39-8	FV45-9	FV47-10	FV-50-11	FV-57-12	FV-58-13
Major element oxides (wt%):																		
SiO_2	49.73	50.22	50.98	49.23	50.55	ND	59.78	74.79	62.75	60.70	59.21	64.10	62.52	62.91	69.80	62.71	61.46	60.68
TiO_2	0.37	0.28	0.39	0.26	0.34	ND	0.15	0.13	0.28	0.90	1.50	0.48	0.80	0.40	0.34	0.39	0.52	0.51
Al_2O_3	17.89	15.13	16.82	14.89	18.42	ND	17.60	14.56	18.45	17.47	17.46	16.67	16.56	16.50	16.37	15.97	19.53	15.69
FeOt	5.24	6.03	5.47	6.22	4.68	ND	2.22	0.96	1.58	2.49	2.86	2.88	2.63	4.24	1.86	3.54	3.98	5.52
MnO	0.10	0.12	0.11	0.11	0.10	ND	0.05	0.01	0.02	0.04	0.05	0.06	0.08	0.07	0.02	0.07	0.06	0.12
MgO	8.63	10.69	7.86	11.67	8.26	ND	7.36	0.42	2.29	3.54	2.99	2.32	1.43	2.96	0.48	5.07	1.22	4.76
CaO	11.23	13.00	12.27	12.26	13.52	ND	5.22	1.73	5.86	7.27	7.19	3.41	4.62	5.46	2.87	7.84	4.21	6.90
Na_2O	3.30	2.40	3.18	2.49	2.89	ND	5.64	6.93	8.11	7.01	6.94	8.45	9.22	6.20	6.85	4.61	7.82	5.02
K_2O	0.10	0.03	0.04	0.08	0.08	ND	0.43	0.30	0.10	0.09	0.10	0.07	0.03	0.57	0.51	0.28	0.35	0.33
P_2O_5	0.04	0.00	0.01	0.00	0.00	ND	0.00	0.01	0.00	0.09	0.07	0.01	0.07	0.03	0.01	0.02	0.05	0.00
LOI	3.14	1.92	2.04	2.40	1.41	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total:	99.78	99.82	99.18	99.61	100.24		98.46	99.83	99.46	99.60	98.36	98.43	97.95	99.34	99.10	100.48	99.20	99.54
Mg#	0.77	0.78	0.74	0.79	0.78	—	0.87	0.46	0.74	0.74	0.67	0.61	0.52	0.58	0.34	0.74	0.38	0.63
Ca#	0.65	0.75	0.68	0.73	0.72	—	0.34	0.12	0.29	0.36	0.36	0.18	0.22	0.33	0.19	0.48	0.23	0.43
CIPW norms:																		
Q	—	—	—	—	—	—	2.62	28.62	1.60	2.07	1.97	4.30	—	8.34	20.49	11.85	2.20	7.89
Or	0.59	0.16	0.24	0.47	0.50	—	2.53	1.75	0.60	0.52	0.57	0.39	0.19	3.35	3.00	1.67	2.06	1.95
Ab	27.95	20.34	26.90	21.03	24.38	—	47.75	58.64	68.65	59.35	58.72	71.47	77.25	52.46	57.93	39.02	66.14	42.50
An	33.70	30.42	31.51	29.25	37.04	—	21.42	7.74	13.64	15.93	16.21	7.37	3.68	15.53	12.43	22.04	17.18	19.30
Ne	—	—	—	—	0.02	—	—	—	—	—	—	—	0.43	—	—	—	—	—
Di	17.42	27.31	23.60	25.31	24.07	—	3.53	0.69	12.41	15.61	15.14	7.76	13.17	9.34	1.45	13.44	2.83	12.22
Hy	1.24	6.75	5.50	2.66	—	—	19.99	1.99	1.80	3.85	2.30	5.79	—	8.86	2.84	11.15	7.09	13.88
Ol	14.15	11.48	7.79	17.07	11.48	—	—	—	—	—	—	—	—	—	—	—	—	—
Mt	0.84	0.97	0.88	1.00	0.75	—	0.36	0.15	0.25	0.40	0.46	0.46	0.42	0.68	0.30	0.57	0.64	0.89
Il	0.70	0.53	0.75	0.50	0.64	—	0.29	0.25	0.53	1.71	2.85	0.91	1.52	0.75	0.65	0.74	0.98	0.97
Ap	0.11	—	0.03	—	0.00	—	0.01	0.01	—	0.21	0.17	0.02	0.16	0.07	0.02	0.05	0.13	—
Trace elements (ppm):																		
Li	38.00	6.34	3.77	1.62	9.78	7.94	6.32	1.90	1.06	0.71	1.08	1.03	0.88	5.54	2.82	2.73	2.19	5.85
Sc	26.8	40.1	36.6	34.4	33.9	9.91	3.84	1.02	10.9	11.1	17.8	6.64	4.13	12.2	2.00	18.7	2.75	16.8
V	102	137	131	119	126	66.1	12.3	7.0	37.0	63.3	76.8	42.8	38.6	46.8	17.3	64.5	27.5	79.2
Cr	93.8	197	78.6	239	219	183	257	2.51	16.0	8.92	12.5	20.4	5.52	41.9	0.54	138	1.22	10.7
Co	40.1	47.3	35.6	46.1	35.1	20.4	19.1	2.90	6.73	11.1	11.0	8.41	9.86	15.8	3.22	20.9	8.92	25.4
Ni	107	120	77.9	133	99.1	98.6	134	5.54	16.0	23.9	26.0	16.2	21.0	34.6	4.63	57.8	9.46	29.8
Cu	86.3	96.7	47.1	31.5	78.6	2.80	22.5	29.8	3.23	2.35	5.60	2.68	4.43	26.7	7.47	12.0	4.38	33.8
Zn	30.0	29.2	33.4	25.7	25.3	13.0	30.1	8.37	6.29	6.43	12.2	11.3	9.72	33.1	12.4	25.6	28.4	45.3
Ga	12.1	11.4	13.9	10.8	12.0	15.5	23.2	24.7	28.5	25.9	27.4	23.4	24.1	25.2	28.4	18.5	33.2	20.0
Rb	0.749	0.221	0.203	0.243	0.307	1.37	3.564	0.736	0.425	0.222	0.23	0.11	0.07	5.45	2.06	1.21	1.16	2.31
Sr	168	144	172	142	177	271	113	59.3	170	187	169	46.9	45.9	112	77.6	122	193	130
Y	7.56	7.06	12.2	7.04	8.62	53.8	54.7	35.9	38.6	65.4	116	82.8	93.2	86.9	55.2	62.3	25.1	42.6
Zr	33.3	5.62	24.1	6.46	15.0	59.5	65.6	81.5	179	308	3532	65.6	327	1954	106	94.6	103	48.5
Nb	0.609	0.034	0.154	0.134	0.136	3.77	5.706	3.987	5.227	7.988	13.8	12.8	18.0	4.84	7.67	6.22	4.16	5.42

Table T8 (continued).

Sample:*	FV-61-14	FV62-15	FV63-16	FV65-17	FV66-18	FV81-20	FV94-21	FV67-19
Major element oxides (wt%):								
SiO_2	56.36	50.53	59.36	62.17	63.03	54.21	62.56	56.35
TiO_2	0.40	2.71	0.50	1.02	1.46	0.58	0.89	0.35
Al_2O_3	16.16	17.68	14.84	15.71	15.91	19.57	17.74	12.53
FeOt	4.59	15.61	4.74	7.23	5.31	4.91	2.68	7.01
MnO	0.11	0.12	0.11	0.06	0.11	0.08	0.06	0.17
MgO	6.06	2.35	5.57	2.64	2.54	2.02	2.32	6.51
CaO	12.15	6.10	8.90	3.04	4.89	5.99	4.02	11.93
Na_2O	3.88	5.45	5.02	6.85	6.12	7.81	8.19	4.14
K_2O	0.31	0.21	0.18	0.18	0.23	0.22	0.13	0.17
P_2O_5	0.07	0.25	0.03	0.14	0.10	0.11	0.00	1.03
LOI	ND	ND	ND	ND	ND	ND	ND	ND
Total:	100.10	101.00	99.24	99.03	99.71	95.50	98.59	100.20
Mg#	0.72	0.23	0.70	0.42	0.49	0.45	0.63	0.65
Ca#	0.63	0.38	0.49	0.20	0.31	0.30	0.21	0.61
CIPW norms:								
Q	2.01	—	4.84	7.73	11.59	—	2.95	2.45
Or	1.82	1.24	1.03	1.06	1.38	1.28	0.75	1.00
Ab	32.87	45.95	42.48	57.95	51.82	52.06	69.31	35.06
An	25.74	23.13	17.43	11.59	15.24	17.70	11.26	15.09
Ne	—	0.11	—	—	—	7.61	—	—
Di	27.49	4.72	21.45	2.20	6.89	9.44	7.02	30.49
Hy	8.54	—	10.27	15.17	8.99	—	5.19	12.00
Ol	—	17.78	—	—	—	5.32	—	—
Mt	0.74	2.52	0.76	1.16	0.85	0.79	0.43	1.13
Il	0.77	5.15	0.95	1.94	2.77	1.10	1.70	0.67
Ap	0.17	0.59	0.07	0.32	0.24	0.26	—	2.44
Trace elements (ppm):								
Li	3.76	1.51	1.94	3.16	4.65	2.27	0.55	1.27
Sc	40.5	11.0	36.2	3.30	11.3	8.41	12.6	45.6
V	135	120	120	45.4	52.3	35.7	25.5	92.5
Cr	82.7	5.18	33.3	1.42	17.8	5.51	21.0	261
Co	21.5	29.2	21.9	13.0	14.1	11.2	8.72	26.0
Ni	37.3	36.8	35.0	12.4	19.3	11.2	10.6	60.3
Cu	26.6	24.3	50.9	14.1	13.5	63.5	3.65	9.64
Zn	39.0	62.8	38.0	23.6	44.7	35.4	22.3	59.1
Ga	18.6	37.3	22.1	32.4	26.1	23.7	29.8	20.5
Rb	1.91	0.31	0.47	0.80	0.65	1.55	0.08	0.25
Sr	161	175	129	121	139	182	153	120
Y	48.0	77.2	60.1	135	70.3	31.2	77.0	132
Zr	35.8	1328	41.1	517	1680	235	40.8	64.1
Nb	0.84	19.9	3.75	7.33	16.3	2.56	8.66	1.70

Table T9. Comparison of model composition of primitive melt parental to Hole 735B gabbros with the bulk hole composition.

	SiO_2	TiO_2	Al_2O_3	FeOt	MgO	CaO	Na_2O	CaO/ Al_2O_3	Ca#	Mg#
Parental melt	50.50	1.45	16.90	8.86	7.85	10.40	3.00	0.62	0.66	0.64
Bulk Hole 735B	50.60	0.87	16.10	7.31	9.21	12.50	2.80	0.78	0.71	0.71

Note: Model composition of primitive melt parental to Hole 735B gabbros. Bulk hole composition of Dick et al. (2001).