In: Ofioliti 1980 special issue. Tethyan ophiolites vol. 2 Eastern area

N

THE BAËR-BASSIT (NORTHWESTERN SYRIA) OPHIOLITIC AREA

PARROT Jean-François

Laboratoire de Géologie, S.S.C.-O.R.S.T.O.M., 70-74, Route d'Aulnay, 93140 Bondy, France

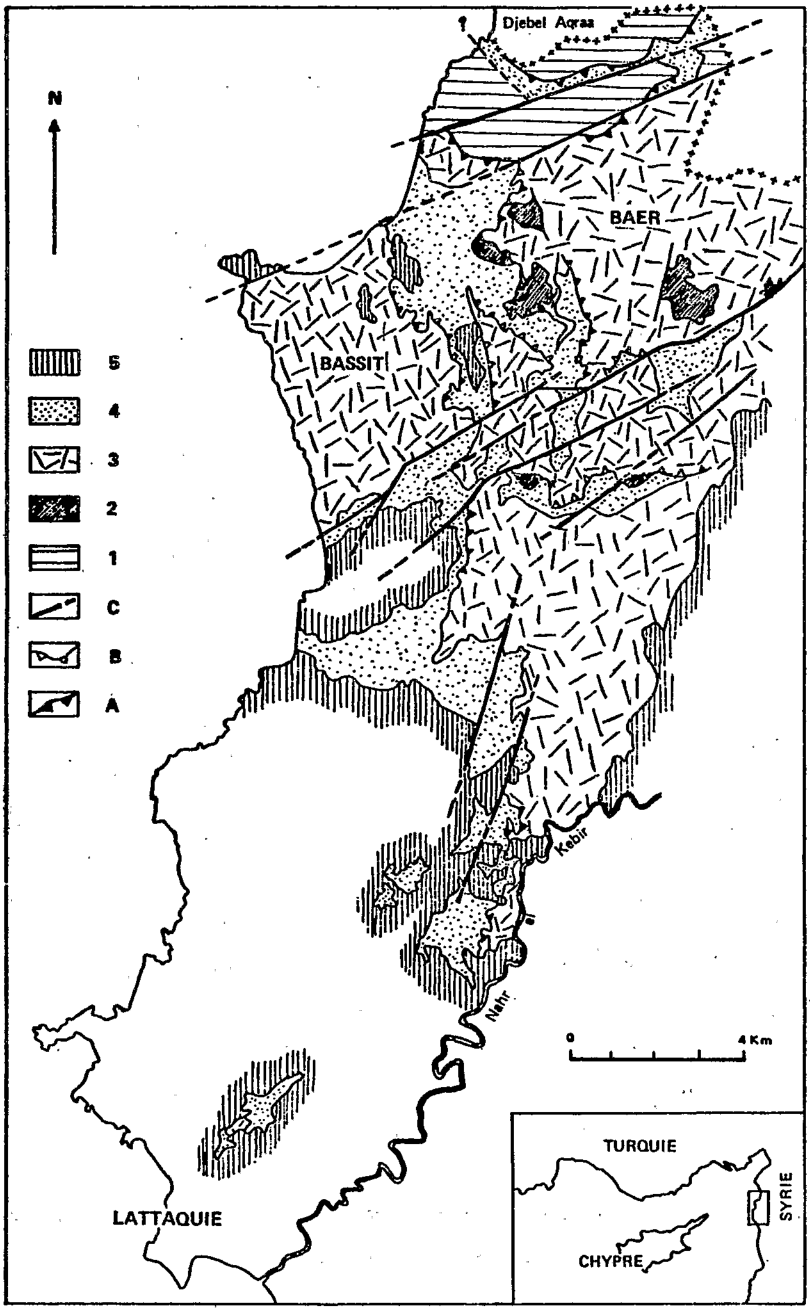
ABSTRACT

The Baër-Bassit ophiolitic massif corresponds to a portion of the Tethyan oceanic crust thrust onto the Arabian platform from north to south during Maestrichtian time. It is composed by peridotitic tectonites and cumulates, layered gabbros, sheeted diabasic complex and two different levels of pillow-lavas, the upper one presenting, as in Troodos, a hyper-tholeiitic composition; "umbers" are linked to this upper level. Moreover, the Baër-Bassit massif comprises also an infra-peridotitic metamorphic sole belonging to the deep green schists and amphibolite facies, and a volcanic and sedimentary series. The study of this series permits to follow the evolution of the southern border of the Tethyan ocean during its formation which began in the Upper Triassic period and stopped just before the tectonic emplacement of the ophiolitic nappes on the continental margin.

The thrusting or obduction would succeed two or more subsequent ocean-directed intra-oceanic subductions and would have been induced by the last one. During this process, a part of the volcanic and sedimentary series would have been engaged in the subduction zone and metamorphosed in deep green schists and amphibolite facies. The intra-oceanic subduction is emphasized by the presence of scattered and subvertical diabasic dikes cutting the gabbros and plagiogranites going up through the peridotites. On the other hand, the upper level of pillow-lavas would have been formed during the last stage of the formation of the oceanic crust, and could be a witness of the volcanic arc linked to the more recent and more southern intra-oceanic subduction.

O.R.S.T.O.M. Fonds Documentaire
N° : 1057 ex 1
Cote : B

Date : 23 MARS 1982


Djebel Aqraa
N
BAER
BASSIT
5
4
3
2
1
C
B
A
Nahr el Kebir
0
4 Km
TURQUIE
SYRIE
CHYPRE
LATTAQUIE

INTRODUCTION

The northwestern Syrian ophiolites and related rocks, previously described by Dubertret (1953) and Kazmin and Kulakov (1968), have been recently re-examined (Parrot, 1974a, 1974b, 1977b; Delaune-Mayere and Parrot, 1976; Delaune-Mayere et al., 1977; Whitechurch and Parrot, 1974; Whitechurch, 1977; Parrot and Whitechurch, 1978).

The Baër-Bassit ophiolites (NW Syria) belong to the southernmost or "external" belt of Tethyan ophiolite nappes thrust onto the northern border of the Arabian platform. They are situated in front of Cyprus, and represent an eastward prolongation of its formations and structures, thus forming the western end of the "peri-Arabic ophiolitic crescent" (Ricou, 1971). In fact, the close similarities existing between the Baër-Bassit Massifs and those of Cyprus, Hatay, and Oman, indicate that they belong to the same geotectonic structure .

The northwestern ophiolitic assemblage and the related rocks are geographically and structurally comprised between a Jurassic and Cretaceous calcareous massif - the Agraa mountain - situated northwards, and different transgressive series (the first one beginning in the Upper Maestrichtian), surrounding the ophiolitic area *stricto sensu* eastwards and southwards. The seashore limits ophiolite on its western border. In fact, the Agraa mountain corresponds to an Arabian platform window which divides presently the Baër-Bassit and the Hatay massifs located northwards, and which has been uplifted after the ophiolite emplacement, probably during Miocene. The ophiolite nappes emplacement took place during Maestrichtian, as indicated by the Lower Maestrichtian age of the upper levels of the Agraa Mountain on which ophiolites rest, and the Upper Maestrichtian age of the oldest terms of post-emplacement transgression . On the other hand, the uninterrupted sedimentation from Upper Cretaceous to Lower Lutetian in the Kurd Dagh (Dubertret, 1953; Wolfart, 1963), northern border of the Alaouite calcareous range situated south of

Fig. 1 - Geological sketch map of north western Syria. 1: basement of the ophiolitic sheets, Arabian-African platform limestones of Jurassic to Upper Cretaceous age; 2: metamorphic sole; 3: ophiolitic suite; 4: volcano-sedimentary formation; 5: Upper Maestrichtian transgressive formations; A: thrusting contact of the ophiolitic assemblage on the Lower and Middle Maestrichtian limestones; B: sheet contact between ophiolitic suite and volcano-sedimentary formation; C: post-nappe faults.

the Baër-Bassit area, shows obviously that this portion of the Arabian platform has never been covered by ophiolitic nappes, and that those nappes went from north to south. Thus, the Baër-Bassit area would correspond to the front of an important ophiolitic nappe, the roots of which are found to the north, in Turkey (Ricou et al., 1975); and this would explain the peculiar development of an oceanic volcanic and sedimentary series pushed by the ophiolitic sheet during its emplacement.

THE OPHIOLITIC COMPLEX

As all the ophiolitic massifs described by Mesorian (1973) in eastern Mediterranean, the Baër-Bassit ophiolitic complex consists of harzburgitic tectonites, peridotitic cumulates which are sometimes fully recrystallized as well as gabbros which succeed them directly, layered gabbros with some cross-cutting dikes, sheeted diabasic dike swarms, and two layers of pillow-lavas, the lower one tholeiitic and directly related to the dike complex, the upper one hypertholeiitic and presenting an unconformity with the two earlier formations; a fine magnesian clay formation first described in Cyprus as "umber", is associated with the upper volcanic level.

Peridotites

The northwestern Syrian ultramafic unit $\simeq$ 3 km thick, is composed by harzburgitic tectonites and cumulates, both strongly serpentinized.

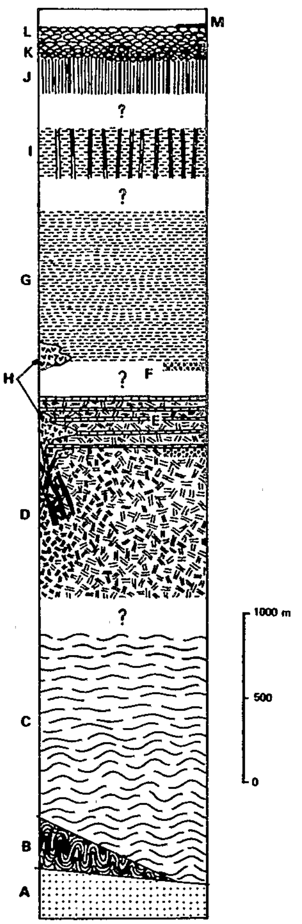


Fig. 2 - Synthetic log of Baër-Bassit ophiolitic formations. A: volcanic and sedimentary series; B: metamorphic sole; C: tectonites; D: peridotitic cumulates; E: lherzolitic and gabbroic series; F: feldspatic peridotites; G: layered gabbro sequence; H: plagiogranite intrusions; I: gabbroic ensemble with scattered diabasic dikes; J: sheeted complex; K: lower pillow-lavas; L: upper pillow-lavas; M: umbers.

(a) The tectonites characterized by metamorphic fabrics are essentially composed by 60 to 70% olivine (Fo 90), 38 to 28% orthopyroxene (En 92) and $\simeq$ 2% spinel. The recrystallization of the olivine phase is the main feature of this type, whereas the foliation is always weak. Except Al_2O_3 which is very high for such a harzburgitic type, the other elements are comprised in the extremely restricted range in composition which characterizes everywhere the tectonites (Coleman, 1977).

(b) The peridotitic cumulates are harzburgitic, partly lherzolitic, and some feldspathic peridotites with a heteradcumulate structure have been encountered at the base of the gabbroic sequence. These rocks present a light layering emphasized by the development of enstatitic "laminae", and a dominant adcumulus structure. The harzburgites contain 65 to 70% olivine (Fo 85), 34 to 29% orthopyroxene (En 86-90) and 1% or so of spinel. The lherzolites contain 65 to 76% olivine (Fo 85), 18 to 20% orthopyroxene (En 88), 14 to 8% clinopyroxene, 2 to 4% spinel and opaque minerals. The feldspathic peridotites contain 50 to 55% olivine (Fo 80), 0 to 2% orthopyroxene, 22 to 35% clinopyroxene and less than 0.5% spinel. The composition of olivine progressively increases in iron stratigraphycally upwards and orthopyroxenes present more or less the same trend. The increase in Al_2O_3 is naturally high for feldspathic peridotites.

(c) The Baër-Bassit massif contains a lot of deformed cumulates with numerous traces of recrystallization and cumulate structure relics. Since the supposed tectonites of the Baër-Bassit area are mainly characterized by the recrystallization of the olivine phase, the problem of the real origin of those rocks remains, and the presence of restites in the Baër-Bassit massif is still hypothetic.

Gabbros

The gabbroic ensemble is essentially represented by a layered series 1 km thick, the basic composition of which is almost constant if one does not take into account the variation of calcic plagioclase percentages. The base of the gabbroic series is formed by an alternation of gabbroic and peridotitic layers of about 1 m thick; this formation succeeds upwards the lherzolitic and/or feldspathic peridotites. The upper levels of the layered series are characterized by a light cumulate texture with a massive texture tendency, and the presence of doleritic cross-cutting dikes. The different cumulate textures of the various gabbroic types (allivalites and troctolites at the base, and upwards gabbros and noritic gabbros with or without olivine) show that these rocks have been formed by settling in a magmatic chamber (Wager, 1953; Hess, 1960; Jackson, 1971; Goode, 1976). As it has been observed in various massifs of Eastern Mediterranean, i.e. Antalya nappes (Juteau, 1974) and Hatay (Parrot, 1973), the absence of cryptic evolution and the presence of ultramafic minerals in almost all the different cyclic units suggest that the magmatic chamber has been fed continuously during cooling and crystallization (Parrot and Ricou, 1976).

Diabasic dikes

Scattered and subvertical diabasic dikes go across the upper gabbro series, the layering of which is perpendicular to the general dike trend. It appears that at least this gabbroic upper level had solidified before the emplacement of the dikes.

Dikes are also comprised in diabasic dike swarms, quite similar to the sheeted complexes of Hatay (Parrot, 1973) and Troodos (Moores and Vine, 1971; Kidd and Cann, 1974). As in these two neighbouring massifs, one can find an asymmetric chilling considered to be the result of magmatic injections along a single fracture, each successive dike being emplaced within the middle of the previously solidified dike (Moores and Vine, 1971). In fact, in the Baër-Bassit area, the relationships between the different dikes are not so plain, and numerous dikes cut across each other, showing obviously that the sheeted complex is formed by multiple arrivals and distinct magmatic sources. Same observations have been recently pointed out in Troodos by Desmet et al. (1977, 1978).

The scattered dikes contain 50 to 55% plagioclases (An 70), 43% or so augite, 2 to 3% opaque minerals, and the dikes of the sheeted complex 43 to 47% plagioclases (An 60 - An 65), 45 to 51% augite, 6 to 10% opaque minerals (magnetite and titano-magnetite); some cutting dikes of this complex present a small amount of quartz (see fig. 3). A $Na_2O + K_2O$ versus SiO_2 diagram shows that the plotted samples are situated on all sides of the Mac Donald and Katsatura (1964) dividing line. The distribution of some samples in the alkalic zone is considered as the result of a

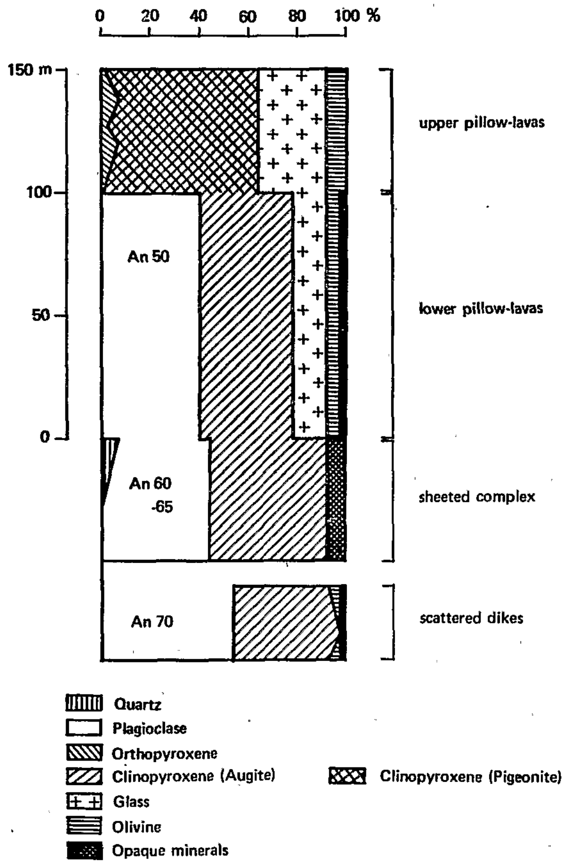


Fig. 3 - Synthetic mineralogical composition and evolution of the dike complex and associated lavas.

post igneous metasomatism rather than the mark of an important variation in the primary magma giving these dikes (Coleman, 1977). As a matter of fact, numerous dikes present complete or partial transformations (uralitization and albitization), and assuming that they have been enriched in alkalic elements, their original Na_2O and K_2O contents can be supposed to have been quite close to that of abyssal tholeiites. At least, a part of them acts as feeding dikes for the overlying pillow-lavas.

Pillow-lavas

As on Troodos (Gass and Smewing, 1973; Searle, 1975), two distinct pillow units have been defined in the Baër-Bassit area (Parrot, 1974b, 1977b, 1977c).

(a) The lower unit, 200 m thick, is structurally and chemically linked to the dikes of the sheeted complex and its lavas are more or less analogous to the MORB. The unaltered pillows are formed (see fig. 3) by 36 to 42% plagioclase (An 50), 40 to 6% augite, 1 to 3% magnetite and 4 to6% idiomorph olivine pseudomorphosis. They are frequently transformed, leading to spilitic types and one can observe the development of various zeolites similar to those found at this level in Troodos and Oman (Smewing et al., 1976). As for the dike complex, it seems that the presence of these spilites is the result of a post-igneous metasomatism, all the more as the TiO_2 content is always weak (0.6%) and remains unchanged in the transformed samples (Parrot, 1977b, p. 113); the same phenomena can be observed in the upper pillow-lavas (0.3% of TiO_2 in both fresh and altered lavas).

(b) The upper level 100 m thick differs from the lower one by the pillow shape, the mineralogy and the chemistry, and it presents an unconformity with the two earlier formations, sheeted complex and lower pillow unit. The unaltered samples present a quench structure and are formed by 52 to 63% feathershape or/and pteridomorphous pigeonitic cristallites, 7 to 1% enstatite, 8 to 6% idiomorphic olivine (Fo 95) and 33 to 30% of brunish glass containing some traces of analcime and rare corroded bytownitic phenocrysts. Mostly, the upper pillow-lavas are altered and transformed; they contain then feldspathic cristallites (albite and K-feldspar , probably adularia), uralitized pyroxenes, olivine phenocrysts replaced by a mixture of calcite and montmorillonite, and partly devitrified glass with improtant analcimic concentrations. If the strongly altered samples present important K_2O and Na_2O contents (respectively 4 and 5%), the unaltered lavas are characterized by a "hypertholeiitic" composition which implies a high partial melting degree. These rocks are enriched in MgO, Cr_2O_3 and NiO, and poor in Al_2O_3 ($\simeq$ 10%), Na_2O (1%), K_2O (0.1%) and TiO_2 (0.3%); they present a spinifex structure and are, for all these reasons, comparable to komatiites, the main features of which are:

(a) high MgO, Cr_2O_3 and NiO percentages;

(b) an ultramafic composition;

(c) a weak Fe/Mg ratio;

(d) a spinifex structure;

(e) a weak TiO_2 content in comparison with the SiO_2 percentage. For Bebien (1972), Pearce and Cann (1973), a weak TiO_2 content in ophiolitic effusives would be distinctive for island arc tholeiites. As for the lower pillows, the upper pillow TiO_2 percentage does not vary with the alteration, meaning that the halmyrolysis or deuteric alteration is a post igneous phenomenón. The origin of the upper level could correspond to the terminal phase of the expansion or to the beginning of an insular arc formation (Parrot, 1977a; 1977b; 1977c).

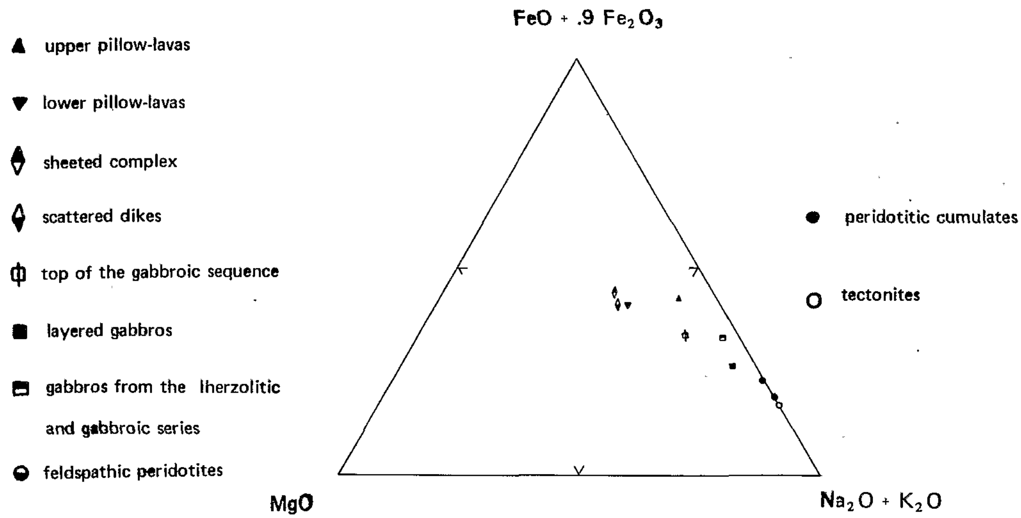


Fig. 4 - AFM diagram for rock averages (see table 1).

Umbers

The umber outcrops of Baër-Bassit area are linked to the upper pillow-lavas; they form either a cement between the pillows, or thin beds on top of them. The Syrian umbers present chemical and mineralogical features, similar to those of the Troodos umbers studies by Elderfield et al. (1972), Desprairies and Lapierre (1973), Robertson and Hudson (1973) and Robertson (1975). They are esssentially formed by goethite (40 to 50%), dioctaedric montomorillonite Al (30 to 35%) and manganese hydroxides (20% or so). They present high Fe and Mn contents and a

Table 1 - Chemical composition of the various petrographic types of the Baër-Bassit ophiolitic assemblage.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SiO_2	48.02	47.67	44.65	49.48	48.28	50.81	53.36	53.78	54.53	54.55
Al_2O_3	1.96	1.28	4.95	18.71	16.25	15.97	15.92	16.40	14.91	13.29
Fe_2O_3	-	-	-	-	-	-	1.50	1.50	1.50	1.50
FeO	8.11	9.24	10.16	5.63	5.43	6.39	6.79	7.51	7.09	6.86
MnO	0.12	0.13	0.13	0.07	0.06	0.12	0.18	0.16	0.15	0.18
MgO	39.56	40.62	34.48	10.66	14.19	10.36	7.49	7.22	8.11	10.45
CaO	2.09	0.83	5.37	14.69	14.63	9.88	8.73	9.06	11.35	
Na_2O	0.06	0.08	0.13	0.57	0.86	2.06	3.61	3.37	3.57	1.23
K_2O	-	0.05	0.01	0.05	0.07	0.18	0.56	0.59	0.32	0.24
TiO_2	0.06	0.05	0.11	0.09	0.14	0.38	0.67	0.70	0.69	0.30
P_2O_5	0.01	0.04	n.d.	0.05	0.09	0.04	0.05	0.05	0.07	0.05

Anhydrous averages with conversion of all Fe_2O_3 to FeO:
(1): 5 tectonites, Parrot (1977) p. 34; (2): 12 peridotitic cumulates, p. 35; (3): 3 feldspatic peridotites, p. 34; (4): 3 gabbros of the gabbroic and lherzolitic sequence, p. 54; (5): 17 gabbros of the layered series, p. 54 and 55; (6): 10 gabbros from the top of the gabbroic sequence, p. 55.

Anhydrous averages for Fe_2O_3 equal to 1.50%:
(7): 6 scattered dikes, p. 74; (8): 9 dikes of the seheted complex, p. 74; (9): 7 fresh lower pillow-lavas, p. 101; (10): 5 fresh and typical upper pillow-lavas, p. 110, samples n. 70039, 72099, 73002, 73187 and 73616.

strong concentration of different trace elements such as V, Co, Ni, Cu, As, W and Pb (Parrot and Delaune-Mayere, 1974). As for the similar Troodos types (Robertson and Fleet, 1976), the Baër-Bassit umbers (Courtois et al., unpublished data) are characterized by a high RE bulk with an important depletion of Ce which could be explained by the role of sea-water during their formation. Parrot and Delaune-Mayere (1974) and Parrot (1977c) have emphasized the link existing in Troodos, Baër-Bassit and Oman between umbers and upper pillow-lava unit which presents, except Cr, the same trace element concentration as umbers, and they have shown that the upper pillow-lava composition was a factor so important as the sea water.

Plagiogranites

The Baër-Bassit plagiogranites, previously studied by Dubertret (1953), Kazmin and Kulakov (1964-1968), Piro (1967) form cross-cutting dykes in cumulate peridotites and in the lower level of the layered gabbro series where, from place to place, they coalesce in small massifs. Thus, they differ completely, because of their structural position, from the leucocratic associates described in several ophiolitic massifs (Coleman and Peterman, 1975). In return, they are mineralogically and chemically similar to the plagiogranites considered as the end product of differenttiation within the ophiolitic magmatic chamber. For Parrot (1977b, 1977c), at least in Syria, such plagiogranitic rocks would come from magmas formed at the expense of oceanic volcanic and sedimentary series involved in a subduction zone with friction phenomena between oceanic lithospheric plates. Similar outcrops have been found by the author in different ophiolite massifs, including troodos (Parrot, 1980).

Infra-ophiolitic metamorphic soles

The largest Baër-Bassit slice of peridotites and gabbros presents at its base a thick sole (from 50 m to 300 m) of metamorphic rocks which consists of ampbibolitic schists, calcschists, amphibolite-pyroxenites with plagioclases, metabasalts, marbles and quartzites (Chenevoy, 1959; Whitechurch and Parrot, 1974). The structural study (Whitechurch, 1977) has pointed out the relationships existing between the main phases of deformation, the synmetamorphic one being anterior to the sheet emplacement and related deformations which affect either peridotites or the volcanic and sedimentary series. Whitechurch (1977) has shown that for each metamorphic level there is a corresponding non-metamorphic level of the volcanic and sedimentary series thrust with the ophiolitic nappe. As all metamorphic soles occurring beneath the ophiolitic suite of numerous eastern Mediterranean massifs (Parrot and Whitechurch, 1978), the northwestern Syrian ophiolite-related metamorphic rocks belong to the deep green schists amphibolite facies.

Those metamorphic rocks would result from the transformation of oceanic supracrustal series settled during expansion, and the metamorphism would occur in intraoceanic subduction zones prior to the tectonic emplacement onto the Arabian platform (Parrot, 1977b; Whitechurch, 1977; Parrot and Whitechurch, 1978). Such a phenomenon is emphasized by the relationships observed in the neighbouring Pozanti-Karsanti massif (Cakir et al., 1978; Cakir, 1978) where subvertical diabasic dikes went across the matamorphic sole and the subsequent peridotitic tectonites.

Volcanic and sedimentary series

The vollcanic and sedimentary formation is represented by a continuous series from Upper Triassic to Turonian. Its formation has to be related with the spreading process giving rise to the Tethyan oceanic crust. Thus, this series would correspond to the supra-oceanic Tethyan crust. On the other hand, siltstones and detrital limestones associated with all the deep-sea members of the volcanic and sedimentary series (radiolarites and cherts), and the diminution from south to north of detrital material, show the proximity of the continental platform over which this series was later thrust from north to south (Delaune-Mayere and Parrot, 1976).

The Upper Triassic volcanism would result from the first stages of distension which are responsible for the fracturing of the northern edge of the Arabian platform. Delaune-Mayere et al. (1977) have emphasized the similarity of the structural arrangement between Halobia limestones and related volcanics and Lapierre and Parrot (1972) have shown that the Baër-Bassit and the Mamonia area (Cyprus) present same formations and same strutcural relationships, although the Baër-Bassit is distinguished by the weak alkaline tendency of its Triassic volcanism in comparison with the clean alkaline composition of the coeval effusive formations in Mamonia and other Mediterranean regions (Rocci et al., 1979). On the other hand, the Cretaceous volcanic and sedimentary series lacking in Cyprus (Ealey and Knox, 1975) is well represented in northwestern Syria (cherts and calcarenites) and contains at its base a second volcanic level which consists, from the base upwards, of basanites, tephrites and lamprophyres, all in pillow form, and considerable phonolite flows with some trachytes (Parrot, 1974c).

As formerly proposed, these volcanic and sedimentary series would be the original material for the infra-ophiolitic metamorphic rocks, and eventually partly the source of plagiogranites.

CONCLUSIONS

The Baër-Bassit ophiolitic area seems to correspond to the front of an ensemble of nappes thrust over the edge of the Arabian plate during Maestrichtian. The roots of these nappes are presumably seated to the north, in Turkey. These nappes would represent a portion of the Tethyan oceanic crust which began to form in this region during the Upper Triassic or the Lower Jurassic period.

The thrusting or obduction of this crust portion onto the Arabian platform would succeed an intra-oceanic subduction or, as advanced by Parrot and Whitechurch (1978), a succession of ocean-directed mini-subductions, the witness of which would be the different east-west Turkish ophiolitic belts. Such a mechanism would be emphasized by the presence of diabasic cross-cutting dikes in more and more structural levels northwards (gabbros in Cyprus and Baër-Bassit, peridotites in Antalya and Pozanti-Karsanti), and would be responsible for the activation of a frontal volcanic arc giving rise to the formation of hypertholeiitic lavas all around the Arabian platform, in the most "meridional" ophiolitic belt.

The volcanic and the sedimentary series formed in the southern district of the Tethyan oceanic crust would have been partially subducted and metamorphosed; the resulting metamorphic rocks would have been partly extracted from the subduction zone during the final stages of thrusting on the Arabian platform. The unmetamorphosed volcanic and sedimentary series which correspond, in the Baër-Bassit area, to the formations settled in vicinity of the continental margin and therefore not involved in subduction, would have been folded and pushed in front of the oceanic crust upthrust during the same stages.

REFERENCES

BEBIEN J. (1972). - Teneurs en TiO_2 des roches volcaniques. Comparaison des volcanismes actuel et ophiolitique. C.R. Acad. Sci., Paris, D, 275: 1967-1970.

ÇAKIR Ü, JUTEAU T. and WHITECHURCH H. (1978). - Nouvelles preuves de l'écaillage intra-océanique précoce des ophiolites téthysiennes: les roches métamorphiques infra-péridotitiques du massif de Pozanti-Karsanti (Turquie). Bull. Soc. Géol. Fr., Sér. 7, 20 (1): 61-70

ÇAKIR Ü (1978) - Pétrologie du massif ophiolitique de Pozanti-Karsanti (Taurus Cilicien, Turquie): Etude de la partie centrale. Thèse Doct. Ing., Strasbourg, p. 258.

CHENEVOY M. (1959). - Le substratum métamorphique des roches vertes dans le Baër-Bassit (Syrie septentrionale). Notes Mem. Moy. Orient, 7: 1-18.

COLEMAN R.G. (1977). - Ophiolites. Ancient oceanic lithosphere? Springer-Verlag Berlin - New York, p. 229.

COLEMAN R.G. and PETERMAN Z.E. (1975). - Oceanic plagiogranite. J. Geoph. Res., 80: 1099-1108.

DELAUNE-MAYERE M. and PARROT J.F. (1976). - Evolution du Mesozoïque de la marge continentale méridionale du bassin téthysien oriental d'après l'étude des séries sédimentaires de la région ophiolitique du NW syrien. Cah. ORSTOM, sér. Géol., 7(2): 173-183.

DELAUNE-MAYERE M., MARCOUX J., PARROT J.F. and POISSON A. (1977). - Modèle d'évolution mésozoïque de la paléomarge téthysienne au niveau des nappes radiolaritiques et ophiolitiques du Taurus lycien, d'Antalya et du Baër-Bassit. Inter. Symp. Struct. Hist. Mediterranean basins, Split Yugoslavia 1976, Biju-Duval and Montadert Eds., TECHNIP, Paris: 79-94.

DESMET A., DESMONS J., GAGNY Cl., LAPIERRE H., PARROT J.F., ROCCI G. and WAGNER J.J. (1977). - Pétrogenèse et évolution d'un complexe filonien ophiolitique. Exemple du Troodos (Chypre). Intern. Coll. BUMA, Grenoble 1977 (in press).

DESMET A., LAPIERRE H., ROCCI G., PARROT J.F. and DELALOYE M. (1978). - Constitution and significance of the Troodos sheeted complex. Nature, 273, 5663: 527-530.

DESPRAIRIES A. and LAPIERRE H. (1973). - Les argiles liées au volcanisme du massif du Troodos et leur remaniement dans sa couverture. Rev. Géogr. Phys. et Géol. Dyn., 15 (5): 499-510.

DUBERTRET L. (1953). - Géologie des roches vertes du Nord-Ouest de la Syrie et du Hatay. Notes et Mém. Moy. Orient, 6: 1-179.

EALEY P.F. and KNOX G.J. (1975). - The pre-Tertiary rocks of SW Cyprus. Geol. Mijnbouw, 54: 85-100.

ELDERFIELD H., GASS I.G., HAMMOND A. and BEAR L.M. (1972). - The origin of ferromanganese sediments associated with the Troodos massif of Cyprus. Sedimentology, 19: 1-19.

GASS I.G. and SMEWING J.D. (1973). - Intrusion, extrusion and metamorphism at constructive margins: evidence from the Troodos massif, Cyprus. Nature, 242: 26-29.

GOODE A.D.T. (1976). - Small scale primary cumulus igneous layering in the Kalka layered intrusion, Giles complex, Central Australia. J. Petrology, 17: 379-397.

HESS H.H. (1960). - Stillwater igneous complex. Geol. Soc. Amer., Mem., 80, p. 230.

JACKSON E.D. (1971). - The origin of ultramafic rocks by cumulus processes. Fortschr. Mineral., 48: 128-174.

JUTEAU T. (1974). - Les ophiolites des nappes d'Antalya (Taurides occidentales, Turquie). Pétrologie d'un fragment de l'ancienne croûte océanique téthysienne. Thèse Doct. en Sciences, Nancy, p. 420.

KAZMIN V.G. and KULAKOV V.V. (1964). - Isvest. vysz. ucheb. zaved. Geol. y razv., 2: 3-14.

KAZMIN V.G. and KULAKOV V.V. (1968). - Geological map of Syria. Report on the geological survey. Techno Export, Moscow, p. 124.

KIDD R.G. and CANN J.R. (1974) - Chilling statistics indicate an ocean-floor spreading origin for the Troodos ophiolite complex. J. Geophys. Res., 81: 125-132.

LAPIERRE H. and PARROT J.F. (1972). - Identité géologique des régions de Paphos (Chypre) et du Baër-Bassit (Syrie). C.R. Acad. Sci., Paris, D, 274: 1999-2002.

MESORIAN H. (1973). - Idées actuelles sur la constitution, l'origine et l'évolution des assemblages ophiolitiques mésogéens. Bull. Soc. Géol. Fr., Sér. 7, 15 (5/6): 478-493.

MOORES E.M. and VINE J.F. (1971). - The Troodos massif (Cyprus) and other ophiolites as oceanic crust: evaluation and implications. Philos. Trans. r. Soc. London, A, 268: 443-466.

PARROT J.F. (1973). - Pétrologie de la coupe du Djebel Moussa, massif basique ultrabasique du Kizil Dag (Hatay, Turquie). Sci. Terre, 18: 143-172.

PARROT J. F. (1974 a). - Les différentes manifestations effusives de la région ophiolitique du Baër-Bassit (Nord Ouest de la Syrie): comparaison pétrographique et géochimique. C.R. Acad. Sci., Paris, D., 279: 627-630.

PARROT J.F. (1974 b). - L'assemblage ophiolitique du Baër-Bassit (Nort Ouest de la Syrie): étude pétrographique et géochimique du complexe filonien, des laves en coussins qui lui sont associées, et d'une partie des formations effusives du volcano-sédimentaire. Cah. ORSTOM, Sér. Géol., 6: 97-126.

PARROT J.F. (1974 c). - Le secteur de Tamimah (Tourk-mânnli): étude d'une séquence volcano-sédimentaire de la région ophiolitique du Bäer-Bassit (Nord Ouest de la Syrie). Cah. ORSTOM, Sér. Géol., 6:127-146.

PARROT J.F. (1977 a). - Ophiolites du Nord Ouest syrien et évolution de la croûte océanique téthysienne au cours du Mésozoique. Tectonophysics, 41: 251-268.

PARROT J.F. (1977 b). - Assemblage ophiolitique du Baër-Bassit et termes effusifs du volcano-sédimentaire. Pétrologie d'un fragment de la croûte océanique téthysienne charriée sur la plate-forme syrienne. Trav. Doc. ORSTOM, n° 72, p. 333.

PARROT J.F. (1977 c). - Deux aspects particuliers de l'assemblage ophiolitique du Baër-Bassit (Nord Ouest de la Syrie): les plagiogranites et la relation laves en coussins-terres d'ombre. Intern. Coll. BUMA, Grenoble, 1977 (sous presse).

PARROT J.F. (1980). - Deux aspects particuliers de l'assemblage ophiolitique du Baër-Bassit (Nord-Ouest Syrien): les plagiogranites et la relation laves en coussins-terres d'ombre. Coll. internat. C.N.R.S., n° 272, "Associations mafiques ultramafiques dans les orogènes", Grenoble, 1977, p. 79-95.

PARROT J.F. and DELAUNE-MAYERE M. (1974). - Les terres d'ombre du Baër-Bassit (Nord Ouest syrien). Comparaison avec les termes similaires du Troodos (Chypre). Cah. ORSTOM, Sér. Géol., 6: 147-159.

PARROT J.F. and RICOU L.E. (1976). - Evolution des assemblages ophiolitiques au cours de l'expansion océanique. Cah. ORSTOM, Sér. Géol., 8: 49-68.

PARROT J.F. and WHITECHURCH H. (1978). - Subductions antérieures au charriage Nord-Sud de la croûte téthysienne: facteur de métamorphisme du volcano-sédimentaire océanique en schistes verts et amphibolites liés aux assemblages ophiolitiques syro-turcs. Rev. Géogr. Phys. Géol. Dyn., 20: 153-170.

PEARCE J.A. (1975). - Basalt geochemistry used to investigate past tectonic environments in Cyprus. Tectonophysics, 25: 41-67.

PEARCE J.A. and CANN J.R. (1973). - Tectonic setting of basic volcanic rocks determined using trace element analysis. Earth Planet. Sci. Lett., 19: 290-300.

PIRO Y. (1967). - Contribution à l'étude des roches vertes du Nord Ouest de la Syrie. Thèse 3ème cycle, Montpellier, p. 142.

RICOU L.E. (1971). - Le croissant ophiolitique péri-arabe, une ceinture de nappes mises en place au Crétacé supérieur. Rev. Géogr. Phys. Géol. Dyn., 13: 327-349.

RICOU L.E., ARGYRIADIS I. and MARCOUX J. (1975). - L'axe calcaire du Taurus: un alignement de fenêtres arabo-africaines sous les nappes radiolaritiques, ophiolitiques et métamorphiques. Bull. Soc. Géol. Fr., Sér. 7, 17: 1024-1044.

ROBERTSON A. (1975). - Cyprus umbers, basalt-sediment relations on a Mesozoic ocean ridge. J. Geol. Soc., 131: 511-531.

ROBERTSON A. and FLEET A.J. (1976). - The origins of rare earths in metalliferous sediments of the Troodos massif, Cyprus. Earth Planet. Sci. Lett., 28: 385-394.

ROBERTSON A. and HUDSON J.D. (1973). - Cyprus umbers: chemical precipitates on a Tethyan ocean ridge. Earth Planet. Sci. Lett., 18: 83-93.

ROCCI G., BAROZ F., BEBIEN J., DESMET A., LAPIERRE H., OHNENSTETTER D., OHNENSTETTER M. and PARROT J.F. (1979). - The mediterranean ophiolites and their related volcano-sedimentary sequences. Internat. Ophiolite Symp., Cyprus, 1979 (in press).

SMEWING J.D., EL BOUSHI I.M., PARROT J.F. and GASS I.G. (1976). - Similar ophiolitic sequences form the Troodos massif, the Oman mountains and the Baër-Bassit region of Syria. Eos, 57: 412 (abstract).

WAGER L.R. (1953). - Layered intrusions. Meddr. Dausk geol. Foren., 12: 335-349.

WHITECHURCH H. (1977). - Les roches métamorphiques infrapéridotitiques du NW syrien, témoin de l'écaillage intra-océanique téthysien. Thèse Doct. 3ème cycle, Nancy, p. 194.

WHITECHURCH H. and PARROT J.F. (1974). - Les écailles métamorphiques infra-péridotitiques du Baër-Bassit (Nord Ouest de la Syrie). Cah. ORSTOM, Sér. Géol., 6: 173-184.

WOLFART R. (1963). - Untersuchungen zur Grundwasserschliessung in West Syrien. 1. Geologie und Hydrogeologie. Bundesanst Bodenforsch., 260, 203 S.