ΠΕΤΡΟΛΟΓΙΑ.— **Phenomena of partial melting in plagioclase lherzolites from different greek ophiolite complexes,** *by George M. Paraskevopoulos* *. Ἀνεκοινώθη ὑπὸ τοῦ Ἀκαδημαϊκοῦ κ. Ἀγγέλου Γαλανοπούλου.

ABSTRACT

The phenomena of partial melting in plagioclase lherzolites included within the harzburgites (tectonites) from different ophiolitic complexes of Greece are examined. These phenomena consist in the formation of the "in situ" small lenses and veinlets of plagioclases, clinopyroxenes and gabbros. The boundaries of these concentrations with the surrounding host rock are not clearly defined, the size of the crystals of the minerals of the concentrations is much bigger than that of the respective minerals of the enclosing rock, whilst by the contact with the concentration the surrounding host rock is depleted in the respective minerals of the concentration. Orientation of the crystals of the concentrations is not observed, whilst with the use of a Röntgen Texture Goniometer has been proved the existence of a preferred orientation of the clinopyroxene crystals of the host rock. The occurrence of the "in situ" concentrations and their development, appear to be related with the tectonic elements of the surrounding tectonites. The composition of the plagioclases in the "in situ" concentrations and the surrounding host rock was determined by electron microprobe analysis and it has been concluded that the plagioclase composition of the "in situ" concentrations is similar to that of the plagioclase of the surrounding host rock. In both cases the variation in An% takes place entirely within the bytownite but predominate values above 80%, varying between 80 and 90% An. Electron microprobe analysis is also carried out for the determination of the composition of the clinopyroxenes for the "in situ" concentrations and for the clinopyroxenes of the surrounding host rock. In both cases the composition is similar. From the presence of zoisite in the parageneses of the rodingites included in tectonites it is concluded that the metamorphism has not exceeded the upper levels of the greenschist facies. Therefore the high temperature minerals of the "in situ" concentrations cannot be related to metamorphism.

The harzburgites, with are the main representatives of the tectonites, are considered as the remnants of the mantle rocks, which have undergone partial melting for the formation of the ophiolite parental magma. A number of authors believe that such rocks which have undergone partial melting,

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are the plagioclase lherzolites. This is supported by the presence within the harzburgites of small gabbroic pods and local development of plagioclase lherzolites. The gabbroic rocks are considered as products of crystallization of small quantities of melt, which did not escape from the harzburgites, whereas the plagioclase lherzolites of local development are considered as remnants of plagioclase lherzolites, which have escaped the partial melting process or have undergone this in such a small degree, that only a small amount of melt was produced.

I. PRODUCTS OF PARTIAL MELTING ("IN SITU" LENSES AND VEINLETS OF PLAGIOCLASES, CLINOPYROXENES AND GABBROS)

F. Boudier and A. Nicolas (1972) describe phenomena of partial melting in the plagioclase lherzolites in Lanzo area of northern Italy. The primary stages of melting lead to the formation of small lenses of plagioclase derived from the anatexis of plagioclase of the original lherzolite, whereas at later stages there were formed veinlets of gabbroic composition "in situ" and finally sizeable gabbroic veins intruded into the surrounding rocks. The lherzolites of the Lanzo area are plagioclastic. The rock has undergone plastic deformation, which is considered responsible, according to the authors, for its foliation. The "in situ" veinlets are inclined with respect to the foliation of the rock and are usually developed "en enchelon" between two foliation planes of the rock. Therefore, the arrangement of the veinlets "in situ" has been mostly influenced by the development of the plastic deformation of the rock.

Veinlets of pyroxenites together with anorthositic gabbros in harzburgites of the Antalya ophiolite of Turkey, are considered by T. Juteau et al. (1977), as the result of partial melting of the ultrabasic rocks. During the plastic deformation of the rock which accompanied the partial melting the rock was foliated and a lineation was produced. The veinlets have also undergone plastic deformation and their surfaces are related with the ductile-flow direction of the rock material. From direction measurements it is concluded that the veinlet development is taking place along the fold axial plane of the surrounding harzburgites, on planes including the direction of the lineation of the surrounding rock.

Similarly, F. Boudier and R. G. Coleman (1979) reported the presence of veinlets of clinopyroxene and patches of pegmatitic texture of pyroxe-

nites consisting of orthopyroxenes, websterites and gabbros in the harzburgites and the dunites of the ophiolites of the Semail area in Oman, which they consider as partial melts, trapped within the rocks during the process of their plastic deformation.

Phenomena of partial melting of plagioclase lherzolites of the Makrirachi area in northwest Orthris Greece, are reported by M. Menzies (1973). These include the formation of small lenses and veinlets of gabbroic composition, within the plagioclase lherzolites. These gabbroic concentrations occasionally attain an elongated form along the direction of the plastic deformation of the rock which took place under solid state conditions. The irregular boundaries of the non idiomorphic crystals of these concentrations is characteristic of their texture.

The author reports that veins of gabbros and pegmatitic gabbros are also found in the deeper layers of the ultrabasic rocks represented by harzburgites, dunites and lherzolites. These deep layer gabbros have a composition which is comparable with that of an anorthositic gabbro and are composed of plagioclases and clinopyroxenes, in similarity to the composition of the gabbroic lenses and veinlets of the plagioclase lherzolites. The plagioclases of the gabbro veins within the deeper ultrabasic layers (harzburgites, dunites, lherzolites) are more acidic than those of the plagioclase lherzolites, whereas their clinopyroxenes (of gabbro veins) are richer in ferrosilite molecules, in comparison with the pyroxenes of plagioclase lherzolites. The bulk composition of these gabbros is, according to the above author, that of an anorthositic gabbro. However, it is not clarified by the author whether the composition of the plagioclases and the pyroxenes of the small lenses and veinlets within the plagioclase lherzolites is the same with that of the plagioclases and the pyroxenes, of the gabbro veins of the deeper layers.

Further M. Menzies (1973) believes that the composition of the gabbro veins should not be representative of the composition of the parental magma, because in the meantime, until the formation of the gabbro, it could have undergone fractionation or removal of a part of the melt. The composition of the primary melt (parental magma) depends on the composition of the original material (rock) of the mantle, its degree of melting and the depth at which the melt was separated from the remaining rock.

Here below we present some personal observations on ophiolite complexes of Greece with regard to the partial melting.

At first, the presence of plagioclase lherzolites in the tectonites is very widespread. These tectonites were observed close to cumulates, near their borders, of the south Pindos complex as for example in the Lambanovon valley between the villages of Korydallos and Panayia (Kato Koutsoufliani), in the Mileotikos valley between the villages of Milea and Kranea, in the

Fig. 1. Plagioclases concentration «in situ» from partial melting of plagioclase lherzolites. The gradation from the «in situ» concentration to the surrounding rock is made without clear boundaries. Lambanovon valley of Pindos complex, Greece.

Aspropotamos valley, east of the village of Perivoli, but also away from the cumulates, as in the area west of the Panayia village, towards the Metsovon, and elsewhere. Within the plagioclase lherzolites, concentrations of plagioclases or of clinopyroxenes or of plagioclases and clinopyroxenes (gabbroic composition) are observed. These are developed in the form of minor lenses or veinlets within the rock (fig. 1 and 2) and represent "in situ" concentrations, originated from the crystallization of products of partial melting

Fig. 2. Plagioclases concentrations «in situ» from partial melting of plagioclase lherzolites. The gradation from the «in situ» concentration to the surrounding rock is made without regular boundaries. Mileotikos valley of Pindos complex, Greece.

of the plagioclase lherzolites. These concentrations are included and isolated within the rock, and correspond to a phase completely different than that of the intrusive gabbros, i.e. of the vein type which cross not only the plagioclase lherzolites but also the other members of the tectonites, usually lherzolites and harzburgites. The intrusive gabbros, as a pure intrusive phase, is represented by dykes which attain a length up to several decades of meters, a few meters width and have clear boundaries with the rock which they cross. This is a later phase, than that of the small lenses and veinlets of plagioclases, clinopyroxenxes and gabbros formed "in situ" within the plagioclase lherzolites. The two phases are distinguished, not only by their form of occurrence, but also by their composition and texture.

(i) Plagioclases concentrations. These are concentrations ranging in size from poorly defined cloudy crystal accumulations of plagioclase to well defined, rather small lenses and veinlets, of plagioclase up to a few centimetres in length. The gradation of these concentrations into the enclosing plagioclase lherzolite takes place without clear or regular boundaries and in the poorly developed concentrations it is smooth and gradational (fig. 1, 2). The presence of concentrations of clinopyroxenes in the form of small lenses and veinlets in place close or even in contact with areas of plagioclases concentrations is common. It may also be observed development of plagioclases and clinopyroxenes in the same place. In the pure plagioclases lenses there are occasionally small greenish "eye" inclusions which correspond to serpentinized remnants of plagioclase lherzolite isolated within the lense during the concentration of the plagioclase crystals. The plagioclase lherzolite becomes poorer in plagioclase near its contact with the concentrations of plagioclases and this becomes more obvious and stronger when the concentrations of plagioclases are of larger development.

(ii) Clinopyroxenes concentrations. These are formed by the accumulation of clinopyroxenes in isolated masses within the enclosing rock. These concentrations obtain the form of small lenses, usually a few centimetres in length, or even the form of veinlets and are developed at many points within the rock, even in places much close to each other. Although they are pure concentrations of pyroxenes, they do not give the impression of an "inclusion" or subsequent intrusion of pyroxene material within the rock, because both the boundaries of the pyroxene concentration with the surrounding lherzolite are poorly defined and the pyroxene concentration itself is totally isolated within the rock. These concentrations

can be easily spotted in the field from the different size of their pyroxene crystals. This is normally much larger than the size of the pyroxene crystals of the rock. From this, it is indicated that the formation of these isolated pyroxene concentrations took place at a different phase than that at which the rock was formed. Near the contact with the concentrations under discussion, the rock is depleted in clinopyroxenes.

(iii) Gabbro veinlets "in situ". These consist of plagioclases and clinopyroxenes and are found enclosed within the surrounding plagioclase lherzolite, without any continuation towards a certain direction, which would have been indicative of external supply.

The thickness of the veinlets is normally below 15 cm, whereas the usual length is of a few decades of centimetres. The boundaries with the enclosing rock are not clearly defined, whereas the size of the plagioclase and clinopyroxene crystals is mach bigger, than that of the respective minerals of the enclosing rock and remains the same at the centre and the outer parts of the veinlet. The surrounding rock near its contact with the veinlets, is depleted in plagioclases or has no plagioclases at all, the same being true for the clinopyroxenes as well.

II. TEXTURAL OBSERVATIONS

With regard to the texture in the "in situ" concentrations of the products of the primary phase of melting, in greek complexes, further to the difference regarding the size of the crystals between the minerals of the concentrations and the respective minerals of the rocks, there appears to exist also a difference in the emplacement of the minerals. The possible existence of a preferred orientation of the crystals of the minerals of the "in situ" concentrations was looked for, but without any result. On the contrary, for the surrounding host rock an examination with the use of a Röntgen Texture Goniometer has proved the existence of a preferred orientation of the clinopyroxene crystals. The drawings of fig. 3 and 4 show the readings on the reflections (220) and (202) faces of the clinopyroxenes from a sample of plagioclase lherzolite of the Aspropotamos area, of the south Pindos complex, which were carried out by professor P. Paulitsch of the Laboratory of Mineralogy of the Technical University of Damrstadt, to whom the present author is very grateful. According to professor P. Pau-

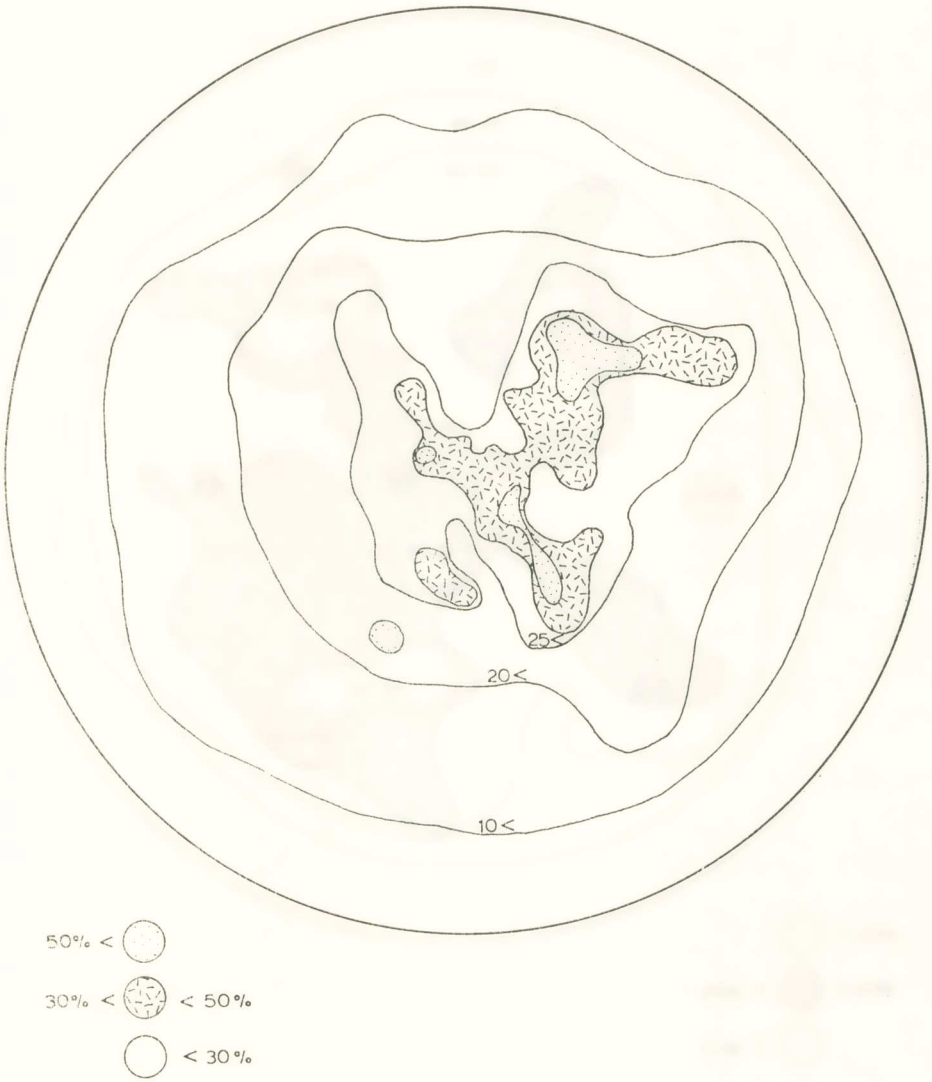

Fig. 3. Reflections from (220) faces of clinopyroxenes from a plagioclase lherzolite, Aspropotamos valley, Pindos. An imperfect distribution zone is evident that is considered to be an ac-zone.

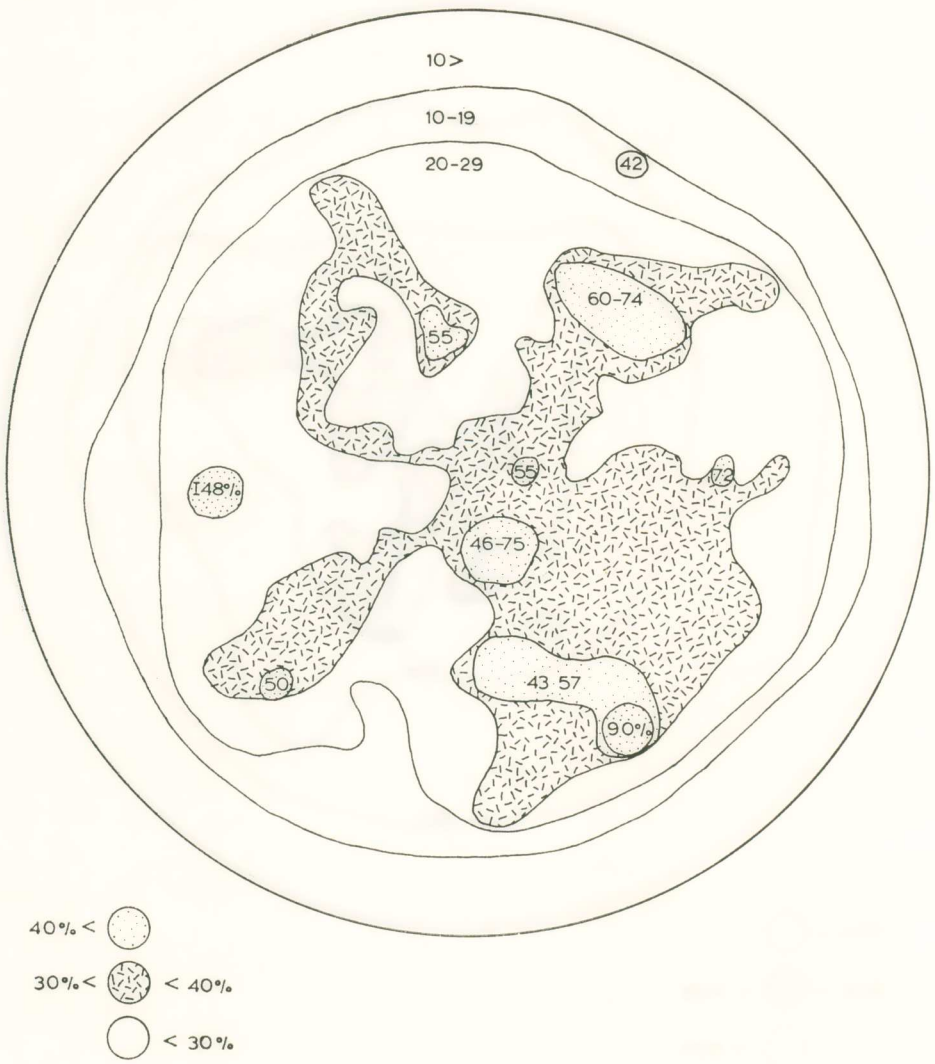

Fig. 4. Reflections from (202) faces of clinopyroxenes from a plagioclase lherzolite, Aspropotamos valley, Pindos. An imperfect distribution zone is evident that is considered to be an ac-zone.

litsch there exists an imperfect diagonal zone and taking into consideration the fact that in the sample there is a recognized lineation, this zone can be interpreted as an ac-zone. Finally the occurrence of the "in situ" veinlets and their development, appears to be related with the tectonic elements of the surrounding tectonites. No systematic work was done on this subject. The orientation of the minerals in the tectonites of the ophiolite complexes, are related with the plastic deformation of the rocks under solid state conditions which took place in the mantle or during the course and intrusion in the crust (A. Nicolas et al., 1971, A. Nicolas et al., 1973 and others).

III. COMPOSITION OF THE "IN SITU" CONCENTRATIONS

The composition of the plagioclase in the "in situ" concentrations and the surrounding host rocks was determined by microprobe analysis. The assays were carried out at the Ore Deposits Geology Laboratory of Athens University with a microprobe Microscan 5 Cambridge analyser.

Table 1 shows the microprobe analysis results together with the computed Ab and An % values.

From table 1 it is concluded that the plagioclase composition of the "in situ" concentrations is similar to that of the plagioclase of the surrounding host rock. In both cases the variation in An % takes place entirely within the bytownite but predominate values above 80 % An, varying between 80 and 90 % An. For each sample the variations of the An % composition (neglecting the decimal values) are as follows :

Sample	Plagioclases of the concentrations «in situ» An %	Plagioclases of the surrounding host rock An %
4	74 - 87	76 - 87
17	71 - 90	75 - 86
18	70 - 89	73 - 88

It has been attempted also to determine with a microprobe analyser the chemical composition of the clinopyroxenes of the "in situ" concentrations and the clinopyroxenes of the surrounding host peridotite (lherzolite).

These results are presented in table 2. The analytical work was carried out in the Ore Deposite Geology Laboratory of the University of Athens with the same microprobe analyser as for the case of plagioclases analyses discussed above.

The chemical composition of the clinopyroxenes of the "in situ" concentrations, is also similar to that of the clinopyroxenes of the surrounding host rock, as it may concluded from table 2. For the assays which were carried out, the slight decrease of Al_2O_3 of the pyroxenes of the "in situ" concentrations, are accompanied with a respective slight increase of SiO_2.

The presence of monomineralic concentrations of high temperature minerals (bytownite, clinopyroxenes), cannot lead to any other interpretation as to the genesis of the "in situ" concentrations, than in their derivation from the anatexis of the respective minerals of the surrounding ultrabasic rock. The different texture and the irregular mineral boundaries of the "in situ" concentrations agrees with this origin provided, that these concentrations represent products, derived from a melt, which was concentrated in very small amounts, practically slightly or none at all removed from the places of their origin. Under these circumstances it is possible to form both monomineralic concentrations and irregular boundaries of the intergrouths of the allotriomorphic crystals. It should be noted that, in the areas where phenomena of anatexis have been reported, the influence of metamorphism is extremely weak and in a few cases weak.

In the ultrabasic members, the formation of serpentinites is reported, as well as the presence of rodingites and based on the presence of zoisite in the parageneses of the rodingites, it is concluded that the metamorphism has not exceeded the upper levels of the greenschist facies (G. Paraskevopoulos, 1969). From the basic members, the effect of metamorphism is apparent mainly in the diabases, by their rather frequent conversion into spilites with parageneses which are classified between the zeolite and greenschist facies (G. Paraskevopoulos, 1975, G. Paraskevopoulos, 1979). Therefore, the high temperature minerals of the "in situ" concentrations cannot be related to metamorphism.

TABLE 1.

Microprobe assays of the plagioclases and their Ab % and An % content in the «in situ» concentrations and the surrounding host rocks from the Pindos complex.

	Concentrations «in situ»								Surrounding host rock (plagioclase lherzolite)						
	SiO_2	Al_2O_3	Na_2O	CaO	Total	Ab %	An %		SiO_2	Al_2O_3	Na_2O	CaO	Total	Ab %	An %
Sample No. 4: Lambanovon valley, between Korydallos and Panayia (Nea Koutsoufliani)															
1	47,78	33,65	2,28	16,36	100,07	20,2	79,8	1	48,28	33,53	2,48	15,80	100,09	22,1	77,9
2	49,36	32,74	2,94	15,08	100,12	25,9	74,1	2	45,98	34,96	1,42	17,77	100,13	12,7	87,3
3	45,12	35,01	1,39	17,81	99,33	12,7	87,3	3	48,71	33,46	2,71	15,64	100,52	24,0	76,0
4	47,72	33,77	2,22	16,47	100,18	19,2	80,8	4	45,83	34,91	1,44	17,55	99,73	12,8	87,2
5	47,92	33,63	2,37	16,17	100,09	21,2	78,8	5	47,88	33,88	2,12	16,58	100,46	18,7	81,3
6	46,92	34,41	1,83	16,80	99,96	16,2	83,8								
7	46,21	34,82	1,50	17,52	100,05	13,3	86,7								
8	47,62	33,70	2,22	16,40	99,94	19,3	80,7								
9	46,91	34,19	1,53	17,50	100,13	13,3	86,7								

Table 1 (continued)

	Concentrations «in situ»							Surrounding host rock (plagioclase lherzolite)							
	SiO_2	Al_2O_3	Na_2O	CaO	Total	Ab %	An %		SiO_2	Al_2O_3	Na_2O	CaO	Total	Ab %	An %
Sample No. 17: Mileotikos valley, north of Milea Metsovou															
1	47,32	34,01	2,01	16,70	100,04	17,7	82,3	1	47,30	34,20	1,91	16,76	100,17	17,1	82,9
2	50,41	31,98	3,33	14,32	100,04	29,4	70,6	2	46,60	34,52	1,72	17,31	100,15	14,9	85,1
3	45,34	35,40	1,14	18,34	100,22	9,9	90,1	3	47,36	34,10	1,78	16,98	100,22	16,1	83,9
4	47,60	33,80	2,21	16,43	100,04	19,3	80,7	4	46,54	34,60	1,65	17,39	100,18	14,4	85,6
5	47,59	33,91	2,19	16,41	100,00	19,3	80,7	5	46,61	34,30	1,70	17,46	100,07	14,7	85,3
6	47,00	34,32	1,87	16,78	99,97	17,1	82,9	6	47,15	34,50	1,90	16,81	100,36	17,1	82,9
								7	46,65	34,55	1,75	17,36	100,31	15,3	84,7
								8	49,90	33,20	2,82	15,61	101,53	24,5	75,5
								9	47,15	34,17	1,89	16,93	100,14	17,1	82,9
								10	47,90	33,60	2,23	16,33	100,06	19,4	80,6

Table 1 (continued)

	Concentrations «in situ»								Surrounding host rock (plagioclase lherzolite)							
	SiO_2	Al_2O_3	Na_2O	CaO	Total	Ab %	An %		SiO_2	Al_2O_3	Na_2O	CaO	Total	Ab %	An %
Sample No. 18: Mileotikos valley, north of Milea Metsovou															
1	46,41	34,49	1,52	17,20	99,62	13,5	86,5	1	48,18	34,28	1,98	16,95	101,39	17,5	82,5
2	46,51	33,98	1,49	17,19	99,17	13,5	86,5	2	47,32	34,05	2,01	16,72	100,10	18,6	81,4
3	47,22	33,89	1,93	16,71	99,75	17,2	82,8	3	45,52	35,22	1,32	18,04	100,10	11,6	88,4
4	45,32	35,40	1,16	18,18	100,06	10,5	89,5	4	47,81	33,73	2,45	16,37	100,36	21,1	78,9
5	47,81	33,72	2,26	16,35	100,14	20,3	79,7	5	49,35	32,48	3,02	14,74	99,59	26,8	73,2
6	50,22	32,12	3,36	14,33	100,03	30,2	69,8								
7	47,35	34,00	2,01	16,81	100,17	17,6	82,4								
8	46,53	34,66	1,86	17,80	100,85	16,4	83,6								
9	48,32	33,41	2,50	15,95	100,18	22,0	78,0								
10	50,41	31,92	3,51	14,38	100,22	30,3	69,7								
11	47,41	34,02	2,02	16,56	100,01	17,8	82,2								

TABLE 2.

Microprobe assays of clinopyroxenes in concentrations «in situ» and in the surrounding host peridotite (lherzolite), from Perivoli area of Pindos complex.

	Concentrations in situ				Surrounding host rock (lherzolite)						
	1	2	3	4	1	2	3	4	5	6	7
SiO_2	52,18	53,06	53,23	52,06	51,65	51,90	51,33	52,13	52,41	52,34	51,06
Al_2O_3	3,02	3,08	2,76	2,87	4,51	4,76	4,89	4,73	4,53	5,56	5,32
FeO*	2,80	2,99	3,73	3,08	2,06	1,92	2,18	2,14	2,28	2,28	2,07
MgO	18,46	18,09	19,87	18,67	18,77	18,08	18,58	18,72	19,31	18,41	18,51
CaO	23,91	23,69	18,23	23,43	21,88	23,87	21,32	21,28	22,08	22,35	20,60
TiO_2	0,16	0,20	0,13	0,27	0,17	0,16	0,06	0,10	0,08	0,42	0,14
Na_2O	0,23	0,23	0,12	0,31	0,08	0,11	0,11	0,13	0,16	0,11	0,11
Cr_2O_3	0,58	0,50	0,36	0,51	0,40	0,47	0,42	0,51	0,48	0,48	0,51
Total	101,34	101,84	98,43	101,20	99,52	101,27	98,89	99,74	101,33	101,95	98,32

* Fe total as FeO.

ΠΕΡΙΛΗΨΙΣ

Ἐξετάζονται τὰ φαινόμενα μερικῆς τήξεως εἰς τοὺς πλαγιοκλαστικοὺς λερζολίθους τοὺς ἐγκεκλεισμένους ἐντὸς τῶν χαρτσβουργιτῶν (τεκτονιτῶν), ἀπὸ διάφορα ὀφιολιθικὰ συμπλέγματα τῆς Ἑλλάδος. Τὰ φαινόμενα ταῦτα συνίστανται εἰς τὸν σχηματισμὸν "in situ" μικρῶν φακῶν καὶ φλεβιδίων ἐκ πλαγιοκλάστων, μονοκλινῶν πυροξένων καὶ γάββρων. Τὰ ὅρια αὐτῶν τῶν συγκεντρώσεων μὲ τὸ περιβάλλον φιλοξενοῦν πέτρωμα (ξενιστὴν) δὲν εἶναι σαφῶς καθωρισμένα, τὸ μέγεθος τῶν κρυστάλλων τῶν ὀρυκτῶν τῶν συγκεντρώσεων εἶναι πολὺ μεγαλύτερον ἀπὸ ἐκεῖνο τῶν ἀντιστοίχων ὀρυκτῶν τοῦ ἐγκλείοντος πετρώματος, ἐνῶ τὸ περιβάλλον φιλοξενοῦν πέτρωμα παρὰ τὴν ἐπαφὴν μὲ τὴν συγκέντρωσιν εἶναι ἀπισχνισμένον κατὰ τὰ ἀντίστοιχα ὀρυκτὰ τῆς συγκεντρώσεως. Προσανατολισμὸς τῶν κρυστάλλων τῆς συγκεντρώσεως δὲν κατέστη δυνατὸν νὰ διαπιστωθῇ, ἐνῶ μὲ τὴν βοήθειαν ἑνὸς γωνιομέτρου ἱστοῦ Röntgen ἀπεδείχθη ἡ παρουσία ἐκδήλου προσανατολισμοῦ τῶν κρυστάλλων τῶν μονοκλινῶν πυροξένων τοῦ περιβάλλοντος πετρώματος. Ἡ ἐμφάνισις τῶν συγκεντρώσεων "in situ" καὶ ἡ ἀνάπτυξις αὐτῶν, φαίνεται ὅτι σχετίζεται μὲ τὰ τεκτονικὰ στοιχεῖα τῶν περιβαλλόντων τεκτονιτῶν. Ἡ σύστασις τῶν πλαγιοκλάστων τῶν συγκεντρώσεων "in situ" καὶ τοῦ περιβάλλοντος πετρώματος προσδιορίσθη δι' ἠλεκτρονικοῦ ὑπολογιστοῦ καὶ ἀπεδείχθη ὅτι ἡ σύστασις τοῦ πλαγιοκλάστου τῶν συγκεντρώσεων "in situ" εἶναι ὁμοία μὲ ἐκείνην τοῦ πλαγιοκλάστου τοῦ περιβάλλοντος φιλοξενοῦντος πετρώματος. Εἰς ἀμφοτέρας τὰς περιπτώσεις, ἡ διακύμανσις εἰς An% εὑρίσκεται ἐξ ὁλοκλήρου ἐντὸς τοῦ βυτοβνίτου, ἐπικρατοῦν ὅμως τιμαὶ ἄνωθεν τοῦ 80%, κυμαινόμεναι μεταξὺ 80 καὶ 90%. Ἀνάλυσις δι' ἠλεκτρονικοῦ ὑπολογιστοῦ ἐπραγματοποιήθη ἐπίσης διὰ τὸν προσδιορισμὸν τῆς συστάσεως τῶν μονοκλινῶν πυροξένων διὰ τὰς συγκεντρώσεις "in situ" καὶ τῶν μονοκλινῶν πυροξένων τοῦ περιβάλλοντος φιλοξενοῦντος πετρώματος. Εἰς ἀμφοτέρας τὰς περιπτώσεις ἡ σύστασις εἶναι ἡ ἰδία. Ἐκ τῆς παρουσίας ζοϊσίτου εἰς τὰς παραγενέσεις τῶν ροδινγιτῶν τῶν ἐγκλειομένων ἐντὸς τῶν τεκτονιτῶν, ἐξάγεται τὸ συμπέρασμα ὅτι ἡ μεταμόρφωσις δὲν ὑπερέβη τὰς ἀνωτέρας βαθμίδας τῆς πρασινοσχιστολιθικῆς φάσεως. Τοιουτοτρόπως ,τὰ ὀρυκτὰ ὑψηλῆς θερμοκρασίας τῶν συγκεντρώσεων "in situ" δὲν δύνανται νὰ σχετίζωνται μετὰ τῆς μεταμορφώσεως.

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