Appendix 5

Laboratory Works 5 − 1

Mineralogy and Petrology of Mafic and Ultramafic rocks

1. Introduction

The petrological characteristics of the lower crust to upper mantle of the ocean floor have been debated (e.g., Dick, 1989; Cannat, 1993, 1996), but have not yet been thoroughly clarified due to undersampling of the materials. The nature of oceanic Moho has been controversial. Hess (1962) proposed that the oceanic Moho was a serpentinization front, constrained by the 500 to 600 °C isotherm, because of uniform thickness of the oceanic crust. Combined with ophiolite studies, mafic crustal nature has been established of the ocean floor (e.g., Greenbaum, 1972). More recently however, Cannat (1993) discussed the lower crust of the slow-spreading ridge system is composed of mixtures of serpentinite and gabbroic intrusion (= a modified Hess model). The Hess model (1962) has revived recently and may be applicable to the ocean floor neat the segment boundaries of the slow-spreading ridge system, such as Southwest Indian Ridge (Muller et al., 1997). Arai and Matsukage (1996) suggested presence of Moho transition zone (MTZ) composed of dunite and related rocks (troctolite, olivine gabbro) for Hess Deep, near the East Pacific Rise (EPR). For the upper mantle, Niu and Hékinian (1997) stressed spreading-rate dependence of the abyssal upper mantle peridotite; that is, the degree of melting (melt extraction) increases with increasing spreading rate. Cannat (1996) suggested strong along-axis petrological heterogeneity of the oceanic lithosphere for the slow-spreading ridge system. That is, the upper mantle peridotite may change its character depending on the position in the ridge segments. Arai (2005) strongly contradicted the Niu-Hékinian model. He suggested that the petrological constituents are basically the same, being independent of spreading rate. The dunite-harzburgite layer is relatively thin in slow-spreading systems, and has been only under-sampled. Rocks from deep parts of the oceanic crust-mantle have been mainly obtained from the oceanic fracture zones (e.g., Bonatti, 1976). As well known, the segment boundaries including them are thermally anomalous (Lin and Phipps-Morgan, 1992) and are rather "special" places, and the materials from them may not represent ordinary oceanic lithosphere. Additionally the oceanic fracture zones are better developed on the slow-spreading ridge system, and the information related to deep-seated rocks has been biased to slow-spreading ridges. Deep or ultra-deep drilling on a "normal" ocean floor in the future IODP is indispensable to understanding the oceanic lithosphere.

For other than the mantle peridotite (lherzolite to harzburgite), dunite has been scarcely documented (e.g., Arai and Matsukage, 1996), but wehrlite to clinopyroxenite has been very rarely reported from the ocean floor. Only Arai and Matsukage (1996) referred to

the presence of wehrlite from Hess Deep, EPR as a very small piece in drill cores. On the other hand, wehrlite and related rocks are quite common in the crustal section of ophiolites (e.g., Benn et al., 1988; Juteau et al., 1988). They form intrusive bodied within gabbro and other crustal rocks, and we call them "wehrlite intrusions" or "late intrusions". In the Oman ophiolite, the wehrlitic rocks intrude into the apparently oceanic crust (Nicolas, 1989). Uesugi (2004) examined the late intrusive rocks and concluded they had arc-magma signature, especially high-Cr# and low-Ti nature of chromian spinel. Olivine-clinopyroxene rocks (dunite, wehrlite, olivine clinopyroxenite and clinopyroxenite) are commonly found as xenoliths in magmas erupted on island arcs (e.g., Arai et al., 1998, 2000).

The olivine-clinopyroxene plutonic rocks have been rarely found from the mid-ocean ridge environment but commonly described from the supra-subduction zone environment as stated above. We would like to examine the olivine-clinopyroxene rocks (dunite, wehrlite, olivine clinopyroxenite and clinopyroxenite) from the ocean floor off Fiji and characterize them in terms of mineral chemistry.

2. Macroscopic observations

The plutonic rocks obtained are ultramafic and mafic rocks. The ultramafic rocks are basically bimineralic rocks composed of olivine and clinopyroxene with small amounts of chromian spinel. The mafic rocks are largely two-pyroxene gabbros (or we may call them as "mafic granulite") suffured from alteration (hydration) to various extents. The ultramafic rocks are commonly heterogeneous in terms of olivine/clinopyroxene ratios. Apparent graded bedding can be observed. Clinopyroxne grains tend to grow finer with an increase of olivine amount. Clinopyroxene-rich clots (or irregular-shaped layers) up to one centimeter in thickness are not rare. The ultramafic rocks are sometimes foliated. Gabbroic rocks intruded into the ultramafic rocks as thin sinuous veins, and exhibit melt impregnation textures (formation of amoebic plagioclase). Gabbroic rocks are massive but are sometimes foliated.

3. Microscopic observations

Following are petrographical descriptions of thin sections. We observed the thin sections by both transmitted and reflected lights. For the transmitted-light observations, some of the thin sections were polished with diamond paste of particle-size of 2 micrometers. For the serpentine species, Ant, C and L are antigorite, chrysotile and lizardite, respectively. Opaque minerals were examined for some polished thin sections by reflected light.

3-1 Individual thin sections

04SFAD07C1 (Medium-grained two-pyroxene gabbro or mafic granulite?)

Minerals are almost equant and anhedral. Primary minerals are clinopyroxene, orthopyroxene, plagioclase, and magnetite. Secondary minerals are hornbldende, biotite (trace), and chlorite. All the minerals seem to be optically unzoned. Orthopyroxene is selectively altered to chlorite (and other clay minerals) to various extents. Clinopyroxene is almost intact and has fine patchy exsolution of orthopyroxene. Plagioclase is fresh and shows albite-twinning. The rock has been altered along a crack, which converted clinopyroxene to pale greenish brown hornblende.

04SFAD07C2 (Medium-grained two-pyroxene gabbro or mafic granulite?).

Almost the same as 04SFAD07C1. Weak foliation is observed, and minerals are almost equant and anhedral. Primary minerals are clinopyroxene, orthopyroxene, plagioclase, and magnetite. Secondary minerals are hornbldende, biotite (trace), and chlorite. All the minerals seem to be optically unzoned. Orthopyroxene is selectively altered to chlorite (and other clay minerals) to various extents (slightly to heavily). Clinopyroxene is almost intact and has fine patchy exsolution of orthopyroxene. Plagioclase is fresh and shows albite-twinning. The rock has been hydrated; pale greenish brown hornblende shows patchy replacement to clinopyroxene..

04SFAD07C3 (Orthopyroxene-bearing clinopyroxenite)

Primary minerals are clinopyroxene and orthopyroxene, and secondary minerals are chlorite and sulfide. Clinopyroxene is relatively coarse in size and is anhedral in shape. It has been replaced in patchy ways by pale yellowish brown hornblende. Orthopyroxene is almost completely altered to chlorite. Small amount of opaque spinel is included by clinopyroxene. Trace amount of sulfide is found.

04SFAD07C4 (Wehrlite to dunite, possibly)

Primary minerals are olivine (altered), clinopyroxene (?), and chromian spinel. Secondary minerals are serpentine (C/L) and magnetite. All primary silicate minerals have been altered completely. Olivine is replaced by serpentine (chrysotile/lizardite). Possible clinopyroxene, highly anhedral, is also converted to serpentine but has preserved texture (e.g., cleavage).

Fine magnetite trails trace the former cleavage of clinopyroxene (pseudomorph). Network of fine magnetite is also found in serpentine after olivine. Chromian spinel, rounded to euhedral in shape and opaque in thin section, has been almost intact.

04SFAD07C5 (possibly wehrlite)

Primary minerals are olivine (altered), clinopyroxene (?), and chromian spinel. Secondary minerals are serpentine (C/L) and magnetite. All primary silicate minerals have been altered completely. Olivine is replaced by serpentine (chrysotile/lizardite). Possible clinopyroxene, highly anhedral, is also converted to serpentine but has preserved texture (e.g., cleavage). Fine magnetite trails trace the former cleavage of clinopyroxene (pseudomorph). Network of fine magnetite is ubiquitous and large in amount in serpentine after olivine. The fine size of chromian spinel, rounded to euhedral in shape and opaque in thin section, is characteristic of this sample. Spinel is totally intact possibly due to high Cr# character.

04SFAD07C6 (Olivine clinopyroxenite)

Primary minerals are clinopyroxene, olivine (altered), and chromian spinel. Secondary minerals are serpentine (C/L) are magnetite Clinopyroxene is coarse and anhedral, and has prominent cleavage. Olivine is interstitial to clinopyroxene and is completely altered to serpentine and magnetite. Chromian spinel, which is euhedral and opaque, is rare.

04SFAD07C7 (Foliated two-pyroxene gabbro or mafic granulite?)

Primary minerals are clinopyroxene, orthopyroxene (altered), and plagioclase. Secondary minerals are serpentine (C/L; after orthopyroxene), "saussurite" (after plagioclase), actinolite (or tremolite), and magnetite. Foliation is prominent. Orthopyroxene is completely altered to serpentine, with relic thin exsolved phases. Clinopyroxene exhibits patchy alteration to produce actinolitic or tremolitic amphibole (almost colorless to pale green). Plagioclase is strongly twinned and rarely zoned, showing network-like alteration by "saussurite".

04SFAD07C8-1 (Two-pyroxene gabbro or mafic granulite)

Primary minerals are clinopyroxene, orthopyroxene (altered to chlorite and serpentine), and plagioclase. Secondary minerals are serpentine (after opx), chlorite (after opx), hornblende (or actinolite), and "saussurite". Clinopyroxene is partly or patchily replaced with actinolite or pale green hornblende. Orthopyroxene is completely converted to serpentine (C/L) and

chlorite. Plagioclase is strongly altered, especially for smaller grains, to saussurite. Alteration veins mainly composed of pale green hornblende is common.

04SFAD07C8-2 (Coarse-grained hornblende-bearing two-pyroxene gabboro)

Primary minerals are clinopyroxene, orthopyroxene (altered to chlorite), hornblende (brown to green), and plagioclase. Secondary minerals are actinolite, chlorite, "saussurite", and prehnite (veinlet). Orthopyroxene is completely altered to chlorites with deep blue to dark grayish brown interference colors. Plagioclase (with albite-type twinning) is prominently cut by cracks and is weakly to moderately altered. Color of hornblende is changeable from brown at the core to light greenish at the rim.

04SFAD07C9-1 (Medium-grained two-pyroxene gabbro (mafic granulite) cut by coarse-grained hornblende gabbro)

Primary minerals are clinopyroxene, orthopyroxene (completely altered), and plagioclase. The vein is composed of hornblende, plagioclase, magnetite, and quartz. Secondary minerals are hornblende (host; pale green) and chlorite (and other clay minerals) after orthopyroxene. Clinopyroxene is partly or patchily replaced with pale green hornblende, especially near the contact with the hornblende gabbro. Orthopyroxene is completely converted to chlorite and other clay minerals. Plagioclase, prominently twinned, is weakly altered. Hornblende and plagioclase (prominently twinned) are coarse, but fine-grained aggregates of plagioclase and quartz are frequently found around the grain boundaries of coarser grains in the hornblende gabbro. Magnetite is also coarse and anhedral.

04SFAD07C9-2 (Medium-grained two-pyroxene gabbro or mafic granulite)

Primary minerals are clinopyroxene, orthopyroxene (altered), and plagioclase. Secondary minerals are hornblende to actinolite, chlorite and serpentine (C/L) after orthopyroxene, and "saussurite". Orthopyroxene (anhedral) is completely altered to serpentine and chlorite. Clinopyroxene shows patchy, lamellar and marginal replacement by pale green hornblende to actinolite. Plagioclace is slightly altered to saussurite.

04SFAD07C10-1 (Medium-grained two-pyroxene gabbro (mafic granulite) invaded by coarse-grained hornblende gabbro)

Primary minerals are clinopyroxene, orthopyroxene (rare, altered), and plagioclase. The vein

is composed of hornblende and plagioclase. Secondary minerals are hornblende, saussurite, prehnite, and chlorite (after orthopyroxene). Orthopyroxene is trace in amount and is totally altered to chlorite. Replacement of clinopyroxene by hornblende is prominent along grain boundaries and cleavage planes. Plagioclase is severely altered in the hornblende gabbro, replaced by prehnite.

04SFAD07C10-2 (Two-pyroxene gabbro)

Primary minerals are clinopyroxene, orthopyroxene (completely altered to chlorite and/or serpentine), and plagioclase. Secondary minerals are serpentine (C/L), chlorite, magnetite, tremolite (actinolite) and "saussurite". Small amount of olivine may have been present (now serpentinized). Clinopyroxene is altered to various degrees to tremolite or actinolite. Hydration has progressed along cracks in the rock. Plagioclase seems not to be optically zoned but is twinned extensively.

04SFAD07C11 (Completely serpentinized wehrlite)

Primary minerals are olivine (altered), clinopyroxene (altered), and chromian spinel. Secondary minerals are serpentine (C/L) and magnetite. Primary silicates are completely altered (serpentinized). Clinopyroxene was anhedral, judged from the shape of pseudomorphs. Opaque chromian spinel is almost intact, and is rounded to euhedral in shape. Large amount of fine magnetite are produced as network.

04SFAD07C12-1 (Olivine clinopyroxenite)

Primary minerals are olivine, clinopyroxene, chromian spine, and orthopyroxene (lamella in cpx). Secondary minerals are serpentine (C/L), magnetite, sulfide, and chlorite. Clinopyroxene is relatively coarse and is only slightly serpentinized. Primary orthopyroxene lamellae in clinopyroxene are completely serpentinized. Olivine is severely altered but small amount survives alteration. Chromian spinel is small in amount and is deep brown and anhedral in thin section. Trace amount of sulfide is found in relatively large grains of magnetite.

04SFAD07C12-2 (Wehrlite or olivine clinopyroxenite)

Primary minerals are olivine, clinopyroxene, and chromian spinel. Secondary minerals are serpentine (C/L), magnetite, and sulfide. Clinopyroxene is anhedral and is relatively fine in

size. It is parted and is altered along the parting planes. Olivine is moderately serpentinized. Chromian spinel is fine in size and is brown to opaque in thin section. Trace amount of grobular minute sulfide is found in clinopyroxene.

04SFAD07C13-1 (Olivine clinopyroxenite cut by a gabbro vein)

Primary minerals are clinopyroxene, olivine, and chromian spinel; and are clinopyroxene and plagioclase for the vein. Secondary minerals are serpentine (C/L) and magnetite; and are actinolite, "saussurite", chlorite, and green spinel for the vein. The rock has a porphyroclastic texture with fine neoblasts of olivine and clinopyroxene. Olivine is severely altered but small amount is still preserved. Chromian spinel, which is euhedral to subhedral and opaque, is very small in amount. The gabbro veinlet is severely altered and large amounts of chlorite, actinolite and saussurite have been formed.

04SFAD07C13-2 (Olivine clinopyroxenite or wehrlite cut by a coarse-grained gabbro vein)

Primary minerals are olivine, clinopyroxene, chromian spinel, and hornblende; and are clinopyroxene and plagioclase for the vein. Secondary mineral are serpentine (C/L) and magnetite; and are chlorite, actinolite, and "saussurite" for the vein. Olivine is severely altered but is partly preserved. Clinopyroxene is anhedral and is only slightly serpentinized. Chromian spinel, which is opaque, is euhedral and fine in size. The most prominent is impregnation of small amount of melt from the vein. Small amount of anhedral "saussurite" is found within this olivine clinopyroxenite.

04SFAD07C13-3 (Wehrlite with clinopyroxene-rich band cut by gabbro vein)

Primary minerals are olivine, clinopyroxene, orthopyroxene (altered, in the band), and chromian spinel; and are clinopyroxene, brown hornblende, and plagioclase for the vein. Secondary minerals are serpentine (C/L), magnetite, and tremolite; are "saussurite", chlorite, green spinel, and actinolite (or tremolite) for the vein. The wehrlite has a thin (< 1 cm) clinopyroxenite (opx-bearing). Chromian spinel is opaque and euhedral, and clinopyroxene is anhedral. Clinopyroxne has been partly replaced, along grain boundaries and cleavage, with amphibole (tremolite). Plagioclase impregnation is prominent especially in the clinopyroxenite band.

04SFAD07C13-4 (Wehrlite to olivine clinopyroxenite)

Primary minerals are olivine, clinopyroxene, and chromian spinel. Secondary minerals are serpentine (C/L), magnetite, tremolite (or actinolite), and sulfide. The rock, especially olivine, is severely altered. Clinopyroxene is partly replaced, especially along grain boundaries, with amphibole (tremolite). Chromian spinel is rounded in shape and is almost free of alteration.

04SFAD07C13-5 (Wehrlite cut by a gabbro vein?)

Primary minerals are olivine, clinopyroxene, chromian spinel, and plagioclase (impregnated); and are plagioclase and clinopyroxene for the vein. Secondary minerals are serpentine (C/L), magnetite, "saussurite", pale green spinel, and tremolite (actinolite); and are chlorite, saussurite, actinolite, and green spinel for the vein. The amount of clinopyroxene gradually changes, apparently increasing toward the gabbro vein (?). The rock is partly dunitic. Chromian spinel is very small in amount. Clinopyroxene is partly replaced by colorless to pale green tremolite (?). Impregnation of plagioclase (now saussuritized) is prominent.

04SFAD07C13-6 (Wehrlite to olivine clinopyroxenite cut by a gabbro vein?)

Primary minerals are olivine, clinopyroxene, chromian spinel, and plagioclase (impregnated); and are plagioclase and clinopyroxene for the vein. Secondary minerals are serpentine (C/L), magnetite, "saussurite", and tremolite (actinolite); and are chlorite, saussurite, actinolite, and green spinel for the vein. Chromian spinel is small in amount, and is opaque. Clinopyroxene is partly replaced by colorless to pale green tremolite (?) around the gabbro vein. Impregnation of plagioclase (now saussuritized) is prominent, especially around the gabbro vein..

04SFAD07C13-7 (Olivine clinopyroxenite with clinopyroxene-rich pods with orthopyroxene-hornblende veinlet)

Primary minerals are olivine, clinopyroxene, chromian spinel, and plagioclase (in clot); and are orthopyroxene and brown hornblende for the vein. Secondary minerals are serpentine (C/L), magnetite, and tremolite. The rock is very heterogeneous in olivine/clinopyroxene ratio. One of the clinopyroxene-rich part (pod) seems to be veined by thin orthopyroxene-hornblende. Orthopyroxene is stout prismatic and is enclosed by hornblende (brown to pale green). Clinopyroxene has patches of serpentine, which were initially orthopyroxene exsolution.

04SFAD07C14-1 (Wehrlite with clinopyroxene-rich clot)

Primary minerals are olivine, clinopyroxene, chromian spinel, and orthopyroxene (?). Secondary minerals are serpentine (C/L, partly Ant?), magnetite, chlorite, and tremolite. The rock is strongly serpentinized: even clinopyroxene is partly serpentinized along grain boundaries and lamellae (completely altered). Chromian spinel is opaque and subhedral to euhedral in shape. Orthopyroxene (?), now bastite, is occasionally found within the clinopyroxene-rich clot.

04SFAD07C14-2 (Wehrlite to olivine clinopyroxenite)

Primary minerals are olivine, clinopyroxene, and chromian spinel. Secondary minerals are serpentine (C/L), magnetite, and tremolite (fibrous). The rock is strongly serpentinized but small amount of olivine survives. Aggregates of fine fibrous tremolite are ubiquitous around clinopyroxene. Secondary fine clinopyroxene sometimes surrounds coarse primary clinopyroxene. Primary clinopyroxene suffers from patchy replacement by serpentine and fine magnetite.

04SFAD07C15-1 (Wehrlite with a gabbroic vein network)

Primary minerals are olivine, clinopyroxene, and chromian spinel; and are orthopyroxene, hornblende, and plagioclase. Secondary minerals are serpentine (C/L), tremolite (or hornblende), magnetite, and plagioclase (impregnated, now saussuritized; and are "saussurite" and actinolite for the vein. The rock is strongly serpentinized, especially for olivine. Clinopyroxene is suffered from patchy serpentinization. Clinopyroxene is strongly anhedral, and is partially replaced with amphibole along grain boundaries, especially around the gabbro veinlet. Plagioclase impregnation is frequent around the vein, and is sometimes rimmed by thin colorless amphibole (hornblende?).

04SFAD07C15-2 (Olivine clinopyroxenite to wehrlite with a thin gabbroic vein)

Primary minerals are olivine, clinopyroxene, and chromian spinel; and are orthopyroxene, plagioclase, hornblende (?) and clinopyroxene (?) for the vein. Secondary minerals are serpentine (C/L), magnetite, tremolite, and plagioclase (impregnated; now saussuritized); and are saussurite and tremolite for the vein. Olivine is strongly serpentinized, and olivine is relatively resistant against serpentinization. Clinopyroxene is highly anhedral and suffers

from patchy alteration. Chromian spinel is opaque, euhedral and fine in size. Large amounts of amphibole (hornblende, tremolite and actinolite) are found in and around the vein.

04SFAD07C16 (Wehrlite (orthopyroxene-bearing?))

Primary minerals are olivine, clinopyroxene, chromian spinel, orthopyroxene (?), and plagioclase (saussuritized). Secondary minerals are serpentine (C/L), "saussurite", chlorite, and tremolite. Olivine is strongly serpentinized with only small amount of relics. Bastite is found associated intact clinopyroxene, possibly indicating initial presence of orthopyroxene. Fine-grained aggregate of tremolite is found around the saussurite.

04SFAD07C17-1 (Wehrlite)

Primary minerals are olivine, clinopyroxene, chromian spinel and plagioclase (completely saussuritized). Secondary minerals are "saussurite", serpentine (C/L), magnetite and amphibole (tremolite?). The rock is homogeneous in appearance, and shows weakly porphyroclastic texture with rounded to subhedral clinopyroxene porphyroclasts. Clinopyroxene sometimes exhibits strong parting along which alteration proceeded. Tremolitic amphibole replaces clinopyroxene to various extents.

04SFAD07C17-2 (Wehrlite to olivine clinopyroxenite)

Primary minerals are olivine, clinopyroxene, chromian spinel, plagioclase (completely saussuritized), and orthopyroxene (?). Secondary minerals are serpentine (C/L), magnetite, "saussurite", and tremolite. The volume and size of clinopyroxene gradually change within the thin section. Degree of serpentinization is moderate to strong. Saussuritized plagioclase (?) is associated with clinopyroxene, which shows patchy replacement by tremolitic amphibole and magnetite. Bastite-like serpentine, occasionally found with intact clinopyroxene, may be pseudomorphous after orthopyroxene. Chromian spinel is subhedral to euhedral, opaque and fine in size.

04SFAD07C18-1 (Wehrlite)

Primary minerals are olivine, clinopyroxene, and chromian spinel. Secondary minerals are serpentine (C/L) and magnetite. Degree of serpentinization is strong, especially in olivine-rich part. Clinopyroxene, which is highly anhedral, is sometimes intact but sometimes parted and replaced by serpentine in patchy ways. Chromian spinel is opaque and

anhedral to subhedral in shape.

04SFAD07C18-2 (Olivine clinopyroxenite with thin dunite band)

Primary minerals are olivine, clinopyroxene and chromian spinel. Secondary minerals are serpentine (C/L) and magnetite. Olivine is severely serpentinized especially in the dunitic part. Clinopyroxene seems to be slightly coarser in olivine-rich part than in clinopyroxene-rich part. The rock shows a weak layered structure and preserves a cumulus texture. Minerals are almost free from deformation: clinopyroxene is anhedral, and suffered from slight alteration especially along cleavage or parting planes. Chromian spinel is euhedral to anhedral and is opaque in thin section.

04SFAD07C18-3 (Olivine clinopyroxenite with clinopyroxene-rich band)

Primary minerals are olivine, clinopyroxene, chromian spinel, and orthopyroxene (?). Secondary minerals are serpentine (C/L), magnetite, and tremolite. The size and distribution of clinopyroxene is highly heterogeneous in the thin section. Clinopyroxene is highly anhedral and shows patchy alteration along cleavage and exsolution. Chromian spinel is euhedral to anhedral and is generally fine in size.

04SFAD07C18-4 (Wehrlite)

Primary minerals are olivine, clinopyroxene, and chromian spinel. Secondary minerals are serpentine (C/L) and magnetite. The rock, especially olivine-rich part, is severely serpentinized. Chromian spinel is subhedral and opaque in thin section. Clinopyroxene is anhedral and is partly altered to serpentine along cleavage planes and exsolution lamellae.

04SFAD07C19-1 (Wehrlite)

Primary minerals are olivine, clinopyroxene, chromian spinel, and plagioclase (almost "saussuritized"). Secondary minerals are serpentine (C/L), magnetite, tremolite, "saussurite", and sulfide. The rock is highly serpentinized: olivine is almost completely altered with few relic grains. Tremolite forms along the margin of "saussurite" and clinopyroxene. Plagioclase impregnation is prominent and part of the plagioclase survives the saussuritization. Chromian spinel is very small both in amount and in grain size. Sulfide is associated with relatively coarse magnetite.

04SFAD07C19-2 (Wehrlite)

Primary minerals are olivine, clinopyroxene and chromian spinel. Secondary minerals are serpentine (C/L) after olivine, magnetite, plagioclase (saussuritized) and amphiboles (hornblende and tremolite). The rock is homogeneous in appearance and preserved a cumulus texture. The degree of serpentinization is strong to moderate. Selective formation of pale green hornblende occurred along cracks. Colorless amphibole (tremolite?) shows patchy replacement in clinopyroxene.

04SFAD07C20 (Dunite and wehrlite ("inter-layered"))

Primary minerals are olivine, clinopyroxene, and chromian spinel. Secondary minerals are serpentine (C/L) and magnetite. The rock has two dunite layers (portions) and one wehrlite layer, in which clinopyroxene decreases in size and amount toward one dunite layer. The boundary between the clinopyroxene-rich side of the wehrlite layer and another dunite layer is relatively sharp. A kind of grading in terms of clinopyroxene (size and volume) can be observed. The dunite parts are strongly serpentinized. Chromian spinel is relatively coarse in size in the dunite parts.

04SFAD07C21-1 (Wehrlite with clinopyroxene-rich band)

Primary minerals are olivine, clinopyroxene and chromian spinel, and secondary minerals are serpentine (C/L) and magnetite. Clinopyroxene is anhedral and shows patchy alteration. Olivine part is severely serpentinized. Chromian spinel, euhedral to subhedral and opaque, is interestingly rich in the clinopyroxene-rich band.

04SFAD07C21-2 (Wehrlite)

Primary minerals are olivine, clinopyroxene and chromian spinel, and secondary minerals are serpentine (C/L), magnetite and tremolite. The rock is severely serpentinized as a whole; olivine is mostly serpentinized out and even clinopyroxene is serpentinized to various degrees. The original rock appears to have had a porphyroclastic texture, with subhedral or rounded clinopyroxene porphyroclasts. Clinopyroxene shows patchy alteration to produce serpentine, magnetite and tremolite. Chromian spinel is fine in size, and is opaque and euhedral in thin section.

04SFAD07C22 (Wehrlite with a clinopyroxenite portion (clot))

Primary minerals are olivine, clinopyroxene, and chromian spinel. Secondary minerals are serpentine, magnetite, and tremolite. The rock is heavily serpentinized, especially in olivine-rich part. Clinopyroxene is anhedral and is altered to serpentine, magnetite and/or tremolite in a patchy way. Chromian spinel is subhedral to euhedral and is totally opaque.

04SFAD07C23 (Wehrlite?)

The rock is completely serpentinized, but I suggest the protolith was dunitic wehrlite judging from the relic texture; pseudomorphs after clinopyroxene are not so abundant. Primary minerals are olivine, clinopyroxene and chromian spinel, and secondary minerals are serpentine (C/L) after olivine and clinopyroxene, and disseminated fine magnetite. The rock is characteristically rich in fine, euhedral (to rounded) chromian spinel, which is almost intact from alteration.

04SFAD07C24 (Olivine clinopyroxenite)

Primary minerals are olivine, clinopyroxene, plagioclase and chromian spinel (?). Secondary minerals are serpentine (C/L), magnetite, tremolite, chlorite and sulfide. This rock is the least serpentinized of all ultramafic rocks examined. Plagioclase is completely altered to chlorite and tremolite. Chromian spinel is very fine and rare, and is completely altered to a mixture of magnetite and sulfide. Clinopyroxene is almost fresh and sometimes show alteration (to serpentine or tremolite) along cleavage planes or exsolution lamellae. Olivine is only moderately to weakly serpentinized.

04SFAD07C25-1 (Wehrlite (or olivine clinopyroxenite) and dunite (a irregular mixture))

Primary minerals are olivine, clinopyroxene, and chromian spinel, and secondary minerals are serpentine (C/L) and magnetite. The rock exhibits irregular (not layered) distribution of dunite and wehrlite (olivine clinopyroxenite) parts. Chromian spinel, euhedral or subhedral and opaque, is relatively abundant throughout the rock, and has rounded silicate inclusions, which are unfortunately altered in most cases. Olivine in the dunitic part is almost completely serpentinized.

04SFAD07C25-2 (Olivine clinopyroxenite (cut by coarse-grained gabbro at a tip))

Primary minerals are olivine, clinopyroxene, chromian spinel, plagioclase, and orthopyroxene(?). Secondary minerals are serpentine (C/L), magnetite, tremolite, and

"saussurite". Olivine is severely serpentinized and clinopyroxene is partly replaced with tremolite. Tremolite also rims the "saussurite". This rock is also relatively rich in chromian spinel, which occasionally has rounded inclusions of silicates. The gabbro part is severely converted to sericite, actinolite and other fine alteration products.

04SFAD07C26 (Wehrlite)

Primary minerals are olivine, clinopyroxene and chromian spinel. Secondary minerals are serpentine (C/L), brucite, magnetite, and chlorite. The rock is completely serpentinized. Brucite is associated with secondary magnetite. Serpentine and small amount of chlorite form pseudomorphs after clinopyroxene (possibly). The possible former clinopyroxene is anhedral. Chromian spinel is subhedral and opaque in thin section. Coarse chromian spinel has orbicular inclusion of silicates, which are now serpentinized.

04SFAD07C27 (Wehrlite (hydrous?))

Primary mineral are olivine, clinopyroxene, chromian spinel, and hornblende (?). Secondary minerals are serpentine (C/L), magnetite, and tremolite. The rock is clearly foliated and is severely serpentinized. Almost olivine is serpentinized out. Large amount of tremolite is found, possibly replacing primary clinopyroxene. Coarse light brown hornblende may be primary. Chromian spinel is anhedral and opaque.

04SFFPG01-1 (Dunite)

Primary minerals are olivine are chromian spinel, and secondary minerals are serpentine (Ant and/or C/L), carbonate, and magnetite. The rock is completely serpentinized with considerable amount of carbonate (network-like). Chromian spinel is euhedral and brown in thin section.

04SFFPG01-2 (Dunite)

Primary minerals are olivine and chromian spinel, and secondary minerals are serpentine (Ant and/or C/L), magnetite, and carbonate. The rock is completely serpentinized with considerable amount of carbonate (network-like). Chromian spinel is euhedral and deep brown to opaque in thin section.

04SFFPG02 P2 (Fine-grained hornblende gabbro (microgabbro))

Primary minerals are green hornblende, plagioclase, and magnetite. The rock is fine-grained hornblende gabbro. It is partly porphyritic with slightly coarse grains of plagioclase. Degree of alteration is moderate.

04SFFPG03 P1 (Two-pyroxene gabbro or mafic granulite?)

Primary minerals are clinopyroxene, orthopyroxene, plagioclase, and magnetite. Secondary minerals are chlorite (or serpentine), hornblende, and sericite. Orthopyroxene is completely altered to chlorite (or serpentine). Minerals are selectively converted to pale green hornblende along cracks.

04SFFPG03 P2 (Microgabbro or dolerite)

Primary minerals are hornblende (yellowish green to green), clinopyroxene, plagioclase, and magnetite. Rare phenocrysts of plagioclase and clinopyroxene are found, The clinopyroxene phenocryst is converted to hornblende at the margin

04SFFPG03 P3-1 (Dunite)

Primary minerals are olivine and clinopyroxene. Secondary minerals are serpentine (C/L?), magnetite, brucite, and carbonate (vein). The rock is completely altered, that is serpentinite. Small amount of brucite is found. Chromian spinel is opaque.

04SFFPG03 P3-2 (Wehrlite)

Primary minerals are olivine, clinopyroxene, and chromian spinel. Secondary minerals are serpentine (C/L), magnetite, carbonate (?), and clay minerals. The rock is completely altered. Chromian spinel is euhedral and opaque.

04SFFAD01 C8 (Dunite with gabbroic impregnation)

Primary minerals are olivine and chromian spinel; and are orthopyroxene, hornblende, and clinopyroxene(?). Secondary minerals are serpentine (C/L?) and magnetite; and is "saussurite" for the vein. The rock is completely altered. Only orthopyroxene in the gabbroic vein survives alteration.

04SFFAD07 M (Wehrlite)

Primary minerals are olivine, clinopyroxene, and chromian spinel. Secondary minerals are

serpentine (C/L), magnetite, brucite, and tremolite. The rock is almost completely serpentinized, with an unaltered patch. Chromian spinel is euhedral and opaque.

3-2 Petrographical summary

In summary, the ultramafic rocks were derived from parts of a kind of layered plutonic body. Dunite may gradually change to clinopyroxenite through wehrlite and olivine clinopyroxenite upward in the layered body. To be interesting, chromian spinel is sometimes concentrated in clinopyroxene-rich parts (especially olivine clinopyroxenite). Chromian spinel in such concentrations contains orbicular silicate inclusions. This character is similar to that in troctolite from Hess Deep (Arai and Matsukage, 1996). Gabbroic rocks may have intrusive relations to the ultramafic rocks. Intrusion and impregnation of the gabbroic melt make the ultramafic rocks much complicated; plagioclase was precipitated from the impregnated melt. The impregnated melt may have been hydrous; secondary amphibole was selectively formed around the gabbroic veins. Alternatively, hydrothermal solution has acted selectively around the gabbroic veins, and forming secondary hydrous minerals (amphiboles, sericite, and "saussurite" composed of hydrogrossular and zoisite). The wehrlite from Fiji is in contrast to that forming the late intrusion from the Oman ophiolite, which is usually homogeneous in terms of olivine/clinopyroxene ratio (Uesugi, 2004).

Some of dunite samples (especially 04SFFPG03 series ones) are very homogeneous in appearance and are free of clinopyroxene. They seem to be different in origin from the dunite that is gradual to wehrlite described above.

3-3 Modal amounts of primary minerals

Modal amounts of primary minerals were measured under the microscope by point counting technique (1000 points). The point counting was not easy because of high degree of alteration and modal heterogeneity. The frequent invasion of gabbroic veins further made the analysis difficult. As expected, the proportion of olivine to clinopyroxene is variable; the rocks are dunite, wehrlite and olivine clinopyroxenite depending on the proportion. Chromian spinel is variable in mode from less than 1 % to around 3 % in ultramafic rocks. To be interesting, the intermediate rocks between the ultramafic rocks and gabbros, that is, troctolites, have not been found.

4. Mineral Chemistry

4-1 Analytical method and conditions

Minerals (olivine, clinopyroxene and chromian spinel) were *in-situ* analyzed on the polished thin sections for 11 elements (Na, Mg, Al, Si, K, Ca, Ti, Cr, Mn, Fe and Ni) with a wave-length dispersive microprobe (JEOL Superprobe JXA-8800) at the Cooperation Research Center, Kanazawa University. Raw intensities for each element have been corrected with ZAF method, and weight percents of oxides (Na_2O, MgO, Al_2O_3, SiO_2, K_2O, CaO, TiO_2, Cr_2O_3, MnO, FeO and NiO) were calculated. The detection limits are 0.01 wt% for Na_2O, K_2O, SiO_2, Al_2O_3, MgO, CaO and NiO, 0.1 wt% for TiO_2, FeO and MnO, and 0.3 wt% for Cr_2O_3. Relative mean standard deviation of analysis is within 10 % for oxides with 0.1 to 1 wt% concentrations and is within 5 % for oxides with >1 wt% concentrations. We used various natural and synthetic minerals ($NaAlSiO_6$, MgO or Mg_2SiO_4, Al_2O_3, SiO_4, $KTiPO_5$, $CaSiO_3$, Cr_2O_3, MnO, Fe_2SiO_4 and NiO) as standard. We adopted 20 (or 15) kv for accelerating voltage, 20 nA (20×10^{-8} A) for beam current, and 3 micrometers for beam diameter on MgO (periclase). Counting time is 20 to 50 seconds on the peak of characteristic X ray for each element.

We assume all iron in silicates is ferrous. Ferrous and ferric irons in chromian spinel were calculated from raw analyses assuming spinel stoichiometry. Mg# and Cr# are Mg/(Mg + Fe^{2+}) atomic ratio and Cr/(Cr + Al) atomic ratio, respectively. Fe^{3+}# is Fe^{3+}/(Cr + Al + Fe^{3+}) atomic ratio of spinel.

4-2 Olivine

Olivine could be analyzed only in wehrlite because it is serpentinized out in dunite. Fo content (100Mg#) of olivine ranges from 88 to 79. NiO content varies in sympathy with the Fo content. CaO content is generally low, being concordant with plutonic nature of the rocks. The Fo content of olivine is weakly correlated with Cr# of coexisting chromian spinel. Note that the initial Fo content of igneous olivine has been changeable to lower values in clinopyroxene-rich rocks due to Mg-Fe redistribution with clinopyroxene during the low-temperature subsolidus stage (see Arai et al., 1988). The Fo content of olivine seems, however, shows no clear relationship with modal amount of olivine (or clinopyroxene).

4-3 Pyroxenes

Clinopyroxene is chromian diopside to augite, showing no prominent chemical zoning. The Mg# varies from 0.93 to 0.84; being from 0.93 to 0.88 in wehrlite and olivine clinopyroxenite and from 0.91 to 0.84 in gabbros. It is negatively correlated with TiO_2 content, which ranges from <0.1 to 0.4 wt %. The TiO_2 content is also negatively correlated with Cr_2O_3 content, which varies from 1 to <0.1 wt%. . Note that the initial Mg# of igneous clinopyroxene has been changeable to higher values in olivine-rich rocks due to Mg-Fe redistribution with olivine during the low-temperature subsolidus stage (see Arai et al., 1988). However, no clear relationship between the Mg# and modal amount of clinopyroxene. The relatively low content (= high content of enstatite component) of some clinopyroxenes may be due to contamination of orthopyroxene lamellae or their alteration products.

Orthopyroxene in gabbroic rocks has relatively low Mg#, around 0.8, which is slightly lower than for coexisting clinopyroxene.

4-4 Chromian spinel

The Cr#, one of the most important parameters, of chromian spinel is generally higher than 0.4 and is up to 0.8, but is mostly ranging from 0.4 to 0.6. The Cr# of spinel is higher on average in dunite than in wehrlite and olivine clinopyroxenite. As stated above, the Cr# of spinel varies in an antipathetic way with the Fo content of coexisting olivine. It is interesting to note that the Cr# of spinel coexisting with the most magnesian olivine (Fo_{88}) ranges from 0.4 to 0.6 (mostly from 0.4 to 0.5). Mg# of chromian spinel is rather low, from 0.5 to 0.1, being negatively correlated with the Cr#. It is noteworthy that the dunite and wehrlite obtained off Fiji are quite different from the abyssal peridotite in the Mg#-Cr# space. TiO_2 content of chromian spinel ranges from almost nil (< 0.1 wt%) to > 1.5 wt%, positively correlated with the Cr#. The Fe^{3+}# (= $Fe^{3+}/(Cr + Al + Fe^{3+})$ atomic ratio) is mostly lower than 0.2 but is rarely up to 0.5. It is positively correlated with the TiO_2 conent as expecte.

It is noteworthy that chromian spinel in the homogeneous dunite (of 04SFFPG03 series) is very high in Cr#, higher than 0.8. It is relatively low in TiO_2 (< 0.5 wt%).

5. Discussion

5-1 Nature of the dunite-wehrlite-clinopyroxenite-gabbro complex

The olivine-clinopyroxene rocks (dunite, wehrlite, olivine clinopyroxenite and clinopyroxenite) show layered structures both in hand specimen and in thin section. A kind of grading in terms of clinopyroxene size and of olivine/clinopyroxene proportion can be interpreted to be of cumulus origin. Mineral chemical change is gradual from wehrlite (dunite) to gabbro, indicating that the whole rock suite (dunite to gabbro) may have been a series of cumulates from magma(s). The order of crystallization was olivine (chromian spinel), clinopyroxene, orthopyroxene and plagioclase (and magnetite). Gabbroic or felsic veins within the ultramafic rocks were due to invasion of fractionated magma into earlier cumulates.

The Mg#s of both olivine and clinopyroxene had been less scattered in the dunite-wehrlite-clinopyroxenite suite at the high-temperature igneous stage (Arai et al., 1988). They have been greatly changed due to element redistribution during cooling depending on temperature and/or mineral proportion (Arai et al., 1988). We suggest the Mg# had been initially around 0.88 for both olivine and clinopyroxene at high-temperature (solidus) stage.

The homogeneous dunite (of 04SFFPG03 series) is very similar in appearance to the dunite from the Moho-transition zone of ophiolite. This dunite is different in origin from the dunite from the possibly layered complex (04SFAD07 series).

5-2 Implications for the tectonic setting of formation

The order of mineral precipitation of the involved melt was olivine (+ chromian spinel) followed by clinopyroxene, which is different from that for ordinary MORB (mid-ocean ridge basalt), olivine followed by plagioclase (e.g., Shido et al., 1971).

The chromian spinel is relatively low in TiO_2 at given Fe^{3+} ratios. The relations of Cr#-TiO_2 content and Fe^{3+}#-TiO_2 content of chromian spinel in the dunite-wehrlite suggest an arc-type signature for the involved magma, although the discrimination diagrams, which were originally proposed for volcanics, are not exactly applied to such deeper-seated cumulative rocks (Arai, 1992). The Cr# of spinel is beyond the range of 0.1 to 0.6, clearly denying the mid-ocean ridge origin and indicating an arc origin for the rock suite. Almost all chromian spinels found in any kind of ocean-floor rocks (MORB and deep-seated rocks) are lower than 0.6 in Cr#. The residual mantle peridotite for the magma responsible for the

possibly layered rock suite (dunite-wehrlite-clinopyroxenite-gabbro of 04SFFPG03 series) may have been harzburgite containing chromian spinel with intermediate Cr#s, 0.4 to 0.6 (Arai, 1994b). This is almost equivalent to the most refractory harzburgite of all abyssal peridotites obtained from the ocean floor (e.g., Dick and Bullen, 1984; Niu and Hékinian, 1997). Please note, however, that this sort of harzburgite is also common to the sub-arc mantle (mantle wedge) (e.g., Arai, 1994a).

The dunite-wehrlite-clinopyroxenite-gabbro suite, possibly with layered structure, (especially of 04SFFPG03 series) obtained from the ocean floor off Fiji is different in lithology from the so-called late intrusive rocks in ophiolites (e.g., the Oman ophiolite). The latter is massive and homogeneous in appearance. The mineral chemistry is, however, strikingly similar in mineral chemistry, especially in spinel chemistry. The comparison between the two suites should be further proceeded based on more detailed mineral chemistry (especially trace-element characteristics of clinopyroxene).

Mineral chemistry, especially spinel chemistry, very clearly denis the mid-ocean ridge affinity, and we suggest that the dunite-wehrlite-clinopyroxenite-gabbro suite from Fiji was originated not from the mid-ocean ridge but from an arc as a whole. This is consistent with that dunite-wehrlite-clinopyroxenite series of rocks have not been documented from the ocean floor (e.g., Dick, 1989; Dick and Natland, 1996; Arai and Matsukage, 1996) but have been very commonly found as xenoliths from arcs (e.g., Arai et al., 1998, 2000). We should further examine trace-element characteristics of clinopyroxene by La-ICP-MS in the future in order to further specify the tectonic setting of its genesis.

6. Remarks

Descriptions and interpretations in this report were achieved by Prof. Shoji Arai, Kanazawa University, Kanazawa, Ishikawa Prefecture, Japan, and Mr.Hidenobu Okamura conducted all microprobe analysis on minerals and modal analysis by point-counter at Kanazawa University supported by Dr. Miki Shirasaka, Kanazawa University.

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modal composition

sample name	rock name	olivine	clino-pyroxene	ortho-pyroxene	plagioclase	amphibole	spinel	magnetite	total	degree of alteration
04SFAD07C1	gabbro		45.2	0.8	53.4			0.6	100.0	2.0
04SFAD07C4	dunite	87.6	9.7				2.7		100.0	97.3
04SFAD07C12-2	wehrlite	56.6	42.2	0.4			0.8		100.0	32.3
04SFAD07C13-5	wehrlite	55.6	43.0		0.1	0.3	1.0		100.0	40.1
04SFAD07C15-2	olivine clinopyroxenite	33.8	65.0	0.2			1.0		100.0	30.1
04SFAD07C17-1	wehrlite	55.9	42.8			0.8	0.6		100.0	38.8
04SFAD07C18-2	olivine clinopyroxenite	27.1	71.4	0.6			0.9		100.0	24.7
04SFAD07C19-2	wehrlite	51.0	47.4	0.6			1.0		100.0	48.4
04SFAD07C21-2	wehrlite	87.1	10.7				2.2		100.0	79.1
04SFFDG03P3-1	dunite	96.9					3.1		100.0	96.9

olivine

Sample name	04SFAD07C12-1					04SFAD07C12-2					
Rock name	wehrlite					wehrlite					
Point number	5	8	11	12	16	4	5	12	14	15	16
Analysis number	10	14	17	18	22	122	123	129	131	132	133
Analysis point	core	core	core	core	core	core	core	core	core	core	core
SiO2	40.52	40.89	40.79	40.92	40.81	40.68	40.76	40.70	40.97	40.59	40.63
TiO2	0.03	0.00	0.01	0.00	0.03	0.02	0.00	0.00	0.00	0.02	0.02
Al2O3	0.02	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00
Cr2O3	0.01	0.00	0.05	0.00	0.01	0.00	0.00	0.03	0.02	0.00	0.00
FeO*	12.08	11.97	12.00	12.28	12.07	11.88	12.07	12.04	12.12	12.05	11.65
MnO	0.21	0.20	0.16	0.17	0.18	0.16	0.19	0.20	0.20	0.20	0.18
MgO	48.03	47.62	47.85	47.89	47.91	47.31	47.36	47.44	47.32	47.13	47.11
CaO	0.03	0.01	0.02	0.05	0.01	0.03	0.02	0.01	0.01	0.02	0.00
Na2O	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01
K2O	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.00	0.01
NiO	0.20	0.18	0.18	0.19	0.19	0.20	0.19	0.19	0.19	0.19	0.18
Total	101.13	100.86	101.10	101.51	101.22	100.29	100.62	100.61	100.85	100.19	99.77
Fo	87.637	87.643	87.672	87.429	87.621	87.655	87.488	87.541	87.439	87.452	87.820
Si	0.993	1.003	0.999	0.999	0.998	1.003	1.003	1.001	1.005	1.003	1.006
Ti	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Al	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Cr	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe	0.248	0.245	0.246	0.251	0.247	0.245	0.248	0.248	0.249	0.249	0.241
Mn	0.004	0.004	0.003	0.003	0.004	0.003	0.004	0.004	0.004	0.004	0.004
Mg	1.755	1.741	1.747	1.743	1.747	1.739	1.737	1.740	1.731	1.736	1.739
Ca	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000	0.000	0.001	0.000
Na	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
K	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ni	0.004	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Total	3.006	2.997	3.001	3.001	3.002	2.997	2.997	2.999	2.995	2.997	2.994
O=	4	4	4	4	4	4	4	4	4	4	4

olivine

Sample name	04SFAD07C13-5					04SFAD07C15-1					
Rock name	wehrlite					wehrlite					
Point number	4	9	16b	17b	8b	3	14	15	16	17	18
Analysis number	70	75	83	85	86	31	41	42	43	44	45
Analysis point	core	core	core	core	core	core	core	core	core	core	core
SiO2	39.12	39.21	39.93	39.63	39.21	39.54	39.79	39.55	39.68	39.79	39.73
TiO2	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.03	0.00	0.02
Al2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
FeO*	19.79	18.11	15.31	15.37	19.00	17.68	16.48	17.34	17.07	16.56	16.39
MnO	0.31	0.32	0.22	0.23	0.32	0.28	0.29	0.28	0.28	0.24	0.23
MgO	41.58	42.32	45.18	44.88	42.59	43.26	44.44	43.94	44.11	44.54	44.73
CaO	0.02	0.04	0.03	0.01	0.01	0.03	0.02	0.02	0.02	0.05	0.02
Na2O	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.03	0.02	0.00
K2O	0.01	0.01	0.01	0.02	0.01	0.00	0.03	0.02	0.02	0.00	0.00
NiO	0.14	0.15	0.16	0.16	0.15	0.16	0.15	0.17	0.14	0.15	0.17
Total	100.96	100.15	100.85	100.31	101.29	100.95	101.27	101.33	101.38	101.35	101.30
Fo	78.924	80.640	84.025	83.886	79.988	81.348	82.775	81.877	82.163	82.740	82.949
Si	0.996	0.998	0.996	0.995	0.991	0.996	0.994	0.992	0.993	0.993	0.992
Ti	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Al	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe	0.421	0.386	0.319	0.323	0.402	0.373	0.344	0.364	0.357	0.346	0.342
Mn	0.007	0.007	0.005	0.005	0.007	0.006	0.006	0.006	0.006	0.005	0.005
Mg	1.577	1.606	1.680	1.679	1.605	1.625	1.655	1.643	1.646	1.657	1.665
Ca	0.000	0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001
Na	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000
K	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.001	0.000	0.000
Ni	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Total	3.005	3.002	3.004	3.006	3.009	3.004	3.006	3.008	3.008	3.007	3.008
O=	4	4	4	4	4	4	4	4	4	4	4

olivine

Sample name	04SFAD07C15-2					04SFAD07C17-1					
Rock name	olivine clinopyroxenite					wehrlite					
Point number	2	4	5	1b	3b	4b	5	7	8	9	11
Analysis number	47	50	51	64	65	141	142	146	147	148	150
Analysis point	core	core	core	core	core	core	core	core	core	core	core
SiO2	38.96	39.46	39.77	39.42	39.25	40.20	40.32	40.41	40.32	40.22	40.09
TiO2	0.00	0.02	0.02	0.02	0.01	0.00	0.03	0.00	0.01	0.00	0.01
Al2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Cr2O3	0.02	0.02	0.02	0.00	0.00	0.00	0.04	0.00	0.04	0.00	0.02
FeO*	17.78	16.78	17.21	17.57	16.78	14.69	14.96	14.93	14.49	14.75	15.23
MnO	0.27	0.24	0.26	0.30	0.24	0.26	0.27	0.23	0.20	0.21	0.22
MgO	42.79	43.96	43.88	43.02	43.62	45.21	45.27	45.00	45.64	45.47	45.42
CaO	0.01	0.03	0.00	0.02	0.02	0.01	0.00	0.02	0.02	0.03	0.02
Na2O	0.01	0.03	0.02	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
K2O	0.00	0.01	0.02	0.01	0.02	0.00	0.00	0.01	0.03	0.01	0.01
NiO	0.18	0.17	0.15	0.15	0.16	0.18	0.17	0.16	0.17	0.16	0.16
Total	100.00	100.72	101.33	100.51	100.09	100.57	101.07	100.75	100.91	100.85	101.19
Fo	81.099	82.361	81.962	81.360	82.246	84.585	84.360	84.311	84.881	84.601	84.164
Si	0.993	0.993	0.996	0.997	0.994	1.002	1.001	1.006	1.001	1.000	0.996
Ti	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Al	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.000
Fe	0.379	0.353	0.360	0.372	0.355	0.306	0.311	0.311	0.301	0.307	0.316
Mn	0.006	0.005	0.005	0.006	0.005	0.006	0.006	0.005	0.004	0.004	0.005
Mg	1.625	1.649	1.638	1.623	1.647	1.680	1.676	1.669	1.688	1.685	1.682
Ca	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.000	0.001	0.001	0.001
Na	0.000	0.002	0.001	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000
K	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000
Ni	0.004	0.003	0.003	0.003	0.003	0.004	0.003	0.003	0.003	0.003	0.003
Total	3.007	3.007	3.004	3.002	3.006	2.999	2.998	2.995	2.999	3.000	3.004
O=	4	4	4	4	4	4	4	4	4	4	4

olivine

Sample name	04SFAD07C18-2					04SFAD07C19-2				
Rock name	olivine clinopyroxenite					wehrlite				
Point number	8	10	11	14	14b	7	12	15	8b	8c
Analysis number	70	72	73	78	79	34	41	43	45	46
Analysis point	core	core	core	core	core	core	core	core	core	core
SiO2	39.96	39.72	40.12	40.03	40.34	40.15	39.39	40.03	39.77	39.92
TiO2	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01
Al2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cr2O3	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
FeO*	14.42	14.29	14.41	14.52	14.54	15.79	15.79	16.10	16.45	16.03
MnO	0.22	0.23	0.23	0.22	0.22	0.26	0.23	0.22	0.25	0.26
MgO	46.13	45.90	46.00	45.59	46.18	44.92	44.41	44.78	44.43	44.66
CaO	0.01	0.01	0.00	0.02	0.02	0.01	0.03	0.03	0.03	0.01
Na2O	0.00	0.01	0.00	0.04	0.05	0.01	0.01	0.05	0.00	0.00
K2O	0.02	0.00	0.02	0.03	0.02	0.02	0.01	0.02	0.03	0.03
NiO	0.16	0.17	0.16	0.18	0.18	0.14	0.16	0.14	0.14	0.16
Total	100.93	100.34	100.93	100.66	101.56	101.30	100.03	101.39	101.11	101.07
Fo	85.084	85.131	85.056	84.840	84.987	83.526	83.374	83.217	82.807	83.238
Si	0.992	0.992	0.995	0.997	0.995	0.999	0.994	0.996	0.995	0.997
Ti	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Al	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe	0.299	0.298	0.299	0.302	0.300	0.328	0.333	0.335	0.344	0.335
Mn	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Mg	1.708	1.709	1.702	1.693	1.699	1.665	1.670	1.662	1.657	1.662
Ca	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.001	0.000
Na	0.000	0.001	0.000	0.002	0.002	0.000	0.000	0.002	0.000	0.000
K	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Ni	0.003	0.003	0.003	0.004	0.003	0.003	0.003	0.003	0.003	0.003
Total	3.008	3.008	3.005	3.004	3.006	3.002	3.007	3.005	3.006	3.003
O=	4	4	4	4	4	4	4	4	4	4

olivine

Sample name	04SFAD07C20				04SFAD07C21-1				
Rock name	wehrlite				wehrlite				
Point number	3	5	6	11	6	7	13	14	15c
Analysis number	91	93	94	99	111	112	118	119	122
Analysis point	core	core	core	core	core	core	core	core	core
SiO2	40.67	40.69	40.83	40.34	40.81	40.12	40.49	40.62	40.38
TiO2	0.00	0.00	0.02	0.03	0.00	0.00	0.00	0.00	0.00
Al2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cr2O3	0.00	0.04	0.00	0.02	0.00	0.02	0.02	0.00	0.00
FeO*	11.77	11.67	11.74	11.85	12.05	11.99	11.75	11.88	12.00
MnO	0.18	0.16	0.16	0.18	0.17	0.19	0.17	0.21	0.19
MgO	48.33	48.26	48.30	48.32	48.48	48.45	48.51	48.27	48.63
CaO	0.02	0.01	0.02	0.02	0.00	0.02	0.02	0.02	0.02
Na2O	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.01	0.00
K2O	0.01	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.02
NiO	0.20	0.20	0.17	0.19	0.18	0.19	0.19	0.19	0.18
Total	101.18	101.03	101.24	100.96	101.70	100.99	101.18	101.20	101.41
Fo	87.978	88.055	88.005	87.903	87.767	87.810	88.038	87.871	87.841
Si	0.995	0.996	0.997	0.990	0.994	0.985	0.991	0.994	0.987
Ti	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Al	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cr	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe	0.241	0.239	0.240	0.243	0.245	0.246	0.240	0.243	0.245
Mn	0.004	0.003	0.003	0.004	0.003	0.004	0.003	0.004	0.004
Mg	1.762	1.761	1.758	1.767	1.760	1.774	1.769	1.761	1.772
Ca	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000
Na	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000
K	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000
Ni	0.004	0.004	0.003	0.004	0.004	0.004	0.004	0.004	0.004
Total	3.006	3.004	3.003	3.010	3.006	3.015	3.010	3.007	3.013
O=	4	4	4	4	4	4	4	4	4

olivine

Sample name	04SFAD07C21-2				
Rock name	wehrlite				
Point number	1	2	3	4	5
Analysis number	47	48	49	51	52
Analysis point	core	core	core	core	core
SiO2	41.00	40.95	40.83	40.82	40.95
TiO2	0.00	0.00	0.00	0.00	0.00
Al2O3	0.00	0.00	0.00	0.00	0.02
Cr2O3	0.00	0.00	0.02	0.01	0.00
FeO*	11.50	11.78	11.89	11.88	11.78
MnO	0.17	0.17	0.15	0.17	0.21
MgO	48.07	48.59	48.44	48.39	48.46
CaO	0.02	0.02	0.03	0.02	0.02
Na2O	0.00	0.02	0.01	0.01	0.01
K2O	0.01	0.01	0.02	0.01	0.02
NiO	0.19	0.02	0.18	0.19	0.18
Total	100.95	101.56	101.57	101.49	101.64
Fo	88.169	88.024	87.898	87.899	88.000
Si	1.003	0.996	0.995	0.995	0.996
Ti	0.000	0.000	0.000	0.000	0.000
Al	0.000	0.000	0.000	0.000	0.000
Cr	0.000	0.000	0.000	0.000	0.000
Fe	0.235	0.240	0.242	0.242	0.240
Mn	0.003	0.004	0.003	0.004	0.004
Mg	1.752	1.762	1.760	1.759	1.758
Ca	0.001	0.000	0.001	0.000	0.000
Na	0.000	0.001	0.000	0.000	0.001
K	0.000	0.000	0.001	0.000	0.001
Ni	0.004	0.000	0.004	0.004	0.003
Total	2.998	3.004	3.005	3.005	3.004
O=	4	4	4	4	4

olivine

Sample name	04SFAD07C24							
Rock name	olivine clinopyroxenite							
Point number	2	6	11	13	15	16b	01b	3
Analysis number	81	83	87	93	95	98	101	102
Analysis point	core	core	core	core	core	core	core	core
SiO2	40.37	40.01	40.15	40.40	39.34	40.61	40.03	40.52
TiO2	0.02	0.01	0.02	0.00	0.00	0.00	0.01	0.00
Al2O3	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
Cr2O3	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
FeO*	14.81	14.75	14.87	14.95	14.99	14.66	14.94	15.14
MnO	0.22	0.21	0.19	0.23	0.21	0.22	0.20	0.24
MgO	46.02	45.57	45.94	45.06	45.03	45.78	45.56	45.44
CaO	0.01	0.02	0.00	0.03	0.01	0.02	0.03	0.06
Na2O	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00
K2O	0.02	0.01	0.02	0.00	0.03	0.02	0.01	0.00
NiO	0.14	0.16	0.15	0.14	0.17	0.15	0.15	0.16
Total	101.60	100.73	101.35	100.83	99.78	101.47	100.95	101.56
Fo	84.711	84.629	84.635	84.311	84.261	84.769	84.459	84.255
Si	0.996	0.996	0.994	1.005	0.992	1.002	0.996	1.001
Ti	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Al	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe	0.306	0.307	0.308	0.311	0.316	0.303	0.311	0.313
Mn	0.005	0.004	0.004	0.005	0.004	0.005	0.004	0.005
Mg	1.693	1.692	1.695	1.671	1.692	1.684	1.689	1.674
Ca	0.000	0.001	0.000	0.001	0.000	0.001	0.001	0.001
Na	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000
K	0.001	0.000	0.001	0.000	0.001	0.001	0.000	0.000
Ni	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Total	3.004	3.004	3.006	2.995	3.009	2.998	3.005	2.998
O=	4	4	4	4	4	4	4	4

clinopyroxene

Sample name	04SFAD07C12-1								
Rock name	wehrlite								
Point number	1	2	4	6	7b	9	13	14	17
Analysis number	6	7	9	11	13	15	19	20	23
Analysis point	core	core	core	core	core	core	core	core	core
SiO2	52.74	54.21	53.12	53.89	55.60	54.26	54.48	54.63	54.07
TiO2	0.09	0.06	0.10	0.08	0.06	0.08	0.10	0.09	0.03
Al2O3	2.95	1.42	2.54	2.24	1.21	2.33	1.77	1.88	2.59
Cr2O3	0.88	0.33	0.62	0.85	0.39	0.52	0.45	0.70	1.00
FeO*	3.15	2.89	3.20	3.09	2.84	3.26	3.04	2.94	5.16
MnO	0.12	0.11	0.14	0.13	0.12	0.16	0.09	0.11	0.13
MgO	16.64	17.04	16.50	16.86	17.38	16.95	16.93	17.28	20.53
CaO	23.55	24.65	23.70	23.76	24.58	23.43	24.06	23.78	16.87
Na2O	0.17	0.08	0.20	0.13	0.05	0.21	0.13	0.11	0.16
K2O	0.01	0.01	0.02	0.01	0.00	0.02	0.02	0.02	0.00
NiO	0.01	0.00	0.01	0.02	0.01	0.01	0.02	0.05	0.03
Total	100.30	100.80	100.16	101.06	102.22	101.23	101.09	101.57	100.56
Mg#	0.904	0.913	0.902	0.907	0.916	0.903	0.908	0.913	0.876
En	47.101	46.832	46.709	47.280	47.434	47.593	47.111	47.976	57.757
Fs	5.000	4.463	5.087	4.852	4.348	5.131	4.753	4.582	8.143
Wo	47.899	48.705	48.204	47.868	48.218	47.275	48.136	47.442	34.099
Si	1.920	1.961	1.936	1.944	1.978	1.951	1.963	1.957	1.940
Ti	0.003	0.002	0.003	0.002	0.001	0.002	0.003	0.002	0.001
Al	0.126	0.061	0.109	0.095	0.051	0.099	0.075	0.079	0.110
Cr	0.025	0.009	0.018	0.024	0.011	0.015	0.013	0.020	0.028
Fe	0.096	0.088	0.098	0.093	0.085	0.098	0.092	0.088	0.155
Mn	0.004	0.003	0.004	0.004	0.004	0.005	0.003	0.003	0.004
Mg	0.903	0.919	0.897	0.907	0.922	0.909	0.909	0.923	1.098
Ca	0.918	0.956	0.925	0.918	0.937	0.903	0.929	0.913	0.648
Na	0.012	0.006	0.014	0.009	0.003	0.015	0.009	0.008	0.011
K	0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.001	0.000
Ni	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.001	0.001
Total	4.008	4.005	4.005	3.999	3.991	3.998	3.995	3.995	3.996
O=	6	6	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C12-2						
Rock name	wehrlite						
Point number	1	3	7	8	9	17	20
Analysis number	120	122	126	127	128	134	136
Analysis point	core	core	core	core	core	core	core
SiO2	54.36	53.00	53.61	53.67	54.36	53.55	53.61
TiO2	0.08	0.15	0.11	0.12	0.04	0.12	0.12
Al2O3	1.68	2.59	2.89	2.65	1.13	2.54	1.60
Cr2O3	0.45	0.75	0.74	0.89	0.23	0.99	0.53
FeO*	3.05	3.12	3.48	3.22	2.70	2.96	2.66
MnO	0.09	0.09	0.08	0.10	0.10	0.12	0.21
MgO	16.93	16.93	16.86	16.71	17.00	16.70	17.05
CaO	24.64	23.17	23.56	23.47	24.61	23.59	23.90
Na2O	0.05	0.19	0.21	0.17	0.06	0.19	0.10
K2O	0.02	0.00	0.02	0.01	0.00	0.02	0.02
NiO	0.02	0.02	0.03	0.03	0.01	0.02	0.01
Total	101.37	100.02	101.58	101.04	100.23	100.78	99.79
Mg#	0.908	0.906	0.896	0.903	0.918	0.909	0.919
En	46.577	47.906	47.173	47.226	46.951	47.283	47.732
Fs	4.703	4.958	5.464	5.100	4.183	4.707	4.180
Wo	48.719	47.136	47.363	47.673	48.866	48.010	48.088
Si	1.957	1.931	1.926	1.937	1.975	1.937	1.957
Ti	0.002	0.004	0.003	0.003	0.001	0.003	0.003
Al	0.071	0.111	0.122	0.113	0.048	0.108	0.069
Cr	0.013	0.022	0.021	0.025	0.007	0.028	0.015
Fe	0.092	0.095	0.105	0.097	0.082	0.090	0.081
Mn	0.003	0.003	0.003	0.003	0.003	0.004	0.006
Mg	0.908	0.920	0.903	0.899	0.920	0.900	0.928
Ca	0.950	0.905	0.907	0.907	0.958	0.914	0.935
Na	0.004	0.014	0.014	0.012	0.004	0.013	0.007
K	0.001	0.000	0.001	0.000	0.000	0.001	0.001
Ni	0.001	0.001	0.001	0.001	0.000	0.001	0.000
Total	4.001	4.005	4.007	3.997	3.999	3.999	4.002
O=	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C13-5					
Rock name	wehrlite					
Point number	3	5	6	11	14	15
Analysis number	69	71	72	77	80	81
Analysis point	core	core	core	core	core	core
SiO2	54.75	53.94	53.78	53.92	53.87	53.66
TiO2	0.07	0.08	0.09	0.04	0.10	0.09
Al2O3	0.92	1.53	1.18	1.13	1.73	1.93
Cr2O3	0.39	0.63	0.37	0.56	0.93	0.91
FeO*	3.31	3.37	4.74	3.34	3.53	3.87
MnO	0.13	0.11	0.13	0.15	0.14	0.15
MgO	17.07	16.44	17.28	16.72	16.68	17.61
CaO	23.98	23.56	22.10	23.32	22.97	21.57
Na2O	0.14	0.13	0.12	0.11	0.16	0.15
K2O	0.02	0.01	0.02	0.01	0.01	0.01
NiO	0.03	0.02	0.04	0.00	0.03	0.00
Total	100.80	99.82	99.87	99.30	100.15	99.93
Mg#	0.902	0.897	0.867	0.899	0.894	0.890
En	47.199	46.623	48.241	47.287	47.422	49.905
Fs	5.137	5.365	7.419	5.302	5.636	6.157
Wo	47.663	48.012	44.341	47.411	46.942	43.938
Si	1.980	1.970	1.969	1.979	1.962	1.953
Ti	0.002	0.002	0.003	0.001	0.003	0.002
Al	0.039	0.066	0.051	0.049	0.074	0.083
Cr	0.011	0.018	0.011	0.016	0.027	0.026
Fe	0.100	0.103	0.145	0.103	0.108	0.118
Mn	0.004	0.003	0.004	0.005	0.004	0.005
Mg	0.920	0.895	0.943	0.914	0.905	0.956
Ca	0.929	0.922	0.867	0.917	0.896	0.841
Na	0.010	0.009	0.008	0.008	0.011	0.010
K	0.001	0.001	0.001	0.001	0.001	0.000
Ni	0.001	0.001	0.001	0.000	0.001	0.000
Total	3.998	3.991	4.003	3.992	3.991	3.995
O=	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C15-1						
Rock name	wehrlite						
Point number	1	2	4	5	6	7	8
Analysis number	29	30	32	33	34	35	36
Analysis point	core	core	core	core	core	core	core
SiO2	53.62	53.65	53.42	53.99	53.83	53.69	53.44
TiO2	0.06	0.09	0.33	0.07	0.10	0.10	0.08
Al2O3	1.79	2.06	1.99	2.05	2.03	1.83	1.87
Cr2O3	0.89	0.83	0.50	0.80	0.69	0.72	0.63
FeO*	3.69	3.68	4.86	3.78	3.31	3.29	3.40
MnO	0.15	0.12	0.17	0.16	0.12	0.14	0.15
MgO	16.94	16.80	15.97	16.67	16.64	16.56	16.79
CaO	22.63	22.89	22.29	22.70	23.53	23.63	23.64
Na2O	0.21	0.17	0.24	0.16	0.11	0.14	0.11
K2O	0.01	0.02	0.00	0.03	0.02	0.02	0.02
NiO	0.01	0.02	0.00	0.03	0.01	0.02	0.01
Total	100.00	100.33	99.77	100.45	100.38	100.12	100.12
Mg#	0.891	0.890	0.854	0.887	0.900	0.900	0.898
En	48.020	47.565	46.007	47.481	46.992	46.791	47.046
Fs	5.868	5.851	7.846	6.044	5.241	5.209	5.345
Wo	46.112	46.584	46.147	46.475	47.767	48.000	47.609
Si	1.956	1.951	1.959	1.959	1.955	1.957	1.949
Ti	0.002	0.003	0.009	0.002	0.003	0.003	0.002
Al	0.077	0.088	0.086	0.088	0.087	0.078	0.080
Cr	0.026	0.024	0.014	0.023	0.020	0.021	0.018
Fe	0.113	0.112	0.149	0.115	0.100	0.100	0.104
Mn	0.005	0.004	0.005	0.005	0.004	0.004	0.005
Mg	0.921	0.911	0.873	0.902	0.901	0.899	0.913
Ca	0.885	0.892	0.876	0.883	0.916	0.923	0.924
Na	0.015	0.012	0.017	0.011	0.008	0.010	0.008
K	0.000	0.001	0.000	0.002	0.001	0.001	0.001
Ni	0.000	0.001	0.000	0.001	0.000	0.001	0.000
Total	3.999	3.997	3.990	3.990	3.993	3.996	4.004
O=	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C15-2								
Rock name	olivine clinopyroxenite								
Point number	1	6	8	9	10	13	14	16	17
Analysis number	46	52	54	55	56	59	60	62	63
Analysis point	core	core	core	core	core	core	core	core	core
SiO2	53.24	53.20	53.26	53.30	54.77	54.57	53.98	54.02	53.48
TiO2	0.14	0.10	0.09	0.36	0.04	0.05	0.06	0.07	0.10
Al2O3	2.05	2.05	1.77	1.86	0.76	1.29	1.85	1.39	2.26
Cr2O3	0.69	0.86	0.81	0.51	0.12	0.39	0.86	0.40	0.84
FeO*	3.73	3.99	3.43	3.64	3.21	3.24	3.40	3.77	3.42
MnO	0.13	0.14	0.13	0.12	0.15	0.11	0.14	0.11	0.11
MgO	16.31	16.53	16.31	16.48	16.96	17.02	16.50	16.71	16.53
CaO	23.33	23.13	24.08	23.76	24.52	24.20	24.03	23.69	23.07
Na2O	0.20	0.23	0.11	0.13	0.02	0.08	0.10	0.12	0.20
K2O	0.04	0.01	0.01	0.01	0.02	0.02	0.02	0.00	0.01
NiO	0.02	0.02	0.01	0.01	0.00	0.01	0.02	0.01	0.02
Total	99.88	100.27	100.01	100.17	100.57	100.96	100.94	100.30	100.03
Mg#	0.886	0.881	0.895	0.890	0.904	0.904	0.896	0.888	0.896
En	46.364	46.714	45.896	46.301	46.611	46.988	46.237	46.615	47.180
Fs	5.955	6.325	5.411	5.734	4.956	5.012	5.353	5.903	5.473
Wo	47.680	46.961	48.693	47.965	48.433	47.999	48.410	47.481	47.348
Si	1.949	1.942	1.949	1.946	1.986	1.971	1.954	1.967	1.949
Ti	0.004	0.003	0.002	0.010	0.001	0.001	0.002	0.002	0.003
Al	0.088	0.088	0.076	0.080	0.033	0.055	0.079	0.060	0.097
Cr	0.020	0.025	0.023	0.015	0.003	0.011	0.025	0.012	0.024
Fe	0.114	0.122	0.105	0.111	0.097	0.098	0.103	0.115	0.104
Mn	0.004	0.004	0.004	0.004	0.005	0.003	0.004	0.003	0.003
Mg	0.890	0.900	0.890	0.897	0.917	0.916	0.890	0.907	0.898
Ca	0.915	0.905	0.944	0.929	0.952	0.936	0.932	0.924	0.901
Na	0.014	0.016	0.008	0.009	0.002	0.005	0.007	0.009	0.014
K	0.002	0.001	0.000	0.000	0.001	0.001	0.001	0.000	0.000
Ni	0.001	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Total	4.001	4.007	4.003	4.001	3.996	3.998	3.997	4.000	3.995
O=	6	6	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C17-1						
Rock name	wehrlite						
Point number	1	2	3	6	12	13b	14
Analysis number	137	138	139	145	151	153	154
Analysis point	core	core	core	core	core	core	core
SiO2	54.91	54.06	53.84	53.97	55.30	54.75	53.85
TiO2	0.05	0.06	0.03	0.12	0.04	0.05	0.10
Al2O3	1.18	2.03	2.08	1.96	0.69	0.95	1.94
Cr2O3	0.43	0.80	0.82	0.78	0.21	0.25	0.61
FeO*	3.22	3.56	3.45	3.39	2.63	3.15	3.30
MnO	0.16	0.15	0.16	0.13	0.15	0.14	0.13
MgO	16.80	16.57	16.46	16.86	16.78	17.08	16.74
CaO	24.48	23.71	24.03	23.63	25.48	24.47	23.54
Na2O	0.03	0.18	0.10	0.16	0.04	0.05	0.18
K2O	0.02	0.02	0.01	0.02	0.00	0.02	0.02
NiO	0.02	0.03	0.01	0.00	0.02	0.01	0.03
Total	101.29	101.18	100.97	101.02	101.33	100.93	100.46
Mg#	0.903	0.892	0.895	0.899	0.919	0.906	0.900
En	46.402	46.540	46.151	47.166	45.887	46.878	47.140
Fs	4.993	5.610	5.427	5.326	4.031	4.853	5.219
Wo	48.605	47.850	48.422	47.507	50.082	48.268	47.641
Si	1.977	1.952	1.949	1.950	1.989	1.978	1.955
Ti	0.001	0.002	0.001	0.003	0.001	0.001	0.003
Al	0.050	0.087	0.089	0.083	0.029	0.041	0.083
Cr	0.012	0.023	0.023	0.022	0.006	0.007	0.018
Fe	0.097	0.108	0.104	0.103	0.079	0.095	0.100
Mn	0.005	0.005	0.005	0.004	0.004	0.004	0.004
Mg	0.902	0.892	0.888	0.908	0.900	0.920	0.906
Ca	0.944	0.917	0.932	0.915	0.982	0.947	0.915
Na	0.002	0.013	0.007	0.011	0.003	0.004	0.013
K	0.001	0.001	0.000	0.001	0.000	0.001	0.001
Ni	0.000	0.001	0.000	0.000	0.001	0.000	0.001
Total	3.992	3.999	3.998	4.000	3.994	3.999	3.999
O=	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C18-2								
Rock name	olivine clinopyroxenite								
Point number	1	2	3	4	04b	11b	12	13	13b
Analysis number	64	65	66	67	68	74	75	74	75
Analysis point	core	core	core	core	core	core	core	core	core
SiO2	54.61	53.52	54.19	54.63	54.33	53.69	53.98	53.97	54.16
TiO2	0.13	0.15	0.15	0.08	0.08	0.07	0.06	0.08	0.10
Al2O3	1.19	2.57	2.15	1.68	1.63	2.15	2.07	2.16	1.61
Cr2O3	0.33	0.66	0.52	0.26	0.39	0.88	0.77	0.63	0.38
FeO*	3.41	3.68	4.08	3.37	3.35	3.03	3.04	3.35	3.43
MnO	0.13	0.15	0.13	0.13	0.13	0.11	0.11	0.15	0.14
MgO	17.08	16.57	17.69	17.27	16.95	16.84	16.80	17.03	16.82
CaO	24.03	23.18	22.21	23.53	23.92	23.68	23.78	23.69	23.45
Na2O	0.07	0.18	0.14	0.15	0.15	0.15	0.15	0.15	0.16
K2O	0.02	0.02	0.01	0.04	0.02	0.00	0.02	0.02	0.01
NiO	0.02	0.05	0.01	0.04	0.02	0.02	0.02	0.00	0.01
Total	101.02	100.72	101.27	101.18	100.96	100.61	100.80	101.22	100.25
Mg#	0.899	0.889	0.886	0.901	0.900	0.908	0.908	0.901	0.897
En	47.090	46.950	49.224	47.878	47.053	47.369	47.197	47.385	47.257
Fs	5.273	5.849	6.361	5.237	5.218	4.772	4.791	5.224	5.398
Wo	47.638	47.201	44.415	46.885	47.729	47.858	48.012	47.392	47.345
Si	1.972	1.940	1.949	1.966	1.963	1.945	1.952	1.945	1.968
Ti	0.004	0.004	0.004	0.002	0.002	0.002	0.002	0.002	0.003
Al	0.050	0.110	0.091	0.071	0.070	0.092	0.088	0.092	0.069
Cr	0.010	0.019	0.015	0.007	0.011	0.025	0.022	0.018	0.011
Fe	0.103	0.112	0.123	0.101	0.101	0.092	0.092	0.101	0.104
Mn	0.004	0.005	0.004	0.004	0.004	0.003	0.003	0.004	0.004
Mg	0.919	0.895	0.948	0.926	0.913	0.910	0.906	0.915	0.911
Ca	0.930	0.900	0.856	0.907	0.926	0.919	0.921	0.915	0.913
Na	0.005	0.013	0.010	0.011	0.010	0.010	0.010	0.011	0.011
K	0.001	0.001	0.001	0.002	0.001	0.000	0.001	0.001	0.000
Ni	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.000	0.000
Total	3.998	3.999	4.000	3.999	4.000	4.000	3.997	4.003	3.995
O=	6	6	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C19-2								
Rock name	wehrlite								
Point number	1	2	3	4	6	9	10	11	13
Analysis number	26	28	29	30	33	37	38	39	42
Analysis point	core	core	core	core	core	core	core	core	core
SiO2	53.76	53.87	54.16	54.49	54.04	53.85	53.60	54.15	53.84
TiO2	0.10	0.04	0.07	0.08	0.10	0.10	0.08	0.14	0.12
Al2O3	1.84	1.58	1.44	1.34	2.20	1.94	2.10	1.54	2.12
Cr2O3	0.51	0.57	0.77	0.48	0.83	0.89	0.80	0.57	0.67
FeO*	3.70	3.79	3.65	3.52	3.76	3.84	3.58	3.64	3.89
MnO	0.12	0.17	0.16	0.10	0.16	0.15	0.15	0.12	0.14
MgO	16.74	16.64	16.68	16.92	16.58	16.56	16.49	16.64	17.01
CaO	23.99	23.97	23.97	24.20	23.94	23.58	23.66	24.54	23.46
Na2O	0.18	0.11	0.07	0.16	0.13	0.20	0.14	0.14	0.13
K2O	0.03	0.01	0.03	0.01	0.02	0.01	0.02	0.01	0.02
NiO	0.01	0.01	0.03	0.01	0.03	0.03	0.03	0.00	0.04
Total	100.98	100.76	101.02	101.30	101.78	101.14	100.63	101.50	101.42
Mg#	0.890	0.887	0.891	0.896	0.887	0.885	0.891	0.891	0.886
En	46.423	46.226	46.386	46.630	46.184	46.430	46.455	45.814	47.179
Fs	5.759	5.904	5.692	5.436	5.879	6.039	5.661	5.623	6.057
Wo	47.818	47.870	47.922	47.933	47.938	47.531	47.884	48.563	46.764
Si	1.948	1.956	1.961	1.965	1.943	1.948	1.947	1.954	1.941
Ti	0.003	0.001	0.002	0.002	0.003	0.003	0.002	0.004	0.003
Al	0.079	0.068	0.062	0.057	0.093	0.083	0.090	0.066	0.090
Cr	0.015	0.016	0.022	0.014	0.024	0.026	0.023	0.016	0.019
Fe	0.112	0.115	0.110	0.106	0.113	0.116	0.109	0.110	0.117
Mn	0.004	0.005	0.005	0.003	0.005	0.005	0.004	0.004	0.004
Mg	0.904	0.901	0.900	0.910	0.888	0.893	0.893	0.895	0.914
Ca	0.931	0.933	0.930	0.935	0.922	0.914	0.921	0.949	0.906
Na	0.012	0.008	0.005	0.011	0.009	0.014	0.010	0.009	0.009
K	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.001	0.001
Ni	0.000	0.000	0.001	0.000	0.001	0.001	0.001	0.000	0.001
Total	4.009	4.004	3.999	4.003	4.001	4.002	4.000	4.007	4.006
O=	6	6	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C20							
Rock name	wehrlite							
Point number	1	2	4	7	9	10	13	14
Analysis number	89	90	92	95	97	98	101	102
Analysis point	core	core	core	core	core	core	core	core
SiO2	53.50	53.46	53.74	53.67	54.66	53.65	52.61	53.65
TiO2	0.12	0.08	0.12	0.13	0.08	0.15	0.07	0.06
Al2O3	2.49	2.54	2.53	2.62	1.27	2.48	2.45	1.95
Cr2O3	0.87	0.86	0.72	0.79	0.44	0.86	1.10	0.37
FeO*	2.93	2.99	3.41	3.01	2.69	3.00	2.98	3.88
MnO	0.11	0.11	0.14	0.12	0.13	0.10	0.13	0.12
MgO	16.87	17.01	17.34	17.20	17.57	17.05	16.98	19.38
CaO	23.00	22.67	22.72	23.69	24.29	23.86	23.07	20.05
Na2O	0.12	0.15	0.12	0.17	0.04	0.18	0.23	0.14
K2O	0.00	0.02	0.02	0.02	0.02	0.02	0.01	0.01
NiO	0.00	0.03	0.02	0.02	0.02	0.02	0.01	0.02
Total	100.03	99.90	100.87	101.43	101.20	101.37	99.62	99.62
Mg#	0.911	0.910	0.901	0.911	0.921	0.910	0.910	0.899
En	48.140	48.626	48.733	47.895	48.095	47.513	48.191	53.879
Fs	4.690	4.791	5.376	4.698	4.128	4.689	4.738	6.047
Wo	47.170	46.583	45.891	47.407	47.777	47.798	47.071	40.073
Si	1.944	1.945	1.939	1.929	1.966	1.931	1.927	1.949
Ti	0.003	0.002	0.003	0.003	0.002	0.004	0.002	0.002
Al	0.107	0.109	0.107	0.111	0.054	0.105	0.106	0.083
Cr	0.025	0.025	0.021	0.022	0.012	0.024	0.032	0.010
Fe	0.089	0.091	0.103	0.090	0.081	0.090	0.091	0.118
Mn	0.003	0.003	0.004	0.004	0.004	0.003	0.004	0.004
Mg	0.914	0.922	0.933	0.922	0.942	0.915	0.927	1.050
Ca	0.896	0.883	0.878	0.912	0.936	0.920	0.905	0.781
Na	0.009	0.010	0.009	0.011	0.003	0.013	0.016	0.010
K	0.000	0.001	0.001	0.001	0.001	0.001	0.000	0.001
Ni	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
Total	3.991	3.992	3.998	4.007	4.001	4.007	4.011	4.007
O=	6	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C21-1					04SFAD07C21-2		
Rock name	wehrlite					wehrlite		
Point number	4	5	8	15	3b	9	01b	07d
Analysis number	110	111	113	120	123	58	62	63
Analysis point	core	core	core	core	core	core	core	core
SiO2	53.46	53.04	54.11	53.91	54.38	54.35	55.31	54.48
TiO2	0.09	0.11	0.05	0.13	0.09	0.13	0.06	0.06
Al2O3	2.85	3.00	0.86	1.56	1.06	2.15	0.81	1.27
Cr2O3	0.92	0.94	0.16	0.56	0.19	0.86	0.30	0.58
FeO*	5.80	3.40	2.56	2.67	2.34	2.98	2.15	2.75
MnO	0.13	0.11	0.11	0.10	0.07	0.12	0.08	0.12
MgO	22.49	16.57	16.99	16.85	17.22	17.74	17.03	17.36
CaO	14.25	22.76	24.54	24.22	25.13	22.83	25.30	23.86
Na2O	0.11	0.20	0.04	0.11	0.05	0.14	0.04	0.11
K2O	0.02	0.02	0.01	0.00	0.02	0.02	0.01	0.00
NiO	0.03	0.03	0.00	0.01	0.01	0.03	0.03	0.02
Total	100.15	100.19	99.42	100.10	100.54	101.35	101.11	100.61
Mg#	0.874	0.897	0.922	0.918	0.929	0.914	0.934	0.918
En	62.500	47.565	47.108	47.123	47.054	49.531	46.755	48.146
Fs	9.047	5.476	3.975	4.185	3.583	4.659	3.310	4.275
Wo	28.453	46.959	48.917	48.692	49.363	45.810	49.935	47.578
Si	1.920	1.930	1.981	1.961	1.969	1.948	1.988	1.970
Ti	0.002	0.003	0.001	0.004	0.002	0.003	0.002	0.002
Al	0.120	0.129	0.037	0.067	0.045	0.091	0.034	0.054
Cr	0.026	0.027	0.005	0.016	0.005	0.024	0.008	0.017
Fe	0.174	0.103	0.078	0.081	0.071	0.089	0.065	0.083
Mn	0.004	0.003	0.003	0.003	0.002	0.004	0.003	0.004
Mg	1.204	0.899	0.927	0.914	0.930	0.948	0.912	0.935
Ca	0.548	0.887	0.963	0.944	0.975	0.877	0.974	0.924
Na	0.007	0.014	0.003	0.008	0.003	0.010	0.003	0.007
K	0.001	0.001	0.000	0.000	0.001	0.001	0.000	0.000
Ni	0.001	0.001	0.000	0.000	0.000	0.001	0.001	0.001
Total	4.009	3.997	3.998	3.998	4.005	3.996	3.990	3.997
O=	6	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C24										
Rock name	olivine clinopyroxenite										
Point number	1	5	7	8	10	12	14	16	17	18	19
Analysis number	80	82	84	85	86	88	94	96	97	99	100
Analysis point	core	core	core	core	core	core	core	core	core	core	core
SiO2	54.08	53.05	53.83	53.58	54.03	54.15	54.70	54.04	54.76	54.00	54.36
TiO2	0.08	0.10	0.04	0.11	0.10	0.09	0.04	0.13	0.05	0.10	0.07
Al2O3	2.05	2.34	2.04	1.61	2.02	1.82	1.31	2.07	1.99	2.13	2.06
Cr2O3	0.47	0.54	0.40	0.40	0.41	0.47	0.39	0.47	0.34	0.47	0.42
FeO*	3.95	3.76	3.56	3.60	3.66	3.54	3.32	3.60	3.94	3.84	3.89
MnO	0.10	0.13	0.12	0.13	0.13	0.11	0.12	0.15	0.15	0.12	0.11
MgO	17.28	17.09	16.85	16.52	17.08	17.18	16.88	16.64	17.54	16.96	16.89
CaO	22.10	22.62	23.23	24.15	22.84	23.70	24.12	23.51	22.67	23.31	23.33
Na2O	0.14	0.12	0.14	0.08	0.19	0.14	0.11	0.15	0.13	0.17	0.13
K2O	0.00	0.02	0.01	0.03	0.02	0.00	0.01	0.02	0.00	0.02	0.03
NiO	0.01	0.03	0.01	0.02	0.02	0.03	0.02	0.02	0.02	0.04	0.03
Total	100.26	99.80	100.21	100.23	100.49	101.22	101.00	100.79	101.60	101.13	101.31
Mg#	0.886	0.890	0.894	0.891	0.893	0.896	0.900	0.892	0.888	0.887	0.886
En	48.851	48.200	47.416	46.019	48.049	47.453	46.781	46.789	48.665	47.288	47.120
Fs	6.262	5.950	5.618	5.626	5.779	5.491	5.169	5.683	6.137	5.999	6.090
Wo	44.888	45.850	46.967	48.355	46.172	47.056	48.050	47.528	45.198	46.713	46.790
Si	1.961	1.939	1.957	1.956	1.958	1.952	1.974	1.956	1.961	1.949	1.957
Ti	0.002	0.003	0.001	0.003	0.003	0.002	0.001	0.003	0.001	0.003	0.002
Al	0.088	0.101	0.087	0.069	0.086	0.077	0.056	0.088	0.084	0.090	0.087
Cr	0.014	0.016	0.011	0.012	0.012	0.013	0.011	0.013	0.010	0.013	0.012
Fe	0.120	0.115	0.108	0.110	0.111	0.107	0.100	0.109	0.118	0.116	0.117
Mn	0.003	0.004	0.004	0.004	0.004	0.003	0.004	0.005	0.004	0.004	0.003
Mg	0.934	0.931	0.913	0.899	0.923	0.923	0.908	0.898	0.937	0.913	0.906
Ca	0.859	0.886	0.905	0.944	0.887	0.916	0.933	0.912	0.870	0.902	0.900
Na	0.010	0.009	0.010	0.006	0.013	0.010	0.008	0.011	0.009	0.012	0.009
K	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.001	0.000	0.001	0.001
Ni	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.001	0.001	0.001
Total	3.991	4.005	3.998	4.004	3.998	4.005	3.996	3.996	3.995	4.003	3.996
O=	6	6	6	6	6	6	6	6	6	6	6

spinel

Sample name	04SFAD07C4					04SFAD07C5				
Rock name	dunite					dunite				
Point number	1	2	3	4	5	1	2	3	4	5
Analysis number	114	115	116	117	118	109	110	111	112	113
Analysis point	core	core	core	core	core	core	core	core	core	core
SiO2	0.00	0.00	0.00	0.03	0.01	0.00	0.01	0.02	0.01	0.00
TiO2	0.26	0.28	0.22	0.22	0.25	0.17	0.26	0.22	0.25	0.30
Al2O3	24.01	23.39	24.44	24.57	24.04	23.71	22.71	23.13	23.99	23.89
Cr2O3	39.58	39.59	39.18	38.84	39.00	37.97	40.63	38.93	39.20	38.79
FeO*	27.21	27.86	26.63	27.02	26.28	28.61	26.70	28.60	28.17	26.78
MnO	0.43	0.41	0.39	0.44	0.38	0.37	0.36	0.38	0.36	0.36
MgO	8.96	8.70	8.87	8.90	9.02	8.45	9.55	8.17	8.82	8.91
CaO	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02
Na2O	0.02	0.02	0.00	0.04	0.02	0.00	0.00	0.00	0.00	0.00
K2O	0.02	0.01	0.00	0.03	0.01	0.02	0.03	0.01	0.01	0.00
NiO	0.07	0.05	0.05	0.05	0.04	0.06	0.06	0.05	0.08	0.06
Total	100.57	100.31	99.78	100.12	99.04	99.35	100.31	99.52	100.88	99.11
Mg#	0.420	0.411	0.418	0.418	0.428	0.401	0.449	0.389	0.412	0.424
Cr#	0.525	0.532	0.518	0.515	0.521	0.518	0.546	0.530	0.523	0.521
Fe3+/(Cr+Al+Fe3+)	0.069	0.075	0.062	0.067	0.065	0.086	0.078	0.080	0.078	0.069
Si	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000
Ti	0.006	0.007	0.005	0.005	0.006	0.004	0.006	0.005	0.006	0.007
Al	0.896	0.879	0.915	0.918	0.907	0.901	0.852	0.880	0.895	0.903
Cr	0.991	0.998	0.985	0.973	0.987	0.968	1.022	0.994	0.981	0.983
Fe3+	0.125	0.136	0.112	0.121	0.117	0.156	0.143	0.145	0.141	0.125
Fe2+	0.583	0.593	0.586	0.585	0.575	0.607	0.555	0.616	0.593	0.579
Mn	0.011	0.011	0.010	0.012	0.010	0.010	0.010	0.010	0.010	0.010
Mg	0.423	0.414	0.420	0.421	0.430	0.406	0.453	0.393	0.416	0.426
Ca	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Na	0.001	0.001	0.000	0.002	0.001	0.000	0.000	0.000	0.000	0.000
K	0.001	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.000
Ni	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.002	0.001
Total	3.039	3.042	3.034	3.040	3.036	3.054	3.045	3.047	3.044	3.035
O=	4	4	4	4	4	4	4	4	4	4

spinel

Sample name	04SFAD07C12-1					04SFAD07C12-2				
Rock name	wehrlite					wehrlite				
Point number	3a	7a	10	15	3b	2	6	13	18	19
Analysis number	8	12	16	21	24	121	125	130	135	136
Analysis point	core	core	core	core	core	core	core	core	core	core
		(included by cpx)								
SiO2	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TiO2	0.08	0.25	0.18	0.13	0.11	0.09	0.06	0.14	0.12	0.29
Al2O3	31.45	18.45	25.86	28.83	31.04	31.48	29.69	27.31	29.34	20.06
Cr2O3	33.67	46.45	32.25	35.71	33.56	34.05	34.16	36.79	35.89	34.65
FeO*	24.08	25.03	32.48	25.18	24.97	23.63	26.12	27.36	24.62	36.63
MnO	0.34	0.32	0.42	0.31	0.35	0.31	0.38	0.38	0.35	0.49
MgO	10.22	9.90	7.84	10.14	9.92	11.18	9.68	9.01	10.57	6.51
CaO	0.00	0.02	0.02	0.01	0.00	0.01	0.00	0.00	0.02	0.01
Na2O	0.02	0.00	0.07	0.00	0.03	0.00	0.02	0.00	0.00	0.01
K2O	0.02	0.02	0.02	0.00	0.02	0.03	0.01	0.02	0.03	0.00
NiO	0.07	0.08	0.07	0.05	0.07	0.07	0.03	0.05	0.08	0.07
Total	99.96	100.52	99.22	100.36	100.07	100.85	100.16	101.06	101.00	98.72
Mg#	0.462	0.472	0.371	0.462	0.450	0.499	0.441	0.414	0.477	0.320
Cr#	0.418	0.628	0.456	0.454	0.420	0.421	0.436	0.475	0.451	0.537
Fe3+/(Cr+Al+Fe3+)	0.039	0.070	0.127	0.056	0.046	0.048	0.060	0.063	0.053	0.176
Si	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ti	0.002	0.006	0.004	0.003	0.002	0.002	0.001	0.003	0.003	0.007
Al	1.128	0.701	0.986	1.045	1.118	1.116	1.079	0.999	1.053	0.803
Cr	0.810	1.183	0.825	0.869	0.811	0.810	0.833	0.903	0.864	0.930
Fe3+	0.069	0.131	0.229	0.100	0.081	0.086	0.107	0.113	0.095	0.326
Fe2+	0.540	0.532	0.642	0.542	0.553	0.505	0.564	0.591	0.526	0.700
Mn	0.009	0.009	0.012	0.008	0.009	0.008	0.010	0.010	0.009	0.014
Mg	0.464	0.475	0.378	0.465	0.452	0.502	0.445	0.417	0.480	0.330
Ca	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Na	0.001	0.000	0.004	0.000	0.002	0.000	0.001	0.000	0.000	0.001
K	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.000
Ni	0.002	0.002	0.002	0.001	0.002	0.002	0.001	0.001	0.002	0.002
Total	3.026	3.040	3.084	3.034	3.030	3.031	3.041	3.039	3.034	3.112
O=	4	4	4	4	4	4	4	4	4	4

spinel

Sample name	04SFAD07C13-5					04SFAD07C15-1				
Rock name	wehrlite					wehrlite				
Point number	2	8	10	12	13	9	10	11	12	13
Analysis number	68	74	76	78	79	37	66	38	39	40
Analysis point	core	core	core	core	core	core	core	core	core	core
SiO2	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
TiO2	0.66	1.06	0.31	0.45	0.27	0.37	0.20	0.91	1.67	0.38
Al2O3	11.78	9.86	16.96	16.10	19.18	19.29	22.00	16.96	13.07	17.10
Cr2O3	31.85	29.25	33.87	33.16	35.82	33.67	34.18	31.99	30.07	32.99
FeO*	50.40	54.07	42.62	44.27	38.58	39.82	36.18	44.68	49.97	42.58
MnO	0.50	0.52	0.46	0.47	0.45	0.44	0.41	0.47	0.57	0.44
MgO	3.24	2.80	4.23	4.03	5.02	5.06	6.24	4.50	2.90	4.79
CaO	0.04	0.03	0.00	0.02	0.06	0.00	0.03	0.04	0.07	0.03
Na2O	0.00	0.01	0.05	0.02	0.01	0.02	0.02	0.01	0.02	0.01
K2O	0.03	0.01	0.02	0.02	0.02	0.01	0.03	0.01	0.01	0.01
NiO	0.08	0.11	0.09	0.07	0.09	0.08	0.08	0.08	0.12	0.10
Total	98.57	97.73	98.61	98.59	99.50	98.75	99.36	99.65	98.47	98.44
Mg#	0.171	0.151	0.215	0.206	0.249	0.252	0.303	0.229	0.157	0.242
Cr#	0.645	0.666	0.573	0.580	0.556	0.539	0.510	0.559	0.607	0.564
Fe3+/(Cr+Al+Fe3+)	0.335	0.393	0.227	0.249	0.171	0.194	0.156	0.252	0.316	0.238
Si	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ti	0.019	0.031	0.008	0.012	0.007	0.010	0.005	0.024	0.046	0.010
Al	0.518	0.448	0.707	0.678	0.772	0.785	0.866	0.702	0.570	0.712
Cr	0.940	0.892	0.947	0.936	0.967	0.919	0.903	0.888	0.880	0.922
Fe3+	0.659	0.782	0.427	0.471	0.316	0.359	0.285	0.470	0.593	0.449
Fe2+	0.878	0.900	0.817	0.828	0.772	0.771	0.716	0.794	0.861	0.789
Mn	0.016	0.017	0.014	0.014	0.013	0.013	0.012	0.014	0.018	0.013
Mg	0.181	0.161	0.223	0.215	0.256	0.260	0.311	0.236	0.160	0.253
Ca	0.001	0.001	0.000	0.001	0.002	0.000	0.001	0.001	0.003	0.001
Na	0.000	0.001	0.003	0.001	0.000	0.001	0.001	0.001	0.002	0.001
K	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001
Ni	0.002	0.003	0.003	0.002	0.003	0.002	0.002	0.002	0.003	0.003
Total	3.216	3.238	3.150	3.158	3.110	3.120	3.102	3.134	3.137	3.153
O=	4	4	4	4	4	4	4	4	4	4

spinel

Sample name	04SFAD07C15-2					04SFAD07C17-1			
Rock name	olivine clinopyroxenite					wehrlite			
Point number	3	7	11	12	15	4	5b	10	13
Analysis number	48	53	57	58	61	140	142	149	152
Analysis point	core	core	core	core	core	core	core	core	core
SiO2	0.00	0.02	0.01	0.00	0.00	0.02	0.00	0.01	0.02
TiO2	0.30	0.29	0.18	0.21	0.23	0.17	0.14	0.20	0.19
Al2O3	19.76	16.95	20.74	22.30	21.95	21.90	21.41	21.12	21.68
Cr2O3	34.80	32.43	36.09	34.61	35.91	34.64	36.11	36.93	36.85
FeO*	39.07	44.09	37.22	35.47	35.87	35.46	35.67	35.21	34.49
MnO	0.43	0.47	0.45	0.43	0.42	0.44	0.49	0.50	0.51
MgO	5.21	4.04	5.63	6.31	5.93	6.30	5.54	5.84	6.16
CaO	0.03	0.09	0.02	0.06	0.03	0.00	0.03	0.01	0.02
Na2O	0.00	0.04	0.01	0.05	0.00	0.05	0.02	0.01	0.03
K2O	0.02	0.01	0.01	0.00	0.01	0.02	0.00	0.02	0.03
NiO	0.05	0.08	0.07	0.06	0.07	0.05	0.06	0.07	0.07
Total	99.68	98.51	100.43	99.50	100.41	99.05	99.47	99.92	100.05
Mg#	0.257	0.205	0.273	0.305	0.286	0.306	0.270	0.284	0.298
Cr#	0.542	0.562	0.539	0.510	0.523	0.515	0.531	0.540	0.533
Fe3+/(Cr+Al+Fe3+)	0.179	0.247	0.155	0.145	0.138	0.149	0.135	0.132	0.126
Si	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.001
Ti	0.008	0.008	0.005	0.005	0.006	0.004	0.004	0.005	0.005
Al	0.793	0.711	0.816	0.873	0.855	0.863	0.845	0.829	0.845
Cr	0.936	0.913	0.953	0.909	0.938	0.916	0.956	0.972	0.964
Fe3+	0.331	0.466	0.284	0.264	0.250	0.272	0.245	0.240	0.229
Fe2+	0.765	0.830	0.746	0.711	0.730	0.711	0.746	0.731	0.715
Mn	0.012	0.014	0.013	0.012	0.012	0.013	0.014	0.014	0.014
Mg	0.264	0.214	0.280	0.312	0.292	0.314	0.277	0.290	0.304
Ca	0.001	0.003	0.001	0.002	0.001	0.000	0.001	0.000	0.001
Na	0.000	0.003	0.001	0.003	0.000	0.003	0.001	0.000	0.002
K	0.001	0.000	0.001	0.000	0.000	0.001	0.000	0.001	0.001
Ni	0.001	0.002	0.002	0.002	0.002	0.001	0.002	0.002	0.002
Total	3.113	3.166	3.102	3.094	3.087	3.099	3.090	3.085	3.083
O=	4	4	4	4	4	4	4	4	4

spinel

Sample name	04SFAD07C18-2			04SFAD07C19-2				
Rock name	olivine clinopyroxenite			wehrlite				
Point number	5	7	9	5	5b	8	11b	15b
Analysis number	68	69	71	31	32	36	40	44
Analysis point	core	core	core	core	core	core	core	core
SiO2	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.00
TiO2	0.17	0.16	0.17	0.24	0.23	0.24	0.21	0.27
Al2O3	24.44	22.04	26.00	20.25	18.95	21.60	21.25	19.86
Cr2O3	33.28	35.54	32.23	34.96	35.13	34.09	35.16	33.68
FeO*	34.04	35.43	32.67	38.33	39.47	37.07	36.18	39.24
MnO	0.45	0.45	0.35	0.43	0.46	0.42	0.42	0.47
MgO	6.73	6.28	7.30	5.52	5.29	5.90	6.17	5.37
CaO	0.02	0.00	0.02	0.01	0.01	0.02	0.00	0.02
Na2O	0.08	0.02	0.02	0.05	0.05	0.04	0.01	0.00
K2O	0.02	0.01	0.02	0.02	0.03	0.01	0.02	0.02
NiO	0.07	0.04	0.06	0.09	0.05	0.06	0.09	0.07
Total	99.28	99.96	98.83	99.89	99.70	99.45	99.52	98.99
Mg#	0.322	0.302	0.347	0.270	0.261	0.287	0.300	0.266
Cr#	0.477	0.520	0.454	0.537	0.554	0.514	0.526	0.532
Fe3+/(Cr+Al+Fe3+)	0.130	0.141	0.119	0.173	0.190	0.162	0.155	0.190
Si	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Ti	0.004	0.004	0.004	0.006	0.006	0.006	0.005	0.007
Al	0.945	0.860	0.996	0.806	0.764	0.854	0.838	0.802
Cr	0.863	0.931	0.828	0.934	0.950	0.904	0.931	0.912
Fe3+	0.233	0.258	0.214	0.319	0.353	0.296	0.284	0.352
Fe2+	0.692	0.715	0.666	0.751	0.764	0.732	0.718	0.758
Mn	0.012	0.013	0.010	0.012	0.013	0.012	0.012	0.013
Mg	0.329	0.310	0.354	0.278	0.270	0.295	0.308	0.274
Ca	0.001	0.000	0.001	0.000	0.000	0.001	0.000	0.001
Na	0.005	0.001	0.001	0.003	0.003	0.003	0.001	0.000
K	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001
Ni	0.002	0.001	0.002	0.002	0.001	0.002	0.002	0.002
Total	3.086	3.093	3.076	3.113	3.127	3.104	3.101	3.122
O=	4	4	4	4	4	4	4	4

spinel

Sample name	04SFAD07C20					
Rock name	wehrlite					
Point number	8	12	14b	15	16	17
Analysis number	96	100	103	104	105	106
Analysis point	core	core	core	core	core	core
		(included by cpx)				
SiO2	0.00	0.18	0.00	0.01	0.01	0.00
TiO2	0.18	0.24	0.21	0.22	0.18	0.19
Al2O3	26.28	24.09	16.49	23.23	24.58	24.58
Cr2O3	37.32	40.39	47.09	39.22	38.15	37.98
FeO*	26.81	25.29	26.38	27.98	27.95	27.26
MnO	0.38	0.39	0.35	0.37	0.34	0.36
MgO	10.00	10.61	9.69	8.84	8.97	9.85
CaO	0.00	0.03	0.02	0.01	0.02	0.00
Na2O	0.02	0.00	0.02	0.00	0.07	0.01
K2O	0.02	0.02	0.02	0.01	0.02	0.01
NiO	0.05	0.06	0.08	0.05	0.06	0.06
Total	101.06	101.28	100.35	99.95	100.35	100.29
Mg#	0.458	0.489	0.467	0.418	0.420	0.458
Cr#	0.488	0.529	0.657	0.531	0.510	0.509
Fe3+/(Cr+Al+Fe3+)	0.078	0.073	0.091	0.083	0.081	0.089
Si	0.000	0.006	0.000	0.000	0.000	0.000
Ti	0.004	0.006	0.005	0.005	0.004	0.004
Al	0.962	0.883	0.636	0.877	0.918	0.915
Cr	0.917	0.993	1.218	0.993	0.956	0.948
Fe3+	0.141	0.134	0.171	0.151	0.146	0.162
Fe2+	0.547	0.513	0.540	0.588	0.586	0.549
Mn	0.010	0.010	0.010	0.010	0.009	0.010
Mg	0.463	0.492	0.473	0.422	0.424	0.464
Ca	0.000	0.001	0.001	0.000	0.001	0.000
Na	0.001	0.000	0.001	0.000	0.004	0.000
K	0.001	0.001	0.001	0.000	0.001	0.000
Ni	0.001	0.001	0.002	0.001	0.002	0.002
Total	3.049	3.040	3.058	3.049	3.052	3.055
O=	4	4	4	4	4	4

spinel

Sample name	04SFAD07C21-1							
Rock name	wehrlite							
Point number	1	2	3	9	10	11	12	15b
Analysis number	107	108	109	114	115	116	117	121
Analysis point	core	core	core	core	core	core	core	core
		(included by cpx)						
SiO2	0.01	0.00	0.00	0.00	0.01	0.01	0.02	0.00
TiO2	0.11	0.16	0.12	0.10	0.17	0.12	0.11	0.09
Al2O3	19.95	16.78	29.54	24.18	24.31	24.95	25.82	25.93
Cr2O3	38.87	44.02	32.65	37.32	37.80	37.00	35.97	35.79
FeO*	31.49	31.27	27.51	29.28	28.95	28.56	28.67	27.94
MnO	0.45	0.55	0.38	0.43	0.44	0.40	0.41	0.43
MgO	7.40	6.57	9.62	8.77	8.36	8.70	8.56	8.92
CaO	0.00	0.00	0.00	0.01	0.01	0.02	0.00	0.01
Na2O	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.03
K2O	0.03	0.02	0.04	0.02	0.01	0.03	0.02	0.02
NiO	0.04	0.03	0.08	0.05	0.04	0.05	0.07	0.04
Total	98.33	99.40	99.95	100.17	100.10	99.86	99.64	99.20
Mg#	0.362	0.325	0.440	0.411	0.394	0.408	0.401	0.418
Cr#	0.567	0.638	0.426	0.509	0.511	0.499	0.483	0.481
Fe3+/(Cr+Al+Fe3+)	0.122	0.102	0.079	0.098	0.084	0.086	0.084	0.083
Si	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ti	0.003	0.004	0.003	0.003	0.004	0.003	0.003	0.002
Al	0.788	0.667	1.081	0.911	0.915	0.937	0.969	0.974
Cr	1.030	1.174	0.801	0.943	0.955	0.933	0.905	0.902
Fe3+	0.225	0.189	0.142	0.179	0.152	0.156	0.152	0.151
Fe2+	0.652	0.685	0.567	0.599	0.613	0.599	0.607	0.589
Mn	0.013	0.016	0.010	0.012	0.012	0.011	0.011	0.012
Mg	0.370	0.330	0.445	0.418	0.398	0.414	0.406	0.424
Ca	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Na	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.002
K	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Ni	0.001	0.001	0.002	0.001	0.001	0.001	0.002	0.001
Total	3.083	3.068	3.051	3.066	3.052	3.057	3.055	3.057
O=	4	4	4	4	4	4	4	4

spinel

Sample name	04SFAD07C21-2									
Rock name	wehrlite									
Point number	03b	6	7	7b	7c	8	8b	09b	10	11
Analysis number	50	53	54	55	56	57	58	59	60	61
Analysis point	core	core	core	core	core	core	core	core	core	core
SiO2	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00
TiO2	0.91	0.16	0.16	0.23	0.13	0.16	0.14	0.12	0.12	0.23
Al2O3	5.22	24.50	24.97	15.85	25.37	24.13	24.18	25.21	24.80	24.85
Cr2O3	38.02	39.29	38.11	46.06	37.91	38.63	38.14	38.64	38.33	38.80
FeO*	51.59	28.57	28.31	32.50	28.69	28.38	29.22	26.44	27.18	26.94
MnO	0.60	0.47	0.41	0.54	0.42	0.43	0.44	0.41	0.34	0.40
MgO	3.42	8.25	8.25	5.92	8.15	8.25	8.11	9.67	9.29	9.31
CaO	0.00	0.00	0.02	0.04	0.01	0.01	0.01	0.02	0.00	0.00
Na2O	0.02	0.01	0.00	0.02	0.01	0.03	0.02	0.03	0.00	0.00
K2O	0.03	0.03	0.01	0.01	0.01	0.01	0.02	0.00	0.02	0.02
NiO	0.13	0.07	0.05	0.03	0.06	0.07	0.05	0.05	0.04	0.07
Total	99.94	101.33	100.28	101.20	100.76	100.08	100.34	100.60	100.12	100.61
Mg#	0.184	0.385	0.387	0.292	0.380	0.389	0.382	0.448	0.433	0.434
Cr#	0.830	0.518	0.506	0.661	0.501	0.518	0.514	0.507	0.509	0.512
Fe3+/(Cr+Al+Fe3+)	0.358	0.070	0.070	0.097	0.071	0.074	0.082	0.071	0.077	0.071
Si	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ti	0.026	0.004	0.004	0.006	0.003	0.004	0.003	0.003	0.003	0.005
Al	0.235	0.911	0.935	0.625	0.945	0.909	0.911	0.932	0.925	0.922
Cr	1.150	0.980	0.957	1.218	0.947	0.976	0.964	0.958	0.959	0.965
Fe3+	0.734	0.126	0.126	0.181	0.127	0.134	0.149	0.130	0.140	0.128
Fe2+	0.864	0.620	0.618	0.717	0.626	0.616	0.625	0.558	0.574	0.570
Mn	0.019	0.012	0.011	0.015	0.011	0.012	0.012	0.011	0.009	0.011
Mg	0.195	0.388	0.390	0.295	0.384	0.393	0.386	0.452	0.438	0.437
Ca	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.001	0.000	0.000
Na	0.001	0.001	0.000	0.001	0.001	0.002	0.001	0.002	0.000	0.000
K	0.001	0.001	0.000	0.000	0.001	0.000	0.001	0.000	0.001	0.001
Ni	0.004	0.002	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.002
Total	3.230	3.044	3.043	3.061	3.045	3.048	3.054	3.048	3.050	3.041
O=	4	4	4	4	4	4	4	4	4	4

spinel

Sample name	04SFAD07C23					
Rock name	dunite					
Point number	2	3	4	04b	5	6
Analysis number	104	105	106	107	108	109
Analysis point	core	core	core	core	core	core
SiO2	0.00	0.04	0.00	0.00	0.01	0.00
TiO2	0.22	0.34	0.22	0.23	0.19	0.24
Al2O3	23.76	24.14	23.64	23.17	25.09	23.76
Cr2O3	38.61	38.42	37.30	38.07	37.92	38.39
FeO*	28.68	29.25	30.23	29.91	27.11	29.55
MnO	0.41	0.46	0.41	0.42	0.39	0.44
MgO	7.75	7.49	7.62	7.73	8.74	7.93
CaO	0.00	0.02	0.01	0.00	0.01	0.03
Na2O	0.03	0.00	0.00	0.00	0.02	0.01
K2O	0.00	0.03	0.03	0.00	0.02	0.00
NiO	0.06	0.05	0.06	0.06	0.05	0.05
Total	99.53	100.25	99.50	99.58	99.54	100.40
Mg#	0.370	0.357	0.364	0.369	0.411	0.375
Cr#	0.522	0.516	0.514	0.524	0.503	0.520
Fe3+/(Cr+Al+Fe3+)	0.071	0.068	0.091	0.089	0.066	0.083
Si	0.000	0.001	0.000	0.000	0.000	0.000
Ti	0.005	0.008	0.005	0.006	0.005	0.006
Al	0.902	0.911	0.903	0.885	0.941	0.897
Cr	0.984	0.973	0.956	0.976	0.954	0.972
Fe3+	0.128	0.122	0.165	0.162	0.119	0.149
Fe2+	0.635	0.645	0.644	0.638	0.593	0.631
Mn	0.011	0.013	0.011	0.011	0.011	0.012
Mg	0.373	0.358	0.368	0.374	0.414	0.378
Ca	0.000	0.001	0.000	0.000	0.000	0.001
Na	0.002	0.000	0.000	0.000	0.001	0.001
K	0.000	0.001	0.001	0.000	0.001	0.000
Ni	0.002	0.001	0.002	0.002	0.001	0.001
Total	3.042	3.033	3.055	3.053	3.039	3.048
O=	4	4	4	4	4	4

spinel

Sample name	04SFFDG03 P3-1							
Rock name	dunite							
Point number	1	2	3	4	5	6	7	8
Analysis number	216	217	218	219	220	221	222	223
Analysis point	core	core	core	core	core	core	core	core
SiO2	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02
TiO2	0.19	0.32	0.25	0.22	0.25	0.54	0.21	0.22
Al2O3	14.67	9.76	14.76	15.20	15.28	5.83	14.58	14.87
Cr2O3	48.87	51.51	46.87	47.37	47.16	49.16	47.92	46.41
FeO*	26.83	29.94	27.32	26.47	27.38	37.44	26.38	27.18
MnO	0.39	0.47	0.42	0.43	0.42	0.56	0.46	0.42
MgO	8.76	7.23	8.81	8.87	8.89	5.68	8.78	8.77
CaO	0.01	0.01	0.00	0.03	0.00	0.00	0.01	0.00
Na2O	0.00	0.02	0.00	0.00	0.00	0.00	0.05	0.03
K2O	0.02	0.02	0.02	0.02	0.04	0.01	0.02	0.01
NiO	0.07	0.07	0.08	0.08	0.08	0.09	0.07	0.10
Total	99.80	99.35	98.53	98.68	99.50	99.33	98.47	98.03
Mg#	0.430	0.369	0.437	0.439	0.436	0.300	0.437	0.437
Cr#	0.691	0.780	0.681	0.676	0.674	0.850	0.688	0.677
Fe3+/(Cr+Al+Fe3+)	0.085	0.111	0.099	0.087	0.095	0.196	0.087	0.100
Si	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Ti	0.005	0.008	0.006	0.005	0.006	0.015	0.005	0.006
Al	0.576	0.400	0.587	0.601	0.601	0.250	0.579	0.594
Cr	1.287	1.415	1.251	1.257	1.244	1.416	1.278	1.244
Fe3+	0.161	0.214	0.189	0.164	0.180	0.391	0.164	0.189
Fe2+	0.577	0.640	0.570	0.567	0.571	0.720	0.569	0.570
Mn	0.011	0.014	0.012	0.012	0.012	0.017	0.013	0.012
Mg	0.435	0.374	0.443	0.444	0.442	0.309	0.441	0.443
Ca	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000
Na	0.000	0.001	0.000	0.000	0.000	0.000	0.003	0.002
K	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.000
Ni	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.003
Total	3.054	3.069	3.062	3.055	3.060	3.123	3.057	3.065
O=	4	4	4	4	4	4	4	4

spinel

Sample name	04SFFDG03 P3-2							
Rock name	dunite							
Point number	1	2	3	4	5	6	7	8
Analysis number	223	224	225	226	227	228	229	230
Analysis point	core	core	core	core	core	core	core	core
SiO2	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00
TiO2	0.19	0.20	0.25	0.29	0.25	0.26	0.24	0.20
Al2O3	15.21	15.31	14.95	8.70	10.47	15.07	14.42	14.96
Cr2O3	47.30	48.21	47.45	52.64	51.08	47.68	47.65	47.56
FeO*	26.85	26.88	26.82	30.16	28.59	26.93	27.94	26.61
MnO	0.46	0.41	0.39	0.49	0.40	0.44	0.40	0.43
MgO	8.83	9.11	8.74	6.97	7.51	8.89	8.46	9.50
CaO	0.00	0.02	0.02	0.00	0.01	0.00	0.01	0.01
Na2O	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.00
K2O	0.01	0.01	0.03	0.01	0.03	0.01	0.01	0.03
NiO	0.10	0.08	0.07	0.05	0.07	0.06	0.09	0.08
Total	98.96	100.23	98.75	99.33	98.41	99.33	99.23	99.38
Mg#	0.436	0.443	0.433	0.358	0.384	0.438	0.419	0.465
Cr#	0.676	0.679	0.680	0.802	0.766	0.680	0.689	0.681
Fe3+/(Cr+Al+Fe3+)	0.091	0.089	0.089	0.111	0.101	0.090	0.098	0.099
Si	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ti	0.005	0.005	0.006	0.008	0.006	0.006	0.006	0.005
Al	0.600	0.596	0.592	0.359	0.429	0.593	0.572	0.588
Cr	1.253	1.259	1.261	1.456	1.405	1.259	1.269	1.253
Fe3+	0.172	0.169	0.168	0.216	0.194	0.171	0.186	0.189
Fe2+	0.571	0.564	0.573	0.652	0.625	0.569	0.589	0.543
Mn	0.013	0.011	0.011	0.015	0.012	0.012	0.011	0.012
Mg	0.441	0.449	0.438	0.364	0.390	0.443	0.425	0.472
Ca	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000
Na	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.000
K	0.000	0.001	0.001	0.000	0.001	0.001	0.000	0.001
Ni	0.003	0.002	0.002	0.001	0.002	0.002	0.002	0.002
Total	3.058	3.057	3.056	3.070	3.064	3.055	3.061	3.065
O=	4	4	4	4	4	4	4	4

amphibole

Sample name	04SFAD07C13-5
Rock name	wehrlite
Point number	1
Analysis number	25
Analysis point	core
SiO2	55.22
TiO2	0.06
Al2O3	2.32
Cr2O3	0.16
FeO*	5.56
MnO	0.14
MgO	20.79
CaO	12.24
Na2O	0.27
K2O	0.03
NiO	0.02
Total	96.81
Mg#	0.869
Si	7.7448
Ti	0.0068
Al	0.3841
Cr	0.0173
Fe	0.6523
Mn	0.0167
Mg	4.3457
Ca	1.8391
Na	0.0729
K	0.0047
Ni	0.0023
Total	15.0865
O=	23

plagioclase

Sample name	04SFAD07C13-5	
Rock name	wehrlite	
Point number	16	17
Analysis number	82	84
Analysis point	core	core
SiO2	44.45	43.21
TiO2	0.01	0.00
Al2O3	35.96	35.67
Cr2O3	0.00	0.00
FeO*	0.20	0.23
MnO	0.01	0.02
MgO	0.01	0.01
CaO	19.20	19.89
Na2O	0.54	0.17
K2O	0.02	0.01
NiO	0.01	0.00
Total	100.42	99.22
An	0.951	0.984
Si	8.184	8.077
Ti	0.002	0.000
Al	7.803	7.858
Cr	0.000	0.000
Fe	0.030	0.037
Mn	0.001	0.004
Mg	0.004	0.003
Ca	3.788	3.984
Na	0.193	0.063
K	0.004	0.001
Ni	0.002	0.000
Total	20.012	20.027
O=	32	32

orthopyroxene

Sample name	04SFAD07C1		04SFAD07C2
Rock name	gabbro		gabbro
Point number	15b	19b	3c
Analysis number	142	148	155
Analysis point	core	core	core
SiO2	55.64	55.90	55.67
TiO2	0.12	0.13	0.13
Al2O3	1.45	1.48	1.30
Cr2O3	0.07	0.06	0.09
FeO*	12.20	12.28	13.14
MnO	0.27	0.28	0.31
MgO	30.17	30.19	29.40
CaO	1.23	1.02	1.06
Na2O	0.02	0.01	0.00
K2O	0.01	0.02	0.02
NiO	0.04	0.02	0.02
Total	101.22	101.36	101.14
Mg#	0.815	0.814	0.800
En	79.596	79.849	78.331
Fs	18.063	18.221	19.641
Wo	2.340	1.930	2.028
Si	1.953	1.958	1.963
Ti	0.003	0.003	0.003
Al	0.060	0.061	0.054
Cr	0.002	0.002	0.003
Fe	0.358	0.360	0.387
Mn	0.008	0.008	0.009
Mg	1.579	1.576	1.545
Ca	0.046	0.038	0.040
Na	0.001	0.001	0.000
K	0.001	0.001	0.001
Ni	0.001	0.000	0.001
Total	4.013	4.008	4.006
O=	6	6	6

clinopyroxene

Sample name	04SFAD07C1						
Rock name	gabbro						
Point number	1	2	9	10	10c	15	18
Analysis number	124	125	128	130	132	141	146
Analysis point	core	core	core	core	core	core	core
SiO2	53.37	53.55	53.43	52.77	54.04	54.04	53.47
TiO2	0.30	0.32	0.32	0.32	0.26	0.29	0.33
Al2O3	2.21	2.26	2.23	2.24	1.47	2.20	2.29
Cr2O3	0.17	0.17	0.00	0.11	0.12	0.14	0.14
FeO*	4.51	4.71	4.89	4.50	4.41	4.65	4.69
MnO	0.17	0.16	0.17	0.18	0.12	0.14	0.15
MgO	16.39	16.49	16.72	16.50	16.76	17.14	16.67
CaO	22.77	22.96	22.28	22.77	23.19	22.10	22.25
Na2O	0.22	0.25	0.21	0.16	0.15	0.18	0.20
K2O	0.02	0.02	0.01	0.02	0.02	0.00	0.02
NiO	0.03	0.02	0.01	0.03	0.02	0.01	0.00
Total	100.15	100.90	100.26	99.60	100.57	100.89	100.22
Mg#	0.866	0.862	0.859	0.867	0.871	0.868	0.864
En	46.443	46.289	47.139	46.620	46.687	48.098	47.234
Fs	7.170	7.408	7.728	7.132	6.893	7.324	7.456
Wo	46.387	46.304	45.133	46.248	46.420	44.578	45.309
Si	1.949	1.944	1.948	1.940	1.965	1.953	1.949
Ti	0.008	0.009	0.009	0.009	0.007	0.008	0.009
Al	0.095	0.096	0.096	0.097	0.063	0.094	0.099
Cr	0.005	0.005	0.000	0.003	0.004	0.004	0.004
Fe	0.138	0.143	0.149	0.138	0.134	0.141	0.143
Mn	0.005	0.005	0.005	0.006	0.004	0.004	0.005
Mg	0.892	0.892	0.909	0.904	0.909	0.924	0.906
Ca	0.891	0.893	0.870	0.897	0.903	0.856	0.869
Na	0.015	0.017	0.015	0.011	0.010	0.012	0.014
K	0.001	0.001	0.001	0.001	0.001	0.000	0.001
Ni	0.001	0.001	0.000	0.001	0.001	0.000	0.000
Total	4.001	4.006	4.002	4.007	4.000	3.996	3.998
O=	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C2						
Rock name	gabbro						
Point number	1	3	6	7	7b	8	9b
Analysis number	151	153	159	161	162	164	167
Analysis point	core	core	core	core	core	core	core
SiO2	53.31	53.26	53.19	53.52	53.91	52.89	54.08
TiO2	0.32	0.28	0.40	0.33	0.36	0.35	0.27
Al2O3	2.08	2.30	2.37	2.13	1.94	2.34	2.26
Cr2O3	0.06	0.17	0.10	0.15	0.16	0.18	0.20
FeO*	4.94	5.94	4.39	5.06	4.77	4.61	4.75
MnO	0.20	0.17	0.17	0.16	0.17	0.14	0.17
MgO	16.11	18.38	16.36	17.04	14.41	16.48	16.66
CaO	23.06	18.69	22.86	21.10	22.44	22.12	22.10
Na2O	0.21	0.23	0.11	0.16	0.15	0.19	0.24
K2O	0.02	0.02	0.01	0.01	0.03	0.01	0.02
NiO	0.00	0.01	0.03	0.02	0.02	0.02	0.01
Total	100.30	99.45	99.98	99.68	98.35	99.33	100.75
Mg#	0.853	0.846	0.869	0.857	0.843	0.864	0.862
En	45.433	52.287	46.419	48.619	43.392	47.126	47.321
Fs	7.824	9.488	6.983	8.107	8.052	7.402	7.566
Wo	46.743	38.226	46.598	43.273	48.556	45.473	45.113
Si	1.949	1.949	1.945	1.958	1.999	1.946	1.958
Ti	0.009	0.008	0.011	0.009	0.010	0.010	0.007
Al	0.089	0.099	0.102	0.092	0.085	0.102	0.097
Cr	0.002	0.005	0.003	0.004	0.005	0.005	0.006
Fe	0.151	0.182	0.134	0.155	0.148	0.142	0.144
Mn	0.006	0.005	0.005	0.005	0.005	0.004	0.005
Mg	0.878	1.002	0.892	0.929	0.797	0.904	0.900
Ca	0.903	0.733	0.895	0.827	0.891	0.872	0.858
Na	0.015	0.017	0.008	0.011	0.011	0.013	0.017
K	0.001	0.001	0.000	0.000	0.001	0.000	0.001
Ni	0.000	0.000	0.001	0.001	0.000	0.001	0.000
Total	4.004	4.000	3.996	3.991	3.952	3.998	3.992
O=	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C7							
Rock name	gabbro							
Point number	3	4	5	6	9	12	14	15
Analysis number	187	188	189	190	193	196	198	199
Analysis point	core	core	core	core	core	core	core	core
SiO2	52.09	53.95	54.31	53.86	53.48	54.66	54.12	54.80
TiO2	0.24	0.25	0.17	0.14	0.30	0.12	0.23	0.12
Al2O3	3.92	2.01	1.32	2.62	2.23	1.40	2.18	0.97
Cr2O3	0.06	0.16	0.10	0.00	0.00	0.21	0.09	0.12
FeO*	3.43	3.95	3.44	3.70	4.00	3.79	3.95	3.45
MnO	0.12	0.12	0.15	0.23	0.15	0.14	0.12	0.14
MgO	16.84	17.26	17.37	16.17	16.62	17.35	16.98	17.22
CaO	21.35	22.01	22.53	22.67	22.51	22.90	22.69	23.29
Na2O	0.12	0.21	0.13	0.19	0.20	0.12	0.18	0.06
K2O	0.01	0.01	0.04	0.03	0.01	0.03	0.01	0.01
NiO	0.02	0.02	0.02	0.00	0.01	0.00	0.02	0.01
Total	98.21	99.96	99.58	99.60	99.51	100.72	100.56	100.18
Mg#	0.898	0.886	0.900	0.886	0.881	0.891	0.885	0.899
En	49.381	48.894	48.941	46.818	47.435	48.286	47.820	47.971
Fs	5.635	6.283	5.443	6.007	6.397	5.912	6.238	5.399
Wo	44.984	44.824	45.616	47.175	46.168	45.802	45.943	46.630
Si	1.922	1.962	1.980	1.965	1.957	1.975	1.959	1.989
Ti	0.007	0.007	0.005	0.004	0.008	0.003	0.006	0.003
Al	0.171	0.086	0.057	0.113	0.096	0.060	0.093	0.041
Cr	0.002	0.005	0.003	0.000	0.000	0.006	0.003	0.004
Fe	0.106	0.120	0.105	0.113	0.122	0.114	0.119	0.105
Mn	0.004	0.004	0.005	0.007	0.004	0.004	0.004	0.004
Mg	0.926	0.936	0.944	0.879	0.907	0.935	0.916	0.932
Ca	0.844	0.858	0.880	0.886	0.883	0.887	0.880	0.906
Na	0.009	0.015	0.009	0.014	0.014	0.008	0.013	0.004
K	0.000	0.000	0.002	0.001	0.001	0.001	0.000	0.001
Ni	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	3.990	3.993	3.991	3.982	3.994	3.994	3.994	3.988
O=	6	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C9-1						
Rock name	gabbro						
Point number	1	3	4	9	10	11	12
Analysis number	168	172	174	177	178	180	181
Analysis point	core	core	core	core	core	core	core
SiO2	53.75	53.65	54.34	53.99	54.44	53.91	53.70
TiO2	0.25	0.26	0.20	0.05	0.07	0.13	0.09
Al2O3	1.56	1.82	0.93	0.77	0.82	1.23	1.55
Cr2O3	0.18	0.29	0.06	0.23	0.28	0.26	0.21
FeO*	4.05	4.12	2.82	3.75	3.58	3.66	3.76
MnO	0.16	0.16	0.13	0.11	0.14	0.13	0.16
MgO	16.82	16.30	16.41	16.93	16.48	16.74	16.72
CaO	23.02	23.14	24.57	22.86	23.80	23.14	23.43
Na2O	0.06	0.09	0.02	0.05	0.09	0.09	0.04
K2O	0.01	0.01	0.03	0.01	0.01	0.01	0.01
NiO	0.01	0.00	0.02	0.00	0.01	0.01	0.00
Total	99.86	99.84	99.52	98.74	99.72	99.31	99.67
Mg#	0.881	0.876	0.912	0.890	0.891	0.891	0.888
En	47.204	46.260	46.025	47.736	46.301	47.261	46.869
Fs	6.370	6.558	4.437	5.926	5.646	5.789	5.913
Wo	46.425	47.182	49.538	46.338	48.053	46.949	47.218
Si	1.964	1.963	1.988	1.991	1.991	1.978	1.966
Ti	0.007	0.007	0.006	0.001	0.002	0.004	0.003
Al	0.067	0.078	0.040	0.033	0.036	0.053	0.067
Cr	0.005	0.008	0.002	0.007	0.008	0.007	0.006
Fe	0.124	0.126	0.086	0.115	0.110	0.112	0.115
Mn	0.005	0.005	0.004	0.003	0.004	0.004	0.005
Mg	0.916	0.889	0.895	0.930	0.899	0.916	0.912
Ca	0.901	0.907	0.963	0.903	0.933	0.910	0.919
Na	0.004	0.006	0.001	0.004	0.006	0.007	0.003
K	0.001	0.001	0.001	0.000	0.000	0.001	0.001
Ni	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	3.995	3.990	3.987	3.989	3.988	3.992	3.997
O=	6	6	6	6	6	6	6

clinopyroxene

Sample name	04SFAD07C9-2							
Rock name	gabbro							
Point number	1	3	5	6	6c	11	12b	14
Analysis number	202	204	206	207	209	212	214	215
Analysis point	core	core	core	core	core	core	core	core
SiO2	52.65	53.57	53.86	53.89	54.33	53.33	53.35	53.29
TiO2	0.17	0.10	0.19	0.12	0.15	0.26	0.12	0.23
Al2O3	2.47	1.55	1.52	1.34	1.29	2.38	1.87	1.84
Cr2O3	0.40	0.36	0.26	0.35	0.22	0.26	0.35	0.27
FeO*	4.16	3.95	3.62	3.70	3.44	3.85	3.86	3.85
MnO	0.14	0.14	0.13	0.15	0.13	0.12	0.16	0.12
MgO	16.66	16.82	16.83	16.73	16.76	16.75	16.48	16.45
CaO	22.51	22.47	23.36	23.23	23.52	22.89	23.03	23.04
Na2O	0.11	0.11	0.05	0.04	0.04	0.13	0.14	0.10
K2O	0.02	0.01	0.02	0.02	0.01	0.00	0.01	0.02
NiO	0.02	0.01	0.02	0.01	0.02	0.01	0.00	0.00
Total	99.32	99.09	99.85	99.56	99.91	99.98	99.37	99.21
Mg#	0.877	0.884	0.892	0.890	0.897	0.886	0.884	0.884
En	47.371	47.800	47.208	47.124	47.089	47.364	46.826	46.781
Fs	6.638	6.292	5.696	5.851	5.421	6.101	6.152	6.141
Wo	45.991	45.909	47.096	47.024	47.490	46.535	47.022	47.078
Si	1.937	1.970	1.967	1.974	1.980	1.945	1.960	1.960
Ti	0.005	0.003	0.005	0.003	0.004	0.007	0.003	0.006
Al	0.107	0.067	0.066	0.058	0.056	0.102	0.081	0.080
Cr	0.012	0.010	0.008	0.010	0.006	0.008	0.010	0.008
Fe	0.128	0.121	0.111	0.113	0.105	0.117	0.119	0.118
Mn	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.004
Mg	0.914	0.922	0.916	0.913	0.911	0.910	0.902	0.902
Ca	0.887	0.886	0.914	0.911	0.918	0.895	0.906	0.908
Na	0.008	0.008	0.003	0.003	0.003	0.009	0.010	0.007
K	0.001	0.000	0.001	0.001	0.000	0.000	0.001	0.001
Ni	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Total	4.003	3.992	3.994	3.991	3.987	3.998	3.997	3.994
O=	6	6	6	6	6	6	6	6

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Sample name	04SFAD07C1						
Rock name	gabbro						
Point number	3	8	9b	10b	11	17	19
Analysis number	126	127	129	131	133	145	147
Analysis point	core	core	core	core	core	core	core
SiO2	45.00	45.43	45.81	45.27	45.73	45.72	45.37
TiO2	0.00	0.01	0.01	0.01	0.01	0.00	0.04
Al2O3	34.42	34.32	34.45	34.17	34.68	34.68	34.59
Cr2O3	0.00	0.01	0.00	0.00	0.00	0.00	0.04
FeO*	0.19	0.19	0.17	0.22	0.18	0.22	0.19
MnO	0.00	0.00	0.02	0.00	0.01	0.00	0.01
MgO	0.01	0.02	0.00	0.00	0.03	0.02	0.04
CaO	18.40	18.28	17.99	18.29	18.24	18.41	18.20
Na2O	1.15	1.19	1.34	1.19	1.15	1.12	1.16
K2O	0.01	0.04	0.03	0.01	0.02	0.02	0.02
NiO	0.00	0.00	0.00	0.01	0.01	0.01	0.00
Total	99.18	99.49	99.82	99.17	100.07	100.18	99.65
An	0.898	0.894	0.881	0.895	0.897	0.901	0.897
Si	8.379	8.426	8.460	8.427	8.426	8.418	8.400
Ti	0.000	0.001	0.001	0.001	0.001	0.000	0.005
Al	7.554	7.503	7.497	7.497	7.531	7.526	7.547
Cr	0.000	0.002	0.000	0.000	0.000	0.000	0.005
Fe	0.029	0.030	0.026	0.034	0.028	0.033	0.029
Mn	0.000	0.000	0.003	0.000	0.002	0.000	0.001
Mg	0.001	0.004	0.000	0.000	0.009	0.005	0.010
Ca	3.671	3.634	3.560	3.648	3.601	3.632	3.611
Na	0.415	0.429	0.479	0.430	0.412	0.400	0.416
K	0.003	0.009	0.008	0.002	0.004	0.005	0.006
Ni	0.000	0.000	0.000	0.001	0.002	0.001	0.000
Total	20.052	20.038	20.034	20.040	20.016	20.020	20.030
O=	32	32	32	32	32	32	32

plagioclase

Sample name	04SFAD07C2								
Rock name	gabbro								
Point number	2	2b	3b	4	4b	5	6b	7c	9
Analysis number	152	153	154	156	157	158	160	163	166
Analysis point	core	core	core	core	core	core	core	core	core
SiO2	45.57	45.52	45.82	45.84	45.84	45.82	45.40	45.80	45.81
TiO2	0.01	0.01	0.02	0.00	0.00	0.02	0.00	0.02	0.01
Al2O3	34.35	34.59	34.53	34.42	34.56	34.56	34.69	34.31	34.38
Cr2O3	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO*	0.21	0.24	0.23	0.18	0.15	0.20	0.26	0.23	0.21
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01
MgO	0.03	0.03	0.02	0.00	0.02	0.01	0.02	0.04	0.03
CaO	18.12	18.10	18.05	18.08	18.06	18.00	17.88	17.69	17.79
Na2O	1.16	1.14	1.29	1.20	1.24	1.11	1.07	1.26	1.29
K2O	0.02	0.02	0.02	0.03	0.01	0.01	0.01	0.03	0.02
NiO	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.02	0.00
Total	99.46	99.67	99.99	99.75	99.88	99.73	99.32	99.41	99.54
An	0.896	0.897	0.886	0.893	0.889	0.900	0.902	0.886	0.884
Si	8.447	8.420	8.449	8.468	8.455	8.460	8.419	8.484	8.476
Ti	0.001	0.001	0.002	0.000	0.000	0.002	0.000	0.003	0.001
Al	7.503	7.542	7.504	7.493	7.512	7.521	7.581	7.489	7.496
Cr	0.000	0.004	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Fe	0.032	0.037	0.035	0.027	0.023	0.031	0.040	0.036	0.032
Mn	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.001
Mg	0.007	0.008	0.004	0.000	0.005	0.002	0.004	0.011	0.009
Ca	3.599	3.587	3.566	3.578	3.570	3.562	3.553	3.511	3.527
Na	0.416	0.410	0.461	0.430	0.445	0.397	0.385	0.454	0.461
K	0.005	0.004	0.004	0.006	0.001	0.003	0.002	0.006	0.004
Ni	0.000	0.000	0.004	0.000	0.000	0.001	0.000	0.003	0.000
Total	20.011	20.013	20.029	20.003	20.012	19.978	19.984	19.998	20.007
O=	32	32	32	32	32	32	32	32	32

plagioclase

Sample name	04SFAD07C7						
Rock name	gabbro						
Point number	7	8	10	11	13	16	17
Analysis number	191	192	194	195	197	200	201
Analysis point	core	core	core	core	core	core	core
SiO2	44.82	45.79	45.00	45.06	45.28	45.47	45.24
TiO2	0.02	0.00	0.02	0.00	0.01	0.01	0.01
Al2O3	34.74	34.47	35.09	34.78	34.60	34.88	34.82
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO*	0.20	0.16	0.14	0.15	0.18	0.14	0.14
MnO	0.00	0.02	0.00	0.00	0.01	0.00	0.00
MgO	0.01	0.01	0.01	0.02	0.03	0.00	0.02
CaO	17.94	17.41	18.32	17.97	17.88	18.17	18.23
Na2O	0.89	1.20	0.85	0.90	1.03	0.88	0.85
K2O	0.03	0.01	0.01	0.02	0.02	0.02	0.04
NiO	0.01	0.01	0.01	0.01	0.00	0.00	0.00
Total	98.66	99.07	99.44	98.91	99.04	99.57	99.35
An	0.917	0.889	0.923	0.917	0.906	0.919	0.923
Si	8.368	8.494	8.340	8.388	8.419	8.407	8.389
Ti	0.002	0.000	0.003	0.000	0.002	0.002	0.001
Al	7.645	7.536	7.665	7.630	7.581	7.600	7.610
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe	0.032	0.024	0.021	0.024	0.028	0.022	0.022
Mn	0.000	0.004	0.000	0.000	0.002	0.000	0.000
Mg	0.003	0.004	0.003	0.004	0.008	0.000	0.004
Ca	3.590	3.460	3.639	3.585	3.562	3.600	3.623
Na	0.324	0.430	0.305	0.324	0.370	0.316	0.304
K	0.007	0.002	0.002	0.005	0.005	0.004	0.010
Ni	0.001	0.001	0.001	0.001	0.000	0.000	0.000
Total	19.972	19.954	19.978	19.961	19.977	19.952	19.962
O=	32	32	32	32	32	32	32

plagioclase

Sample name	04SFAD07C9-1						
Rock name	gabbro						
Point number	2	2b	2c	5	6	7	10b
Analysis number	169	170	171	174	175	176	179
Analysis point	core	core	core	core	core	core	core
SiO2	44.59	43.83	44.47	44.44	44.50	44.35	44.85
TiO2	0.01	0.00	0.00	0.01	0.01	0.00	0.01
Al2O3	35.00	35.24	34.92	34.96	34.71	34.44	35.00
Cr2O3	0.00	0.01	0.04	0.02	0.00	0.00	0.00
FeO*	0.17	0.17	0.18	0.19	0.21	0.23	0.18
MnO	0.00	0.00	0.01	0.02	0.01	0.00	0.00
MgO	0.00	0.00	0.02	0.00	0.01	0.02	0.04
CaO	18.40	18.68	18.60	18.21	18.10	18.27	18.62
Na2O	0.80	0.48	0.67	0.82	0.82	0.79	0.71
K2O	0.02	0.01	0.02	0.02	0.02	0.02	0.01
NiO	0.00	0.00	0.01	0.01	0.02	0.01	0.00
Total	98.98	98.41	98.93	98.70	98.40	98.13	99.42
An	0.927	0.956	0.939	0.924	0.924	0.927	0.935
Si	8.310	8.221	8.297	8.306	8.338	8.340	8.323
Ti	0.001	0.000	0.000	0.001	0.002	0.000	0.001
Al	7.687	7.791	7.680	7.700	7.664	7.633	7.654
Cr	0.000	0.001	0.005	0.003	0.000	0.000	0.000
Fe	0.027	0.026	0.029	0.029	0.032	0.036	0.028
Mn	0.000	0.000	0.002	0.003	0.001	0.000	0.000
Mg	0.000	0.001	0.007	0.000	0.003	0.006	0.012
Ca	3.674	3.754	3.717	3.645	3.634	3.681	3.702
Na	0.288	0.173	0.243	0.298	0.299	0.289	0.257
K	0.004	0.003	0.004	0.005	0.004	0.004	0.002
Ni	0.000	0.000	0.001	0.002	0.002	0.001	0.000
Total	19.991	19.970	19.984	19.993	19.979	19.990	19.979
O=	32	32	32	32	32	32	32

plagioclase

Sample name	04SFAD07C9-2						
Rock name	gabbro						
Point number	2	4	6b	8	9	10	12
Analysis number	203	205	208	210	211	212	213
Analysis point	core	core	core	core	core	core	core
SiO2	44.72	43.41	44.42	44.81	44.94	45.17	44.70
TiO2	0.02	0.00	0.00	0.01	0.01	0.00	0.00
Al2O3	35.12	34.74	35.51	34.84	34.87	35.06	35.22
Cr2O3	0.00	0.00	0.00	0.00	0.01	0.00	0.00
FeO*	0.17	0.07	0.13	0.22	0.16	0.16	0.27
MnO	0.00	0.01	0.00	0.01	0.00	0.01	0.01
MgO	0.01	0.04	0.00	0.02	0.02	0.01	0.02
CaO	18.54	19.42	19.22	18.50	18.34	18.21	18.45
Na2O	0.79	0.32	0.49	0.80	0.78	0.84	0.75
K2O	0.02	0.02	0.02	0.02	0.02	0.01	0.02
NiO	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Total	99.39	98.03	99.79	99.24	99.15	99.46	99.43
An	0.928	0.971	0.956	0.927	0.928	0.923	0.931
Si	8.302	8.196	8.226	8.333	8.355	8.365	8.296
Ti	0.003	0.000	0.000	0.002	0.001	0.000	0.000
Al	7.684	7.730	7.749	7.636	7.640	7.652	7.702
Cr	0.000	0.000	0.000	0.000	0.002	0.000	0.000
Fe	0.026	0.011	0.020	0.035	0.025	0.025	0.041
Mn	0.000	0.001	0.000	0.002	0.000	0.001	0.001
Mg	0.004	0.012	0.000	0.007	0.005	0.004	0.006
Ca	3.688	3.928	3.813	3.687	3.653	3.612	3.668
Na	0.286	0.117	0.176	0.288	0.282	0.301	0.271
K	0.004	0.004	0.005	0.005	0.004	0.002	0.005
Ni	0.000	0.002	0.000	0.000	0.000	0.000	0.000
Total	19.997	20.000	19.989	19.994	19.966	19.960	19.991
O=	32	32	32	32	32	32	32

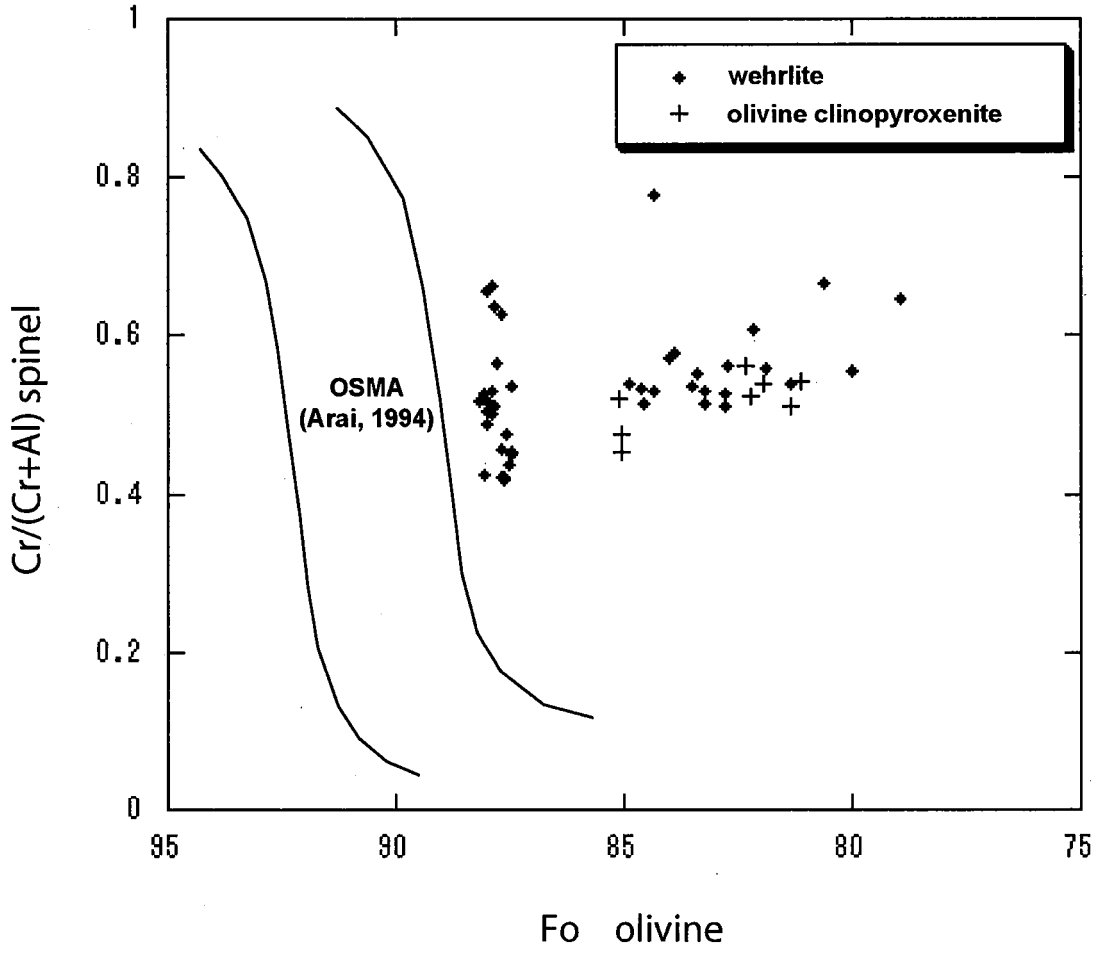


Fig.1 Relationships between Fo content of olivine and Cr/(Cr+Al) atomic ratio of chromian spinel

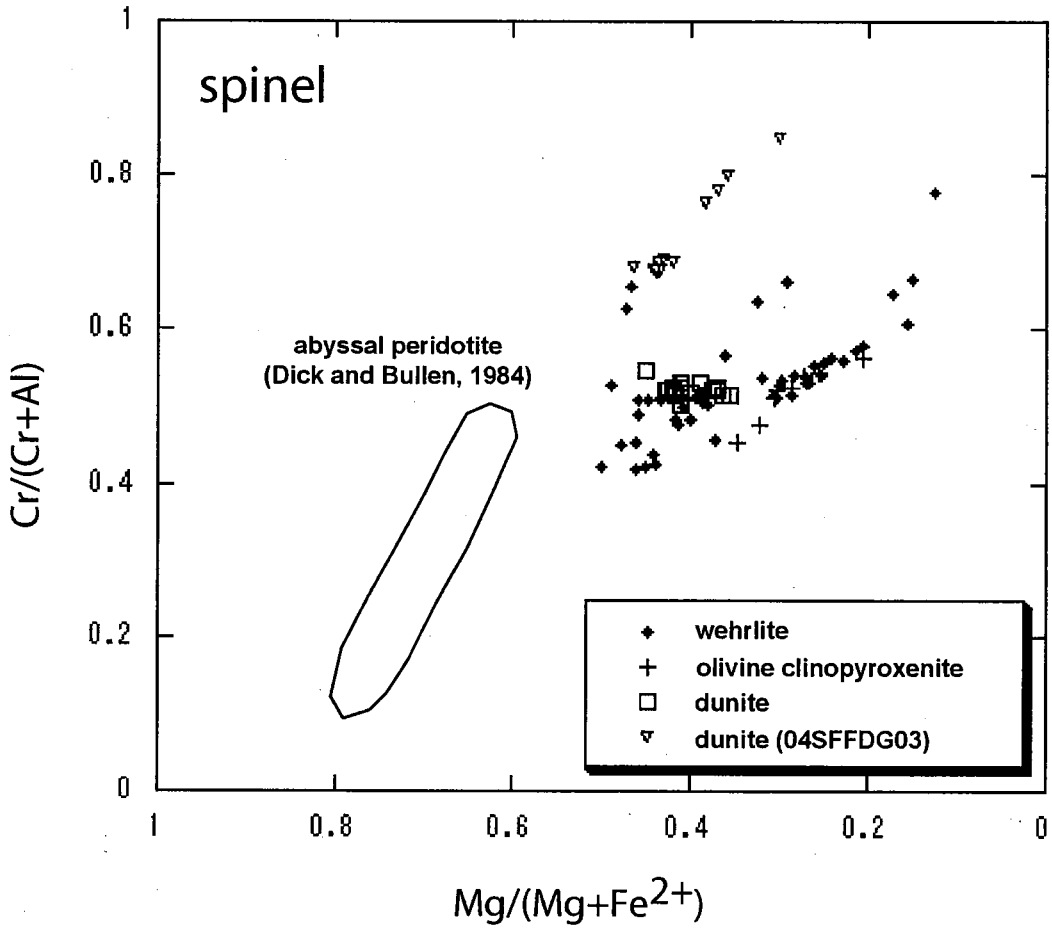


Fig.2 Relationships between $Mg/(Mg+Fe^{2+})$ and Cr/(Cr+Al) atomic ratios of chromian spinel

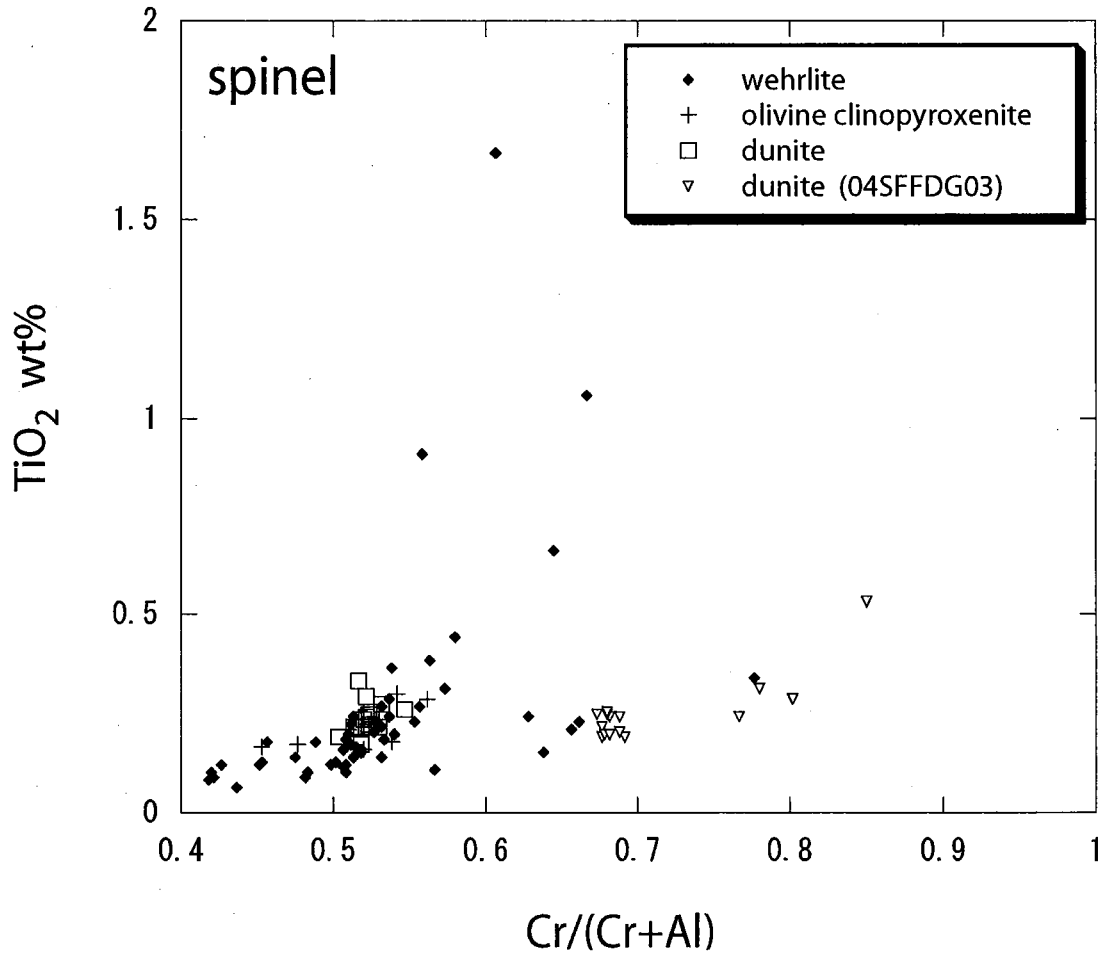


Fig.3 Relationships between Cr/(Cr+Al) atomic ratio and TiO2 content of chromian spinel

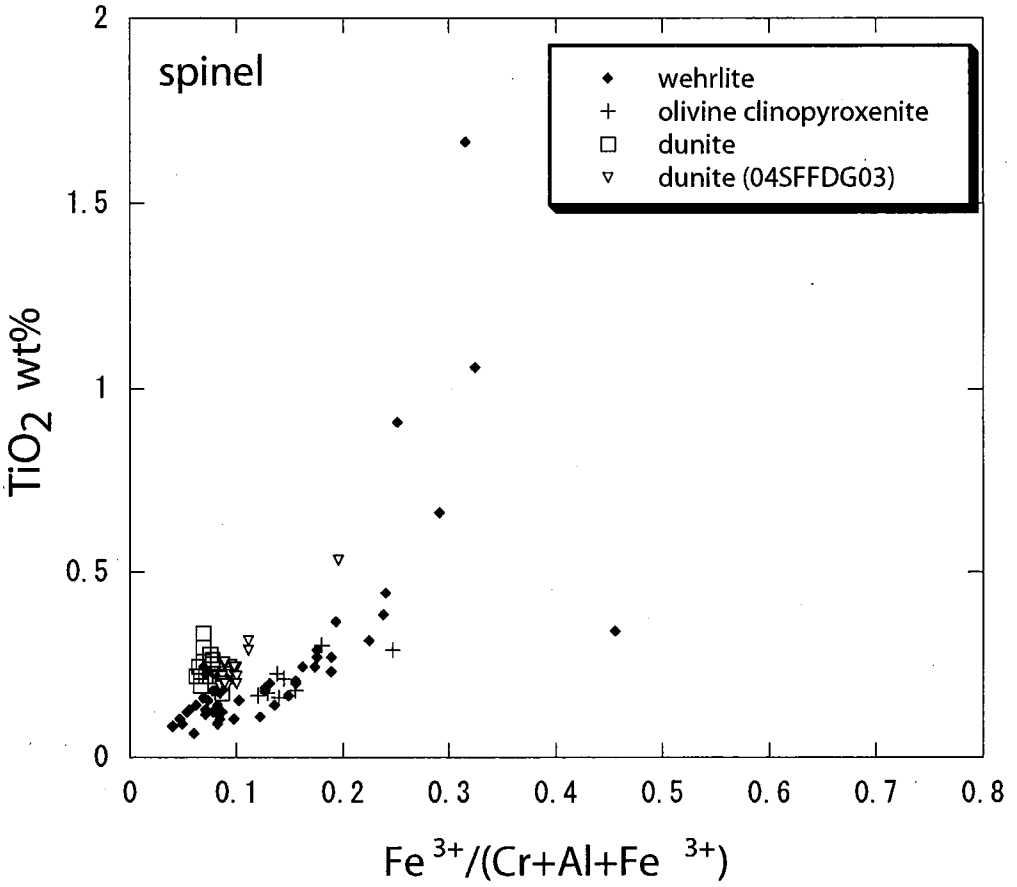


Fig.4 Relationships between $Fe^{3+}/(Cr+Al+Fe^{3+})$ atomic ratio and TiO_2 content of chromian spinel

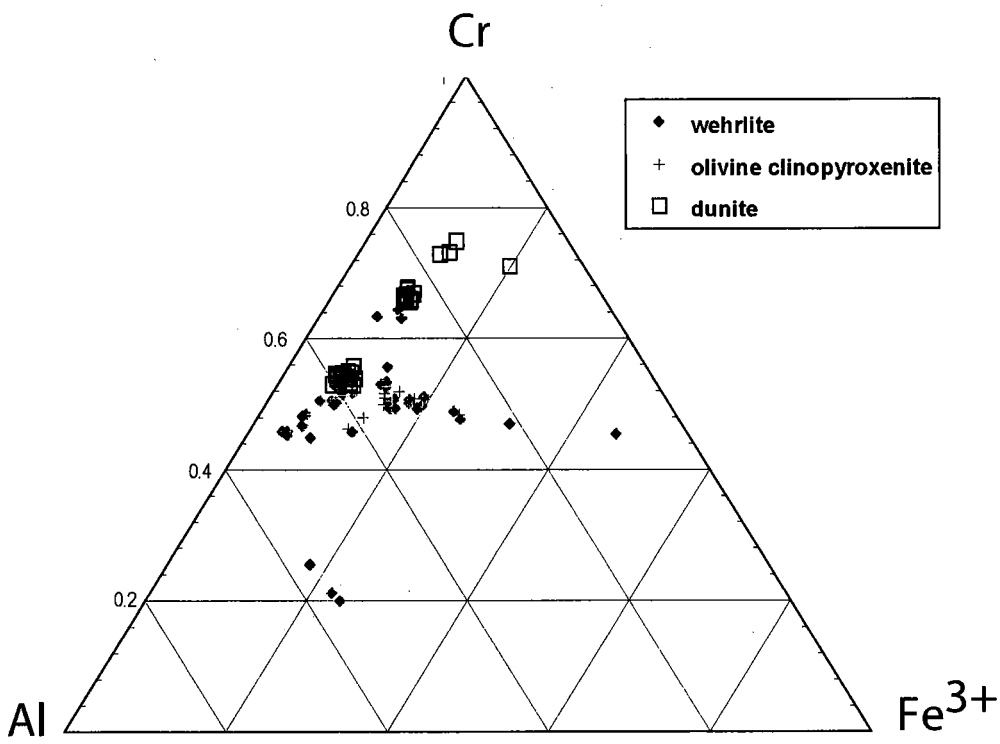


Fig.5 Trivalent cation ratios of chromian spinel in ultramafic rock

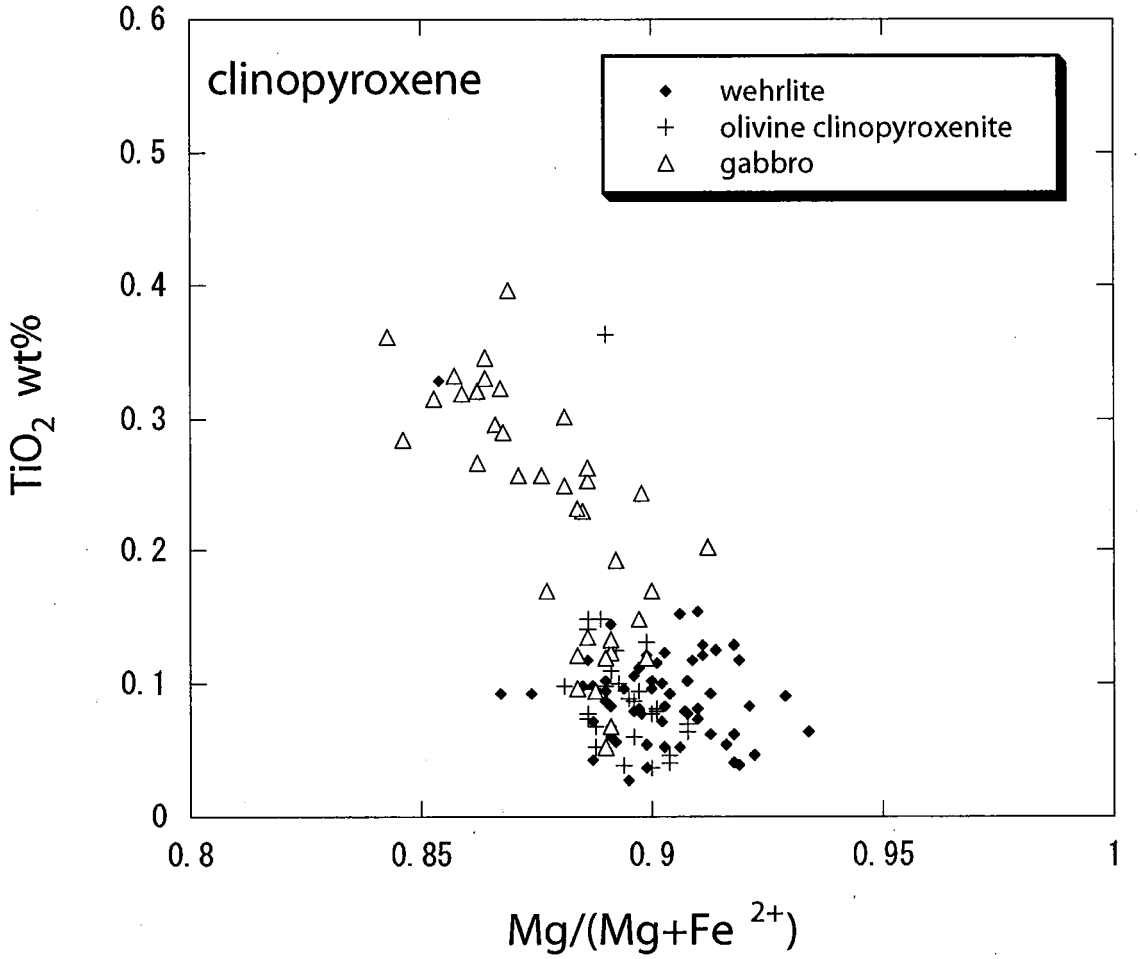


Fig.6 Relationships between Mg/(Mg+Fe^{2+}) atomic ratio and TiO_2 content of clinopyroxene

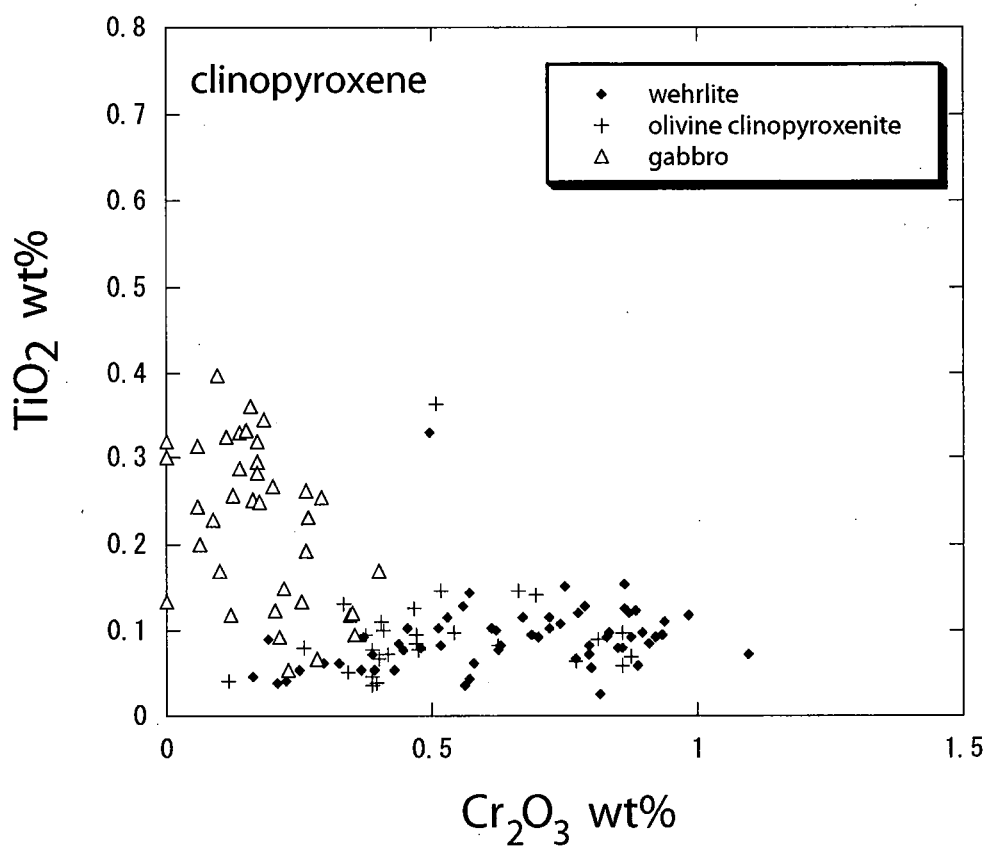


Fig.7 Relationships between Cr_2O_3 and TiO_2 content of clinopyroxene

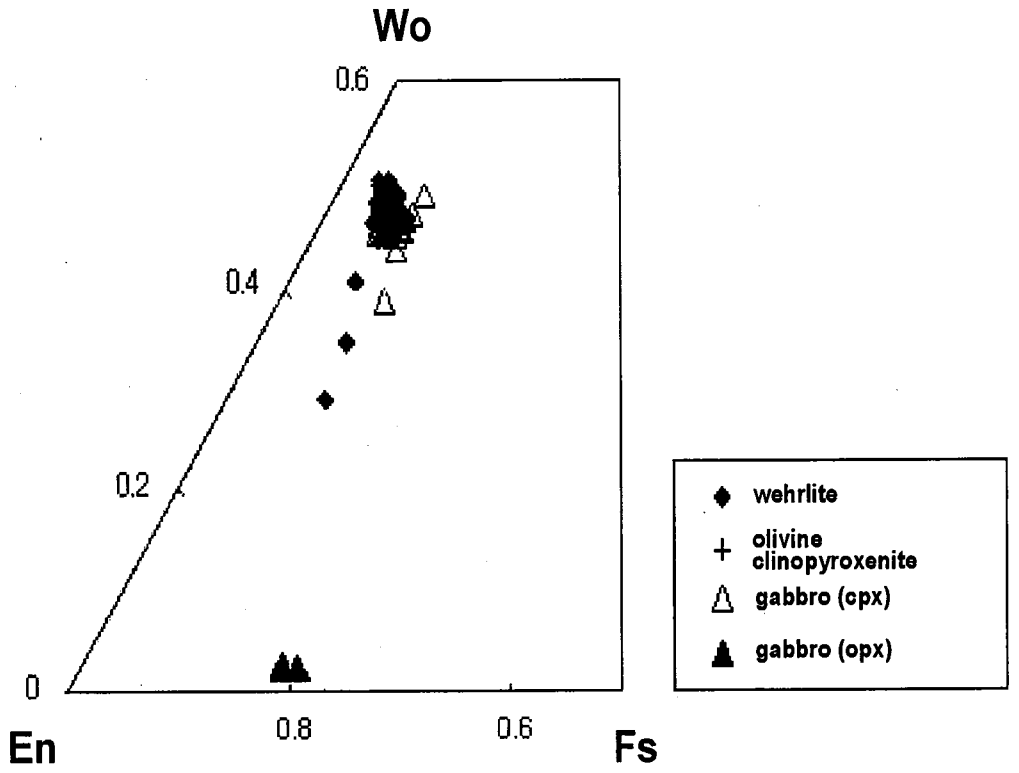
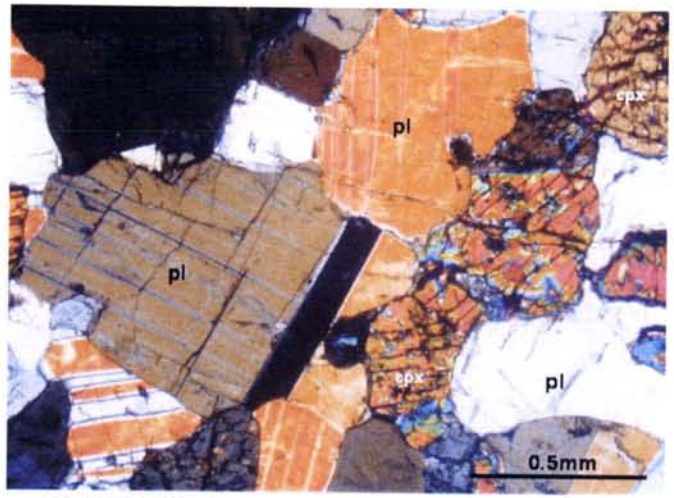
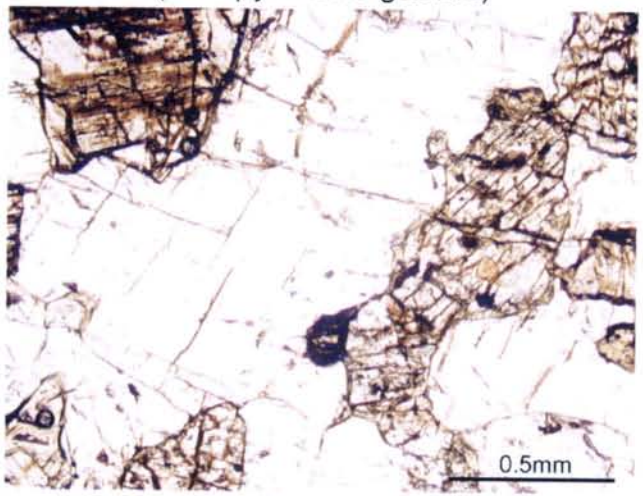


Fig.8 Pyroxene quadrilateral

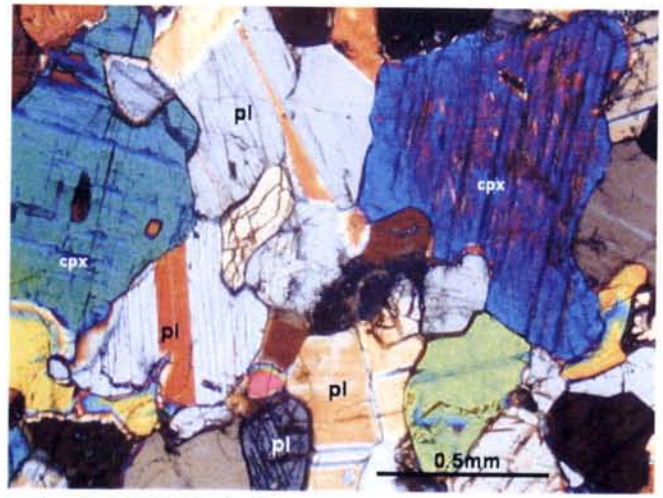


04SFAD07C1 -01 crossed polarized light

(Two-pyroxene gabbro)

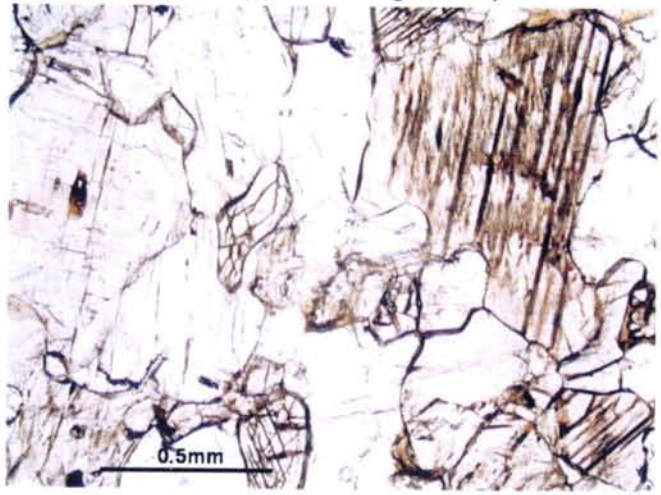


04SFAD07C1 -01 plane-polarized light



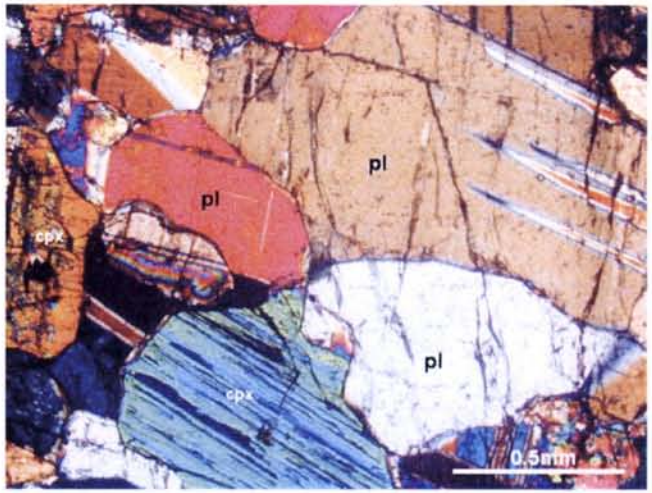
04SFAD07C1 -02 crossed polarized light

(Two-pyroxene gabbro)



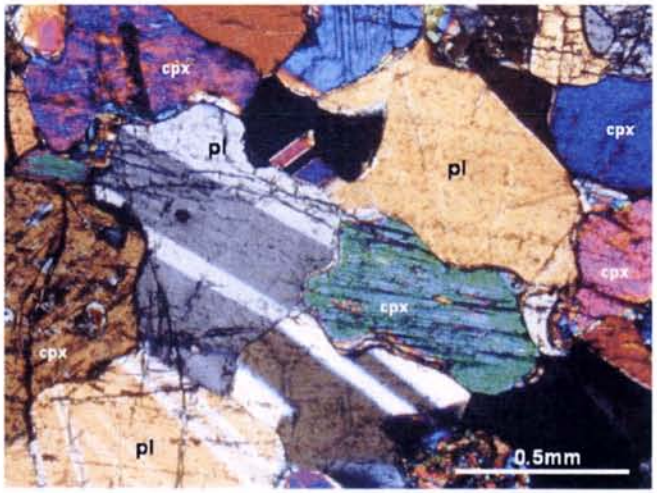
04SFAD07C1 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



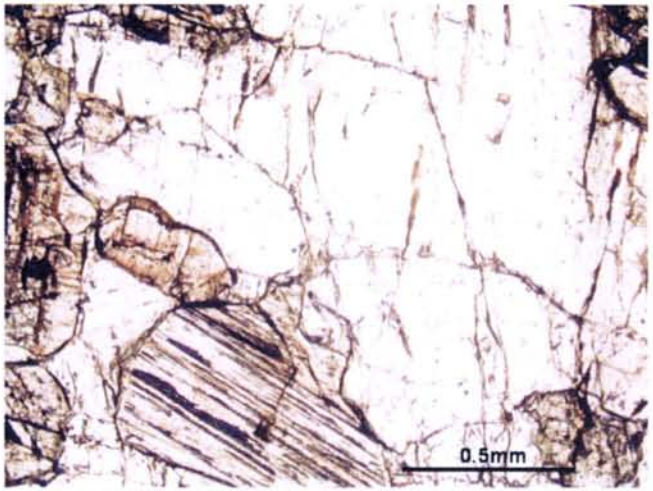
04SFAD07C2 -01 crossed polarized light

(Two-pyroxene gabbro)

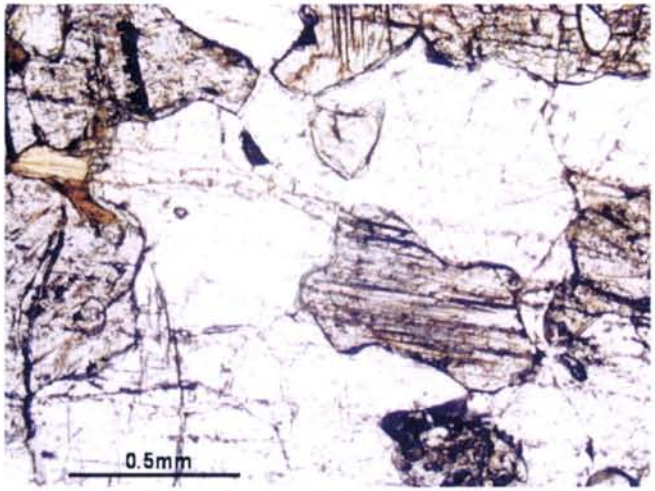


04SFAD07C2 -02 crossed polarized light

(Two-pyroxene gabbro)

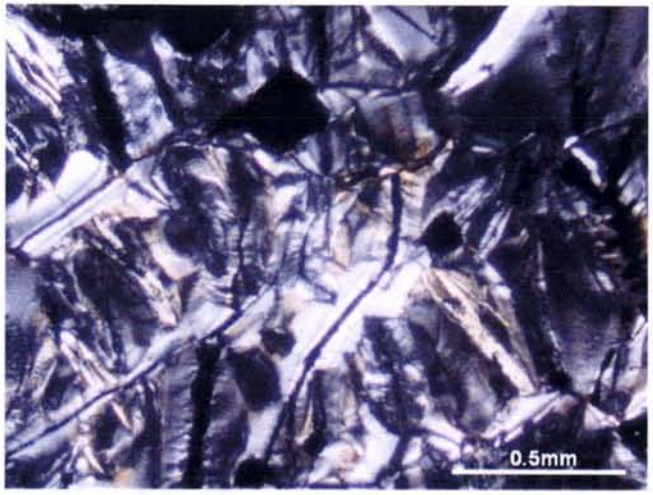


04SFAD07C2 -01 plane-polarized light



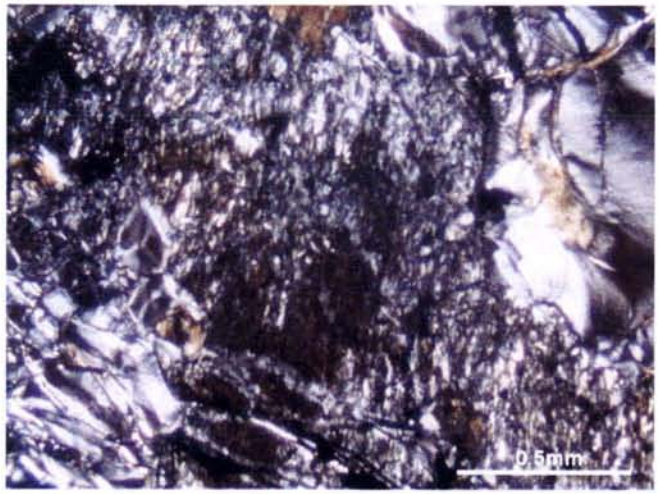
04SFAD07C2 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



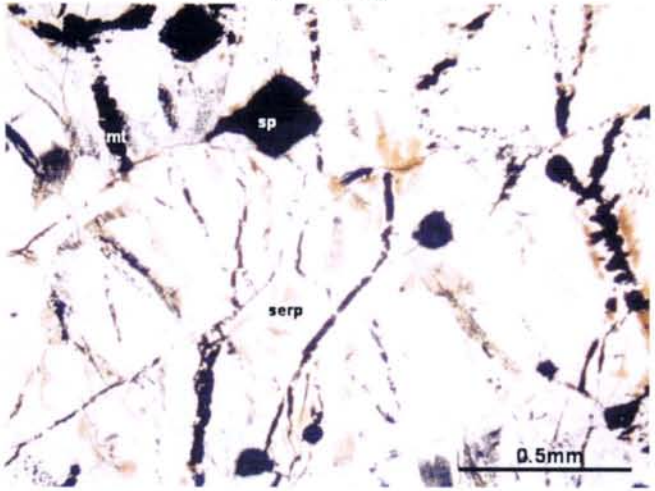
04SFAD07C4 -01 crossed polarized light

(Dunite)

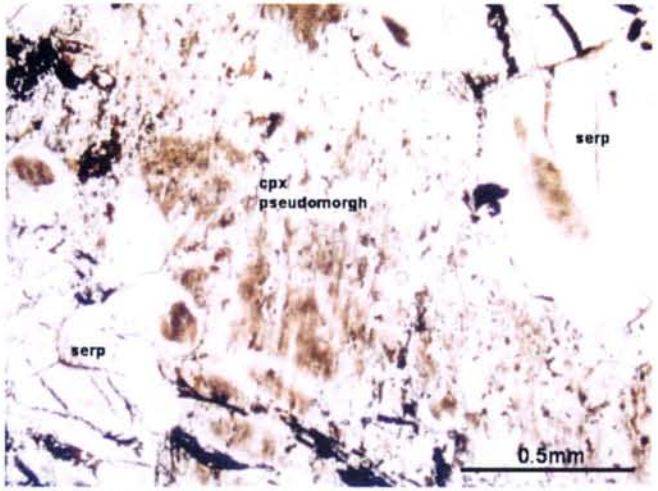


04SFAD07C4 -02 crossed polarized light

(Dunite)

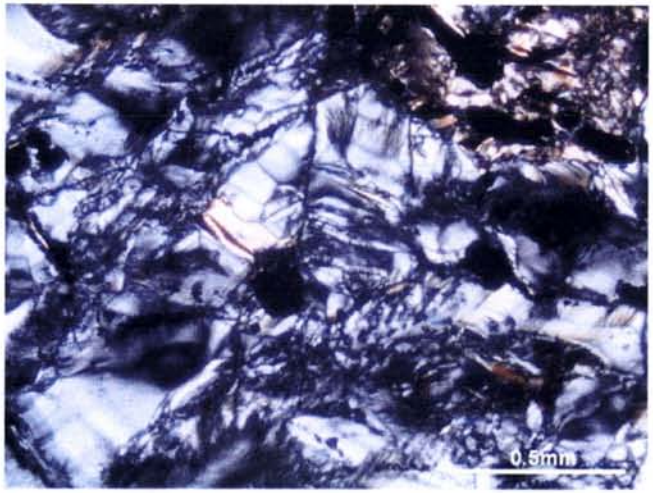


04SFAD07C4 -01 plane polarized light



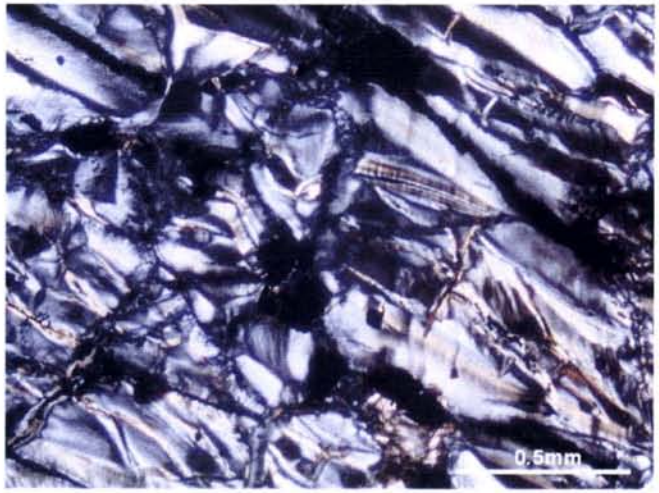
04SFAD07C4 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



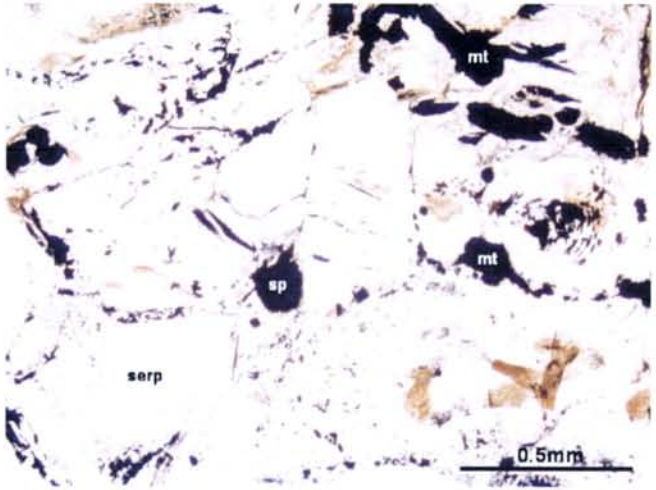
04SFAD07C5 -01 crossed polarized light

(Wehrlite)

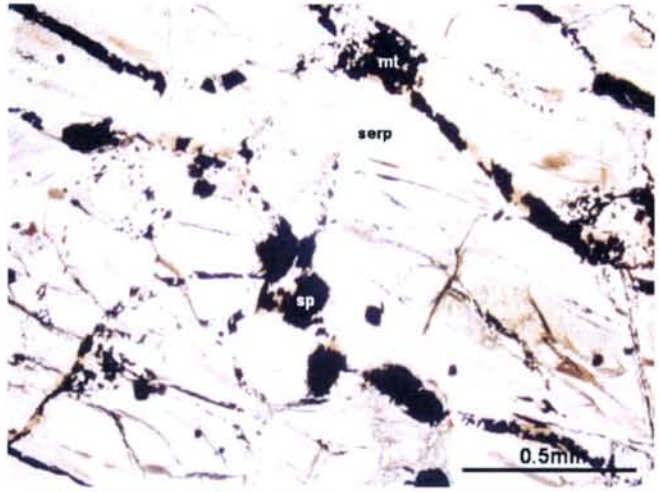


04SFAD07C5 -02 crossed polarized light

(Wehrlite)

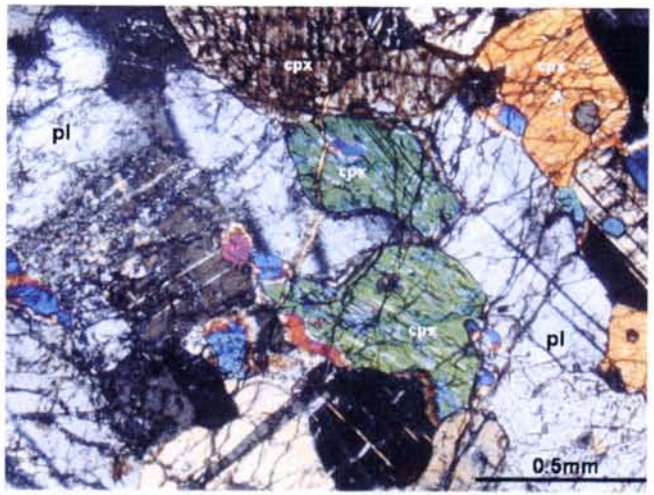


04SFAD07C5 -01 plane-polarized light



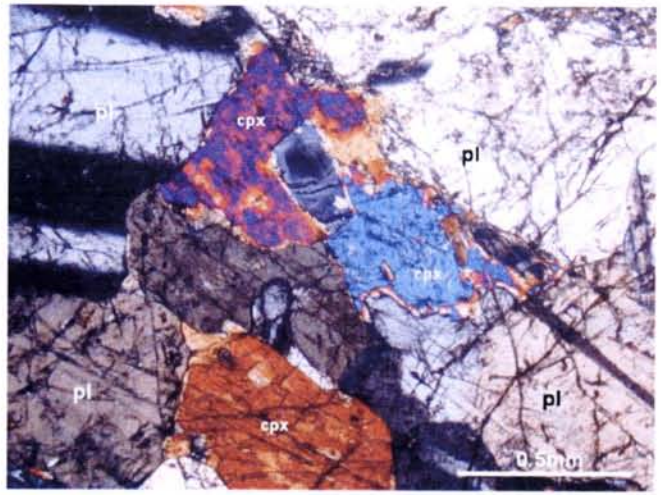
04SFAD07C5 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



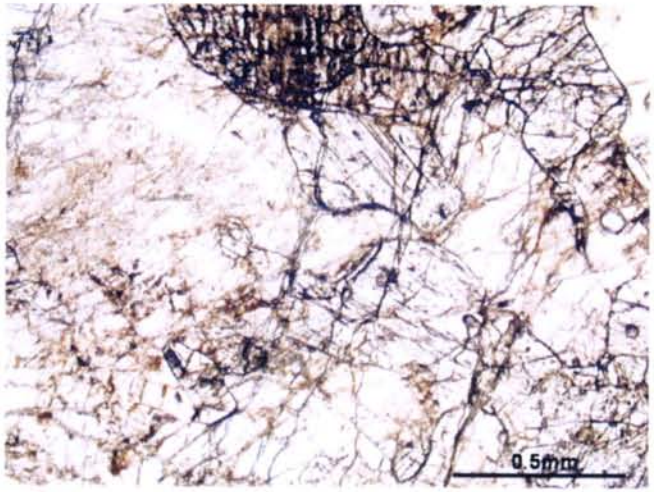
04SFAD07C7 -01 crossed polarized light

(Two-pyroxene gabbro)

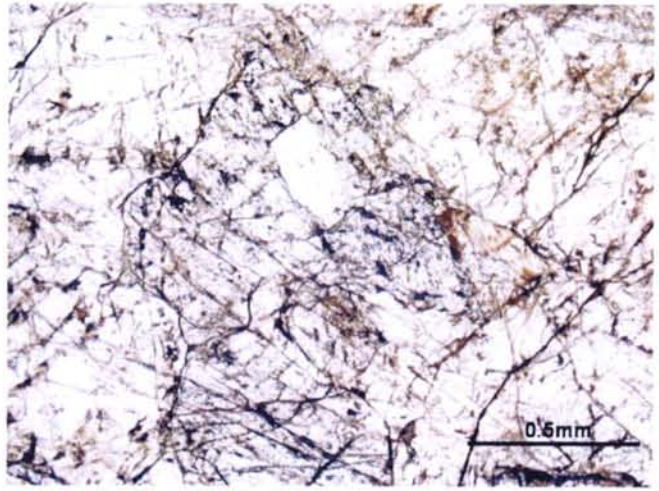


04SFAD07C7 -02 crossed polarized light

(Two-pyroxene gabbro)

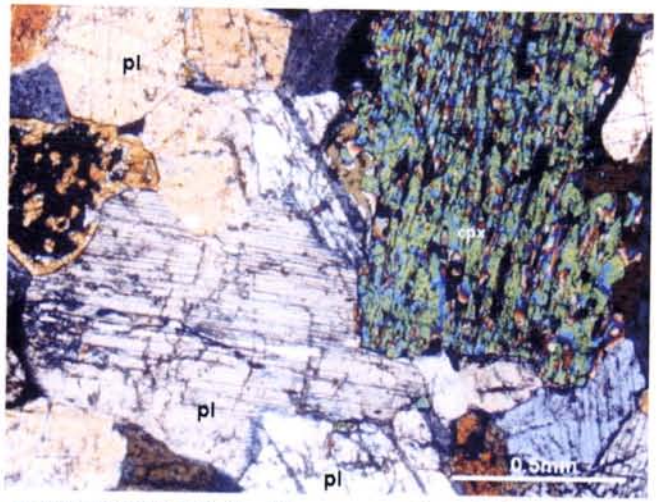


04SFAD07C7 -01 plane-polarized light



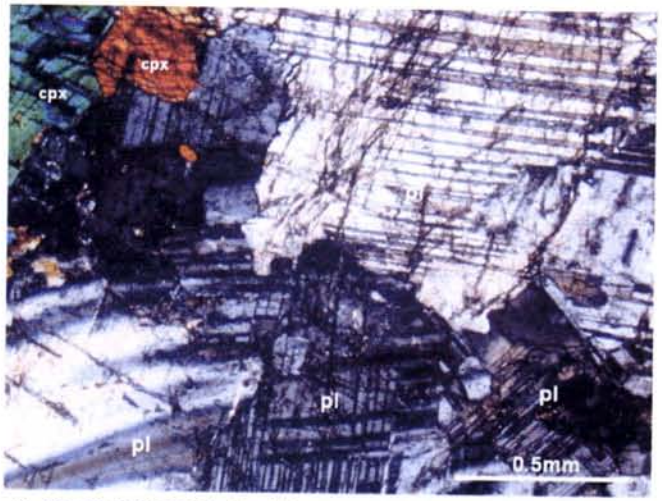
04SFAD07C7 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



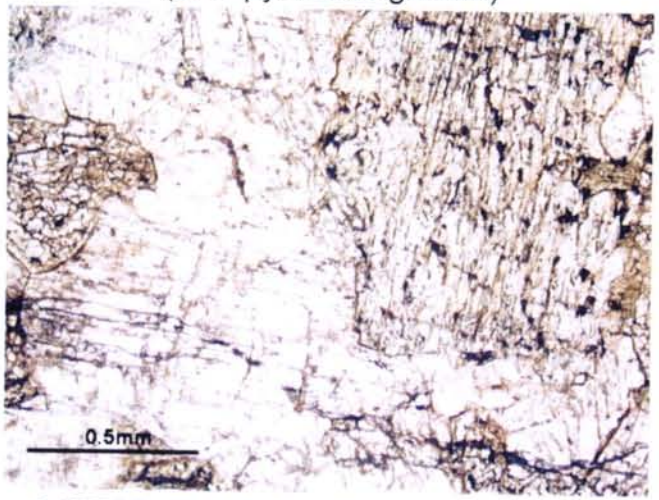
04SFAD07C9-1 -01 crossed polarized light

(Two-pyroxene gabbro)

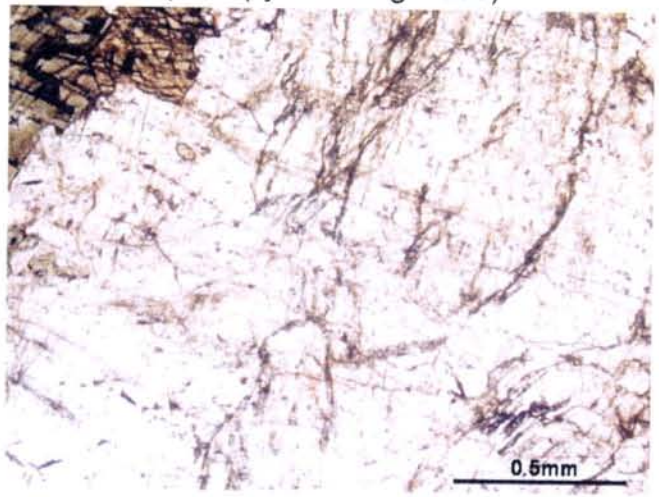


04SFAD07C9-1 -02 crossed polarized light

(Two-pyroxene gabbro)

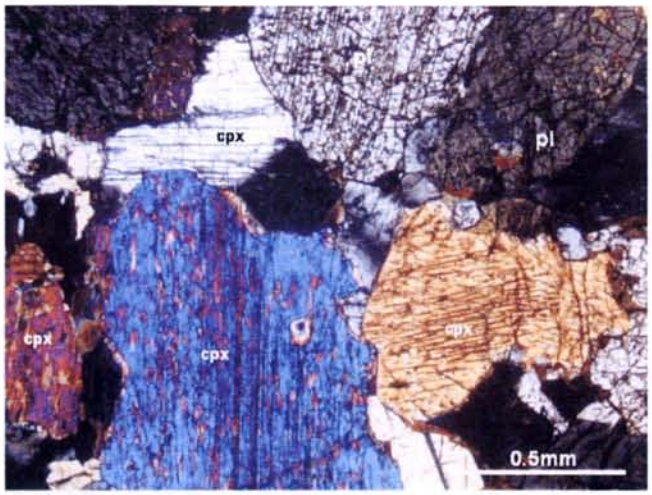


04SFAD07C9-1 -01 plane-polarized light



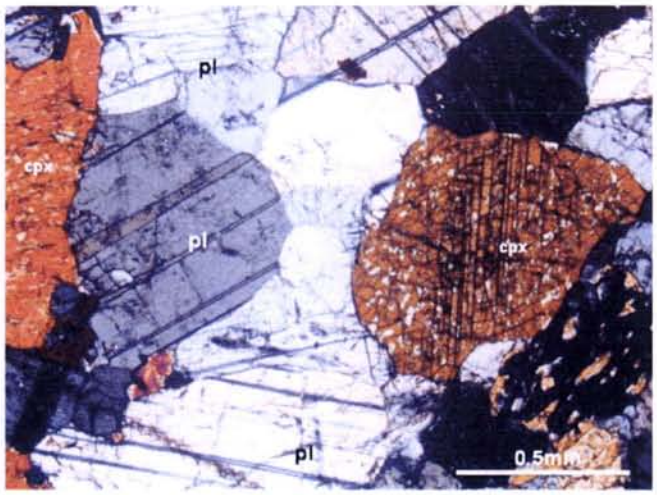
04SFAD07C9-1 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



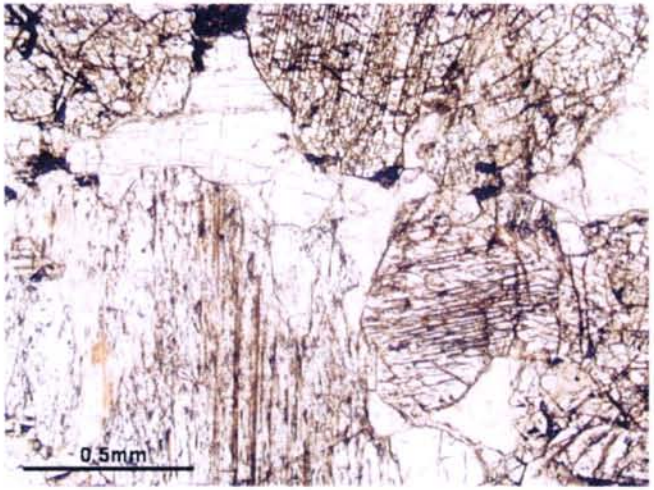
04SFAD07C9-2 -01 crossed polarized light

(Two-pyroxene gabbro)

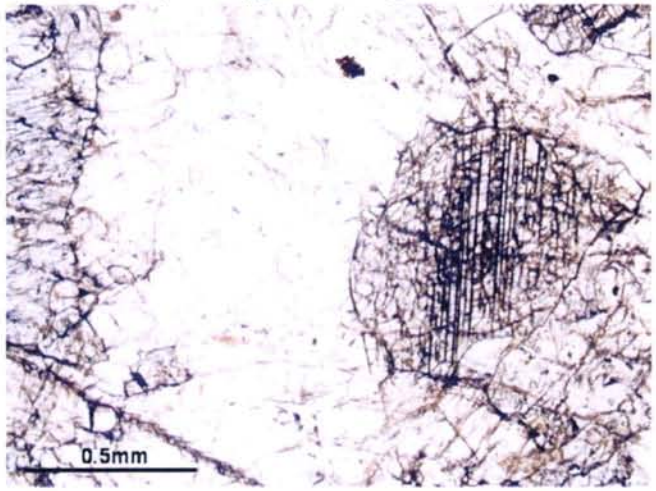


04SFAD07C9-2 -02 crossed polarized light

(Two-pyroxene gabbro)

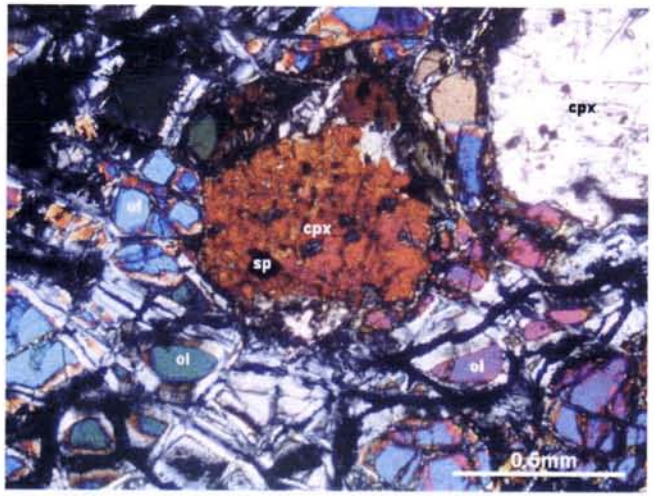


04SFAD07C9-2 -01 plane-polarized light



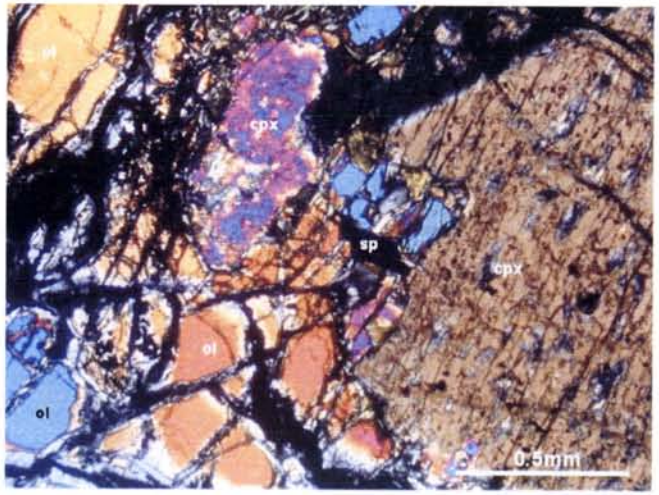
04SFAD07C9-2 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



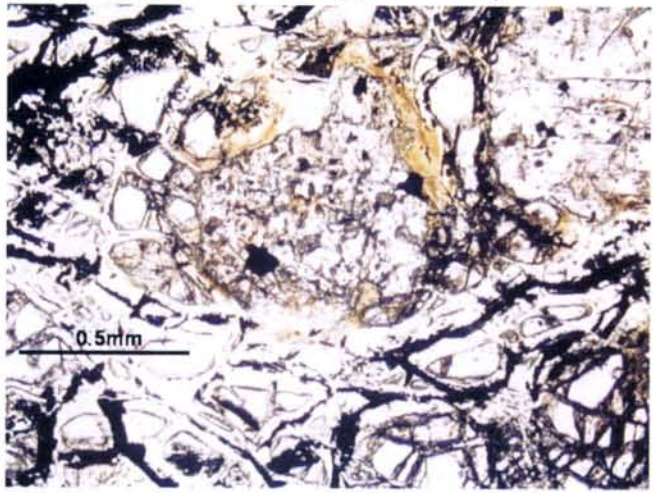
04SFAD07C12-1 -01 crossed polarized light

(Olivine clinopyroxenite)

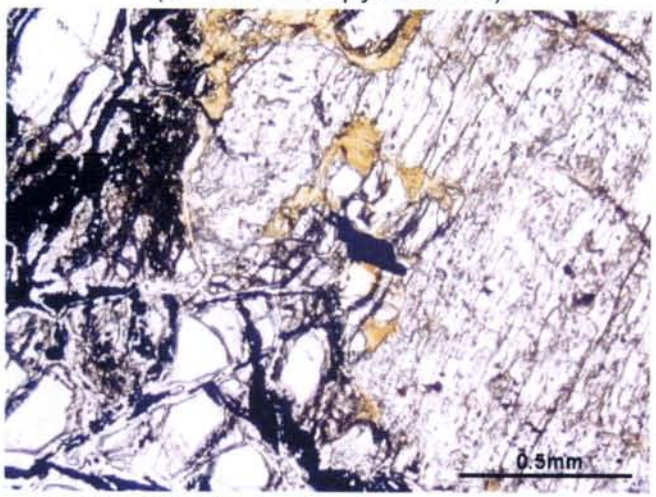


04SFAD07C12-1 -02 crossed polarized light

(Olivine clinopyroxenite)

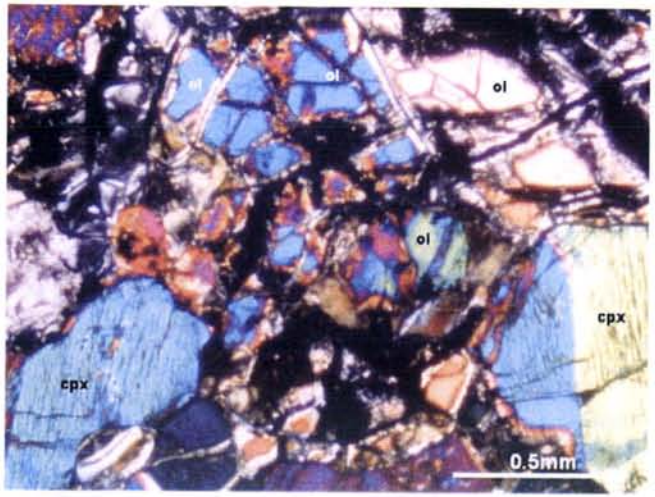


04SFAD07C12-1 -01 plane-polarized light



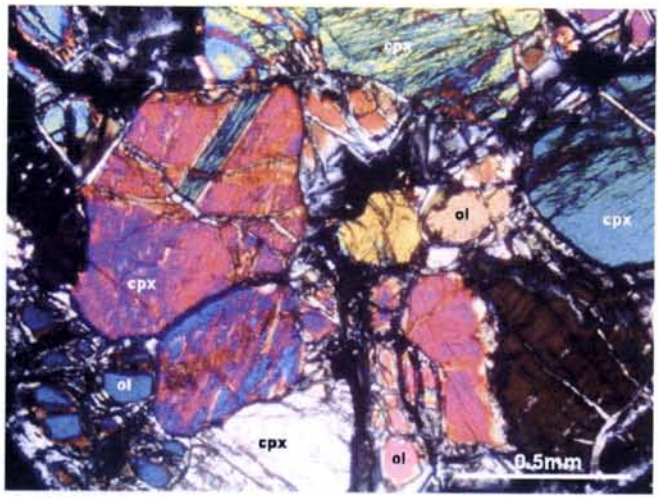
04SFAD07C12-1 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



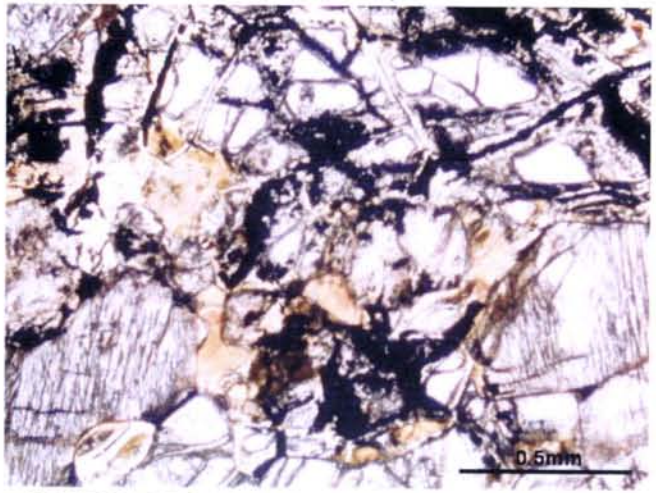
04SFAD07C12-2 -01 crossed polarized light

(Wehrlite)

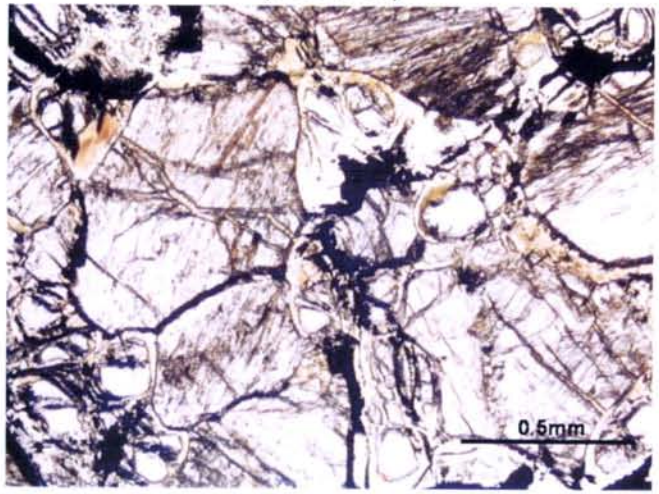


04SFAD07C12-2 -02 crossed polarized light

(Wehrlite)

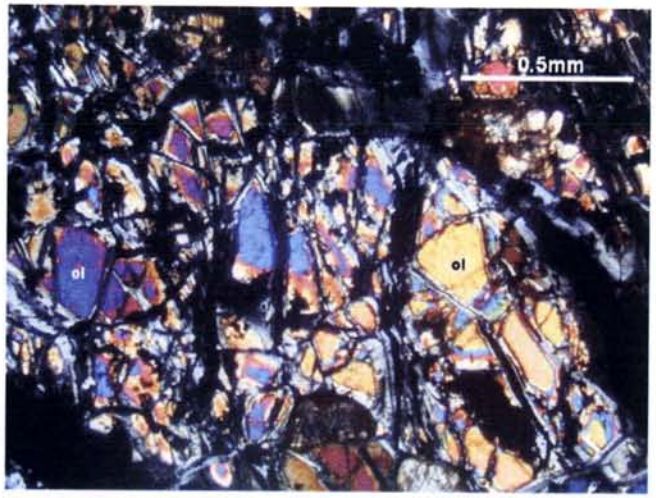


04SFAD07C12-2 -01 plane-polarized light



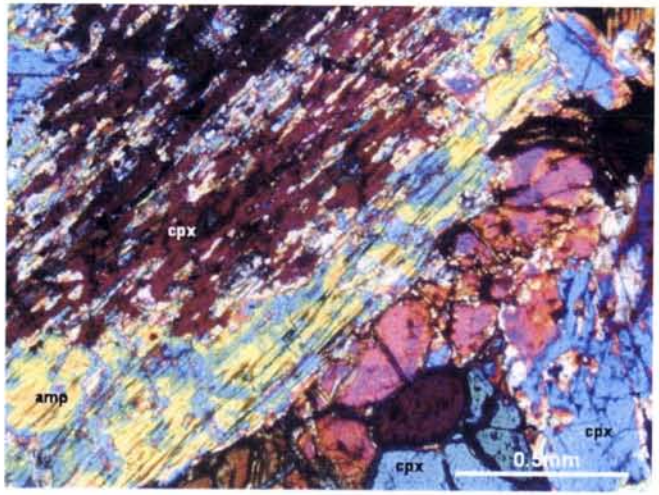
04SFAD07C12-2 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



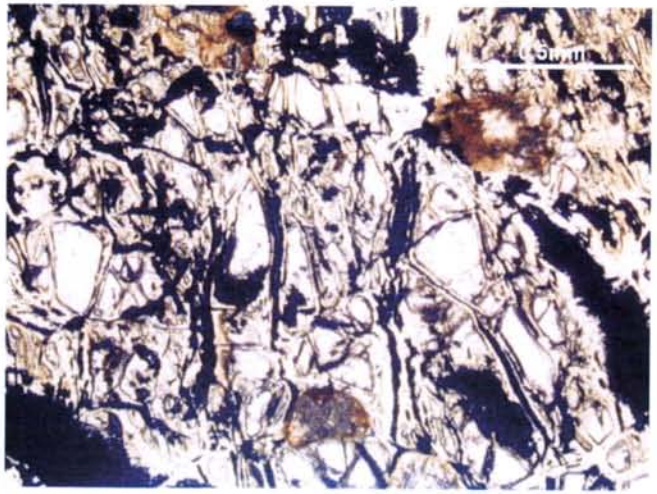
04SFAD07C13-5 -01 crossed polarized light

(Wehrlite)

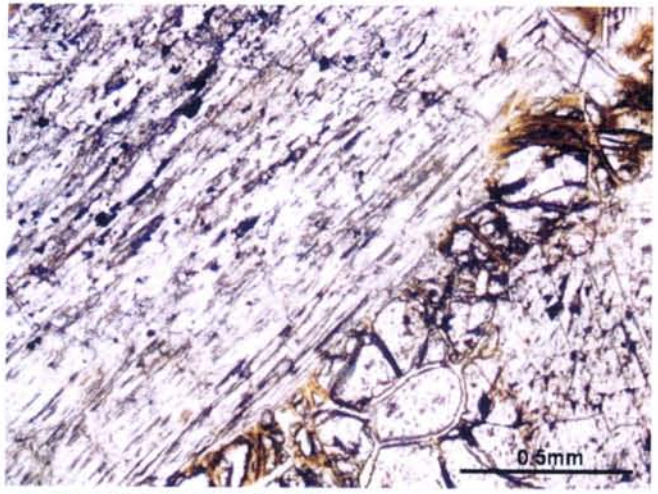


04SFAD07C13-5 -02 crossed polarized light

(Wehrlite)

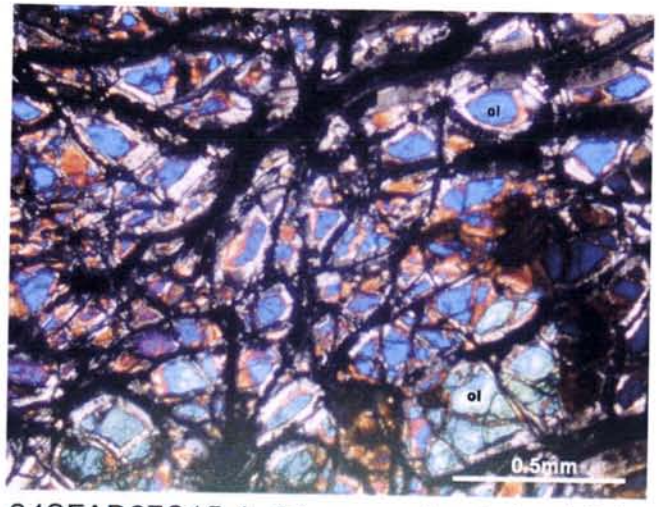


04SFAD07C13-5 -01 plane-polarized light



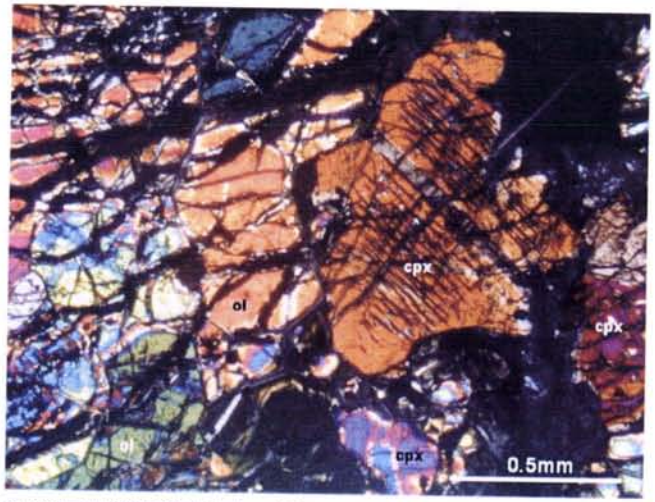
04SFAD07C13-5 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



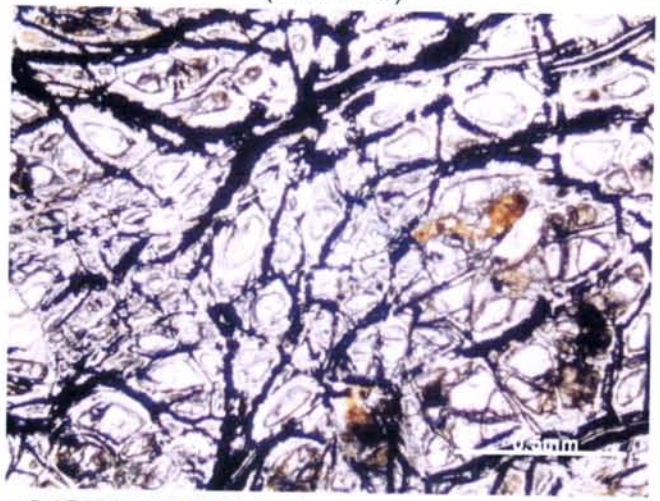
04SFAD07C15-1 -01 crossed polarized light

(Wehrlite)

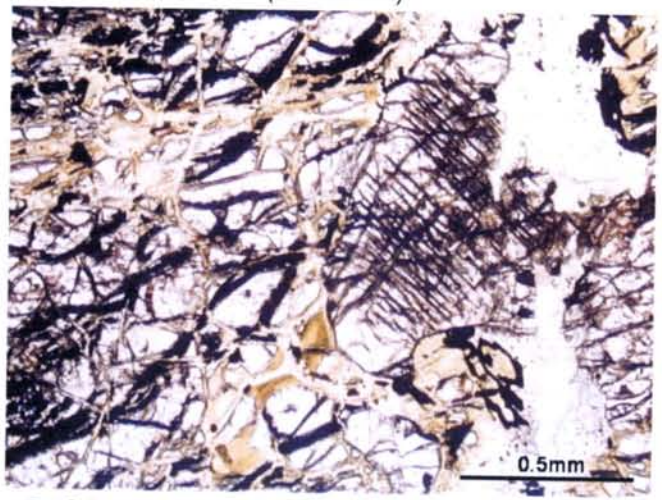


04SFAD07C15-1 -02 crossed polarized light

(Wehrlite)

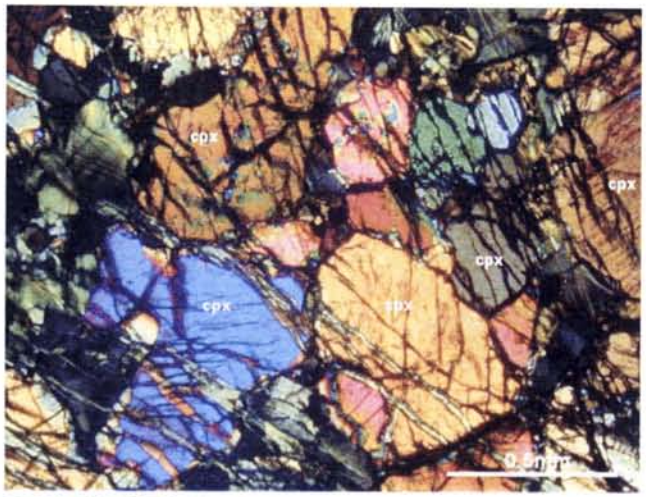


04SFAD07C15-1 -01 plane-polarized light



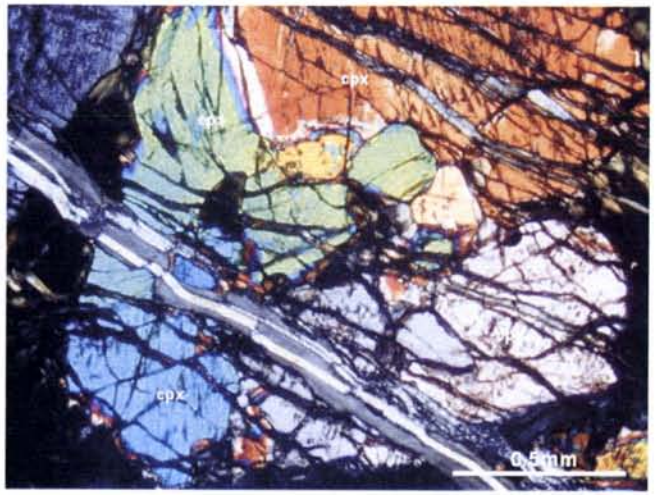
04SFAD07C15-1 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



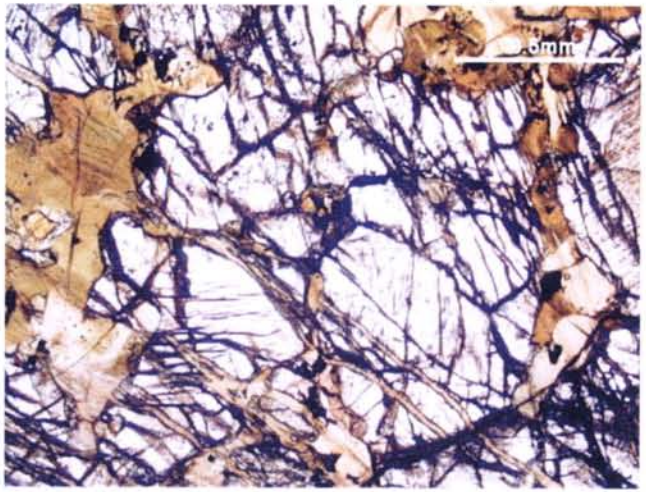
04SFAD07C15-2 -01 crossed polarized light

(Olivine clinopyroxenite)



04SFAD07C15-2 -02 crossed polarized light

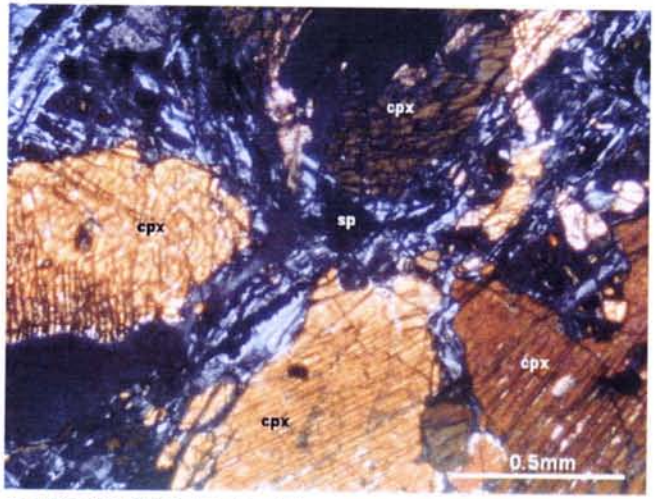
(Olivine clinopyroxenite)



04SFAD07C15-2 -01 plane-polarized light

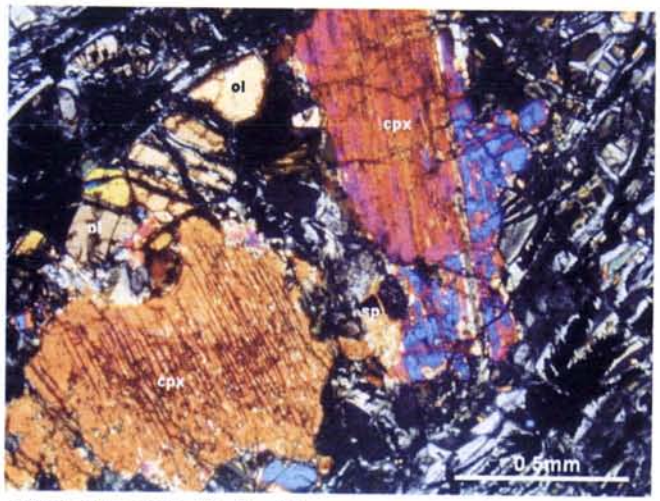
04SFAD07C15-2 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



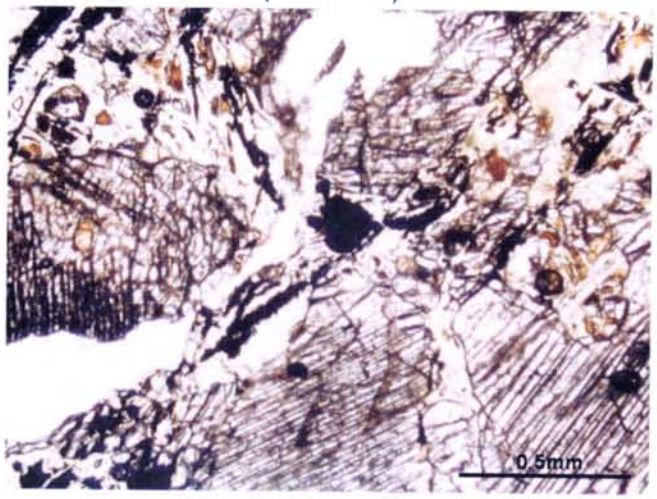
04SFAD07C17-1 -01 crossed polarized light

(Wehrlite)

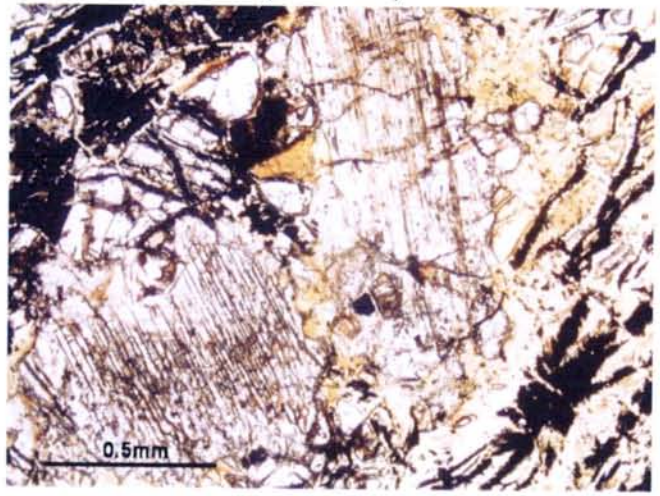


04SFAD07C17-1 -02 crossed polarized light

(Wehrlite)

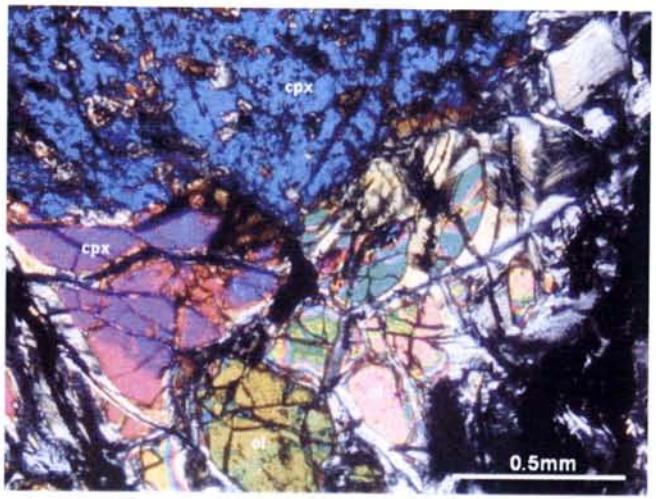


04SFAD07C17-1 -01 plane-polarized light



04SFAD07C17-1 -02 plane-polarized light

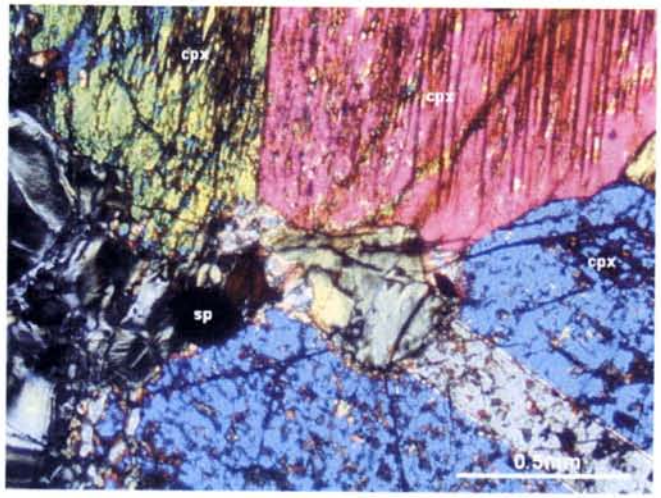
ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



04SFAD07C18-2 -01 crossed polarized light

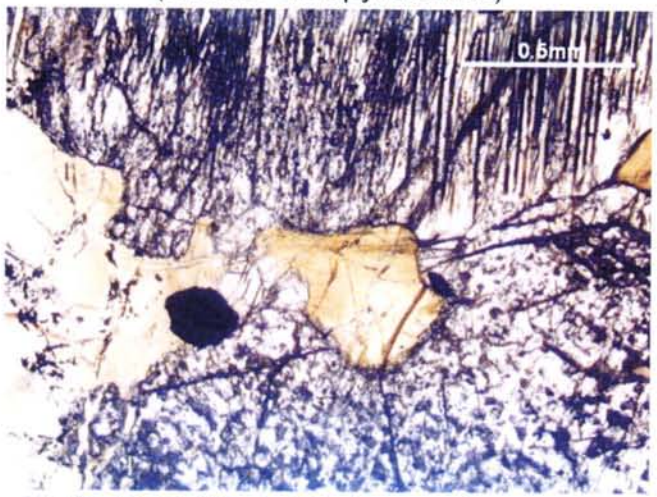
(Olivine clinopyroxenite)

04SFAD07C18-2 -01 plane-polarized light



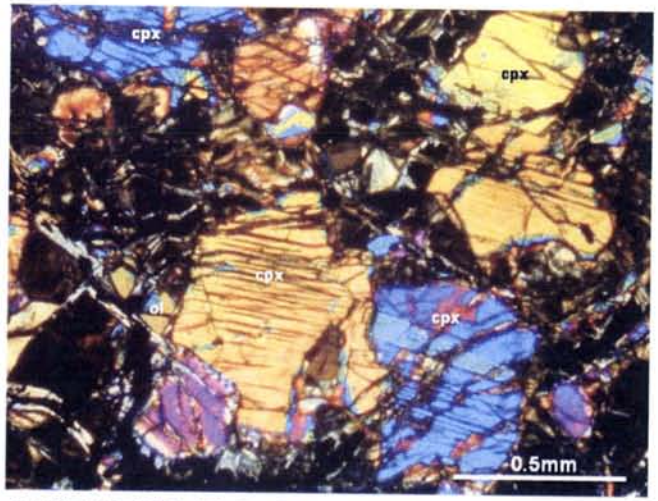
04SFAD07C18-2 -02 crossed polarized light

(Olivine clinopyroxenite)



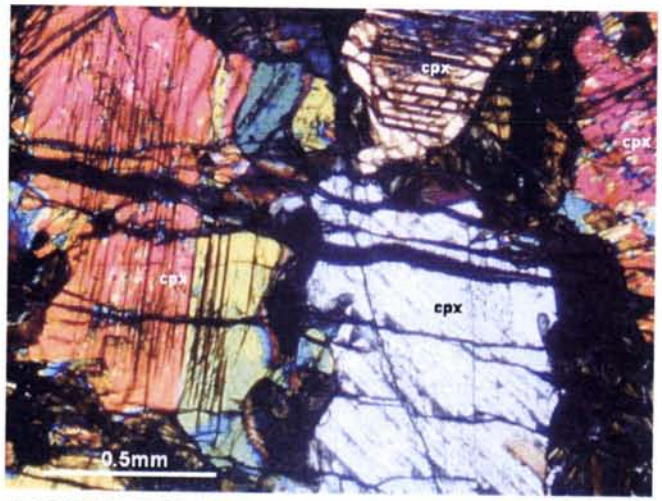
04SFAD07C18-2 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



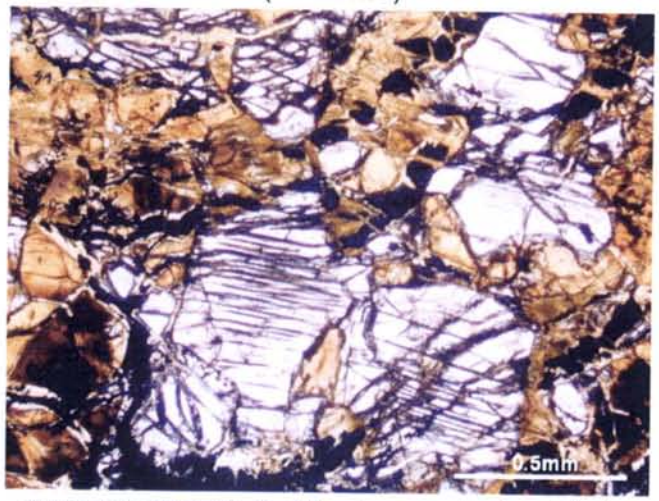
04SFAD07C19-2 -01 crossed polarized light

(Wehrlite)

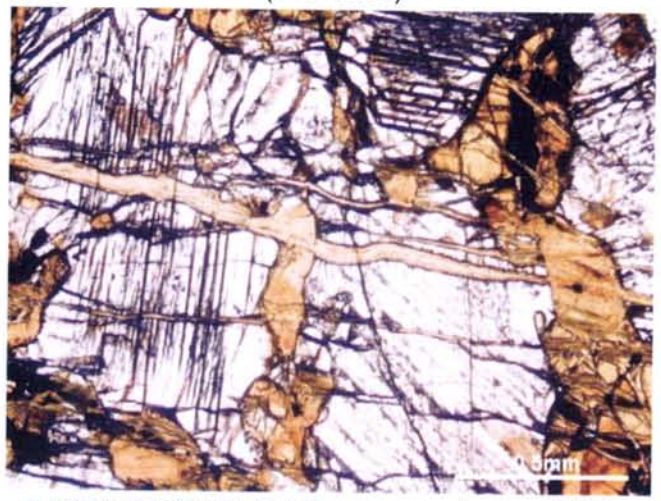


04SFAD07C19-2 -02 crossed polarized light

(Wehrlite)

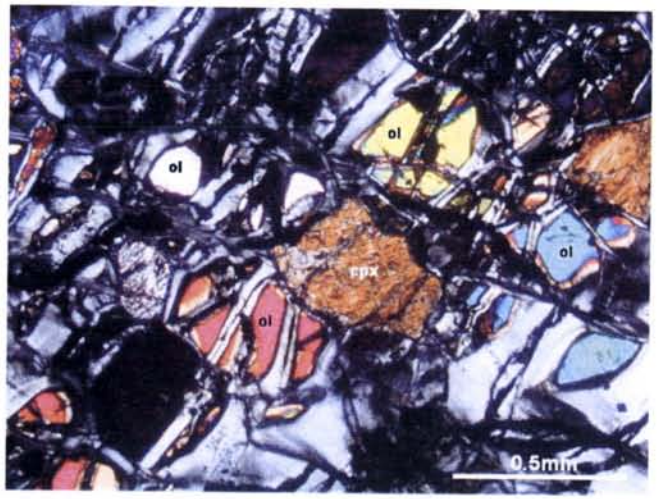


04SFAD07C19-2 -01 plane-polarized light



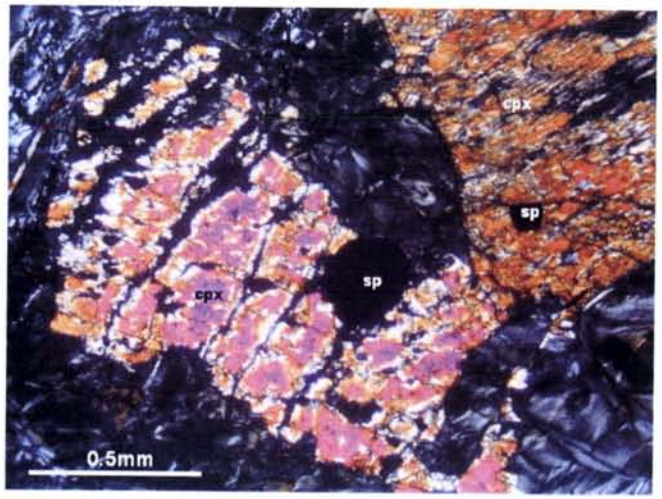
04SFAD07C19-2 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



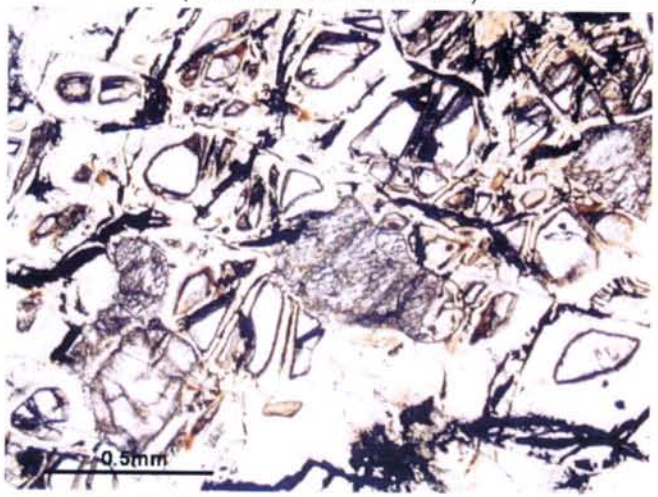
04SFAD07C20 -01 crossed polarized light

(Dunite and wehrlite)

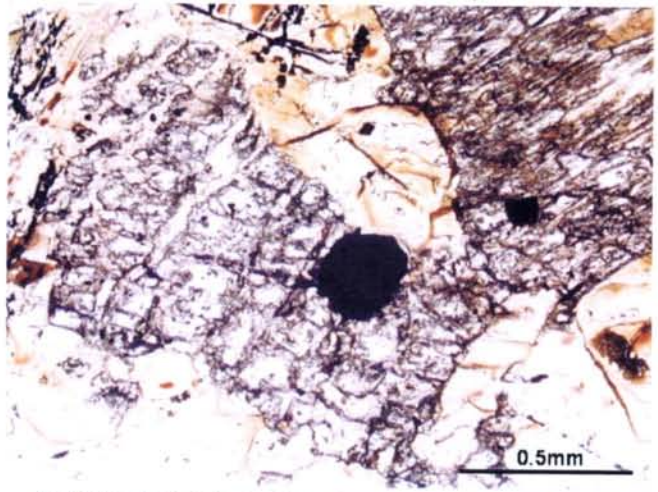


04SFAD07C20 -02 crossed polarized light

(Dunite and wehrlite)



04SFAD07C20 -01 plane-polarized light

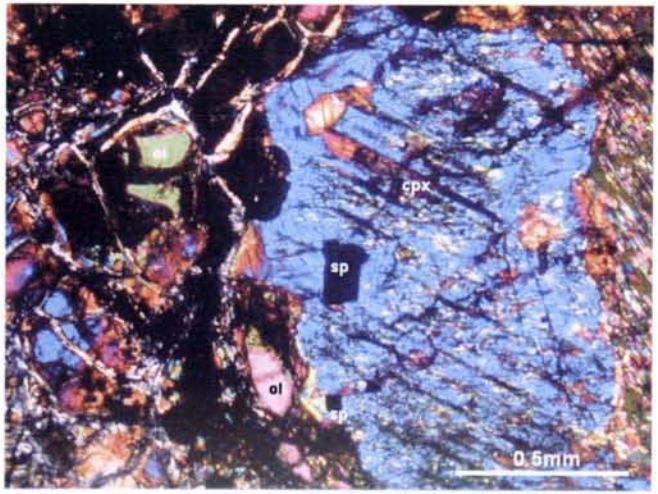


04SFAD07C20 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite

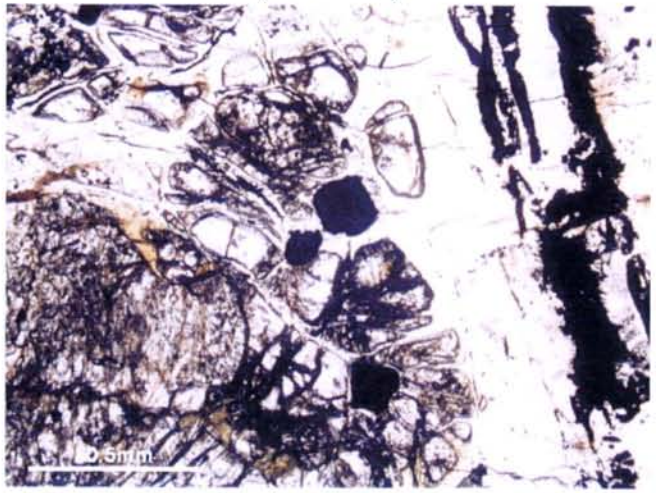
04SFAD07C21-1 -01 crossed polarized light

(Wehrlite)



04SFAD07C21-1 -02 crossed polarized light

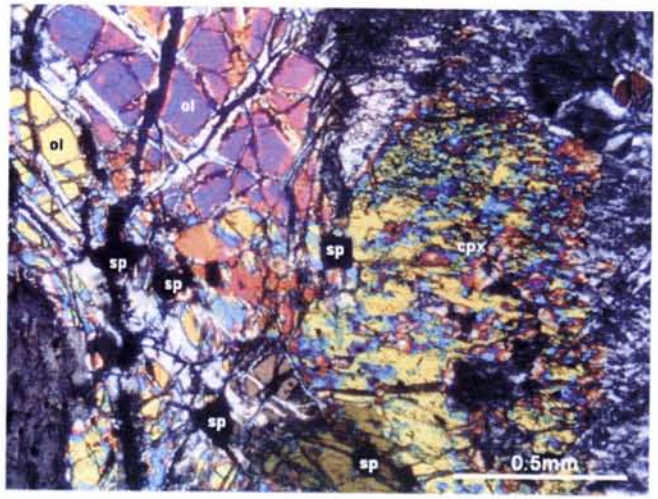
(Wehrlite)



04SFAD07C21-1 -01 plane-polarized light

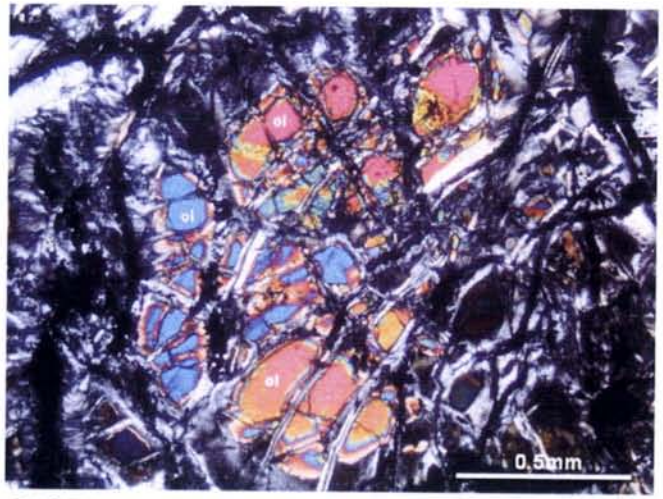
04SFAD07C21-1 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



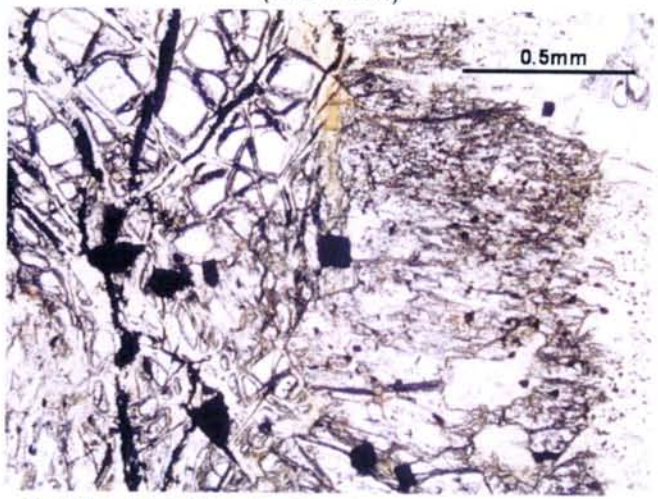
04SFAD07C21-2 -01 crossed polarized light

(Wehrlite)

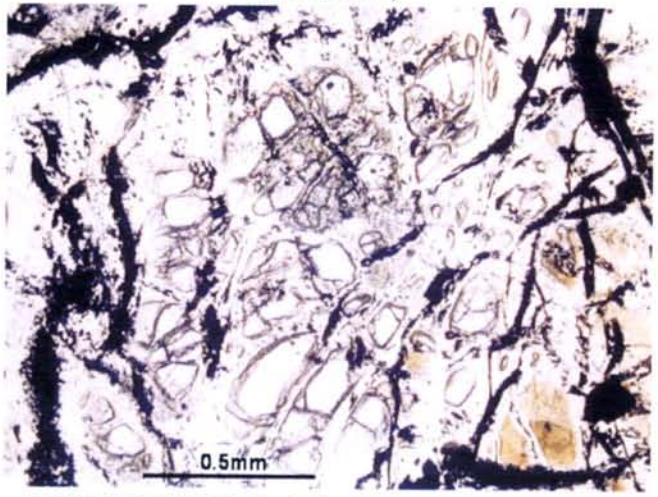


04SFAD07C21-2 -02 crossed polarized light

(Wehrlite)

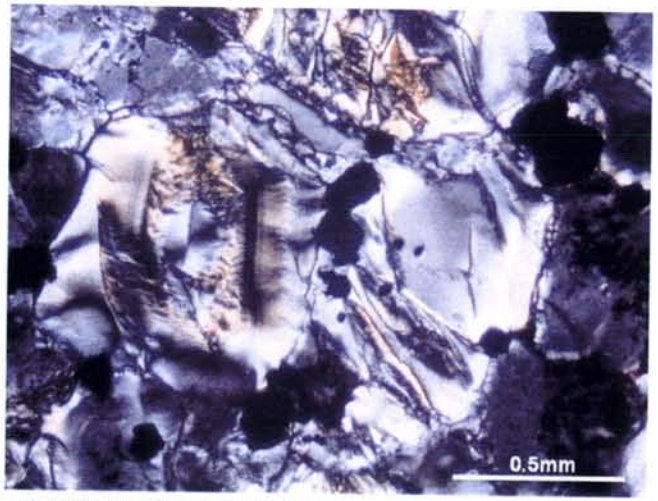


04SFAD07C21-2 -01 plane-polarized light



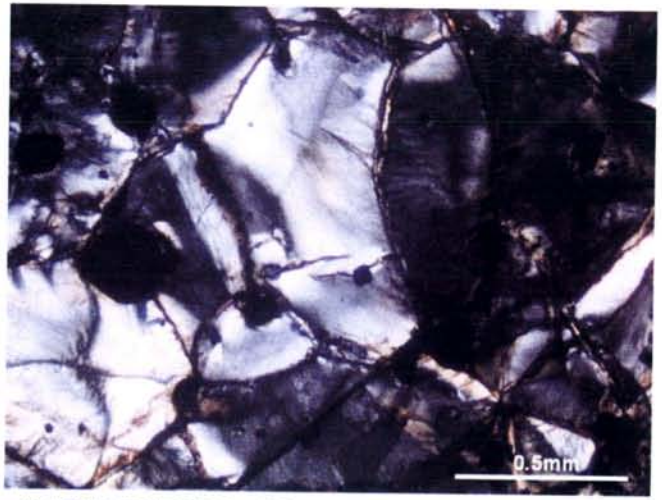
04SFAD07C21-2 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



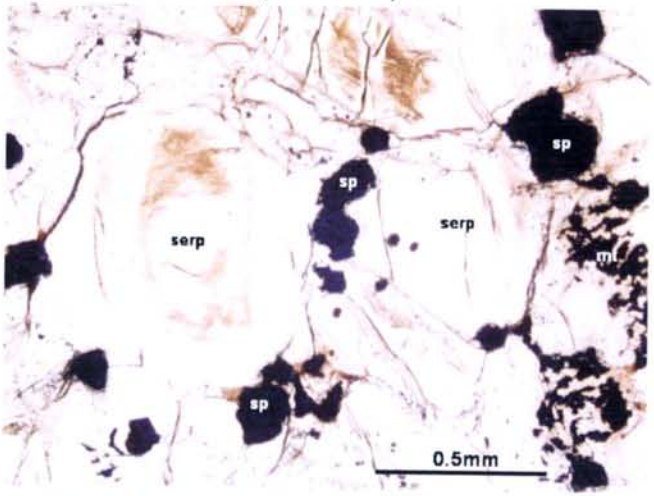
04SFAD07C23 -01 crossed polarized light

(Wehrlite)

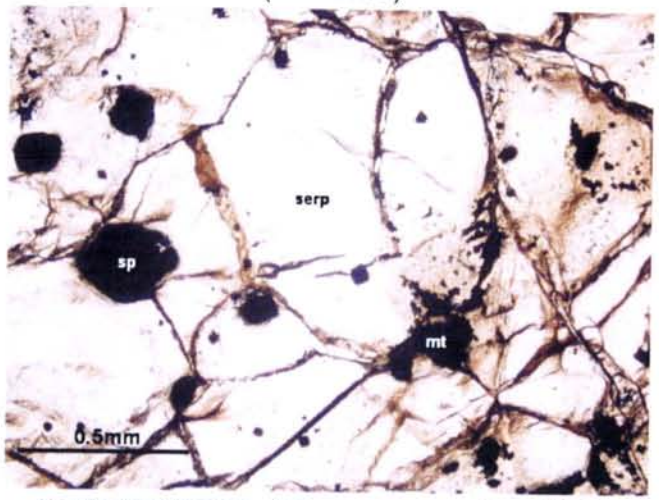


04SFAD07C23 -02 crossed polarized light

(Wehrlite)

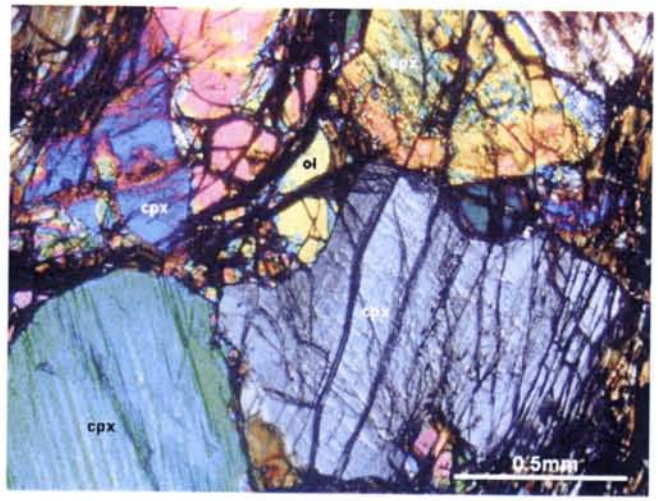


04SFAD07C23 -01 plane-polarized light



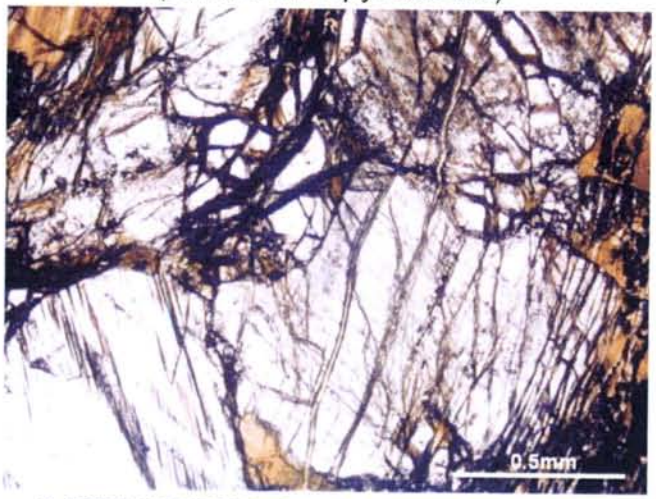
04SFAD07C23 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite

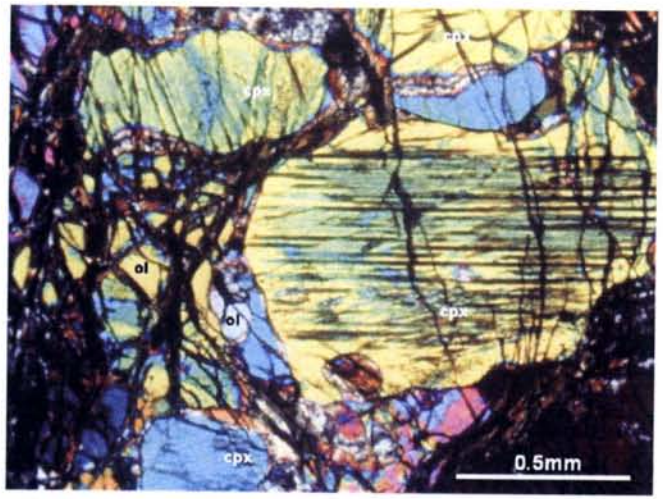


04SFAD07C24 -01 crossed polarized light

(Olivine clinopyroxenite)

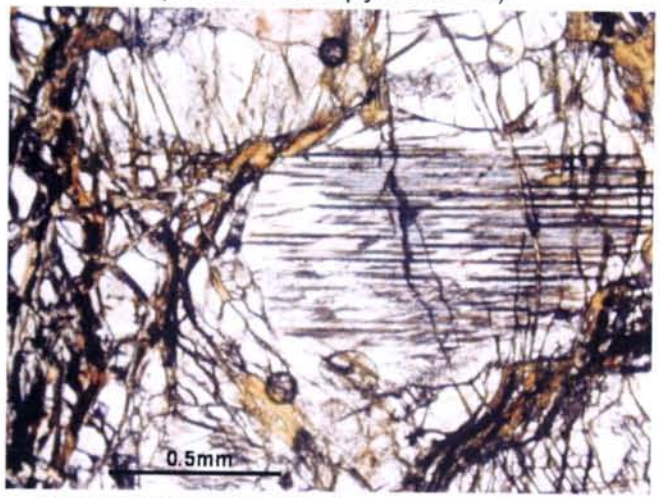


04SFAD07C24 -01 plane-polarized light



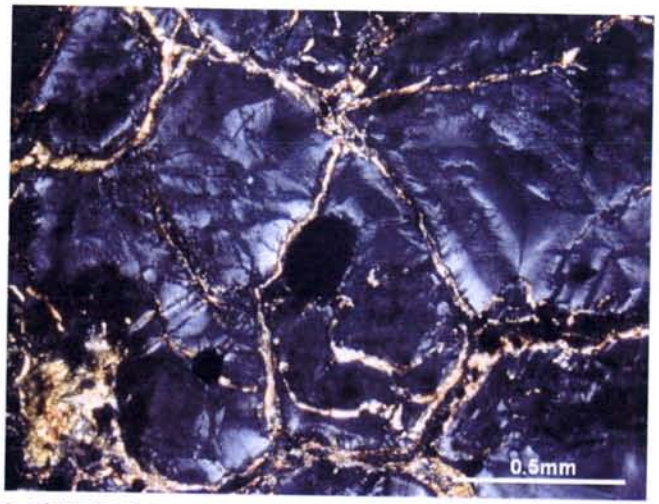
04SFAD07C24 -02 crossed polarized light

(Olivine clinopyroxenite)



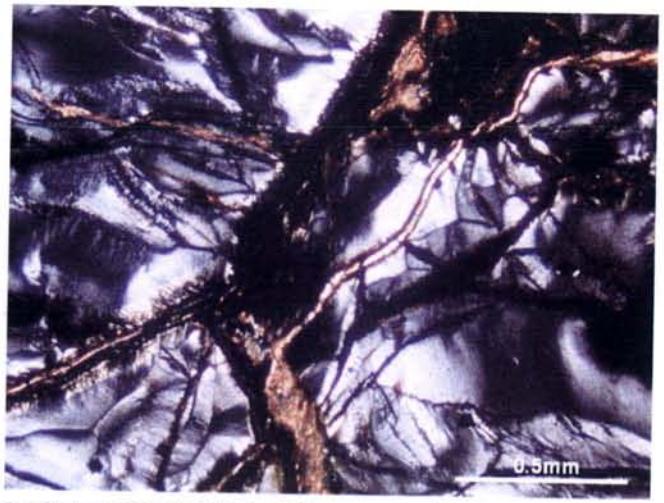
04SFAD07C24 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



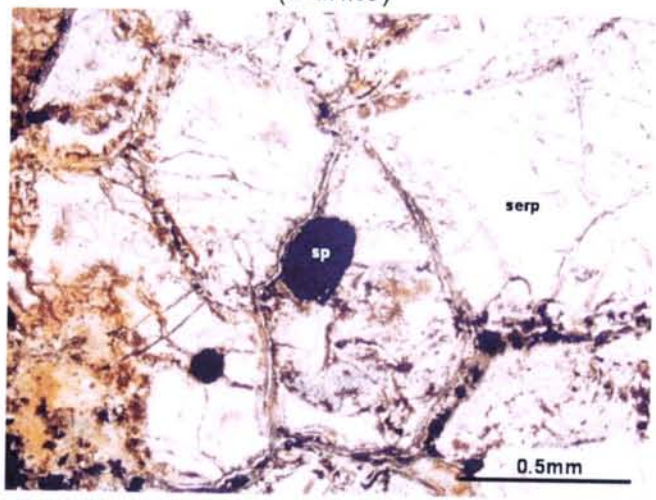
04SFFDG03 P3-1 -01 crossed polarized light

(Dunite)

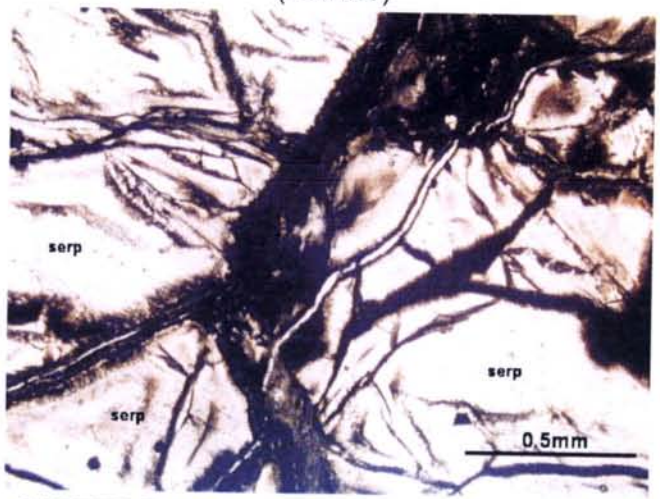


04SFFDG03 P3-1 -02 crossed polarized light

(Dunite)

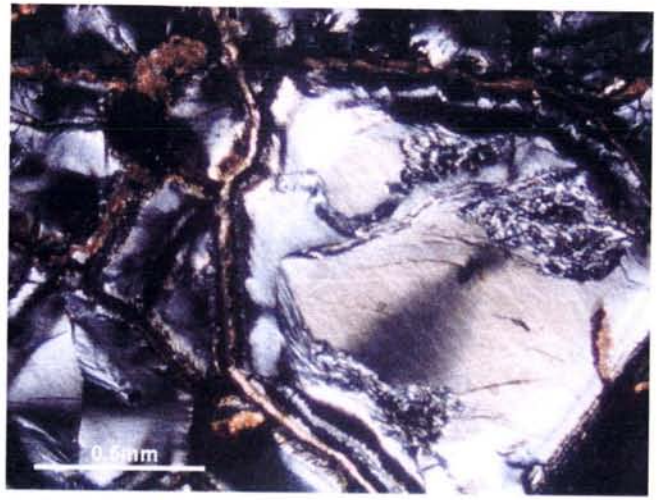


04SFFDG03 P3-1 -01 plane-polarized light



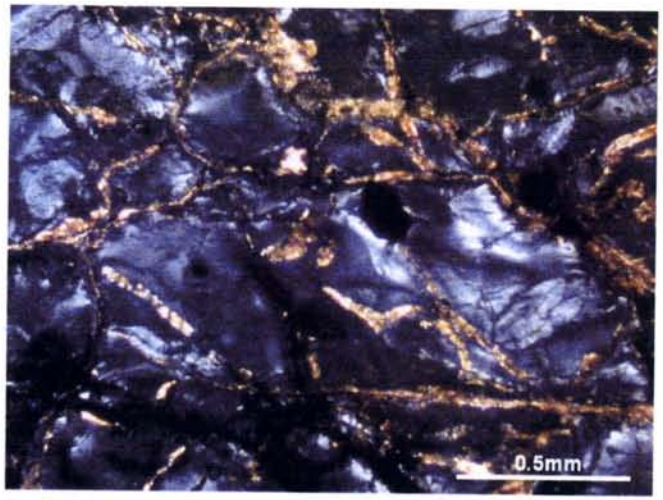
04SFFDG03 P3-1 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite



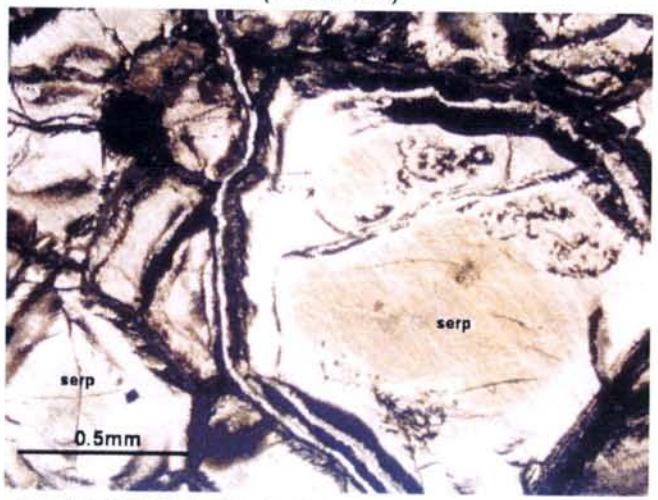
04SFFDG03 P3-2 -01 crossed polarized light

(Wehrlite)

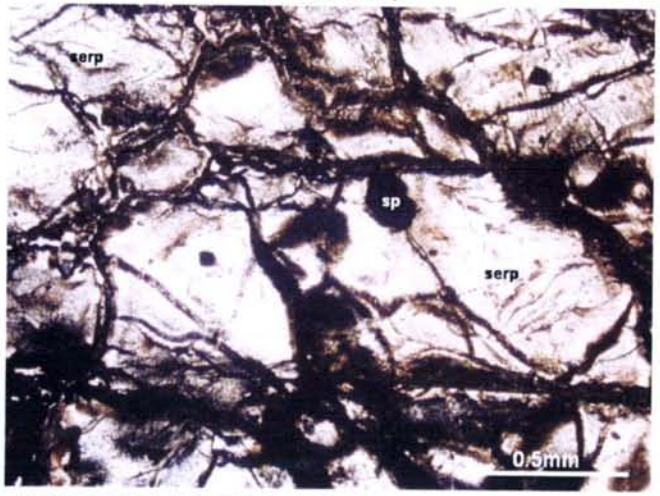


04SFFDG03 P3-2 -02 crossed polarized light

(Wehrlite)



04SFFDG03 P3-2 -01 plane-polarized light



04SFFDG03 P3-2 -02 plane-polarized light

ol: olivine; cpx: clinopyroxene; pl: plagioclase; am: amphibole; sp: spinel; serp: serpentine; mt: magnetite