

NGU Report 2000.108

Geological and geochemical investigations of  
the Idil olivine occurrence, Köycegis,  
Southwestern Turkey

Report no.: 2000.108		ISSN 0800-3416	Grading: Confidential until 31.12 2009
Title: Geological and geochemical investigations of the Idil olivine occurrence, Köycegis, Southwestern Turkey			
Authors: Håvard Gautneb, Leif Furuhaug		Client: A/S Olivin	
County:		Commune:	
Map-sheet name (M=1:250.000)		Map-sheet no. and -name (M=1:50.000)	
Deposit name and grid-reference: Idil dunite Turkey		Number of pages: 19	Price (NOK):
		Map enclosures: 2	
Fieldwork carried out: Sept. 2000	Date of report: 14.112000	Project no.: 288700	Person responsible: <i>Nigel Cook</i>
Summary:			
<p>The Idil olivine occurrence (37° 02'N 28° 44' E) is situated 13 km north of the city Köycegis in south-west Turkey. The distance to nearest port (Göcek) is 53 km. The deposit is situated in a steep valley side with altitude from 750 to 1100 metres above sea level. The main rock units in the area includes (from bottom to top):</p> <ul style="list-style-type: none"> <li>A) a tectonic melange unit comprising large blocks of crystalline metamorphic rocks (gneisses, amphibolites meta-arkose).</li> <li>B) Chaotically distributed rocks in a radiolarian silty clay stone.</li> <li>C) Overlying this, and with a low angle thrust contact, rocks of dunitic and harzburgitic composition occur.</li> <li>D) Some scattered diabase dykes intrude these rocks. The area has undergone extensive block faulting with vertical movement of up to 300-400 metres in some places. The block faulting and its displacement of the thrust is the main factor controlling the depth distribution of the ultramafic rocks.</li> </ul> <p>The dunite body is about 600 metres long and 100 to 200 metres wide and shows a gradual transition to the surrounding harzburgite. The ultramafic rocks were systematically sampled and show the following average values: % MgO = 45.28, % LOI = 2.09 and MgO/SiO<sub>2</sub> = 1.08. The dunite alone shows the following averages: % MgO = 46.07, % LOI = 2.05 and MgO/SiO<sub>2</sub> = 1.11. The eastern part of the harzburgite (the largest area) has average values: % MgO = 45.38, % LOI = 1.11 and MgO/SiO<sub>2</sub> = 1.07. In both units, the chemical variation is large and the harzburgite units contain small pockets of dunitic composition.</p> <p>Future investigations must include core drilling to check the accurate location of the thrust and detailed compositional variation along the drill holes.</p>			
Keywords:	Dunite	Mineral deposit	
Industrial minerals	Harzburgite	Dust sampling	
Olivine	Ophiolite		

1. INTRODUCTION.....	4
1.1 EXPLANATION OF IMPORTANT GEOLOGICAL TERMS .....	4
1.2 OTHER OLIVINE OCCURRENCES IN TURKEY .....	5
1.3 GEOGRAPHICAL SETTING.....	5
1.4 GEOLOGICAL SETTING.....	6
1.4.1 Earlier investigations of the Idil deposit .....	7
1.4.2 Methods of investigation.....	7
2. FIELD DESCRIPTIONS .....	8
2.1 DESCRIPTION OF INDIVIDUAL UNITS .....	8
2.1.1 The Lycian melange .....	8
2.1.2 Peridotites.....	9
2.1.3 Block faulting.....	10
3. GEOCHEMISTRY.....	11
4. PETROGRAPHY.....	17
5. SUMMARY AND CONCLUSIONS.....	18
6. REFERENCES.....	19

## FIGURES

Figure 1 Classification of peridotites .....	5
Figure 2 Simplified geological map of the Lycian Taurides Turkey .....	6
Figure 3 Rock relation diagram for the Lycian Taurides. The Idil occurrence is part of the Lycian peridotite thrust sheet. ....	7
Figure 4 Overview picture of the Idil area with the main rocks and contacts outlined .....	8
Figure 5 The contact between harzburgite and melange.....	9
Figure 6 Central part of the dunite area.....	10
Figure 7 Variation in MgO.....	13
Figure 8 Variation in LOI.....	14
Figure 9 Variation in total alkali .....	15
Figure 10 MgO/SiO <sub>2</sub> variation .....	16
Figure 11 Photomicrograph of dunite rock .....	17
Figure 12 Photomicrograph of harzburgite. ....	18

## TABLES

Table 1 Summary of chemical variation of Idil samples .....	11
Table 2 Mineralogical composition of selected rocks from the Idil olivine occurrence.....	17

## APPENDIX

- Appendix 1 Geological map 1:5000 Idil Olivine occurrence, Köycegis South west Turkey.  
Appendix 2 Profiles 1:5000 Idil Olivine occurrence, Köycegis South west Turkey.  
Appendix 3 Geochemical data from Idil Olivine occurrence.

## 1. INTRODUCTION

This report is the result of contract work carried out by NGU for A/S Olivin. The field work was done during 3 weeks in September 2000. Participants from NGU were Håvard Gautneb and Leif Furuhaug. Transportation and logistic facilities was provided by Vedat Saygili from *ATS Trade & Industry LTD*, Turkey and by Özcan Yaves from *Gender, Madencilik Mühendisilik*, Turkey. We thank these individuals for all their help during our stay in Turkey.

In this report, most geographical names will be written with standard English letters for simplicity and may therefore deviate from official Turkish spelling. We have purposely tried to keep the report concise and have used plain language to make the report readable for the none-geologist. The necessary geological nomenclature is explained in section 1.1

The result of this report has been presented to A/S Olivin in oral form and layout has been discussed and approved by A/S Olivin. Information regarding tonnage and reserve estimates and certain analytical results are as required by A/S Olivin omitted from this report for reasons of confidentiality.

### 1.1 Explanation of important geological terms

Certain important geological terms are defined as:

**Dunite:** Rock that contains more than 90% olivine

**Fault gauge:** Crushed rock formed as a result of movement along a fault plane

**Fault:** A slip plane in the rock where there has been and/or is movement.

**Harzburgite:** A type of peridotite, Rock that contains 90-60 % olivine and 40-90% enstatite

**Lycian Taurides:** Mountain belt in the southern part of Turkey

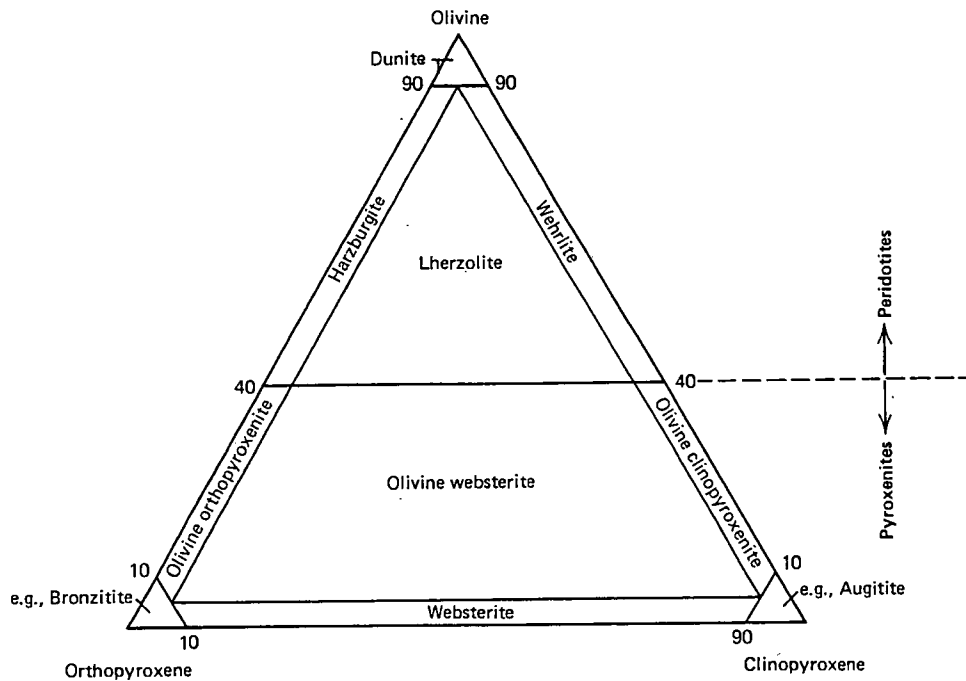
**Melange:** Chaotic mixture of blocks and fragments of rocks of different compositions

**Ophiolite:** A suite of oceanic rocks, which represents segments of the oceanic crust, which has been brought to the surface by continent collision

**Peridotite:** A rock that consists of olivine, and/or orthopyroxene and clinopyroxene

**Thrust:** A low-angle fault plane where rocks are pushed on top of each other.

A classification diagram for peridotites is shown in Fig. 1



**Figure 1 Classification of peridotites (from Dietrich & Skinner 1979)**

## 1.2 Other olivine occurrences in Turkey

According to Yavuz (pers. comm.) olivine has been produced, together with chromite in the Konya area about 240 km northwest from Antalya. The so-called Beykrom dunite is produced from chromite rich harzburgitic rocks from a deposit near Beysehir city (see index map on appendix 1). Several small deposits have been operating in this area, but are now dormant. Reserves are believed to be small and the quality lower than in the Idil deposit.

## 1.3 Geographical setting

The Idil olivine occurrence is situated 37° 02' North and 28° 44' East, about 900 m above sea level, in the Lycian Taurides mountains of Southwestern Turkey. The occurrence is situated about 4 km along a dry season road from the small village of Agla which again is situated 13 km north of the city of Köycegis along an all-season road. Along the present road network the distance to the nearest port (Göcek) is 53 km.

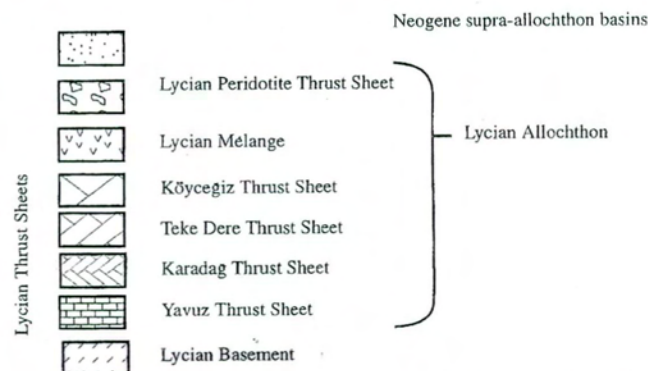
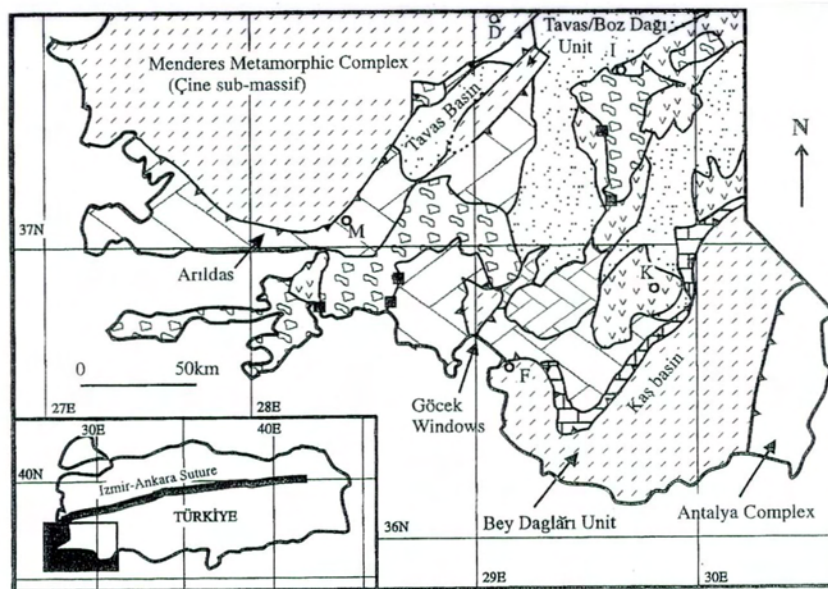
During our mapping we had access to topographical maps at the scale of 1:5000 and geological maps at the scale of 1:25000. The 1:5000 topographical map appeared to be somewhat inaccurate with regards to contours and locations of rivers and roads.

## 1.4 Geological setting

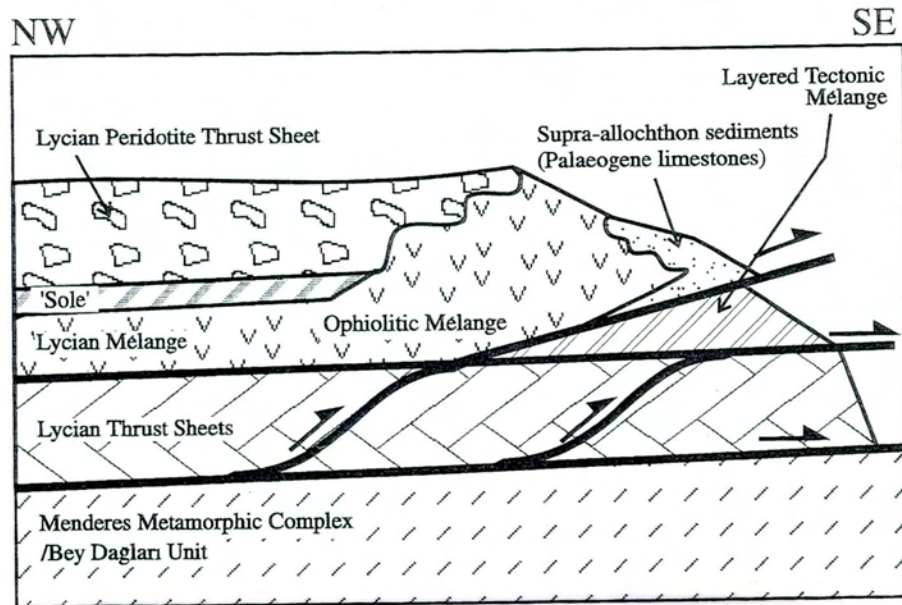
A simplified geological map of the Lycian Taurides is shown on Figs. 2 and 3. The Idil olivine occurrence is part of a thrust sequence that comprises the following main units, from bottom to top (Collins & Robertson 1998):

- 1) Lycian Basement, comprising Proterozoic granites, and Paleozoic schists and marbles in the north. In the south there are Cretaceous limestones, turbidites and pelagic sediments.
- 2) Lycian thrust sheets. This units contain 4 thrust units that comprise rocks of Jurassic to Cretaceous sediments and Eocene basaltic rocks.
- 3) Lycian Melange. This units is divided in 2, the layered tectonic melange and the ophiolitic melange. This unit is 2-3 km thick and comprises an amalgam of large blocks of limestone, radiolarian chert, amphibolite, basalts, in a strongly sheared shale and conglomerate matrix.
- 4) Lycian peridotite thrust sheet. This unit forms an extensive outcrop of more than 4500 km<sup>2</sup> and more that 2 km in thickness. It mostly comprises harzburgites with minor dunite, pyroxenite and chromitite.
- 5) Supra allochthon sediments. Paleogene limestone overlies the Lycian nappes.

The Idil olivine occurrence is part of unit 4 and only units 3 and 4 are exposed in the investigated area. The geological map and profiles are shown in the attached figures.



**Figure 2 Simplified geological map of the Lycian Taurides Turkey (from Collins & Robertson 1998)**



**Figure 3** Rock relation diagram for the Lycian Taurides. The Idil occurrence is part of the Lycian peridotite thrust sheet. (from Collins & Robertson 1998)

#### 1.4.1 Earlier investigations of the Idil deposit

An unpublished report by Jansen (1999) gives a brief description of the deposit and contains a single chemical analysis. No map or any interpretation of the internal variations or outer contacts was given. Jansen (1999) recommended the deposit to be “followed along strike, to the other side of the mountain”. Our mapping documents that this statement cannot be verified. Jansen (1999) presents one analysis with 50.27 % MgO and LOI of 0.71%. Our studies also document that these values are not representative for the entire deposit. According to Özcan Yavuz (pers. comm.) 80 tons of rock from the central part of the deposit was shipped to Romania by an earlier investigator, as slag conditioner,.

#### 1.4.2 Methods of investigation

The deposit is located in a relatively steep hillside with altitudes from 700 to 1100 m.a.s.l. The overburden is thin however, and most of the area is covered with loose scree. The area is vegetated with pine trees, juniper and holly bushes. The lower eastern part of the mapped area consists a deforested logging area and contains no vegetation. An overview picture of the area is shown in Fig. 4.

The deposit was mapped in the scale of 1:5000, and sampled by using a Pionjär 140 drilling machine. This equipment drills down about 50 cm and the dust is collected for analysis. About 1 kg of dust is collected at each sampling point



**Figure 4 Overview picture of the Idil area with the main rocks and contacts outlined**

## **2. FIELD DESCRIPTIONS**

The stratigraphy of the Idil area can be described as follows. In ascending order (from bottom to top):

- 1) The Lycian tectonic melange
- 2) Peridotites of the Marmaris ophiolite.

The peridotites are intruded by diabase dykes and there is a thrust contact between the melange and the peridotites. The area has undergone extensive block faulting.

### **2.1 Description of individual units**

#### **2.1.1 The Lycian melange**

This unit consists of red and grey silty clay stone, rather uniform in grain size and primary bedding is rarely observed. The clay stones are well foliated and isoclinally folded, and contain large blocks (often more than 10 metres) of crystalline rocks of amphibolitic and quarzo-feltspatic composition. The blocks are strongly foliated and often randomly oriented within the clay stone matrix.



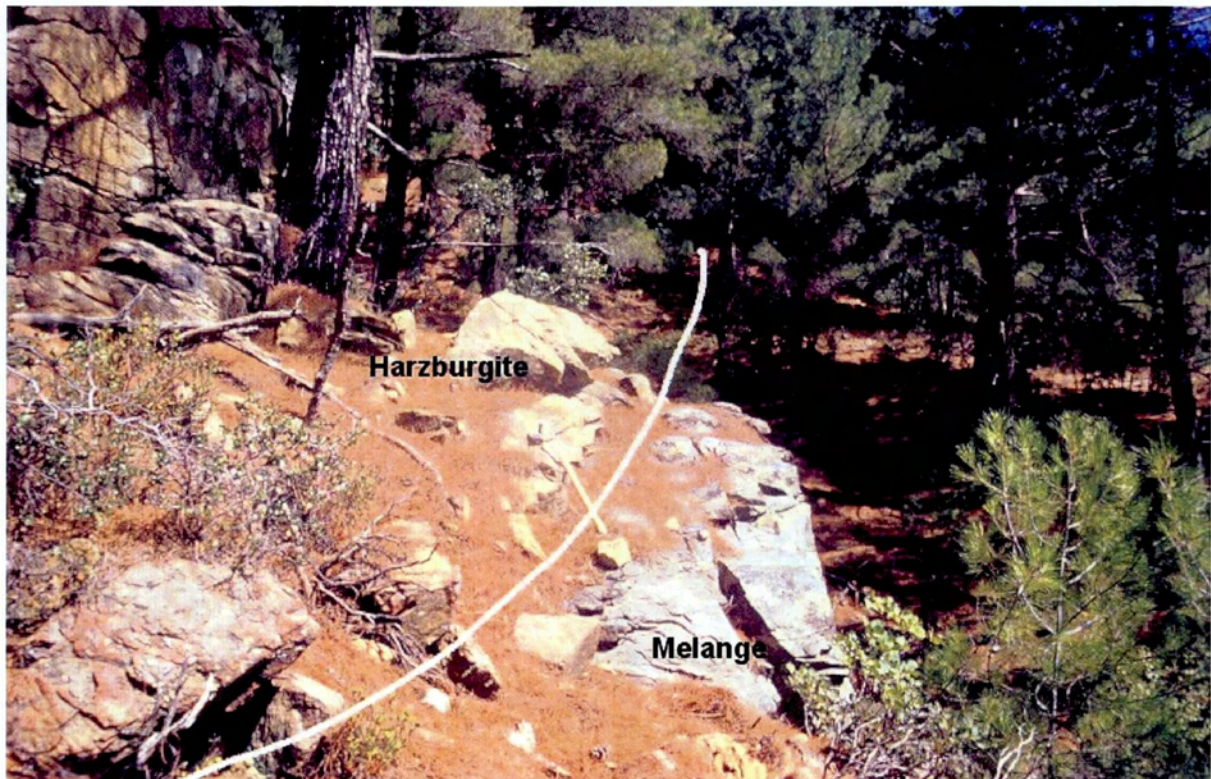
The thrust towards the overlying peridotites (Fig. 5) is rarely exposed in the terrain area, but based on the appearance of blocks it can often be traced with an accuracy of less than 10 meters. Where exposed the melange has a mylonitic fabric extending one metre from the thrust, the thrust is always shallow dipping, about 30° towards north.

### 2.1.2 Peridotites

The contact between the melange and the peridotites are characterised by a 2-4 metres wide zone immediately above the thrust where the peridotites are partly serpentinised. A mylonitic fabric is rarely observed in the peridotites.

#### 2.1.2.1 Harzburgite

In the mapped area about 70% of the peridotites comprise harzburgite. This is a medium-grained grey to brown rock. It is always without fabric or mineral orientation and appears in the field as a spotted rock where the enstatite crystals are weathered out at the expense of olivine. On small outcrops the harzburgite appears as rather homogenous. Modal layering is absent, and only transitional variations in the amount of enstatite are observed in some places. The enstatite content is less than 20 % and in samples subjected to detailed modal counting the maximum enstatite content was measured at 18.7%. (chapter 4). However, on the scale of 30 to 50 meters the geochemistry show that the harzburgite is quite inhomogeneous, and small unmappable pockets of dunite may be present in many places (see chapter 3).



**Figure 5** The contact between harzburgite and melange.

### 2.1.2.2 Dunite

The greenish-grey dunite (on the surface light brown), is medium- to fine-grained and uniform in field appearance containing only scattered chromite or enstatite crystals. A tectonic or igneous fabric is absent. The contacts to harzburgite are transitional and the dunite can be regarded as the magnesium (olivine) rich equivalents of the harzburgite. The central part of the dunite body, in the vicinity of the two upper roads, appear to be particularly pure and homogenous. This is confirmed by the chemical sampling and analysis (chapter 3 and Fig. 7) which also show that upper western part of the dunite has a broad (about 100 m) transitional zone into harzburgitic composition.



**Figure 6 Central part of the dunite area, 80 tons of rock has been exported to Romania from this locality.**

### 2.1.2.3 Diabase dykes

The peridotites are intersected by occasional diabase dykes, they are never seen below the thrust and therefore may only be present in the ophiolite rocks. The diabase is a fine-grained rock with small phenocrysts of plagioclase feldspar. The diabase dykes are relatively few (only about 5 are observed in the mapped area) would probably pose no problem for mining.

### 2.1.3 Block faulting

As seen from the map and the profiles (Appendix 1 & 2) the area has undergone extensive block faulting, and the faults are one of the main factors controlling the distribution of the rock types. The faults strike in a northerly direction and they are usually easily recognised in the field by being commonly located in small valleys, excavated by streams. The rocks on each side of the faults are always crushed, and an up-to 10 m wide fault gauge is commonly developed.

The absolute movement of the faults would be one of the main factors controlling the depth of the deposit. However the absolute movement (pure vertical, strike slip or rotation)

along the fault planes is not known. From topographical relief and location of the nearly flat-lying thrust, the vertical displacement was in the order of 300-400 meters or less. This was the case on the fault just to the west of the dunite body (see appendix 2 and 3). Core drilling at critical locations would be necessary to give a more precise understanding of fault movements.

### 3. GEOCHEMISTRY

The harzburgite and dunite units were systematically sampled by dust drilling. A petrol driven Pionjär 140 drilling machine was used to drill 0.5 meter down in the rock and all the drill dust was collected. This gave a sample of about 1 kg for each sampling point. The position of each sampling point was recorded with a GPS (accuracy is expected to be better than 10 metres). All samples were analysed by XRF and by loss on ignition with the analytical facilities at A/S Olivin. A complete table of analysis is included as appendix 3, including coordinates for each sample. As seen from the map (appendix 1), the investigated area is very steep in certain places, giving an uneven distribution of some samples in some small areas. The sampled area is covered by many large boulders and to obtain an evenly distribution of the sampling points, boulders had to be sampled in many places. Most of the large boulders were probably close to their initial location.

A summary of the chemical variation is shown in Tab. 1. The samples have an average wt.% MgO and LOI (loss on ignition) of 45.28 and 2.09, respectively. By sorting the samples according to their rock type on the map (appendix 1) it appears that the dunite samples have an average MgO and LOI of 46.07% and 2.05% respectively. However samples with as high as 50.10 % MgO and as low as 0.06% LOI are also present.

**Table 1 Summary of chemical variation of Idil samples (all numbers in wt. %)**

All samples		215 samples												
		MgO	SiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>	Cr <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	NiO	MnO	CaO	LOI	Na <sub>2</sub> O	K <sub>2</sub> O	MgO/SiO <sub>2</sub>	
Average		45.28	41.91	8.68	0.40	0.84	0.30	0.11	0.89	2.09	0.04	0.00	1.08	
Max		50.50	44.70	12.60	0.47	2.30	0.34	0.15	2.57	12.65	0.40	0.05	1.25	
Min		36.40	37.80	6.00	0.23	0.08	0.25	0.07	0.08	0.00	0.00	0.00	0.89	
Stand.dev.		2.83	1.64	0.56	0.04	0.75	0.02	0.01	0.79	2.27	0.05	0.01	0.10	
Dunite		105 samples												
		MgO	SiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>	Cr <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	NiO	MnO	CaO	LOI	Na <sub>2</sub> O	K <sub>2</sub> O	MgO/SiO <sub>2</sub>	
Average		46.07	41.60	8.66	0.41	0.63	0.30	0.11	0.65	2.05	0.02	0.00	1.11	
Max		50.10	44.30	12.00	0.47	2.05	0.33	0.15	2.18	8.35	0.15	0.01	1.25	
Min		41.00	37.80	7.30	0.23	0.08	0.27	0.08	0.10	0.06	0.00	0.00	0.93	
Stand.dev		2.51	1.50	0.45	0.03	0.66	0.01	0.01	0.68	1.61	0.03	0.00	0.09	
Harzburgite Western part		38 samples												
		MgO	SiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>	Cr <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	NiO	MnO	CaO	LOI	Na <sub>2</sub> O	K <sub>2</sub> O	MgO/SiO <sub>2</sub>	
Average		43.46	41.63	8.45	0.39	1.09	0.29	0.11	1.15	3.93	0.03	0.00	1.05	
Max		48.80	44.00	9.00	0.45	2.10	0.34	0.12	2.22	12.65	0.15	0.05	1.25	
Min		38.10	37.80	6.00	0.23	0.09	0.26	0.07	0.12	0.91	0.00	0.00	0.95	
Stand. Dev.-		2.57	1.92	0.52	0.04	0.72	0.02	0.01	0.76	3.23	0.04	0.01	0.09	
Harzburgite Eastern part		72 samples												
		MgO	SiO <sub>2</sub>	Fe <sub>2</sub> O <sub>3</sub>	Cr <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	NiO	MnO	CaO	LOI	Na <sub>2</sub> O	K <sub>2</sub> O	MgO/SiO <sub>2</sub>	
Average		45.38	42.53	8.71	0.40	0.97	0.30	0.12	1.01	1.11	0.05	0.00	1.07	
Max		50.50	44.70	9.60	0.46	2.30	0.33	0.13	2.44	10.77	0.40	0.02	1.25	
Min		36.40	39.80	7.90	0.24	0.08	0.26	0.10	0.08	0.00	0.00	0.00	0.89	
Stand.dev.		2.95	1.39	0.32	0.04	0.80	0.02	0.01	0.83	1.55	0.7	0.00	0.10	

By plotting the analysis representing the most important parameters on simplified geological maps, a large variation is evident (Fig 7, 8, 9 and 10). Two samples give the impression of being sampled within the melange unit, The exact location of the borders of the melange can not be verified in this area.

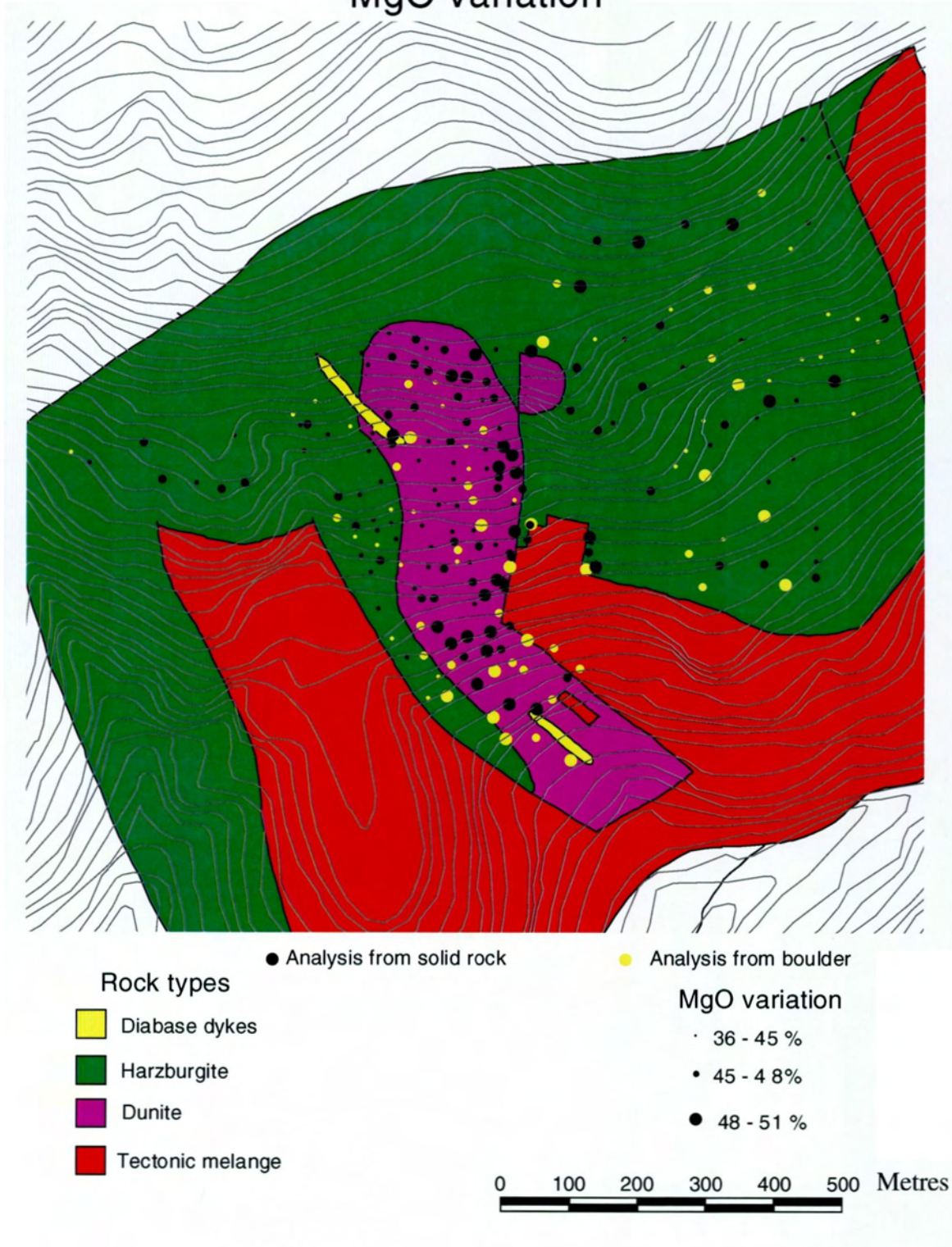
Both within the dunite and harzburgite units, the variation is large and relatively random, even in small areas. There is however a tendency for higher MgO values near the eastern and lower part of the dunite unit (Fig. 7). The area of harzburgite to the east of the dunite shows a more or less random MgO variation. The harzburgite therefore must be a very inhomogeneous rock.

The LOI shows variation that interpretation of is more straightforward (fig. 8). There is an inverse relationship with MgO. Samples with high LOI values are also located in the vicinity of faults where brecciation and serpentinisation are observed, explaining the higher LOI values here.

The total alkali distribution (Fig. 9) shows a complex variation. It is evident that samples with high LOI also show an elevated total alkali concentration, which is interpreted to be related to serpentinisation. However many of the harzburgitic samples with low LOI also show somewhat elevated total alkali contents. This is believed to be due to the higher concentrations of pyroxene (enstatite) in these rocks. Variation of the MgO/SiO<sub>2</sub> ratio (Fig. 10) is similar to the variation of MgO.

Its clear that the limited data presented by Jansen (1999) is far from representative. Had Jansen presented 5 instead of only one chemical analysis its likely that he would have picked up the same large chemical variation as we have shown, and the conclusions regarding the quality of the deposit would have been quite different in the earlier reports.

# MgO variation



**Figure 7 Variation in MgO**

# LOI variation

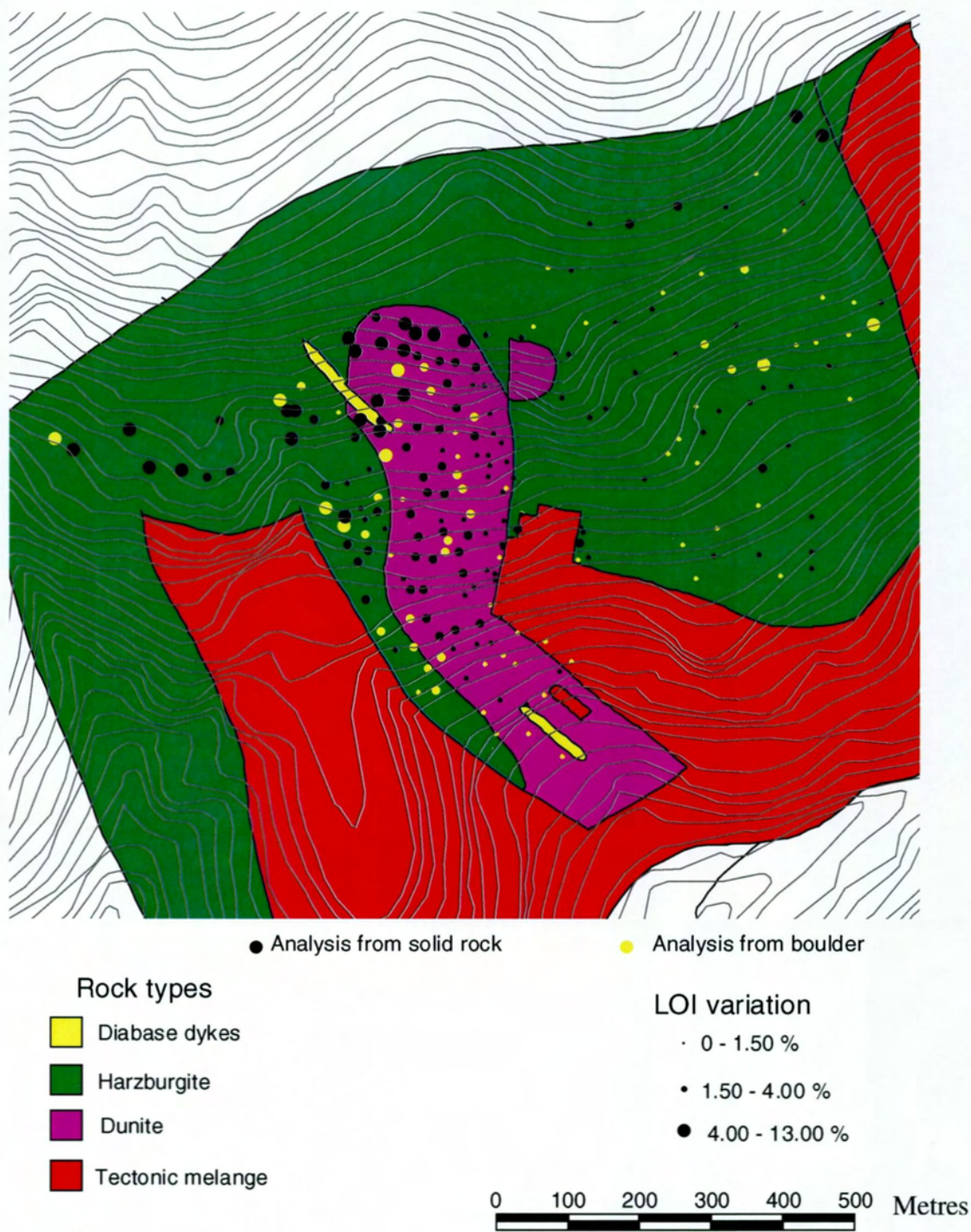


Figure 8 Variation in LOI

# Total alkali variation

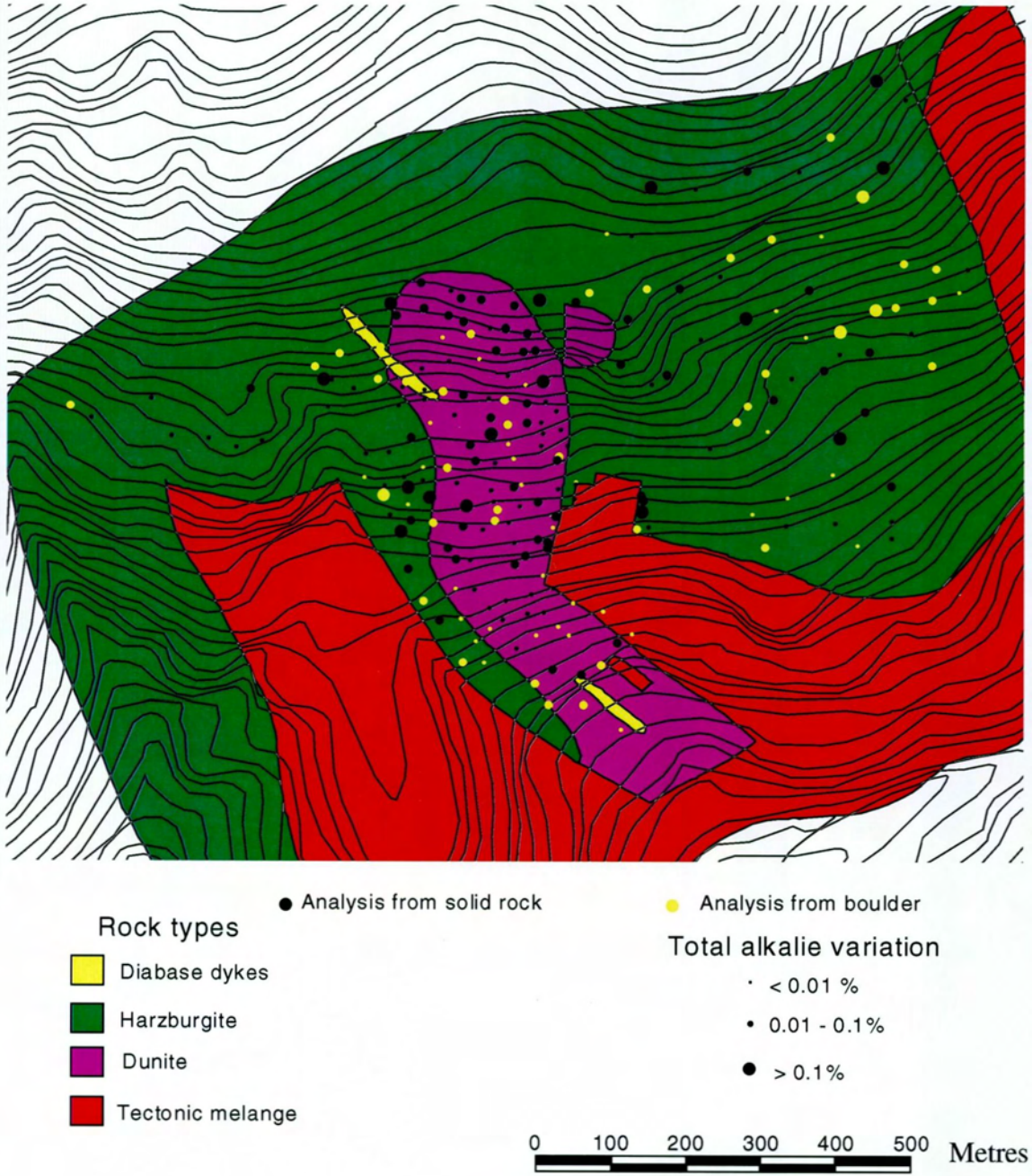
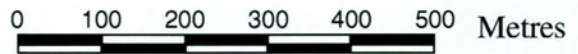
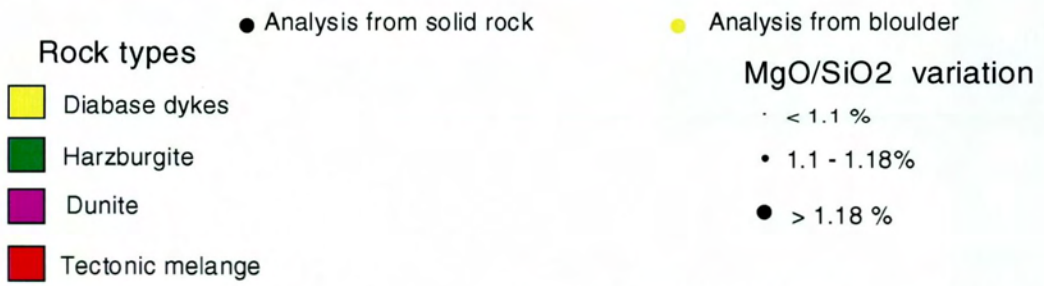
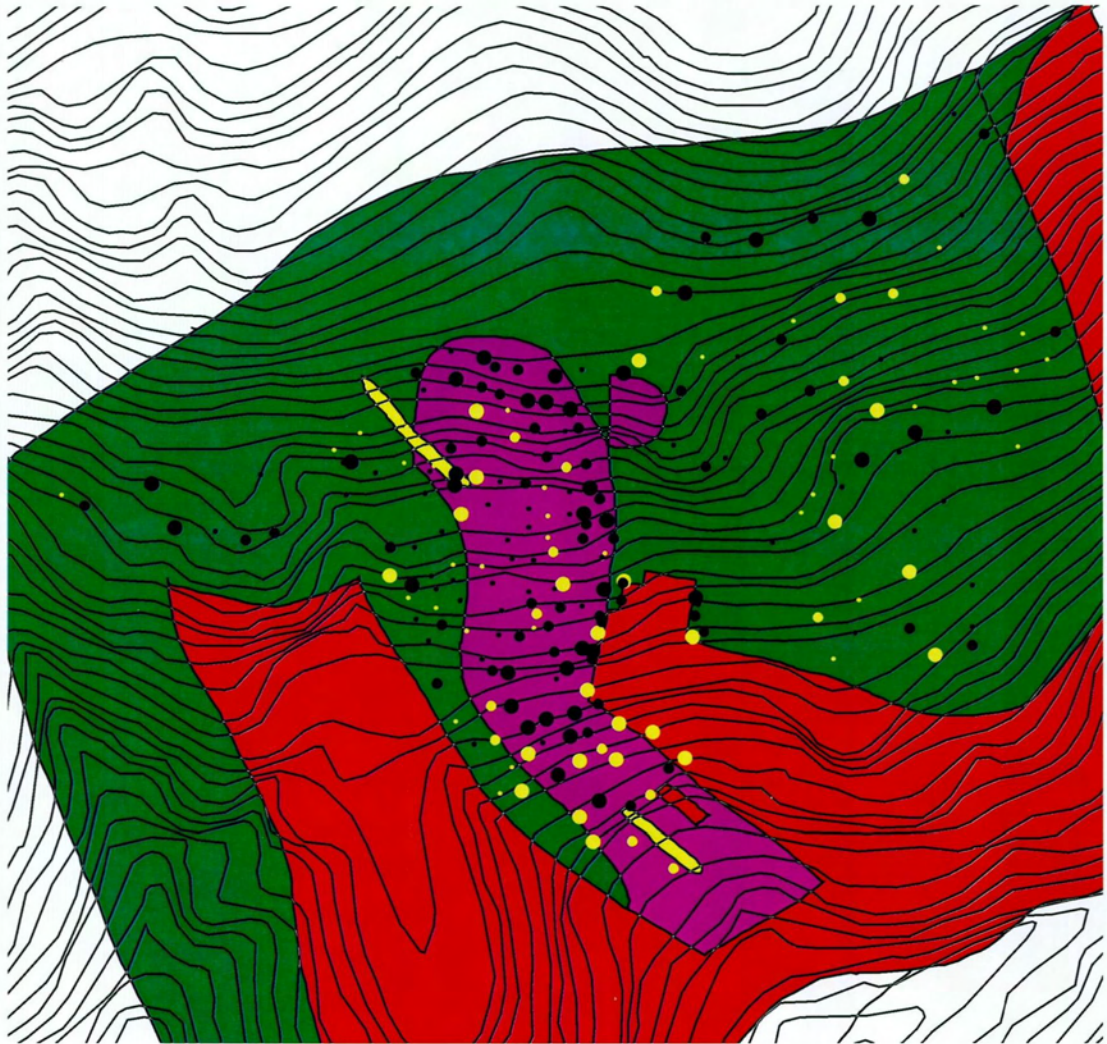


Figure 9 Variation in total alkali

# MgO/SiO<sub>2</sub> variation



**Figure 10 MgO/SiO<sub>2</sub> variation**



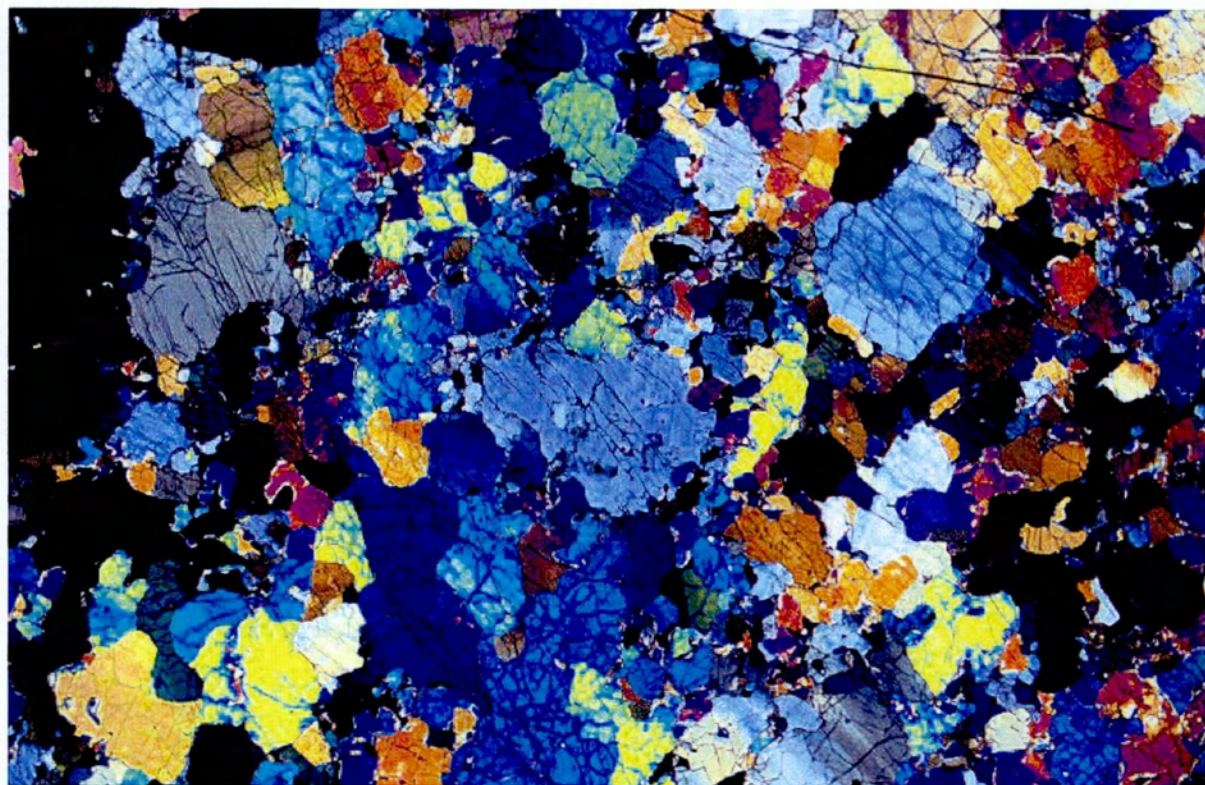
#### 4. Petrography

The mineralogical composition of selected representative rocks has been determined by point counting are listed in Tab. 2. The main textural difference between the harzburgite and dunite can be summarised as follows: The harzburgite in general has a coarser grain size than the dunite, it varies in general from 1-5 mm in the harzburgite and from 0.1 to 4 mm for the dunite. 0.5 mm is a typical crystal size for the dunite. Both rock types show interlocked and irregular grain boundaries. Common particularly in the case of the dunites, are small crystals (sub-grains) concentrated along, and in between, the grain boundaries of larger crystals. Chromite and magnetite occurs as inclusions in both the olivine and enstatite. Photomicrographs of the Idil rocks are shown on fig. 11 and 12.

**Table 2 Mineralogical composition of selected rocks from the Idil olivine occurrence (vol. %).**

Sample no.	2	3	4	5	6
Rock type	Harzburgite	Dunite	Dunite	Harzburgite	Harzburgite
Olivine	84.99	93.65	93.49	86.85	80.37
Enstatite	15.00	4.70	4.73	12.44	18.69
Chromite	1.12	1.66	1.78	0.70	0.93
Chlorite	0.18	*	*	*	0
Magnetite		*	*		

\* = present in minor amounts



**Figure 11 Photomicrograph of dunite rock (scale bar is 2 mm)**

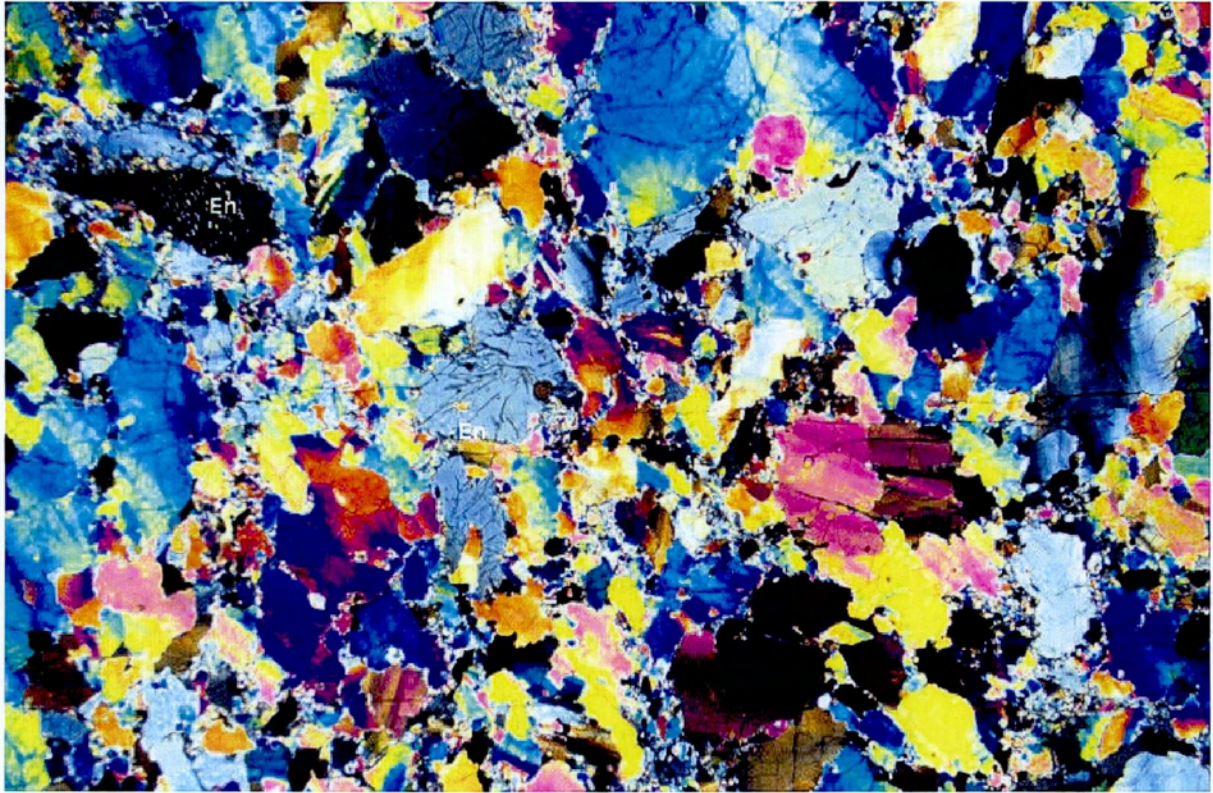


Figure 12 Photomicrograph of harzburgite, enstatite grain is marked, all other grains is olivine (scale bar 2 mm).

## 5. SUMMARY AND CONCLUSIONS

The Idil olivine occurrence is situated at about 900 metres above sea level, 13 km north of the city Köcegis in southwestern Turkey. The occurrence consists of an about 600 metres long and 100-200 metres wide dunite unit with gradual contacts to surrounding rock of harzburgitic composition. The peridotites are totally without any tectonic fabric or mineral lamination and the transition from harzburgite to dunite is represented by variation in the content of enstatite. These ultramafic rocks have a tectonic thrust contact to an underlying heterogeneous tectonic melange unit. The thrust contact has undergone later normal block faulting with vertical movement up to about 200 metres. Absolute fault movement is not known.

Geochemical analysis show that the dunite and harzburgite, on the scale of 20-30 metres, are quite heterogeneous and 4-5% variation in the MgO content is normal over this distance. The largest area with high MgO values is found along the eastern margin, and lower part of the dunite body. Average MgO values are: the deposit as a whole, 45.28%; the dunite part, 46.07%; the harzburgite (eastern part) 45.38%. LOI varies in a more systematic manner with the highest values in samples close to fault zones, where serpentinisation can be observed in the field.

Further investigations of this deposit should include core drilling to give information on the following:

- a) Depth to and location of the thrust contact.
- b) Chemical variation along the cores
- c) Character and absolute movement along the normal faults.

At least one hole should be drilled through the harzburgite on the eastern side of the dunite body to check how the large variations observed on the surface appears in a drill core. 4 holes of altogether 800 metres of drilling (4 holes of 200 metres each) should be sufficient to answer the critical factors listed above.

## **6. REFERENCES**

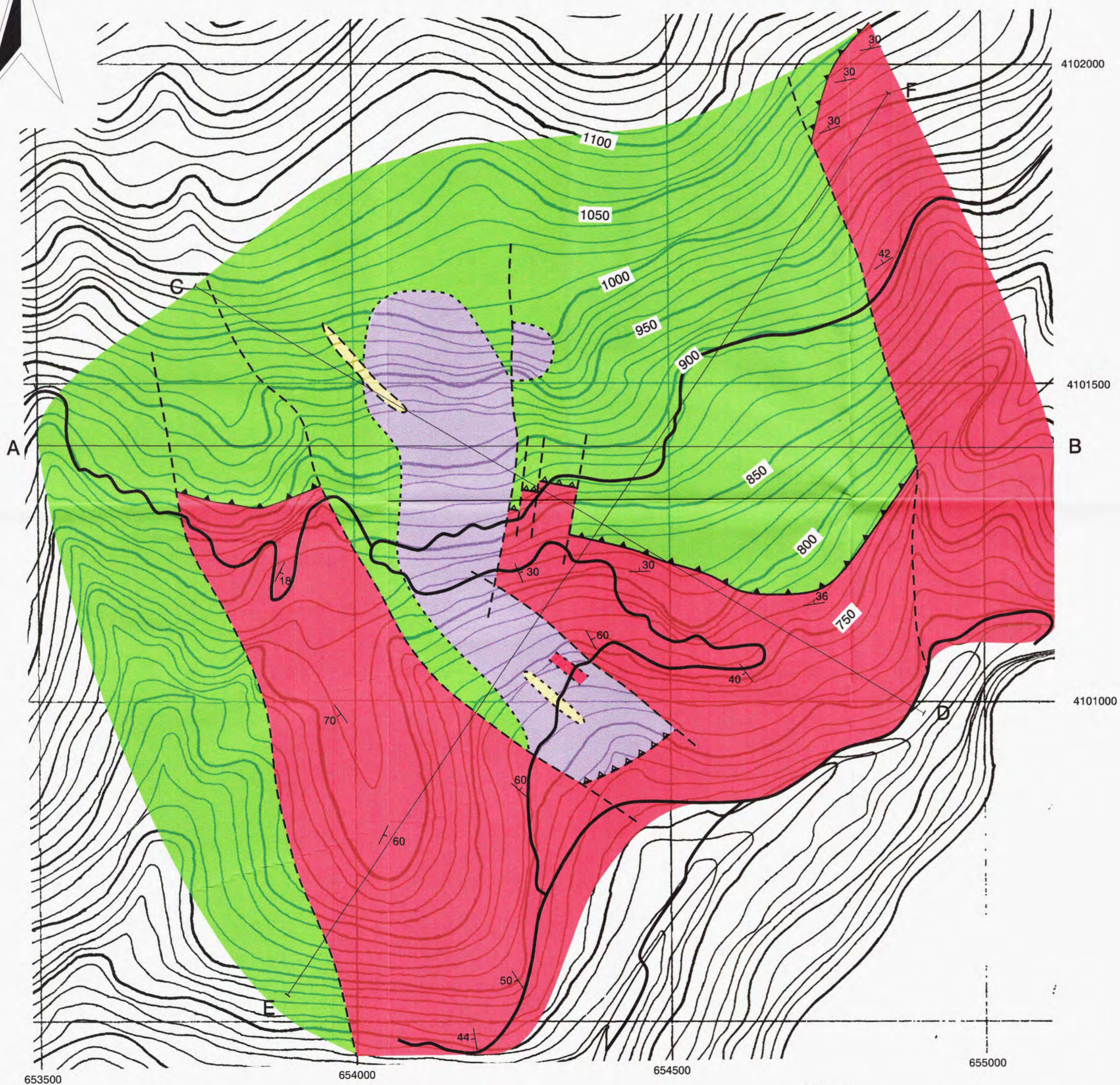
Collins A.S & Robertson A.H. F 1998: Processes of late Cretaceous to late Miocene thrust sheet translation in the Lycian taurides , SW Turkey. *Journal of the Geological Society of London*, 155, 759-772.

Dietrich R.V. & Skinner B.J. 1979: *Rocks and Minerals* Wiley & Sons 317 pp.

Jansen J. Ben H. 1999: Report on the resources and quality of the of the dunite concession near Mugla Turkey. Unpublished report Bogavemi bv. 6 pp.

N

# GEOLOGICAL MAP OF THE IDIL OLIVINE OCCURRENCE. KÖYCEGIS, SOUTH-WEST TURKEY



- DIABASE DYKES
- HARZBURGITE
- DUNITE
- TECTONIC MELANGE  
(Radiolarite with blocks of metamorphic rocks)

MARMARIS OPHIOLITE  
LYZIAN MELANGE

- THRUST OBSERVED/INFERRED BASE OF OPHIOLITE LYZIAN PERIDOTITE NAPPE
- NORMAL FAULT
- TRANSITIONAL IGNEOUS BOUNDARY
- ROAD
- PROFILES

Appendix 1

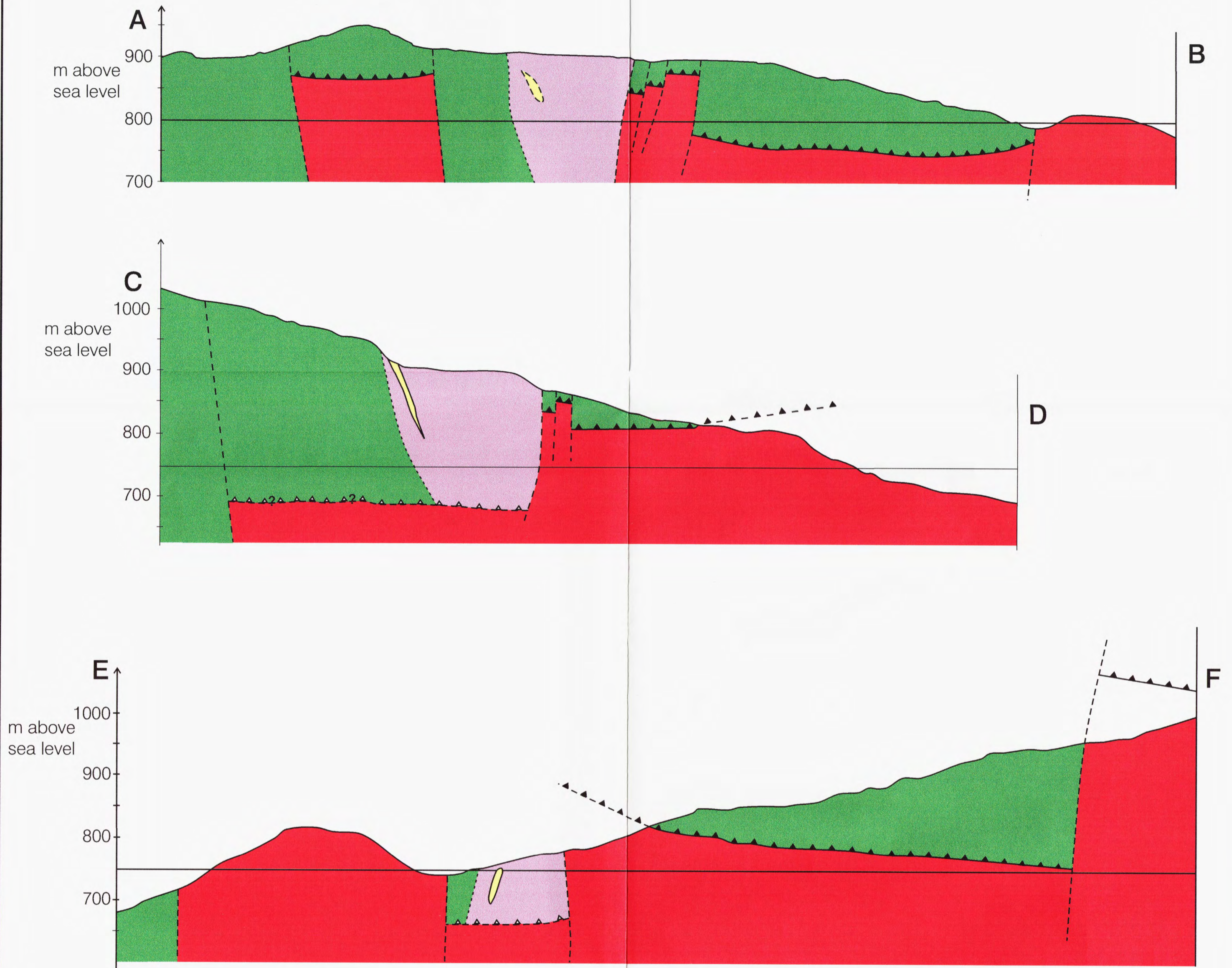


**OLIVIN**



Norges geologiske undersøkelse  
Geological Survey of Norway

# IDIL OLIVINE OCCURRENCE, SOUTH-WEST TURKEY. PROFILES



- DIABASE DYKES
  - HARZBURGITE
  - DUNITE
  - TECTONIC MELANGE  
(Radiolarite with blocks  
of metamorphic rocks)
- } MARMARIS OPHIOLITE
- } LYZIAN MELANGE

- THRUST OBSERVED/INFERRED  
BASE OF OPHIOLITE LYZIAN  
PERIDOTITE NAPPE
- NORMAL FAULT
- TRANSITIONAL IGNEOUS  
BOUNDARY

M 1:5000  
VERTICAL=HORIZONTAL SCALE

0                      250                      500 m

Profiles are hypothetical  
towards depth

Mapped by Håvard Gautneb 2000.



**OLIVIN**



## Appendix 3 chemical analysis

Data are grouped according to main rock units and sorted with decreasing MgO content.

## Dunite

Sample name	ZONE	E_COORD_	N_COORD_	BLOCK	MGO	SiO2	FE2O3	CR2O3	AL2O3	NiO	MNO	CAO	L_O_I	NA2O	K2O	MGO_SiO2	TOT_ALK
LF 025-00	35	654246	4101324	Solid rock	50.10	40.30	8.40	0.42	0.11	0.33	0.10	0.14	0.76	0.00	0.00	1.24	0.03
LF 123-00	35	654221	4101249	Solid rock	50.00	40.00	8.30	0.41	0.09	0.33	0.10	0.10	1.18	0.03	0.00	1.25	0.07
LF 133-00	35	654203	4101224	Solid rock	49.90	40.30	8.20	0.43	0.13	0.33	0.10	0.16	1.00	0.03	0.00	1.24	0.01
LF 124-00	35	654239	4101269	Block	49.60	40.10	8.80	0.43	0.09	0.32	0.10	0.10	0.95	0.01	0.00	1.24	0.01
LF 141-00	35	654177	4101160	Solid rock	49.50	39.90	8.60	0.42	0.09	0.32	0.11	0.12	1.64	0.00	0.00	1.24	0.00
LF 145-00	35	654265	4101155	Block	49.50	40.20	8.70	0.44	0.11	0.32	0.11	0.14	1.00	0.00	0.00	1.23	0.00
LF 047-00	35	654249	4101412	Solid rock	49.40	40.60	8.40	0.41	0.08	0.32	0.10	0.10	1.00	0.01	0.00	1.22	0.00
LF 061-00	35	654230	4101454	Solid rock	49.40	40.50	8.80	0.41	0.11	0.32	0.11	0.15	1.07	0.00	0.00	1.22	0.00
LF 115-00	35	654068	4101472	Solid rock	49.30	39.80	8.70	0.43	0.13	0.31	0.11	0.16	1.64	0.00	0.00	1.24	0.05
LF 153-00	35	654192	4101088	Solid rock	49.30	41.10	8.10	0.41	0.09	0.32	0.10	0.12	0.90	0.01	0.00	1.20	0.04
LF 147-00	35	654206	4101139	Solid rock	49.20	40.50	8.80	0.42	0.13	0.32	0.11	0.15	0.90	0.01	0.00	1.21	0.00
LF 049-00	35	654223	4101422	Solid rock	49.10	41.40	8.20	0.42	0.15	0.32	0.11	0.14	0.50	0.00	0.00	1.19	0.02
LF 154-00	35	654217	4101108	Block	49.10	40.30	8.70	0.43	0.08	0.31	0.11	0.12	1.23	0.00	0.00	1.22	0.08
LF 163-00	35	654216	4101036	Block	48.70	41.30	9.00	0.41	0.12	0.31	0.11	0.15	0.26	0.04	0.00	1.18	0.03
LF 082-00	35	654176	4101561	Solid rock	48.60	39.20	8.70	0.43	0.08	0.31	0.12	0.12	2.88	0.03	0.00	1.24	0.03
LF 083-00	35	654154	4101563	Solid rock	48.60	39.90	7.30	0.29	0.12	0.32	0.08	0.13	3.53	0.01	0.00	1.22	0.01
LF 164-00	35	654234	4101004	Block	48.50	41.80	8.40	0.41	0.17	0.31	0.11	0.16	0.81	0.03	0.00	1.16	0.02
LF 056-00	35	654093	4101468	Block	48.40	38.90	8.60	0.44	0.09	0.31	0.11	0.12	3.63	0.03	0.00	1.24	0.03
LF 048-00	35	654243	4101440	Solid rock	48.40	42.20	8.30	0.43	0.18	0.31	0.11	0.18	0.50	0.01	0.00	1.15	0.04
LF 142-00	35	654212	4101168	Solid rock	48.40	40.70	8.60	0.41	0.15	0.31	0.11	0.18	1.64	0.00	0.00	1.19	0.08
LF 140-00	35	654154	4101149	Solid rock	48.30	40.10	8.60	0.39	0.10	0.31	0.11	0.14	2.60	0.00	0.00	1.20	0.01
LF 135-00	35	654134	4101176	Solid rock	48.20	40.40	8.70	0.43	0.18	0.31	0.11	0.17	2.11	0.00	0.00	1.19	0.03
LF 092-00	35	654188	4101594	Solid rock	48.10	39.30	7.80	0.43	0.23	0.32	0.10	0.20	4.23	0.04	0.00	1.22	0.02
LF 035-00	35	654197	4101332	Block	48.10	39.60	9.20	0.44	0.11	0.31	0.12	0.15	2.57	0.00	0.00	1.21	0.04
LF 161-00	35	654279	4101049	Solid rock	48.10	41.70	8.80	0.42	0.25	0.31	0.11	0.22	0.68	0.04	0.00	1.15	0.00
LF 162-00	35	654240	4101056	Solid rock	48.10	41.20	8.40	0.42	0.25	0.31	0.11	0.20	1.24	0.03	0.00	1.17	0.00
LF 161-00	35	654279	4101049	Solid rock	48.10	41.70	8.80	0.42	0.25	0.31	0.11	0.22	0.68	0.04	0.00	1.15	0.00

Sample name	ZONE	E_COORD	N_COORD	BLOCK	MGO	SIO2	FE2O3	CR2O3	AL2O3	NIO	MNO	CAO	L_O_I	NA2O	K2O	MGO_SIO2	TOT_ALK
LF 166-00	35	654330	4100970	Block	48.10	41.70	8.70	0.41	0.24	0.31	0.11	0.25	0.74	0.01	0.00	1.15	0.01
LF 156-00	35	654261	4101109	Block	48.00	41.00	8.80	0.39	0.23	0.31	0.11	0.27	1.10	0.00	0.00	1.17	0.06
LF 144-00	35	654225	4101197	Block	47.90	41.20	9.10	0.43	0.23	0.31	0.12	0.22	1.17	0.00	0.00	1.16	0.11
LF 143-00	35	654241	4101178	Solid rock	47.80	41.20	8.60	0.41	0.22	0.31	0.11	0.23	1.48	0.00	0.00	1.16	0.00
LF 038-00	35	654259	4101388	Solid rock	47.70	42.30	8.40	0.44	0.22	0.31	0.11	0.22	1.03	0.00	0.00	1.13	0.00
LF 121-00	35	654130	4101219	Solid rock	47.70	40.40	8.60	0.42	0.10	0.31	0.11	0.15	2.80	0.00	0.00	1.18	0.01
LF 146-00	35	654228	4101141	Solid rock	47.70	41.50	8.90	0.43	0.23	0.31	0.11	0.24	1.12	0.00	0.00	1.15	0.01
LF 155-00	35	654245	4101121	Block	47.70	41.70	8.90	0.42	0.29	0.30	0.12	0.32	1.00	0.00	0.00	1.14	0.04
LF 055-00	35	654067	4101457	Solid rock	47.60	38.60	8.40	0.43	0.09	0.30	0.11	0.13	4.75	0.00	0.00	1.23	0.05
LF 125-00	35	654244	4101283	Solid rock	47.50	41.70	9.10	0.36	0.68	0.30	0.12	0.22	0.66	0.02	0.00	1.14	0.05
LF 131-00	35	654233	4101245	Solid rock	47.40	39.60	12.00	0.29	0.15	0.27	0.15	0.23	0.50	0.08	0.00	1.20	0.01
LF 081-00	35	654206	4101553	Solid rock	47.30	39.50	9.90	0.23	0.18	0.30	0.13	0.17	2.86	0.03	0.00	1.20	0.00
LF 046-00	35	654225	4101406	Solid rock	47.30	42.10	9.10	0.41	0.31	0.31	0.12	0.31	0.44	0.00	0.00	1.12	0.07
LF 114-00	35	654075	4101422	Block	47.30	39.20	8.60	0.41	0.14	0.30	0.11	0.18	4.50	0.00	0.00	1.21	0.01
LF 122-00	35	654187	4101244	Solid rock	47.30	41.10	9.10	0.42	0.28	0.31	0.12	0.28	1.61	0.01	0.00	1.15	0.05
LF 039-00	35	654223	4101389	Solid rock	47.10	41.90	9.00	0.37	0.29	0.31	0.11	0.26	1.09	0.01	0.00	1.12	0.06
LF 165-00	35	654280	4101005	Block	47.10	42.20	8.80	0.41	0.31	0.30	0.12	0.33	1.10	0.02	0.00	1.12	0.00
LF 160-00	35	654303	4101063	Block	47.00	42.00	8.90	0.41	0.27	0.30	0.12	0.29	1.06	0.02	0.00	1.12	0.05
LF 084-00	35	654121	4101570	Solid rock	46.90	40.70	8.60	0.38	0.18	0.30	0.11	0.28	3.23	0.02	0.00	1.15	0.00
LF 132-00	35	654233	4101235	Solid rock	46.90	42.90	8.90	0.40	0.51	0.30	0.12	0.46	0.20	0.06	0.00	1.09	0.01
LF 078-00	35	654164	4101529	Solid rock	46.80	40.80	9.00	0.42	0.20	0.30	0.12	0.27	2.71	0.02	0.00	1.15	0.01
LF 136-00	35	654110	4101177	Block	46.60	41.10	8.90	0.42	0.19	0.30	0.13	0.26	2.95	0.00	0.00	1.13	0.00
LF 063-00	35	654202	4101479	Block	46.50	42.10	8.60	0.41	0.35	0.30	0.12	0.34	1.53	0.01	0.00	1.10	0.05
LF 004-00	35	654242	4101289	Solid rock	46.50	43.20	8.60	0.42	0.73	0.30	0.12	0.58	0.21	0.01	0.00	1.08	0.00
LF 120-00	35	654112	4101220	Solid rock	46.40	41.40	8.40	0.42	0.23	0.30	0.12	0.21	2.92	0.03	0.00	1.12	0.03
LF 027-00	35	654195	4101300	Solid rock	46.30	41.30	8.50	0.43	0.21	0.30	0.11	0.30	2.92	0.00	0.00	1.12	0.06
LF 058-00	35	654153	4101460	Solid rock	46.20	41.20	8.20	0.41	0.25	0.30	0.10	0.26	3.30	0.01	0.00	1.12	0.15
LF 028-00	35	654165	4101294	Block	46.10	42.00	8.70	0.43	0.23	0.30	0.12	0.27	2.08	0.03	0.00	1.10	0.00
LF 033-00	35	654160	4101306	Solid rock	46.10	42.30	8.70	0.42	0.32	0.30	0.11	0.34	1.87	0.00	0.00	1.09	0.04
LF 067-00	35	654063	4101503	Solid rock	45.80	40.00	8.70	0.40	0.19	0.29	0.12	0.27	4.80	0.00	0.00	1.15	0.00
LF 002-00	35	654145	4101265	Solid rock	45.80	41.80	9.00	0.44	0.55	0.30	0.12	0.52	2.14	0.00	0.00	1.10	0.03
LF 040-00	35	654186	4101371	Block	45.80	41.50	8.90	0.44	0.20	0.30	0.12	0.28	2.83	0.00	0.00	1.10	0.04
LF 076-00	35	654092	4101550	Block	45.50	38.30	8.50	0.40	0.14	0.29	0.11	0.18	7.18	0.00	0.00	1.19	0.00
LF 091-00	35	654144	4101602	Solid rock	45.50	40.70	8.60	0.41	0.18	0.29	0.11	0.27	4.30	0.02	0.00	1.12	0.00

Sample name	ZONE	E_COORD_	N_COORD_	BLOCK	MGO	SIO2	FE2O3	CR2O3	AL2O3	NIO	MNO	CAO	L_O_I	NA2O	K2O	MGO_SIO2	TOT_ALK
LF 085-00	35	654100	4101580	Solid rock	45.40	39.90	8.40	0.45	0.19	0.29	0.12	0.26	5.26	0.03	0.00	1.14	0.07
LF 086-00	35	654068	4101590	Solid rock	45.30	38.40	8.30	0.40	0.11	0.29	0.11	0.15	7.23	0.04	0.00	1.18	0.00
LF 064-00	35	654178	4101492	Solid rock	45.20	42.00	8.90	0.42	0.54	0.29	0.12	0.82	2.43	0.00	0.00	1.08	0.00
LF 148-00	35	654173	4101130	Solid rock	45.20	43.50	8.40	0.41	0.70	0.30	0.11	0.63	1.14	0.01	0.00	1.04	0.09
LF 066-00	35	654100	4101513	Solid rock	45.10	41.30	8.50	0.42	0.29	0.29	0.12	0.32	4.02	0.00	0.00	1.09	0.03
LF 089-00	35	654102	4101618	Solid rock	45.10	37.80	8.20	0.37	0.12	0.29	0.10	0.16	8.35	0.01	0.00	1.19	0.00
LF 045-00	35	654179	4101392	Block	45.10	44.00	8.40	0.42	0.52	0.30	0.11	0.50	1.54	0.00	0.00	1.03	0.01
LF 003-00	35	654181	4101276	Solid rock	45.00	42.50	8.70	0.40	0.74	0.29	0.12	0.63	2.04	0.01	0.00	1.06	0.03
LF 065-00	35	654140	4101517	Block	44.90	42.10	8.70	0.41	0.92	0.29	0.11	0.96	1.95	0.00	0.00	1.07	0.01
LF 079-00	35	654200	4101527	Solid rock	44.40	43.20	8.50	0.39	1.30	0.29	0.12	1.11	1.22	0.08	0.00	1.03	0.02
LF 104-00	35	654112	4101333	Solid rock	44.30	42.90	8.60	0.36	1.18	0.29	0.11	0.88	2.00	0.00	0.00	1.03	0.08
LF 090-00	35	654117	4101605	Solid rock	43.90	41.00	8.30	0.39	0.19	0.29	0.11	0.21	7.00	0.03	0.00	1.07	0.06
LF 032-00	35	654124	4101299	Solid rock	43.80	42.90	8.40	0.39	1.22	0.29	0.11	1.12	2.18	0.15	0.00	1.02	0.03
LF 053-00	35	654107	4101433	Solid rock	43.70	42.40	8.70	0.38	1.10	0.29	0.11	1.06	2.87	0.01	0.00	1.03	0.02
LF 060-00	35	654205	4101450	Solid rock	43.70	42.70	8.80	0.47	1.13	0.29	0.12	1.53	1.64	0.06	0.00	1.02	0.00
LF 030-00	35	654120	4101268	Solid rock	43.50	42.80	8.70	0.36	1.22	0.29	0.11	1.03	1.64	0.04	0.00	1.02	0.00
LF 051-00	35	654179	4101420	Block	43.30	43.10	9.00	0.38	1.55	0.29	0.12	1.67	1.14	0.05	0.00	1.00	0.00
LF 037-00	35	654247	4101372	Block	43.30	43.60	8.80	0.43	1.78	0.29	0.12	2.00	0.06	0.04	0.00	0.99	0.00
LF 041-00	35	654162	4101363	Solid rock	43.30	42.80	8.80	0.41	0.99	0.29	0.12	1.32	2.35	0.00	0.00	1.01	0.00
LF 042-00	35	654136	4101365	Solid rock	43.20	43.70	8.10	0.42	1.49	0.29	0.12	1.53	1.61	0.07	0.00	0.99	0.00
LF 077-00	35	654130	4101553	Block	43.10	43.20	8.70	0.39	1.37	0.28	0.12	1.28	2.21	0.05	0.00	1.00	0.00
LF 043-00	35	654130	4101388	Solid rock	43.10	43.10	8.20	0.39	1.42	0.29	0.11	1.34	1.64	0.06	0.00	1.00	0.00
LF 050-00	35	654206	4101421	Solid rock	43.00	43.50	8.50	0.39	1.82	0.29	0.12	1.84	1.13	0.04	0.00	0.99	0.01
LF 116-00	35	654038	4101475	Solid rock	42.80	41.40	8.70	0.41	0.99	0.28	0.12	1.10	4.70	0.00	0.00	1.03	0.00
LF 029-00	35	654162	4101277	Block	42.70	42.90	8.70	0.40	1.73	0.28	0.12	1.73	1.81	0.06	0.00	1.00	0.00
LF 034-00	35	654187	4101326	Solid rock	42.70	44.10	8.70	0.40	1.77	0.28	0.12	1.94	0.48	0.04	0.00	0.97	0.01
LF 036-00	35	654245	4101366	Solid rock	42.70	44.20	8.80	0.38	1.88	0.28	0.12	1.97	0.45	0.03	0.00	0.97	0.01
LF 026-00	35	654220	4101304	Solid rock	42.60	44.20	8.60	0.40	1.87	0.28	0.12	2.06	0.40	0.05	0.00	0.96	0.01
LF 105-00	35	654156	4101323	Solid rock	42.60	43.30	8.70	0.38	1.73	0.28	0.13	1.73	1.45	0.00	0.00	0.98	0.00
LF 001-00	35	654100	4101236	Solid rock	42.50	43.20	8.80	0.39	1.93	0.28	0.12	1.99	1.28	0.05	0.00	0.98	0.00
LF 134-00	35	654189	4101212	Solid rock	42.40	44.30	8.80	0.39	1.87	0.28	0.12	2.00	0.21	0.02	0.00	0.96	0.00
LF 057-00	35	654121	4101463	Solid rock	42.20	42.90	8.40	0.39	1.67	0.28	0.12	1.68	2.72	0.07	0.00	0.98	0.04
LF 044-00	35	654157	4101404	Solid rock	42.20	43.00	8.40	0.40	1.70	0.28	0.12	1.74	2.52	0.10	0.01	0.98	0.03
LF 057-00	35	654121	4101463	Solid rock	42.20	42.90	8.40	0.39	1.67	0.28	0.12	1.68	2.72	0.07	0.00	0.98	0.04



Sample name	ZONE	E_COORD_	N_COORD_	BLOCK	MGO	SIO2	FE2O3	CR2O3	AL2O3	NIO	MNO	CAO	L_O_I	NA2O	K2O	MGO_SIO2	TOT_ALK
LF 059-00	35	654175	4101455	Block	42.20	44.10	8.70	0.39	2.05	0.28	0.12	2.18	0.57	0.05	0.00	0.96	0.03
LF 106-00	35	654099	4101355	Block	41.70	43.90	8.70	0.39	2.02	0.28	0.12	2.15	1.33	0.08	0.01	0.95	0.02
LF 052-00	35	654157	4101429	Solid rock	41.50	43.80	8.60	0.39	2.00	0.28	0.12	2.11	1.00	0.05	0.00	0.95	0.02
LF 075-00	35	654031	4101579	Solid rock	41.10	41.90	8.60	0.38	1.92	0.27	0.12	1.99	4.02	0.03	0.01	0.98	0.04
LF 088-00	35	654063	4101628	Solid rock	41.10	44.10	8.60	0.39	2.04	0.28	0.12	2.05	1.53	0.08	0.00	0.93	0.02
LF 068-00	35	654043	4101483	Block	41.00	42.70	8.40	0.39	1.89	0.28	0.12	1.88	4.03	0.05	0.00	0.96	0.01
<b>Avreage</b>					<b>46.01</b>	<b>41.61</b>	<b>8.66</b>	<b>0.40</b>	<b>0.65</b>	<b>0.30</b>	<b>0.11</b>	<b>0.67</b>	<b>2.07</b>	<b>0.02</b>	<b>0.00</b>	<b>1.11</b>	<b>0.02</b>
<b>Max</b>					<b>50.10</b>	<b>44.30</b>	<b>12.00</b>	<b>0.47</b>	<b>2.05</b>	<b>0.33</b>	<b>0.15</b>	<b>2.18</b>	<b>8.35</b>	<b>0.15</b>	<b>0.01</b>	<b>1.25</b>	<b>0.15</b>
<b>Min</b>					<b>41.00</b>	<b>37.80</b>	<b>7.30</b>	<b>0.23</b>	<b>0.08</b>	<b>0.27</b>	<b>0.08</b>	<b>0.10</b>	<b>0.06</b>	<b>0.00</b>	<b>0.00</b>	<b>0.93</b>	<b>0.00</b>
<b>Stand.dev.</b>					<b>2.53</b>	<b>1.52</b>	<b>0.46</b>	<b>0.03</b>	<b>0.67</b>	<b>0.01</b>	<b>0.01</b>	<b>0.69</b>	<b>1.63</b>	<b>0.03</b>	<b>0.00</b>	<b>0.09</b>	<b>0.03</b>

### Harzburgites western part

Sample name	ZONE	E_COORD_	N_COORD_	BLOCK	MGO	SIO2	FE2O3	CR2O3	AL2O3	NIO	MNO	CAO	L_O_I	NA2O	K2O	MGO_SIO2	TOT_ALK
LF 152-00	35	654148	4101069	Block	48.80	39.70	8.50	0.41	0.10	0.32	0.11	0.22	2.30	0.01	0.00	1.23	0.00
LF 109-00	35	654015	4101330	Solid rock	47.70	39.30	8.50	0.41	0.10	0.31	0.10	0.14	4.12	0.00	0.00	1.21	0.20
LF 110-00	35	653988	4101343	Block	47.60	38.40	8.50	0.42	0.09	0.30	0.11	0.12	5.13	0.00	0.00	1.24	0.06
LF 215-00	35	653704	4101459	Solid rock	47.20	37.80	6.00	0.23	0.09	0.34	0.07	0.16	8.50	0.01	0.00	1.25	0.05
LF 210-00	35	653732	4101402	Solid rock	46.80	38.80	8.60	0.41	0.17	0.30	0.11	0.17	5.15	0.00	0.00	1.21	0.01
LF 212-00	35	653817	4101387	Solid rock	46.00	42.20	8.80	0.43	0.26	0.30	0.12	0.27	2.40	0.01	0.00	1.09	0.01
LF 111-00	35	653990	4101377	Solid rock	46.00	41.70	7.60	0.40	0.38	0.30	0.10	0.34	3.85	0.00	0.00	1.10	0.06
LF 139-00	35	654116	4101132	Block	46.00	41.40	8.40	0.44	0.36	0.30	0.12	0.40	3.26	0.00	0.00	1.11	0.01
LF 213-00	35	653852	4101396	Solid rock	45.70	41.20	8.40	0.40	0.31	0.27	0.11	0.39	3.96	0.00	0.00	1.11	0.00
LF 070-00	35	653943	4101487	Solid rock	45.60	38.60	8.80	0.40	0.09	0.30	0.11	0.12	6.59	0.00	0.00	1.18	0.01
LF 119-00	35	654047	4101204	Solid rock	44.50	41.70	9.00	0.36	0.95	0.29	0.12	1.19	2.30	0.06	0.00	1.07	0.01
LF 099-00	35	654046	4101303	Block	44.30	42.70	8.70	0.41	0.87	0.29	0.12	0.88	2.03	0.00	0.00	1.04	0.00
LF 214-00	35	653836	4101472	Solid rock	44.00	42.50	8.50	0.41	1.23	0.29	0.11	1.23	2.39	0.05	0.00	1.04	0.05
LF 150-00	35	654136	4101100	Block	43.90	42.50	8.70	0.40	1.18	0.29	0.12	1.14	2.11	0.01	0.00	1.03	0.01
LF 151-00	35	654121	4101067	Block	42.90	43.70	8.70	0.39	1.79	0.28	0.12	1.84	1.00	0.03	0.00	0.98	0.15
LF 098-00	35	654074	4101312	Solid rock	42.70	43.20	8.80	0.38	1.68	0.28	0.12	1.84	1.48	0.13	0.02	0.99	0.00
LF 117-00	35	653973	4101474	Solid rock	42.50	43.30	8.50	0.39	1.81	0.28	0.12	1.93	1.64	0.01	0.00	0.98	0.01
LF 107-00	35	654065	4101358	Block	42.50	43.10	8.70	0.39	1.81	0.28	0.12	1.95	1.66	0.01	0.00	0.99	0.11
LF 113-00	35	654052	4101400	Solid rock	42.50	43.50	8.60	0.40	1.84	0.28	0.11	1.87	1.36	0.04	0.00	0.98	0.12
LF 073-00	35	653954	4101525	Block	42.40	43.10	8.60	0.40	1.63	0.28	0.12	1.71	2.34	0.05	0.00	0.98	0.01

Sample name	ZONE	E_COORD_	N_COORD_	BLOCK	MGO	SIO2	FE2O3	CR2O3	AL2O3	NIO	MNO	CAO	L_O_I	NA2O	K2O	MGO_SIO2	TOT_ALK
LF 138-00	35	654090	4101129	Solid rock	42.40	43.40	8.80	0.38	1.78	0.28	0.12	1.88	1.42	0.03	0.00	0.98	0.01
LF 102-00	35	654046	4101326	Solid rock	42.30	44.00	8.80	0.38	1.70	0.28	0.12	1.69	0.91	0.10	0.02	0.96	0.01
LF 103-00	35	654065	4101337	Solid rock	42.30	43.50	8.70	0.39	1.84	0.28	0.12	1.93	1.51	0.01	0.00	0.97	0.00
LF 108-00	35	654040	4101342	Solid rock	42.30	43.50	8.70	0.40	1.85	0.28	0.12	1.95	1.46	0.01	0.00	0.97	0.00
LF 137-00	35	654068	4101158	Block	42.30	43.60	8.40	0.39	1.82	0.28	0.12	1.90	1.66	0.02	0.00	0.97	0.00
LF 100-00	35	654022	4101287	Solid rock	42.10	43.10	8.70	0.39	1.88	0.28	0.12	1.95	1.86	0.01	0.00	0.98	0.01
LF 112-00	35	654020	4101380	Solid rock	42.10	43.90	8.50	0.38	1.83	0.28	0.12	1.95	1.42	0.01	0.00	0.96	0.04
LF 101-00	35	654013	4101316	Block	42.00	41.50	8.50	0.40	1.51	0.28	0.12	1.92	4.37	0.10	0.01	1.01	0.06
LF 211-00	35	653780	4101399	Solid rock	41.70	41.80	8.20	0.38	1.04	0.28	0.11	1.16	5.80	0.01	0.00	1.00	0.02
LF 208-00	35	653596	4101446	Block	41.40	41.10	8.60	0.37	1.41	0.27	0.11	1.40	5.70	0.05	0.01	1.01	0.03
LF 209-00	35	653623	4101430	Solid rock	40.30	38.30	7.90	0.36	0.43	0.27	0.10	0.42	12.40	0.01	0.00	1.05	0.00
LF 072-00	35	653922	4101504	Block	40.00	39.00	8.30	0.40	0.90	0.27	0.11	0.83	10.37	0.04	0.02	1.03	0.01
LF 118-00	35	653938	4101447	Solid rock	38.70	40.40	7.80	0.45	0.16	0.29	0.09	0.13	12.65	0.01	0.00	0.96	0.03
LF 071-00	35	653933	4101487	Solid rock	38.10	40.00	8.40	0.35	2.10	0.26	0.11	2.22	8.60	0.15	0.05	0.95	0.01
<b>Average</b>					<b>43.46</b>	<b>41.63</b>	<b>8.45</b>	<b>0.39</b>	<b>1.09</b>	<b>0.29</b>	<b>0.11</b>	<b>1.15</b>	<b>3.93</b>	<b>0.03</b>	<b>0.00</b>	<b>1.05</b>	
<b>max</b>					<b>48.80</b>	<b>44.00</b>	<b>9.00</b>	<b>0.45</b>	<b>2.10</b>	<b>0.34</b>	<b>0.12</b>	<b>2.22</b>	<b>12.65</b>	<b>0.15</b>	<b>0.05</b>	<b>1.25</b>	
<b>Min</b>					<b>38.10</b>	<b>37.80</b>	<b>6.00</b>	<b>0.23</b>	<b>0.09</b>	<b>0.26</b>	<b>0.07</b>	<b>0.12</b>	<b>0.91</b>	<b>0.00</b>	<b>0.00</b>	<b>0.95</b>	
<b>Stand dev.</b>					<b>2.57</b>	<b>1.92</b>	<b>0.52</b>	<b>0.04</b>	<b>0.72</b>	<b>0.02</b>	<b>0.01</b>	<b>0.76</b>	<b>3.23</b>	<b>0.04</b>	<b>0.01</b>	<b>0.09</b>	

### Harzburgites eastern part

Sample name	ZONE	E_COORD_	N_COORD_	BLOCK	MGO	SIO2	FE2O3	CR2O3	AL2O3	NIO	MNO	CAO	L_O_I	NA2O	K2O	MGO_SIO2	TOT_ALK
LF 189-00	35	654565	4101794	Solid rock	50.50	40.40	8.30	0.39	0.08	0.33	0.10	0.10	0.46	0.00	0.00	1.25	0.00
LF 017-00	35	654715	4101555	Solid rock	50.40	40.30	7.90	0.37	0.08	0.33	0.10	0.10	0.88	0.01	0.00	1.25	0.01
LF 193-00	35	654342	4101700	Solid rock	49.90	40.60	8.30	0.44	0.10	0.33	0.10	0.08	0.93	0.01	0.00	1.23	0.01
LF 023-00	35	654524	4101410	Block	49.70	40.50	8.40	0.41	0.19	0.33	0.10	0.16	0.58	0.00	0.00	1.23	0.00
LF 019-00	35	654620	4101524	Solid rock	49.30	41.10	8.60	0.43	0.13	0.32	0.11	0.13	0.65	0.00	0.00	1.20	0.00
LF 204-00	35	654644	4101241	Block	49.30	40.60	9.20	0.45	0.18	0.32	0.11	0.14	0.37	0.00	0.00	1.21	0.00
LF 094-00	35	654270	4101599	Solid rock	49.00	40.80	8.40	0.42	0.09	0.31	0.11	0.16	1.16	0.05	0.00	1.20	0.05
LF 198-00	35	654612	4101347	Block	49.00	41.40	8.40	0.40	0.14	0.32	0.11	0.17	0.48	0.01	0.00	1.18	0.01
LF 006-00	35	654270	4101335	Block	48.90	41.60	8.30	0.42	0.20	0.32	0.11	0.20	0.61	0.01	0.00	1.18	0.01
LF 095-00	35	654287	4101614	Block	48.90	40.80	8.60	0.43	0.09	0.32	0.11	0.11	1.04	0.02	0.00	1.20	0.02
LF 011-00	35	654574	4101550	Block	48.60	39.80	9.50	0.24	0.17	0.33	0.12	0.25	1.75	0.00	0.00	1.22	0.00

Sample name	ZONE	E_COORD	N_COORD	BLOCK	MGO	SIO2	FE2O3	CR2O3	AL2O3	NIO	MNO	CAO	L_O_I	NA2O	K2O	MGO_SIO2	TOT_ALK
LF 126-00	35	654356	4101314	Solid rock	48.60	41.40	8.60	0.42	0.16	0.31	0.11	0.15	0.82	0.05	0.00	1.17	0.05
LF 191-00	35	654428	4101768	Solid rock	48.50	40.20	9.00	0.32	0.24	0.32	0.11	0.20	1.57	0.00	0.00	1.21	0.00
LF 130-00	35	654351	4101264	Block	48.30	41.80	8.40	0.42	0.17	0.31	0.11	0.17	0.72	0.06	0.00	1.16	0.06
LF 128-00	35	654366	4101269	Solid rock	48.20	42.00	9.00	0.46	0.15	0.31	0.12	0.23	0.08	0.01	0.00	1.15	0.01
LF 021-00	35	654556	4101488	Solid rock	48.00	41.10	9.30	0.44	0.17	0.31	0.12	0.23	0.90	0.00	0.00	1.17	0.00
LF 203-00	35	654614	4101273	Solid rock	48.00	41.90	9.00	0.42	0.17	0.31	0.12	0.23	0.45	0.01	0.00	1.15	0.01
LF 024-00	35	654270	4101332	Solid rock	47.60	42.30	8.40	0.45	0.22	0.31	0.11	0.20	0.77	0.00	0.00	1.13	0.00
LF 175-00	35	654369	4101479	Solid rock	47.60	42.80	8.90	0.44	0.21	0.30	0.12	0.25	0.13	0.00	0.00	1.11	0.00
LF 190-00	35	654497	4101794	Solid rock	47.40	40.90	8.70	0.40	0.29	0.30	0.11	0.31	2.18	0.07	0.00	1.16	0.07
LF 206-00	35	654689	4101252	Solid rock	47.30	41.70	9.20	0.41	0.18	0.30	0.12	0.28	1.11	0.00	0.00	1.13	0.00
LF 005-00	35	654267	4101310	Solid rock	47.20	42.20	8.10	0.41	0.36	0.30	0.11	0.33	1.52	0.01	0.00	1.12	0.01
LF 183-00	35	654594	4101699	Block	47.10	41.00	9.20	0.45	0.11	0.32	0.12	0.14	2.17	0.00	0.00	1.15	0.00
LF 188-00	35	654608	4101843	Block	47.10	43.20	8.40	0.42	0.41	0.31	0.11	0.35	0.18	0.06	0.00	1.09	0.06
LF 177-00	35	654339	4101574	Solid rock	46.90	40.70	9.60	0.29	0.60	0.30	0.12	0.80	1.20	0.10	0.00	1.15	0.10
LF 180-00	35	654460	4101640	Solid rock	46.70	42.40	8.80	0.44	0.36	0.30	0.11	0.33	1.34	0.00	0.00	1.10	0.00
LF 171-00	35	654535	4101588	Block	46.50	41.40	8.80	0.44	0.23	0.30	0.12	0.27	2.60	0.00	0.00	1.12	0.00
LF 173-00	35	654435	4101546	Solid rock	46.50	43.20	9.00	0.42	0.40	0.30	0.12	0.37	0.28	0.00	0.00	1.08	0.00
LF 192-00	35	654368	4101770	Solid rock	46.50	42.30	8.70	0.43	0.34	0.30	0.11	0.33	1.34	0.14	0.00	1.10	0.14
LF 182-00	35	654530	4101694	Block	46.20	42.80	8.60	0.39	0.72	0.30	0.12	0.58	0.76	0.05	0.00	1.08	0.05
LF 194-00	35	654309	4101703	Block	46.20	42.60	8.50	0.39	0.67	0.30	0.11	0.51	1.35	0.00	0.00	1.08	0.00
LF 129-00	35	654356	4101290	Solid rock	46.00	41.60	9.00	0.43	0.55	0.29	0.12	0.73	1.60	0.14	0.01	1.11	0.15
LF 202-00	35	654549	4101270	Solid rock	45.60	43.70	8.60	0.42	0.84	0.30	0.12	0.73	0.30	0.01	0.00	1.04	0.01
LF 167-00	35	654790	4101650	Solid rock	45.40	43.20	8.80	0.40	0.72	0.30	0.11	0.64	0.86	0.01	0.00	1.05	0.01
LF 007-00	35	654448	4101385	Solid rock	45.30	44.00	8.70	0.40	0.82	0.29	0.12	0.85	0.00	0.01	0.00	1.03	0.01
LF 176-00	35	654330	4101509	Solid rock	45.30	43.80	8.80	0.40	0.76	0.29	0.12	1.19	0.00	0.05	0.00	1.03	0.05
LF 200-00	35	654503	4101288	Block	45.30	43.00	8.80	0.40	0.75	0.30	0.12	0.82	1.00	0.01	0.00	1.05	0.01
LF 201-00	35	654522	4101237	Block	45.20	43.90	8.50	0.40	0.88	0.30	0.11	0.75	0.66	0.03	0.00	1.03	0.03
LF 127-00	35	654360	4101307	Solid rock	44.80	43.70	8.60	0.40	0.89	0.29	0.12	0.93	0.55	0.08	0.00	1.03	0.08
LF 186-00	35	654705	4101900	Solid rock	44.70	40.20	8.90	0.41	0.59	0.29	0.11	0.64	4.76	0.00	0.00	1.11	0.00
LF 022-00	35	654533	4101456	Solid rock	44.60	43.80	8.50	0.39	1.34	0.29	0.11	1.37	0.00	0.02	0.00	1.02	0.02
LF 178-00	35	654364	4101620	Block	44.50	43.00	8.90	0.41	1.38	0.29	0.11	1.46	0.50	0.10	0.00	1.03	0.10
LF 199-00	35	654552	4101312	Block	44.20	44.30	8.50	0.44	0.69	0.29	0.12	1.84	0.16	0.01	0.00	1.00	0.01
LF 169-00	35	654705	4101657	Block	44.10	43.60	8.00	0.40	1.65	0.29	0.11	1.57	1.03	0.05	0.00	1.01	0.05
LF 205-00	35	654690	4101277	Solid rock	44.10	44.20	8.80	0.46	0.76	0.29	0.12	1.82	0.00	0.01	0.00	1.00	0.01

Sample name	ZONE	E_COORD_	N_COORD_	BLOCK	MGO	SiO2	FE2O3	CR2O3	AL2O3	NIO	MNO	CAO	L_O_I	NA2O	K2O	MGO_SiO2	TOT_ALK
LF 172-00	35	654494	4101575	Solid rock	44.00	41.70	9.00	0.39	1.76	0.29	0.12	2.05	0.81	0.40	0.00	1.06	0.40
LF 014-00	35	654695	4101592	Block	43.60	43.50	8.70	0.39	1.61	0.29	0.12	1.66	0.54	0.02	0.00	1.00	0.02
LF 179-00	35	654407	4101620	Solid rock	43.50	43.70	8.80	0.38	1.88	0.29	0.11	1.89	0.15	0.04	0.00	1.00	0.04
LF 181-00	35	654475	4101666	Block	43.50	43.40	8.70	0.41	1.53	0.29	0.12	1.70	1.02	0.03	0.00	1.00	0.03
LF 008-00	35	654483	4101423	Block	43.00	44.50	8.50	0.37	1.95	0.29	0.12	1.86	0.00	0.10	0.00	0.97	0.10
LF 015-00	35	654743	4101602	Block	43.00	43.80	8.60	0.37	1.83	0.29	0.12	1.79	0.67	0.02	0.00	0.98	0.02
LF 170-00	35	654580	4101617	Solid rock	43.00	43.80	8.70	0.39	1.93	0.28	0.12	1.95	0.36	0.03	0.00	0.98	0.03
LF 174-00	35	654392	4101492	Solid rock	42.80	44.50	8.60	0.39	1.90	0.29	0.12	1.87	0.08	0.05	0.00	0.96	0.05
LF 185-00	35	654677	4101799	Solid rock	42.30	44.20	8.80	0.39	2.05	0.28	0.12	2.19	0.32	0.11	0.00	0.96	0.11
LF 195-00	35	654744	4101506	Block	42.30	43.60	8.50	0.38	1.97	0.29	0.11	1.90	1.05	0.07	0.00	0.97	0.07
LF 196-00	35	654655	4101437	Solid rock	42.20	43.50	9.10	0.38	2.01	0.28	0.12	2.04	0.94	0.05	0.00	0.97	0.05
LF 184-00	35	654650	4101758	Block	42.00	44.50	8.60	0.40	2.11	0.28	0.12	2.14	0.20	0.13	0.00	0.94	0.13
LF 197-00	35	654620	4101400	Solid rock	42.00	42.40	8.80	0.39	2.03	0.28	0.12	2.32	2.00	0.30	0.02	0.99	0.32
LF 009-00	35	654498	4101447	Block	41.90	44.70	8.80	0.39	2.09	0.28	0.12	2.25	0.02	0.09	0.00	0.94	0.09
LF 018-00	35	654660	4101526	Solid rock	41.90	43.90	8.80	0.39	2.02	0.28	0.12	2.14	1.00	0.02	0.00	0.95	0.02
LF 013-00	35	654667	4101588	Block	41.80	43.10	8.90	0.39	2.06	0.28	0.12	2.21	1.44	0.11	0.01	0.97	0.12
LF 207-00	35	654689	4101329	Solid rock	41.70	44.10	8.80	0.39	2.24	0.28	0.12	2.28	0.64	0.05	0.00	0.95	0.05
LF 010-00	35	654522	4101495	Block	41.60	44.30	8.80	0.39	2.24	0.28	0.12	2.37	0.35	0.10	0.00	0.94	0.10
LF 168-00	35	654750	4101650	Block	41.60	43.80	8.60	0.38	2.17	0.28	0.12	2.17	1.22	0.10	0.00	0.95	0.10
LF 020-00	35	654601	4101500	Solid rock	41.30	44.40	8.70	0.40	2.30	0.28	0.12	2.44	0.57	0.09	0.00	0.93	0.09
LF 187-00	35	654668	4101927	Solid rock	41.10	41.60	8.50	0.37	1.84	0.27	0.11	1.80	4.88	0.12	0.00	0.99	0.12
LF 012-00	35	654620	4101557	Block	40.30	42.20	8.30	0.38	1.89	0.27	0.11	2.07	4.39	0.10	0.01	0.95	0.11
LF 016-00	35	654779	4101616	Block	36.40	40.70	9.30	0.29	2.16	0.26	0.13	0.38	10.77	0.00	0.01	0.89	0.01
<b>Average</b>					<b>45.38</b>	<b>42.53</b>	<b>8.71</b>	<b>0.40</b>	<b>0.97</b>	<b>0.30</b>	<b>0.12</b>	<b>1.01</b>	<b>1.11</b>	<b>0.05</b>	<b>0.00</b>	<b>1.07</b>	<b>0.05</b>
<b>Max</b>					<b>50.50</b>	<b>44.70</b>	<b>9.60</b>	<b>0.46</b>	<b>2.30</b>	<b>0.33</b>	<b>0.13</b>	<b>2.44</b>	<b>10.77</b>	<b>0.40</b>	<b>0.02</b>	<b>1.25</b>	<b>0.40</b>
<b>Min</b>					<b>36.40</b>	<b>39.80</b>	<b>7.90</b>	<b>0.24</b>	<b>0.08</b>	<b>0.26</b>	<b>0.10</b>	<b>0.08</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.89</b>	<b>0.00</b>
<b>Stand.dev</b>					<b>2.95</b>	<b>1.39</b>	<b>0.32</b>	<b>0.04</b>	<b>0.80</b>	<b>0.02</b>	<b>0.01</b>	<b>0.83</b>	<b>1.55</b>	<b>0.07</b>	<b>0.00</b>	<b>0.10</b>	<b>0.07</b>