ΠΕΤΡΟΛΟΓΙΑ.— **The significance of dykes and sills of gabbros and pyroxenites in tectonites (harzburgites)**, *by George M. Paraskevopoulos**. Ἀνεκοινώθη ὑπὸ τοῦ Ἀκαδημαϊκοῦ κ. Ἀγγέλου Γαλανοπούλου.


ABSTRACT

The significance of dykes and sills of gabbros and pyroxenites which belong to the intrusive phase within the tectonites (harzburgites) is examed. The gabbroic dykes within the harzburgites are more numerous, developed in the form of a dense network, in their upper parts, which are close to the chamber. In the greek ophiolite complexes this consitutes a rule. The second observation refers to the fact that the gabbroic dykes cross the cumulate products.

The chemical analyses of gabbros in dyke-like form (intrusive gabbros) within the harzburgites from different alpine complexes are given, sofar as the An % content of plagioclases of gabbros and the host rock (tectonite). A variation of the An % content of the plagioclases in the gabbros and of their composition is observed. Similarly it is evident that a deviation of the composition of the plagioclases in the gabbros from that of the plagioclases of the host rock is observed.

With regard to pyroxenites, the observation in the greek ophiolite complexes shows that the gabbros in the tectonites are found, as a rule, together with pyroxenites in the upper parts of the tectonites, not infrequently close to neighbouring cumulates. The gabbros and pyroxenites occuring within the tectonites have, as a rule, a pegmatitic texture. The boudaries of the dykes and sills of the gabbros and the pyroxenites with the surrounding host tectonite are clear with a well defined intrusive character. There is a close genetic relationship between the gabbros and the pyroxenites. In addition to the similarities between these rock types regarding their position, mode of occurrence, texture etc. often there has been observed a transition of the one rock type to the other in the same occurrence, with the intervention of transitional (intermediate) types.

The opinion that the gabbros and pyroxenites represent products of partial melting of the original rock of the mantle (lherzolite) in the stage of their transportation for concentration and homogenization but without escaping from the mantle rock due to their small mass, is supported by the evidence, that within the tectonites close to the dykes and sills under discussion occur veinlets and small concentrations "in situ" consisting of pyroxenes, plagioclases and material of gabbroic composition. Similarly, this is supported by the presence of pegmatitic texture in the gabbros and pyroxenites, by the occurrence of exsolution products in the pyroxenes crystals of these rocks, together


* Γ. Μ. ΠΑΡΑΣΚΕΥΟΠΟΥΛΟΥ, **Ἡ σημασία τῶν φλεβῶν καὶ κοιτῶν γάββρων καὶ πυροξενιτῶν ἐντὸς τῶν τεκτονιτῶν (χαρτζβουργιτῶν).**

with the absence of chilling phenomena. These indicate, that the surrounding host tectonite was still hot, far from its cooling stage. However, the presence of dykes of differentiated products in the tectonites, is also considered certain. It is evident that if the gabbro dykes in the tectonites, contain differentiated material, i.e. they are enriched in $SiO_2$ and $Na_2O$ and have more acidic plagioclase, or contain amphiboles, then such dykes should be derived from intrusions of differentiated material from the overlying magma chamber, or from neighbouring chambers in the case of multiple magma chambers, or they could be even derive from differentiated residual material, which moved towards the chambers.

The gabbros within the harzburgites, which belong to the intrusive phase and occur in the form of dykes having occasionally a length of a several decabes of metres and a width over one meter, represent a very important subject for research. Their presence has been reported in many ophiolite complexes and their origin and especially their significance is very interesting. T. Juteau and H. Whitechurch (1979) report from Antalya complex in Turkey, the presence of a dense network of gabbro dykes and sills and occasionally of pyroxenites consisting of clinopyroxenes, which cross the lower parts of the cumulate sequence and continue into the underlying tectonites. These intrusive gabbros are pegmatitic and consist of diallage, bronzite and anorhite. According to the above authors, most of the gabbro dykes are related genetically with the syn-sedimentary normal faulting of the chamber and the squeezing of the cumulate sequence. But the thick dykes within the gabbros, represent, according to the same authors, feeding channels of the magma chamber by new magma. According to J. Malpas (in T. Juteau and H. Whitechurch, 1979, p. 391) similar phenomena in Oman have been interpreted as indicating multiple neighbouring chambers, where differentiated fractions of magma from one chamber produce multiple intrusions in a neighbouring chamber. Under such circumstances this material during its movement from one chamber into another, can form intrusions also into the harzburgites occuring at the base and in between the two chambers. The composition of these gabbros, according to J. Malpas, cannot represent the composition of the magma which has supplied the chamber, because it should have been of more picritic nature. It should be noted, that the gabbro dykes under considerations are undisturded and do not follow the tectonic pattern of the tectonites, in contrast to the veinlets of gabbros (and pyroxenites), which occur exclusively in the tectonites and which follow the tectonic pattern of the enclosing tectonites.

At first, two observations may be mentioned which could be of significant interest. The first refers to the fact, that the gabbroic dykes within the harzburgites are more numerous, developed occasionally in the form of a dense network, in their upper parts, which are close to the chamber. In the greek ophiolite complexes, with a well developed phase of cumulate rocks, this constitutes a rule. In the Lambanovon valley of the Pindos complex, as well as in the Mileotikos valley, there can be observed a dense net-

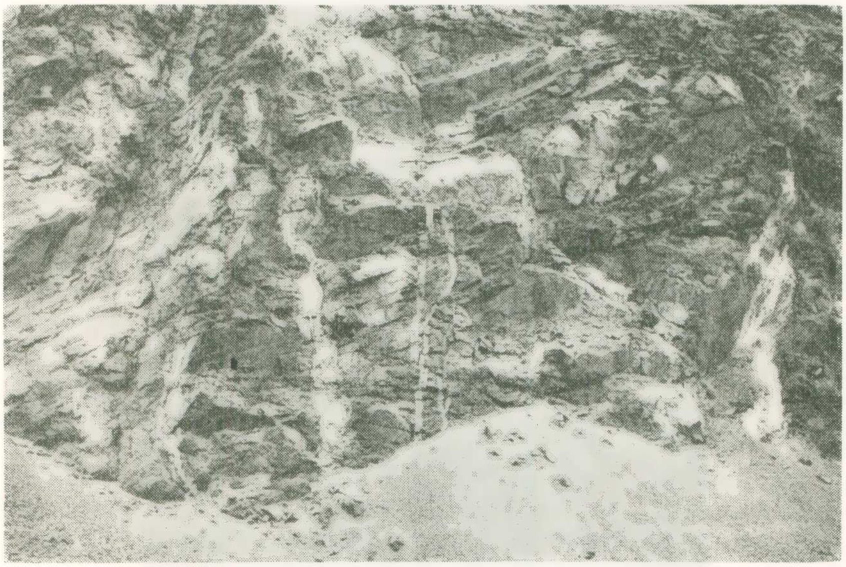

Fig. 1. Dense network of great gabbro dykes crosses the harzburgites which are found below cumulates. The intrusive character of gabbros and the clear boundaries in respect to the surrouding tectonites are well distinctive. Lambanovon valley of Pindos complex, Greece.

work of sizeable gabbro dykes crossing the harzburgites near the base of the cumulate sequense (fig. 1). Similar phenomena are observed in the Aspropotamos valley. In the deeper levels of the harzburgites the gabbro dykes are rare and more commonly absent.

The second observation refers to the fact, that the gabbroic dykes, occasionally pegmatitic, cross the cumulate products (fig. 2). Table 1 gives the chemical analyses of gabbros in dyke-like form (intrusive gabbros) within the harzburgites from different alpine ophiolite complexes. From these, the first five analyses refer to greek complexes. The An % content of plagioclases of the gabbros and the host rock (tectonites) is given in table 2.

From these tables, a variation of the An% of the plagioclases in the gabbros and of their composition, is firstly observed. Similarly it is evident that a deviation of the composition of the plagioclases in the gabbros, from

Fig. 2. Pegmatitic gabbro crosses cumulates. Lambanovon valley of pindos complex, Greece.

that of the plagioclases of the surrounding host tectonites exists. Since the origin of these gabbroic concentrations is not related with intrusions of material from the magma chamber, the above observations indicate that there has been a removal of the material produced by the melting of lherzolite from its original positions after it has been a mixing up of this material in different degree.

T A B L E 1.

**Intrusive gabbros (dykes) within the tectonites of some alpine ophiolite complexes, mostly from Greece.**

| | G A B B R O S | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| $SiO_2$ | 44,9 | 48,0 | 40,00 | 44,87 | 46,03 | 49,76 | 50,86 | 51,54 |
| $Al_2O_3$ | 18,6 | 17,0 | 22,2 | 19,69 | 24,72 | 19,60 | 20,43 | 15,56 |
| $Fe_2O_3$ | 1,1 | 0,7 | 0,55 | | | 0,89 | 0,73 | 1,43 |
| FeO | 5,4 | 2,8 | 3,00 | 2,72* | 2,31* | 1,95 | 2,15 | 4,97 |
| MnO | 0,14 | 0,09 | 0,01 | 0,07 | 0,03 | 0,04 | 0,05 | 0,12 |
| MgO | 10,0 | 10,9 | 11,30 | 14,11 | 8,75 | 10,78 | 11,83 | 11,22 |
| CaO | 15,7 | 14,5 | 14,00 | 16,46 | 13,79 | 10,52 | 8,37 | 9,64 |
| $Na_2O$ | 0,5 | 0,9 | 0,76 | 1,77 | 3,10 | 3,05 | 3,26 | 4,29 |
| $K_2O$ | 0,3 | 0,2 | 0,54 | 0,03 | 0,09 | tr. | 0,01 | 0,03 |
| $TiO_2$ | 0,12 | 0,12 | 0,10 | 0,09 | 0,06 | 0,14 | 0,01 | 0,42 |
| $P_2O_5$ | 0,02 | 0,01 | 0,31 | | 0,75 | 0,05 | 0,03 | tr. |
| $Cr_2O_3$ | | | | | | 0,13 | 0,14 | tr. |
| NiO | | | | | | 0,06 | 0,05 | 0,01 |
| LOI | | | | | | 0,61 | 0,45 | 0,35 |
| $H_2O^+$ | } 2,8 | } 4,5 | 0,12 | | | 1,71 | 0,99 | } 0,50 |
| $H_2O^-$ | | | 6,60 | | | 0,12 | 0,16 | |
| T o t a l | 99,6 | 99,7 | 99,49 | 99,81 | 99,63 | 99,41 | 99,51 | 100,08 |
| MgO : (MgO+ +FeO*) | 0,61 | 0,76 | 0,76 | 0,84 | 0,79 | 0,79 | 0,81 | 0,64 |
| FeO*: MgO | 0,64 | 0,31 | 0,31 | 0,19 | 0,26 | 0,26 | 0,24 | 0,59 |
| FeO* | 6,39 | 3,43 | 3,49 | 2,72 | 2,31 | 2,75 | 2,81 | 6,26 |

1. Pegmatitic gabbro in tectonites, 1 km NE of Perivoli village, Grevena, Pindos complex. Unpuplished analysis. Analyst: Prof. M. Weibel, E. T. H., Zürich.
2. Gabbro in tectonites, 2 km N of Kila village, Kozani. Vourinos complex. Unpublished analysis. Analyst: Prof. M. Weibel, E. T. H., Zürich.
3. Olivine gabbro in tectonites, near Armata village, Konitsa, Pindos complex. After G. Paraskevopoulos (1948).
4. Gabbro in tectonites (harzburgites), Makrirachi area, Dhomokos, Othris complex. After M. Menzies (1973).
5. Olivine gabbro in lherzolites, Mega Isoma area, western Othris, Mirna group, Othris complex. After A. Haynes (1972).

6. 7. 8. Intrusive gabbros, in tectonites (lherzolites), Lanzo area nothern Italy, Camerletto hillrange, Colombano mountain range and Arpone mountain range, respectively. Pedemontion Alps complex. After F. Boudier and A. Nicolas (1972).

* Fe total as FeO.

TABLE 2.

**Anorthite content % of the plagioclases of the gabbros intruded into the tectonites and the plagioclases of the host rock tectonites, of table 1.**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Anorthite content % of the plagioclase of the host rocks (tectonites) | | | 85 - 95 microscopically (lherzolites) | 80 - 90 microprobe analysis (harzburgites) | 76,4 - 82,3 microprobe analysis (lherzolites) | 80 and 55 - 65 (two different positions) microscopically (lherzolites) | | |
| Anorthite content % of the plagioclase of the gabbros | 91,4+ | 83,3+ | 70 - 75 microscopically | 73,8+ | 69,6 microprobe analysis | 59,3+ | 58,7+ | 38 micro-scopically |

+ Calcutated from the chemical analysis of the rock sample.

Note: In the cases of calculation of the composition of the plagioclases in An % from the chemical analyses of the rock samples, the actual composition in An % of the plagioclase should be lower than the calculated value, because a small amount of $Al_2O_3$ has been associated with the pyroxenes and in the case of ultrabasic rock in the spinels too.

The following are some observations on the mode of occurrence of the gabbros in the tectonites especially of the greek complexes.

(i) The gabbros in the tectonites are found, as a rule, together with pyroxenites, with which they have resemblance in their mode of occurrence and are genetically related with, as mentioned below.

(ii) The gabbros within the tectonites with the accompanying them pyroxenites are found in the upper parts of the tectonites and not infrequently close to neighbouring cumulates. In the deeper parts of the tectonites, the presence of the gabbro dykes and the pyroxenites is becoming more rare and finally they disappear.

(iii) The gabbros and pyroxenites occuring within the tectonites have, as a rule, a pegmatitic texture. The crystal size of the pyroxenes and that of the plagioclases, is usually over 2 cm, provided that the rock has not suffered rodingitization, whereas in many cases it was observed that crystals of the same minerals, especially of pyroxenes, exceed 20 cm. This, in contrast to the texture of the gabbros and pyroxenites of the magma chamber, which are usually medium to fine grained. The pegmatitic texture of the gabbros and pyroxenites in the tectonites indicates that the surrounding host tectonites, during the formation within them of the sills and dykes of gabbros and pyroxenites, were still sufficiently hot, so that the rate of cooling during their formation (of the gabbros and pyroxenites) was slow. This is also indicated by the presence of exsolution products within the crystals of the pyroxenes of these rocks, as well as the total absence of chilling phenomena at the contacts of the dykes and sills of the gabbros and the pyroxenites.

(iv) The boundaries of the dykes and sills of the gabbros and the pyroxenites with the surrounding host tectonite are clear with a well defined intrusive character (fig. 1). On the contrary in the "in situ" concentrations within the tectonites of pyroxenes, plagioclases and gabbroic material, the boundaries with the surrounding host tectonite are not clear and occasionally gradational. In fig. 3 there may be observed intrusions of pyroxenites within the tectonites of Aspropotamos of the Pindos complex, with a cutting off of a part of the tectonite by the intruded pyroxenite (lower right corner of the section).

(v) There is a close genetic relationship between the gabbros and the pyroxenites. In addition to the similarities between these rock types regarding their position, mode of occurrence, texture e.t.c., as described above, often there has been observed a transition of the one rock type to the other in the same occurrence, with the intervention of transitional (intermediate) types. In the Pindos complex, the later phenomenon is common, as for example in the valleys of Aspropotamos, Mileotikos, Lambanovon, etc. In the section of fig. 3 the pyroxenites have, in some places, plagioclase as well, in varying proportions. The intermediate types found between the gabbros and pyroxenites belong to the melagabbros and plagioclase pyroxenites so that the whole spectrum observed in the various occurrences of the gabbros and pyroxenites within the tectonites includes types belonging to gabbros, melagabbros, plagioclase pyroxenites, pyroxenites. In the Vourinos complex, E. Moores (1969, p. 19 - 20), mentions the presence in the tectonites of numerous dykes of pegmatitic pyroxenites some of which consist of clinopyroxenes and other of ortho- and clino-pyroxenes, i.e. with hyperthene and diallage, called websterites. Some of these pyroxenite dykes are composite, as the above author describes them, including also plagioclase material thus producing pegmatitic dykes of gabbroic composition. The same author reports as follows the relationship between the two types of a composite dyke. "Some dykes (of pyroxenite) are composite and contain residual masses or cores of feldspathic material, from which gabbroic pegmatite dykes have originated. Near the western margin of the central area these dykes coalesce to form irregular bodies of pyroxenite which comprise the lower region of a transition zone into gabbro." It may be finally mentioned, that in some areas of the Vourinos complex, such as Kerasista and Koursoumia, pyroxenite dykes were observed which cross at the same time the harzburgites and the enclosed dunites and chromite schlieren enclosed in the dunites.

The common characteristics and the close relationship, between the pyroxenites and the gabbros, which is apparent by the frequent occurrence together with the presence of intermediate types, transitional from one to the other type of rock, as these have been described above, indicate a genetic relationship between the pyroxenites and gabbros. The composition of some gabbros indicates that these rocks are derived from melts, differentiated at various degrees (enrichment in $Na_2O$, $SiO_2$, and more acidic plagioclases). The presence of the gabbros and pyroxenites in the upper parts

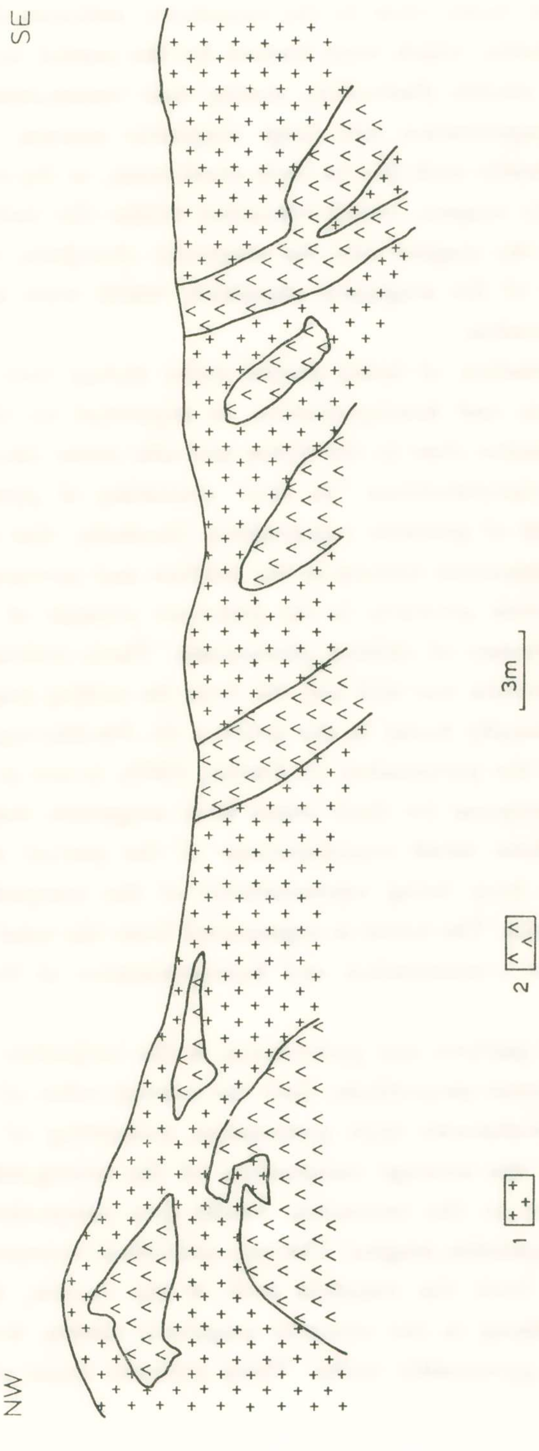


Fig. 3. Intrusions of pyroxenites cutting partly the host tectonite. Aspropotamos valley of the Pindos complex.

1 = tectonites    2 = pyroxenites

of the tectonites, not rarely close to the cumulates, indicates that this is a case (a) of partial melts, which were formed by the partial melting of the original rock of the mantle (lherzolite), during their transportation for concentration and homogenization into large magmatic sources, but without escaping from the mantle rock due to their small mass, or (b) of differential residuals of ophiolitic magma, which remained within the tectonites, after the emplacement of the magma into the magmatic chambers, or (c) of differentiated residuals of the magmatic chambers, which were intruded into the surrounding tectonites.

The first explanation of being partial melts during their transportation for concentration and homogenization, is supported by the evidence, that within the tectonites close to the dykes and sills under discussion occur veinlets and small concentrations "in situ" consisting of pyroxenes, plagioclases and material of gabbroic composition. Similarly, this is supported by the presence of pegmatitic texture in the gabbros and pyroxenites, by the occurrence of exsolution products in the pyroxene crystals of these rocks, together with the absence of chilling phenomena. These indicate, that the surrounding host tectonite was still hot, far from its cooling stage. The fact that olivine is occasionally found in the gabbros (G. Paraskevopoulos, 1948, A. Hynes, 1972) and the pyroxenites (J. Parrot, 1967), is not in support, in these cases, of the proposal for their origin from magmatic residuals of an ophiolite magma. These small concentrations of the partial melts, taken individually, are far from being representative of the composition of the parent ophiolite magma. The latter is represented from the total of the partial melts, after their concentration and homogenization at the magmatic source.

If the dykes of gabbros and pyroxenites in the tectonites were represented by about the same proportions, then the average value of the average composition of the websterite type pyroxenites (consisting of ortho- and clino-pyroxenes) and the average composition of the leucogabbros (protogabbroic melts) found in the tectonites, would give composition close to those of the parent ophiolite magma. The two individual extreme categories of melts, originated from the remelted rock of the mantle, before their concentration and mixing in the common magmatic source, would be the plagioclasic and the pyroxenitic melts. These extreme types of melts are formed by the "in situ" concentrations of plagioclases and pyroxenes. Under these circumstances, the search for crystallization products of these individual melts would be interesting, as long as the observations are made in harzburgites of the tectonites, i.e. in rocks which are totally devoid of plagioclase. Total depletion of the mantle rock from the plagioclase, indicates strong partial melting of the mantle rock. Thus, the average bulk composition of all the leucogabbroic dykes (protogabbroic melts) and of all the websterite dykes, would represent a composition close to that of the ophiolite parent magma. The leucogabbroic dykes, i.e. material with minor pyroxene content, represent approximately a plagioclasic melt.

The dykes of gabbro and pyroxenite within the tectonites have clear boundaries with the surrounding tectonites, which they often cross linearly. These dykes do not show phenomena of plastic deformation, and their development and orientation does not appear to have been affected by the direction of the plastic flow and the general tectonic elements of the surrounding tectonites. Similar phenomena are reported also by F. Boudier and A. Nicolas (1972 p. 52) for the gabbros intruded in the lherzolites of the Lanzo area in nothern Italy.

However, the presence of dykes of differentiated products in the tectonites, is also considered certain. T. Juteau and H. Whitechurch (1979, p. 389) report, for the Antalya area of Turkey, dykes of gabbros and clinopyroxene pyroxenites, which cross the lower parts of the cumulates and extend into the underlying tectonites. For most of these dykes, the above authors express the opinion, as already mentioned, that they are related with the syn-sedimentary normal faulting of the magma chamber and the squeezing of the cumulate sequence. Similarly R. G. Coleman (1977, p. 47) reports that there are occurences of intrusions of plagiogranites into the ultrabasic members of the ophiolite group (tectonites). It is evident that if the gabbro dykes in the tectonites contain differentiated material, i.e. they are enriched in $SiO_2$ and $Na_2O$, and have acidic plagioclase, or contain amphiboles, then such dykes should be derived from intrusions of differentiated material from the overlying magma chamber, or from neighbouring chambers in the case of multiple magma chambers, or they could be even derived from differentiated residual material, which moved towards the chambers.

ΠΕΡΙΛΗΨΙΣ

Ἐξετάζεται ἡ σημασία τῶν φλεβῶν καὶ κοιτῶν γάββρων καὶ πυροξενιτῶν πού ἀπαντοῦν ὡς φάσις διεισδύσεως ἐντὸς τῶν τεκτονιτῶν (χαρτζβουργιτῶν). Αἱ γαββροϊκαὶ φλέβες ἐντὸς τῶν χαρτζβουργιτῶν εἶναι πολυπληθέστεραι, ἀναπτύσσονται εἰς τὰ ἀνώτερα τμήματα αὐτῶν ὑπὸ μορφὴν πυκνοῦ δικτύου, ἐγγὺς πρὸς τὰ πετρώματα τοῦ θαλάμου. Διὰ τὰ ἑλληνικὰ ὀφιολιθικὰ συμπλέγματα αὐτὸ ἀποτελεῖ κανόνα. Ὡς δευτέρα παρατήρησις ἀναφέρεται τὸ γεγονὸς ὅτι αἱ γαββροϊκαὶ φλέβες διασχίζουν πολλάκις τὰ προϊόντα τοῦ θαλάμου.

Δίδονται αἱ χημικαὶ ἀναλύσεις γάββρων ἐκ διεισδύσεως ἐντὸς τῶν χαρτζβουργιτῶν ἀπὸ διάφορα ἀλπικὰ συμπλέγματα ὡς καὶ ἡ An% περιεκτικότης τῶν πλαγιοκλάστων τῶν γάββρων καὶ τοῦ φιλοξενοῦντος πετρώματος (τεκτονίτου). Ἐκ τούτων προκύπτει διαφορὰ εἰς τὴν περιεκτικότητα εἰς An% τῶν πλαγιοκλάστων τῶν γάββρων καθὼς καὶ εἰς τὴν σύστασιν αὐτῶν (τῶν γάββρων). Ὁμοίως παρατηρεῖται ἀπόκλισις τῆς συστάσεως τῶν πλαγιοκλάστων τῶν γάββρων ἀπὸ τὴν σύστασιν τοῦ πλαγιοκλάστου τοῦ φιλοξενοῦντος πετρώματος.

Ἐν σχέσει μὲ τοὺς πυροξενίτας, ἡ παρατήρησις εἰς τὰ ἑλληνικὰ συμπλέγματα δεικνύει ὅτι οἱ γάββροι συναντῶνται ὁμοῦ μετὰ τῶν πυροξενιτῶν εἰς τοὺς τεκτονίτας, ἤτοι εἰς τὰ ἀνωτέρω τμήματα αὐτῶν, συχνάκις ἐγγὺς πρὸς τὰ πετρώματα τοῦ θαλάμου καὶ ἔχουν ἀμφότεροι συνήθως ἱστὸν πηγματιτικόν. Τὰ ὅρια τῶν φλεβῶν καὶ κοιτῶν τῶν γάββρων καὶ πυροξενιτῶν μετὰ τοῦ περιβάλλοντος φιλοξενοῦντος πετρώματος εἶναι σαφῆ, μὲ καλῶς ὁριζόμενον τὸν χαρακτῆρα διεισδύσεως. Μεταξὺ τῶν γάββρων καὶ τῶν πυροξενιτῶν ὑφίσταται γενετικὴ σχέσις. Ἐκτὸς τῆς ὁμοιότητος μεταξὺ τούτων ἀναφορικῶς μὲ τὴν θέσιν, τρόπον ἐμφανίσεως, ἱστὸν κ.τ.λ., παρατηρεῖται συχνάκις εἰς τὴν αὐτὴν ἐμφάνισιν μετάβασις τοῦ ἑνὸς τύπου πετρώματος πρὸς τὸν ἄλλον, διὰ τῆς παρεμβολῆς μεταβατικῶν (ἐνδιαμέσων) τύπων.

Ἡ ἄποψις ὅτι οἱ γάββροι καὶ οἱ πυροξενῖται παριστοῦν προϊόντα μερικῆς τήξεως τοῦ ἀρχικοῦ πετρώματος τοῦ μανδύου (λερζολίθου) εὑρισκόμενα εἰς τὸ στάδιον τῆς μεταφορᾶς πρὸς συγκέντρωσιν καὶ ὁμογενοποίησιν, ἀλλὰ μὴ δυνάμενα νὰ διαφύγουν ἀπὸ τὸ πέτρωμα τοῦ μανδύου λόγῳ τῆς μικρᾶς των μάζης, ὑποστηρίζεται ἀπὸ τὸ γεγονὸς ὅτι ἐντὸς τῶν τεκτονιτῶν καὶ ἐγγὺς τῶν φλεβῶν καὶ κοιτῶν τοιούτων γάββρων καὶ πυροξενιτῶν ἐμφανίζονται φλεβίδια καὶ μικραὶ συγκεντρώσεις "in situ" συνιστάμενα ἀπὸ πλαγιόκλαστα, πυροξένους καὶ ἀπὸ γαββροϊκὸν ὑλικόν. Ὁμοίως τοῦτο ὑποστηρίζεται ἀπὸ τὴν παρουσίαν πηγματιτικοῦ ἱστοῦ εἰς τοὺς γάββρους καὶ πυροξενίτας, ἀπὸ τὴν παρουσίαν προϊόντων ἀπομίξεως εἰς

τοὺς κρυστάλλους τῶν πυροξένων καθὼς καὶ τὴν ἀπουσίαν φαινομένων ἀποψύξεως εἰς τὸ πέτρωμα, φαινόμενα τὰ ὁποῖα δηλοῦν ὅτι τὸ περιβάλλον φιλοξενοῦν πέτρωμα ἦτο ἀκόμη θερμόν. Ἐν τούτοις ἡ παρουσία φλεβῶν ἀπὸ διαφοροποιημένα προϊόντα ἐντὸς τῶν τεκτονιτῶν πρέπει νὰ θεωρῆται βεβαία. Εἶναι φανερὸν ὅτι ἐὰν αἱ φλέβες τῶν γάββρων ἐντὸς τῶν τεκτονιτῶν περιέχουν διαφοροποιημένον ὑλικόν, ἤτοι ἐὰν αὗται εἶναι ἐμπλουτισμέναι εἰς $SiO_2$ καὶ $Na_2O$ καὶ περιέχουν ὄξινα πλαγιόκλαστα ἢ περιέχουν ἀμφιβόλους, αἱ φλέβες αὗται ὀφείλουν νὰ προέρχωνται ἀπὸ διείσδυσιν διαφοροποιημένου ὑλικοῦ ἐκ τοῦ ὑπερκειμένου μαγματικοῦ θαλάμου ἢ ἐκ γειτονικῶν θαλάμων εἰς τὴν περίπτωσιν ὑπάρξεως πολλαπλῶν θαλάμων ἢ ἀκόμη αἱ φλέβες αὗται προέρχονται ἀπὸ διαφοροποιημένα μαγματικὰ ὑπόλοιπα, τὰ ὁποῖα κινοῦνται πρὸς τοὺς θαλάμους.

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