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PLAGIOGRANITES FROM THE OPHIOLITE COMPLEXES OF DINARIDES AND VARDAR ZONE

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Key-words: Plagiogranite, Ophiolite, CDOB, VZOB, Supra-subduction ocean ridge granite, Volcanic arc granite, Crystal-liquid differentiation process

Geochemical data of plagiogranites associated with ophiolite complexes of Central Dinaride Ophiolite Belt (CDOB) and Vardar Zone Ophiolite Belt (VZOB) are presented. Plagiogranites occur as dikes or small intrusive bodies in the upper part of the gabbrodolerite or diabase section in the ophiolite sequence. On the basis of normative An-Ab-Or diagram most of studied plagiogranites are classified as trondhjemites. They are typically low in K_2O, FeO and MgO and contain low to moderate Al_2O_3, but light SiO_2 and Na_2O. Their ocean ridge granite normalized patterns of trace elements displaying low contents of HFS and high contents of LIL elements are very similar to those of the volcanic arc granites. But assuming that in trace element pattern elevated K_2O and Rb contents are result of alteration, the studied plagiogranites have also strong similarity with typical Troodos supra-subduction ocean ridge granite. The using of Peacock index reveals that they are characterized by calcic character what is typical for supra-subduction ocean ridge granite. The studied plagiogranites are probably formed in extensional conditions above a subduction zone and in terms of their origin the most probably related to crystal-liquid differentiation process.

Ključne riječi: Plagiogranit, Ofiolit, CDOB, VZOB, Graniti supra-subdukcijskog oceanskog grebena, Graniti vulkanskog luka, Proces kristalno-likvidne diferencijacije

Prikazani su geokemijski podaci plagiogranita koji se nalaze u ofiolitnim kompleksima Centralne ofiolitne zone Dinarida (CDOB) i Vardarske ofiolitne zone (VZOB). Plagiograniti se pojavljuju kao dajkovi ili mala intruzivna tijela u gornjem dijelu gabro-doleritne ili dijabazne jedinice ofiolitne sekvence. Na temelju normativnog An-Ab-Or dijagrama većina proučavanih plagiogranita je klasificirana kao trondhjemiti. Oni tipično imaju niske sadržaje K_2O, FeO i MgO, niski do srednji sadržaj Al_2O_3, ali visoke sadržaje SiO_2 i Na_2O. Usporedba elemenata u tragovima u plagiogranitima s onima tipičnim za granite oceanskog grebena pokazuje da plagiograniti imaju viši sadržaj elemenata velikog radijusa (LIL elementi), a niži sadržaj elemenata malog radijusa i visokog naboja (HFS elementi). Slično ponašanje elemenata u tragovima pokazuju i graniti vulkanskog luka uspoređeni s onima u granitima oceanskog grebena. Međutim, ako se pretpostavi da je povišeni sadržaj K_2O i Rb u proučavanim plagiogranitima rezultat alteracije, tada oni imaju također veliku sličnost s Troodos granitom koji je tipični predstavnik granita supra-subdukcijskih oceanskih grebena. Upotreba Peacock indeksa pokazuje da su plagiograniti karakterizirani kalcijskim karakterom što je tipično za granite supra-subdukcijskih oceanskih grebena. Proučavani plagiograniti su vjerovatno formirani u ekstenzijskim uvjetima iznad subdukcijske zone, a njihov postanak je najvjerovatnîje vezan za procese kristalno-likvidne diferencijacije.

Introduction

In nearly all ophiolite complexes in small volumes high-SiO_2, low-K_2O leucocratic rocks of hypabyssal type. They usually belong to the upper section of the ophiolite sequence. Because this leucocratic rocks contain potassium feldspar only in very rare instances the term plagiogranite is used as a general descriptive term. Their compositions encompass a large spectrum of rocks including tonalites, trondhjemites, albite granites, albitites and quartz diorites. To avoid the confusion with the same rock types originated in the continental environment Coleman & Peterman (1975) proposed the name *"oceanic plagiogranites"* for the plagiogranites associated with ophiolites.

Three different petrogenetic models have been sugested to explain the genesis of ophiolitic plagiogranites. They could be produced by: **1)** crystal-liquid differentiation process from primitive basic magma (Coleman & Peterman, 1975; Coleman & Donato, 1979; Pallister & Knight, 1981; Wildberg, 1987); **2)** liquid immiscibility in silicate melts (Dixon & Rutherford, 1979); **3)** partial melting of basic rocks under hydrous conditions (Helz, 1976; Malpas, 1979; Gerlach et al., 1981).

The plagiogranites were also found at numerous localities within Central Dinaride Ophiolite Belt (CDOB) and Vardar Zone Ophiolite Belt (VZOB). Shematic position of CDOB or lherzolite province and VZOB or harzburgite province are shown in the Fig 1. This paper has the goal to summarize the unpublished and published analyses of plagiogranites occurring in the ophiolite complexes of these two ophiolite belts and discuss their geochemical characteristics, possible tectonic setting and origin.

Analytical techniques

Major elements and the trace elements of sample PGL-2 were measured by wavelength-dispersive X-ray fluorescence spectrometry in the Mineralogical institute in Heidelberg using fusion discs and pressed powder tablets respectively. International reference samples, some of which were also run as unknown, were used as standards. The wet chemical analysis of the whole rock was done on the sample PGL-13, PGL-14, PGL-16, PGH-4, PGH-5 and PGH-6 in the Institute for Mineralogy, Petrology and Mineral Resources (Faculty of Mining, Geology and Petroleum Engineering) in Zagreb. The measurement conditions of other plagiogranites used in this paper are described in the reference articles.

Field relations and petrography

Leucocratic acid and intermediate rocks are found at more than twenty localities in ophiolitic complexes of Banija, Kozara, Ljubić, Bosnian Ozren, Krivaja-Konjuh, Borja, Mahnjača, Višegrad, Varda, Zlatibor, Sjenica Ozren, Maljen, Ibar-Kopaonik and Dren Boula (Karamata, 1958; Majer, 1963; Karamata & Pamić, 1964; Đorđević & Stojanović, 1964; Pamić & Olujić, 1969; Pamić & Tojerkauf, 1970; Đorđević & Mojičević, 1972; Jović, 1984; Lugović, 1986). They usually occurr as vein, dike or small intrusive bodies in the upper part of the gabbrodolerite or diabase section in the ophiolite sequence. Sometimes they also intrude the mantle peridotite parts of the ophiolite sequences. The thickness of the dikes is commonly in

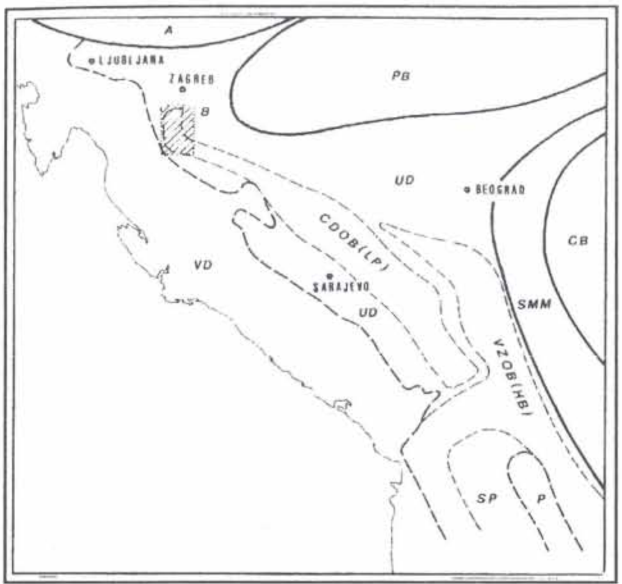

Fig. 1. Shematic position of the Central Dinaride Ophiolite Belt (CDOB) or lherzolitic province and the Vardar Zone Ophiolite Belt (VZOB) or harzburgite province, modified after Herak (1986, 1990.). Shaded area represents Banija region from where come two analyses with trace element data.

A - Alps
B - Banija region
CB - Carpatho-Balkan Arc
P - Pelagonian Basin
PB - Pannonian Basin
SP - Subpelagonian zone
SMM - Serbian-Macedonian mass
UD - Inner Dinarides
VD - Outer Dinarides

Sl. 1. Shematska pozicija Centralne ofiolitne zone Dinarida (CDOB) ili lercolitne provincije i Vardarske ofiolitne zone (VZOB) ili harcburgitne provincije, modificirano prema Heraku (1986, 1990). Osjenčano područje predstavlja Baniju odakle potječu dva uzorka s analiziranim elementima u tragovima.

the range of centimeter to meters. Plagiogranites can also form dike swarms as is the case in the peridotite near Bosansko Petrovo Selo in Bosnian Ozren. Plagiogranite dikes exhibit sharp boundaries in contact with serpentinized peridotite, whereas contact paragenesis containing commonly talc, hrysotile, brucite and carbonate minerals is usually developed in serpentinized peridotite (Majer & Slovenec, 1973). Additionaly, small plagiogranite blocks and conglomerates containing the pebbles of plagiogranite composition are found in the ophiolitic melange.

Investigated plagiogranites encompass a wide spectrum of rock types ranging from dominant albite granites and plagioclase granophyric granites to granophyres, trondhjemites, quartz diorites, albitites and oligoclasites.

The textures of the plagiogranites are determinated by their position in the ophiolite sequence. They vary from alotriomorphic and hypidiomorphic granular types to subporphyritic type being characterized by the micrographic, myrmekitic or granophyric groundmass. The plagiogranites generally exhibit more or less cataclastic deformation.

The principal minerals in plagiogranites are quartz, albite or acidic plagioclase and sporadically amphibole. The plagioclase is often zoned. Accessory minerals are represented by apatite, zircon, rutile and magnetite. The rocks are always more or less altered containing different secondary minerals such as actinolite, chlorite, epidote, coisite, prehnite, muscovite, sericite and sphene.

Geochemistry

Representative major and trace element data of plagiogranites from CDOB are shown in Table 1 and of those from VZOB in Table 2.

In the Ab-An-Or normative triangle of O'Connor (1965) the most plagiogranites fall within the trondhjemite field and few od them into tonalite and granite field (Fig. 2).

Table 1: Representative analyses of plagiogranites from CDOB
Tablica 1 Reprezentativne analize plagiogranita iz CDOB-a

Sample	PGL-1	PGL-2	PGL-3	PGL-4	PGL-5	PGL-6	PGL-7	PGL-8	PGL-9	PGL-10	PGL-11	PGL-12	PGL-13	PGL-14	PGL-15	PGL-16	PGL-17
Author	Majer	Garašić	Golub	Pamić & Kapeler	Pamić & Kapeler	Majer	Đorđ. & Mojičiv.	Pamić & Tojerk.	Đorđ. & Mojičiv.	Đorđ. & Mojičiv.	Đorđ. & Stojanov.	Pamić & Olujić	Majer	Majer	Karam. & Pamić	Majer	Karamata
Year of publ.	1983		1962	1969	1969	1963	1972	1970	1972	1972	1964	1969			1964		1958
Localities	Banija	Banija	Kozara	Kozara	Kozara	Ljubić	Borja	Borja	Borja	Borja	Žepče	B. Ozren	B. Ozren	B. Ozren	Konjuh	Zlatibor	Sj. Ozren
SiO_2	74.82	77.39	62.16	65.70	61.25	67.31	75.68	74.69	64.34	65.23	71.4	72.46	67.65	73.11	68.68	70.15	67.56
TiO_2	0.00	0.15	0.00	0.48	0.42	0.74	0.26	0.05	0.64	0.28	0.24	0.04	0.25	0.30	0.50	0.00	0.22
Al_2O_3	13.60	12.50	22.61	17.11	19.15	15.97	13.26	12.46	19.25	18.39	13.02	10.83	14.95	12.73	17.60	14.18	15.06
Fe_2O_3	0.20	0.98	0.55	2.71	1.89	1.09	1.27	1.17	1.52	0.35	2.64	1.86	5.72	1.75	0.95	2.38	0.68
FeO	0.53	0.00	0.06	2.49	0.41	2.98	0.00	0.37	0.47	0.69	3.03	1.28	0.68	0.55	2.03	2.77	3.04
MnO	0.02	0.01	0.00	0.05	0.06	0.05	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.02	0.00	0.10	0.09
MgO	0.00	0.52	0.00	2.23	2.40	1.36	1.19	1.28	1.40	2.63	0.60	3.27	0.53	3.22	0.64	0.10	0.83
CaO	2.29	0.64	3.27	2.65	3.73	2.13	0.68	1.78	2.27	0.52	1.40	2.90	0.63	1.72	2.90	0.43	2.77
Na_2O	5.56	5.70	8.18	4.86	9.30	6.81	5.39	6.39	9.06	10.11	4.30	6.05	4.05	2.95	4.49	7.31	5.09
K_2O	1.68	0.42	1.48	0.22	0.23	0.16	1.16	1.10	0.18	0.00	1.21	0.45	3.11	3.27	1.19	0.89	0.94
P_2O_5	0.62	0.06	0.00	0.09	0.17	0.17	0.23	0.00	0.32	0.09	0.07	0.18	0.30	0.05	0.12	0.00	0.08
H_2O^+	0.30	0.67	1.26	1.40	1.07	1.35	0.74	0.82	0.55	1.14	0.99	0.98	2.20	0.04	1.29	1.16	0.69
H_2O^-	0.00	0.00	0.35	0.52	0.02	0.13	0.00	0.12	0.09	0.15	0.00	0.01	0.54	0.39	0.07	0.23	0.69
CO_2	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00
Σ	99.62	99.10	99.92	100.51	100.10	100.25	99.86	100.23	100.09	99.58	100.55	100.33	100.61	100.10	100.46	99.70	100.32
Cr	3	14															
Ni	4	5															
Co	3	4															
Cu	3	0															
Zn	12	8															
V	0	13															
Ba	206	73															
Sr	76	94															
Rb	128	11															
Pb	50	20															
Zr	70	92															
Ga	13	13															
Th	5	5															
Y	18	32															
Nb	5	7															

Table 2: Representative analyses of plagiogranites from VZOB
Tablica 2 Reprezentativne analize plagiogranita iz VZOB-a

Sample	PGH-1	PGH-2	PGH-3	PGH-4	PGH-5	PGH-6	PGH-7	PGH-8	PGH-9
Author	Lugović	Jović	Jović	Majer	Majer	Majer	Lugović	Ivanov et al.	Ivanov et al.
Year of publ.	1986	1984	1984				1986	1987	1987
Localities	Maljen	Ibar-Kop.	Ibar-Kop.	Ibar-Kop.	Ibar-Kop.	Ibar-Kop.	Dren-Boula	Dren-Boula	Dren-Boula
SiO_2	67.23	64.07	63.10	68.91	69.04	64.86	61.15	67.98	75.85
TiO_2	0.35	0.42	1.25	0.36	0.25	0.43	0.99	0.25	0.30
Al_2O_3	14.41	20.92	21.97	14.77	12.54	21.18	14.22	12.35	13.30
Fe_2O_3	1.54	0.14	1.45	1.58	1.78	0.14	3.56	2.05	0.89
FeO	2.63	1.00	0.06	2.70	7.72	1.01	5.67	7.60	0.59
MnO	0.01	0.00	0.00	0.01	0.10	0.00	0.13	0.10	0.02
MgO	1.75	0.59	0.20	1.79	1.06	0.60	2.15	1.04	0.30
CaO	3.67	1.85	2.50	3.76	4.10	1.87	4.67	4.04	1.10
Na_2O	5.46	9.35	7.95	5.60	3.01	9.49	4.65	2.96	6.80
K_2O	0.41	0.40	0.41	0.42	0.30	0.40	0.53	0.30	0.06
P_2O_5	0.10	0.02	0.02	0.10	0.10	0.02	0.57	0.10	0.00
H_2O^+	2.07	1.00	1.11	0.00	0.00	0.00	2.09	1.18	0.62
H_2O^-	0.00	0.66	0.40	0.00	0.00	0.00	0.00	0.18	0.35
CO_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	99.63	100.42	100.42	100.00	100.00	100.00	100.38	100.13	100.18

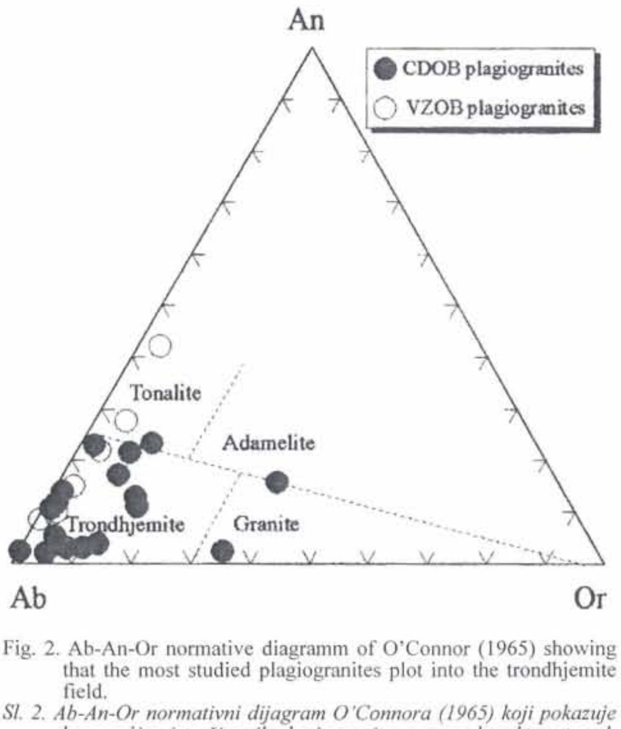

Fig. 2. Ab-An-Or normative diagramm of O'Connor (1965) showing that the most studied plagiogranites plot into the trondhjemite field.
Sl. 2. Ab-An-Or normativni dijagram O'Connora (1965) koji pokazuje da su većina istraživanih plagiogranita po svom karakteru trondhjemiti.

The plagiogranites from CDOB display highly variable K_2O contents (0.00-3.27%) indicating that some of them have undergone secondary alteration process, what also can be seen in the presence of abundant secondary muscovite and sericite. The K_2O contents of plagiogranites from VZOB are low (0.06-0.53%). The contents of Na_2O in both group of plagiogranites are very high, being in the range between 2.95 and 10.11 wt.%. Their Al_2O_3 contents are low to moderate varying between 10.83 and 22.61 wt.%, whereas SiO_2 contents show high values (61.15-77.39 wt.%). The contents of iron and magnesium oxide are generally low (Table 1 and 2). All these features are typical for plagiogranites from ophiolite complexes all over the world (Coleman & Peterman, 1975).

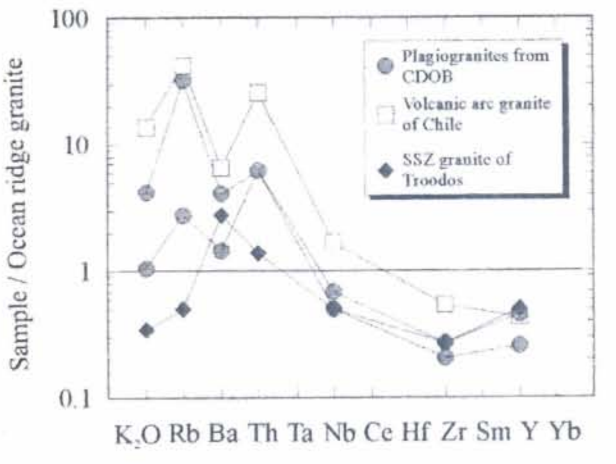

Fig. 3. Trace element patterns of plagiogranites from CDOB normalized relative to an ocean ridge granite are compared with typical volcanic arc granite from Chile and typical supra-subduction ocean ridge granite from Troodos. The normalizing and comparing values are from Pearce et al. (1984).
Sl. 3. Elementi u tragovima u plagiogranitima iz CDOB normalizirani su u odnosu na elemente u tragovima u granitu oceanskog grebena i uspoređeni s elementima u tragovima u tipičnom granitu vulkanskog luka iz Čilea i tipičnom granitu supra-subdukcijskog oceanskog grebena iz Troodosa. Normalizirajuće i usporedne vrijednosti za elemente preuzete su iz rada Pearcea i dr. (1984).

Trace elements are determinated only for two plagiogranites of CDOB. Their ocean ridge granite (ORG) normalized patterns are presented in Fig. 3. The plagiogranites display enrichments in K, Rb, Ba and Th and are depleted in Nb, Zr and Y relative to the normalizing composition. This pattern is typical for volcanic arc granites, what is also demontrated by plotting of the typical volcanic arc granites of Chile on the same diagram (values from Pearce et al., 1984). In the logRb-log(Y+Nb) tectonic discrimination diagram (Pearce et al., 1984) the studied plagiogranites plot in the volcanic arc granite field (Fig. 4). However, in this diagram volcanic arc granite cannot be geochemically distinguished from plagiogranites of supra-subduction ocean ridges which plot in the same field (Pearce et al., 1984). Comparing the trace element pattern of typical supra-subduction ocean ridge granite from Troodos with studied plagiogranites, it is evident from Fig.

3 that the plagiogranites from CDOB are very similar to Troodos granites too except for high K_2O and Rb, which may be, on the basis of sometimes abundantly present secondary muscovite and sericite, attributed to alteration. Using the P e a c o c k index (P e a c o c k , 1931) reveals that the plagiogranites of CDOB and VZOB have calcic character (Fig. 5).

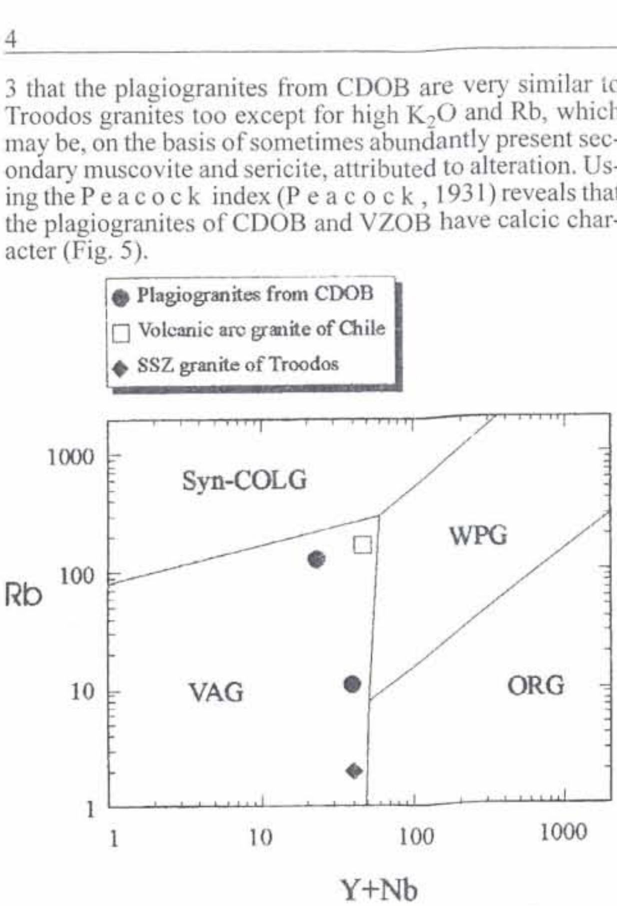

Fig. 4. The logRb-log(Y+Nb) tectonic discrimination diagram for granitic rocks (after Pearce et al., 1984) shows that studied plagiogranites, volcanic arc granite from Chile and supra-subduction ocean ridge granite from Troodos all plot into the volcanic arc granite field. VAG – volcanic arc granite, ORG – ocean ridge granite, WPG – within plate granite, syn-COLG – syncollisional granite.

Sl. 4. Tektonski diskriminacijski dijagram logRb-log(Y+Nb) prema Pearceu i dr. (1984) pokazuje da se istraživani plagiograniti, granit vulkanskog luka iz Čilea i granit supra-subdukcijskog oceanskog grebena iz Troodosa svi plotaju u polje granita vulkanskog luka. VAG – granit vulkanskog luka, ORG – granit oceanskog grebena, WPG – granit unutar ploče, syn-COLG – sinkolizijski granit.

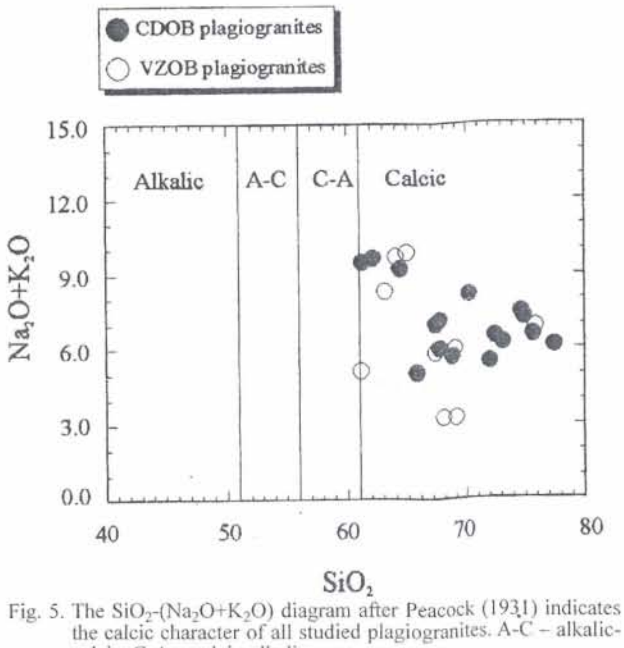

Fig. 5. The SiO_2-(Na_2O+K_2O) diagram after Peacock (1931) indicates the calcic character of all studied plagiogranites. A-C – alkalic-calcic, C-A – calcic-alkalic.

Sl. 5. Dijagram SiO_2-(Na_2O+K_2O) prema Peacocku (1931) ukazuje na kalcijski karakter svih proučavanih plagiogranita. A-C – alkalijsko-kalcijski, C-A – kalcijsko-alkalijski.

Discussion

Tectonic setting

P e a r c e et al. (1984) classified granites according to their tectonic setting into collision, volcanic arc, within plate and ocean ridge granite. Each group can be further divided into tectonic and petrologic sub-groups. Oceanic plagiogranite are assumed to have formed at ocean ridges. They could be formed at subduction - unrelated ocean ridge, but also at subduction-induced ocean ridges. The former are named as "normal" if their main volcanic product is an N-type MORB and "anomalous" if dominates an E- of T-type MORB (W o o d , 1979). The subduction-induced ocean ridges could also be "normal" if their associated basalts are N-type MORB, but they are described as "supra-subduction zone" (SSZ) if their volcanic product has an island arc tholeiite or boninite character (P e a r c e et al., 1984). The plagiogranites formed in this four subgroup of ocean ridge are distinguished by using the Peacock index. The plagiogranites from normal and anomalous subduction-unrelated ridges plot into alkali-calcic field, those from normal back-arc ridges into calc-alkalic field, whereas plagiogranites from SSZ ridges plot into calcic field (P e a r c e et al., 1984). All studied plagiogranites from CDOB and VZOB plot into calcic field (Fig. 5) indicating that they could belong to supra-subduction ocean ridge granites. Although it is difficult to relate the formation of the investigated plagiogranites to definite tectonic setting only on the limited data base, the available data indicate that they are probably formed in extensional conditions above a subduction zone. This opinion is in the accordance with conclusion of L u g o v i ć et al. (1991) that mafic extrusives of CDOB show geochemical characteristics similar to back arc spreading center.

Origin of plagiogranites

Some of the ophiolite complexes are characterized by notable lack of intermediate compositions between gabbros and the plagiogranites. D i x o n and R u t h e r f o r d (1979) pointed out that such compositional gap ranging maximal from 50 to 60% SiO_2 could be explained by the process of silicate liquid immiscibility. They performed a series of experiments using a low-potassium abyssal tholeiite as starting material and showed that highly differentiated basaltic magma after about 95% crystallization separates into two immiscible melts: a very Fe-enriched (~20%) basaltic melt and plagiogranitic melt. According to the available data there is no evidence for the complementary very Fe-enriched basaltic rocks in the ophiolite complexes of CDOB and VZOB and the compositional gap of this complexes is usually small (51.2%-54.72% SiO_2). Thus the genesis of the investigated plagiogranites by silicate liquid immiscibility seems to be precluded.

Plagiogranite melts can also result from hydrous partial melting of basalts and from the dehydration partial melting of amphibolite (H e l z , 1976; S p u l b e r & R u t h e r f o r d , 1983; B e a r d & L o f g r e n , 1991). Experimental data on partial melting of tholeiite and olivine tholeiite (H e l z , 1976) are compared with studied plagiogranite variation, relative to fractionation index (SiO_2) on Harker's diagrams (Fig. 6). The trend of the studied plagiogranites differs from the trend of partial melting showing on an average higher contents of Na and Mg, the same or higher content of Fe and Si, and lower concentration of Ca comparing with partial melts of tholeiites.

The very small total amount of plagiogranites in the ophiolite complexes and their close association with the uppermost part of the ophiolitic gabbros are considered to

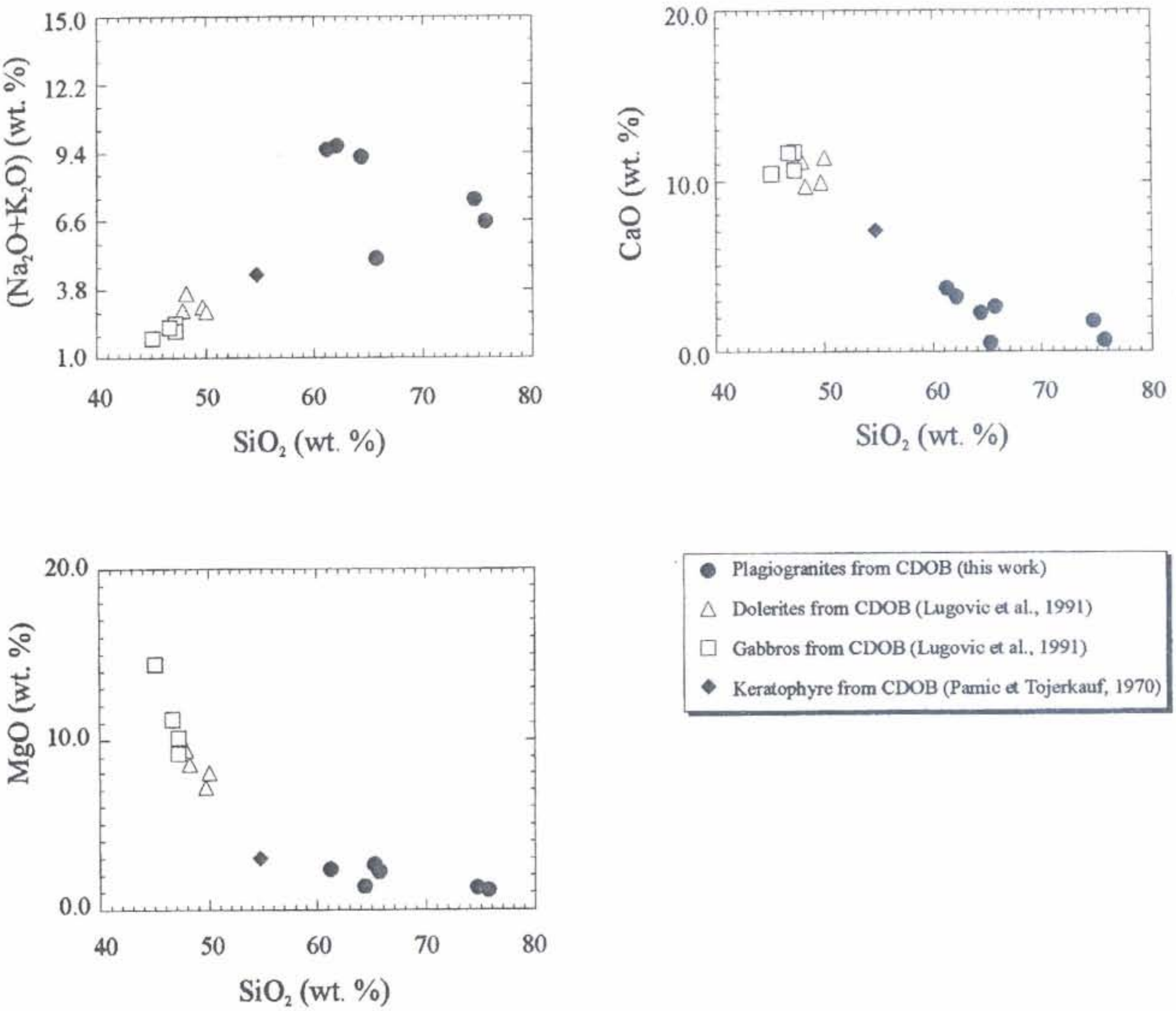

Fig. 6. Harker's diagrams of selected major oxide of studied plagiogranites are compared with experimentally produced partial melts of tholeiite and olivine tholeiite by Helz (1976) in an attempt on finding out the mechanism of plagiogranite origin. The trend of plagiogranites differs from the trend of partial melts precluding the genesis of plagiogranites by partial melting.

Sl. 6. Harkerovi dijagrami pojedinih glavnih oksida u plagiogranitima su uspoređeni s glavnim oksidima eksperimentalno proizvedenih parcijalnih taljevina toleiita i olivinskog toleiita (Helz, 1976) u pokušaju da se odredi mehanizam postanka plagiogranita. Trend plagiogranita se razlikuje od trenda parcijalnih taljevina čime se isključuje geneza plagiogranita parcijalnim taljenjem.

be due to crystal-liquid differentiation process (C o l e m a n & P e t e r m a n, 1975; C o l e m a n & D o n a t o, 1979; P a l l i s t e r & K n i g h t, 1981; W i l d b e r g, 1987). Plotting MgO, CaO and Na_2O+K_2O contents of some available gabbros, dolerites, keratophyre and plagiogranites from Borja and Kozara in CDOB versus SiO_2 (Fig. 7) reveals that they may be related to fractional crystallization of olivine and clinopyroxene. Additionally, some gabbro dolerite rocks from CDOB and VZOB exhibit porphyritic to ophitic texture, with groundmass corresponding compositionally and texturally to granophyric plagiogranites. Such graphic intergrowth of plagioclase and quartz are usually regarded as an indication of the incomplete extraction of interstitial plagiogranitic melt (W i l d b e r g, 1987).

In summary the most probable process responsible for the origin of plagiogranites in CDOB and VZOB could be crystal-liquid differentiation process. But additional studies, specially those based on the REE patterns of the plagiogranites and their asociated mafic rocks are necessary to support this conclusion.

Conclusions

The most plagiogranites associated with CDOB and VZOB are classified as trondhjemites and only few as tonalites and granites.

Their petrographic and geochemical characteristics closely resemble volcanic arc granites having low contents of HFS and high contents of LIL elements (ocean ridge granite-normalized). But bearing in the mind the fact that high K_2O and Rb contents could also be a product of low-grade alteration, the investigated plagiogranites could also be a product of low-grade alteration, the investigated plagiogranites could present supra-subduction ocean ridge granites. Using the Peacock index they classified as calcic ocean ridge granites, what is typical for supra-subduction granites (P e a r c e et al. 1984). Although it is difficult to make conclusions on the basis of only two available trace element analyses, they indicate that the plagiogranites could be formed in extensional conditions above a subduction zone.

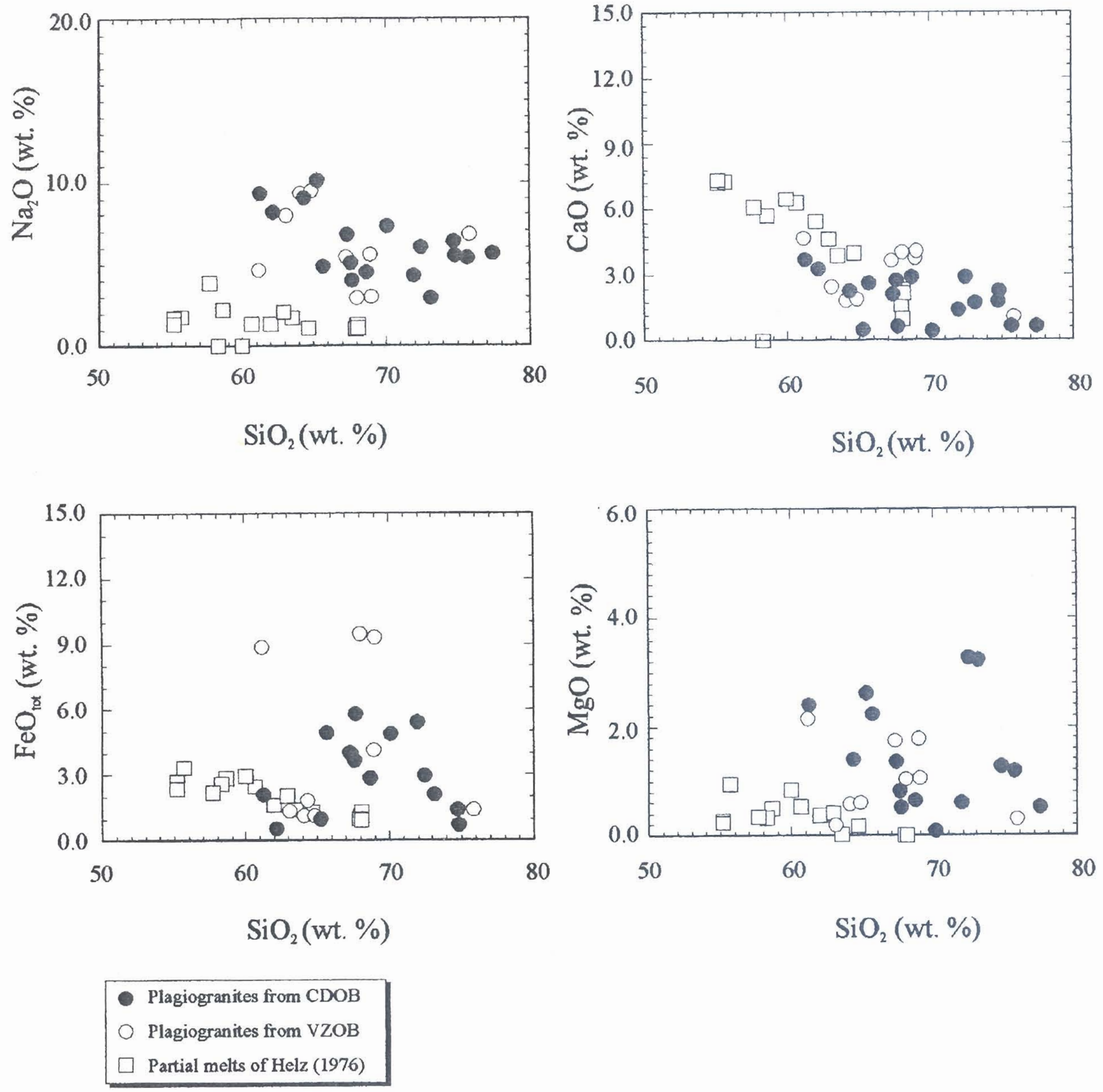

Fig. 7. Comparation of selected major oxide of different ophiolite rocks (gabbros, dolerites, keratophyres) with associated plagiogranites relative to crystall-liquid differentiation process as measured by increasing SiO_2. Geochemical data for gabbros and dolerites are from Lugović et al. (1991) and those for keratophyres from Pamić & Tojerkauf (1970).

Sl. 7. Usporedba pojedinih glavnih oksida različitih ofiolitnih stijena (gabrovi, doleriti, keratofiri) s asociranim plagiogranitima u odnosu na proces kristalno-likvidne diferencijacije koji je mjeren porastom SiO_2. Geokemijski podaci za gabrove i dolerite potječu od Lugovića i dr. (1991) a oni za keratofire od Pamića i Tojerkaufa (1970).

Plagiogranites of CDOB and VZOB are in terms of their origin the most probably related to crystal-liquid differentiation process.

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