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ALPINE COLLISIONAL - TYPE GRANITOIDS FROM WESTERN CENTRAL ANATOLIAN CRYSTALLINE COMPLEX, TURKEY

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Abstract :
Field, geochemical and isotope evidence obtained from Ekecidağ Granitoids of the Central Anatolian Crystalline Complex (CACC) indicate that they were generated mainly by partial melting of the continental crust. we propose that this process occured due to a two-stage collision related to the closure of İzmir-Ankara branch of Neotethys during Late Upper Cretaceous. The first stage comprises the collision and subsequent obduction of an ensimatic arc with the northeastern edge of Tauride-Anatolide Platform, generating CACC. The second stage is the collision of Sakarya Continent with CACC giving way to the formation of Ekecidağ Granitoids.

INTRODUCTION

The Central Anatolian Crystalline Complex (CACC) is located to the south of the Northern Branch of Neotethys (Şengör and Yılmaz, 1981) within the metamorphosed northern extension of the Tauride-Anatolide Platform. It is bounded by Tuzgölü and Ecemiş faults and İzmir-Ankara-Erzincan Suture Zone (Fig.1). CACC comprises medium to high grade metamorphic rocks of Paleozoic-Mesozoic age, overthrusted by Upper Cretaceus ophiolites and intruded by a number of granitoids. Ekecidağ area is situated in the central part of the western edge of CACC, where almost all subtypes of the Central Anatolian granitoids are represented. Detailed work in Ekecidağ region (Türeli, 1991) has shown that, not only the relationships of the intrusive phases, but also, the different geodynamic models proposed in previous works could be checked in this particular area.

Three different evolutionary models were suggested for the formation of the granitoids in CACC:

a- The southwards emplacement of ophiolitic nappes (Bozkır Ophiolitic nappes) from the İzmir-Ankara ocean has caused crustal thickening and metamorphism during Upper Campanian-Maastrichtian times. The subsequent northwards-subduction of the Inner Tauride Ocean beneath the CACC during Lower Paleocene-Eocene times initiated the calc-alkaline arc magmatism in the region (Şengör and Yılmaz, 1981).

b- The eastwards subduction of the Inner Tauride Ocean during Pale rocene-Early Eocene under the CACC created an Andean-type arc magmatism, which produced the granitoids in the region (Görür *et al.*, 1984).

c- The granitoids are formed by the Late Cretaceous collision of an ensimatic arc which is represented by Çiçekdağı igneous complex and numerous overthrusted bodies, with the main trunk of CACC (Göncüoğlu *et al.*, 1991)

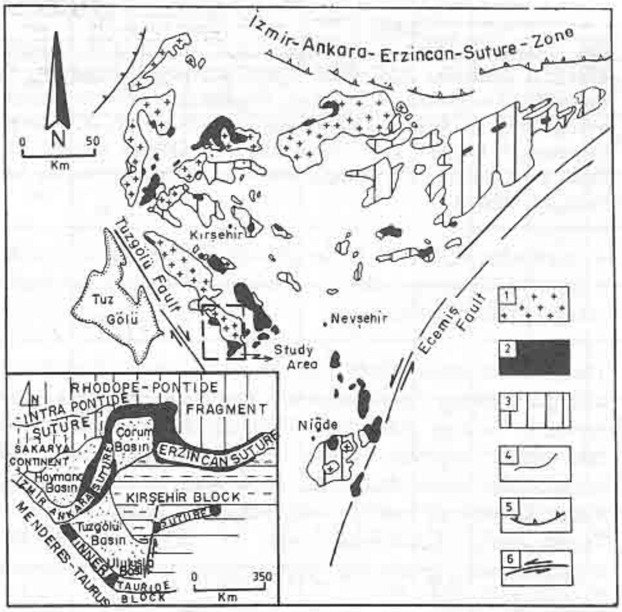

Fig. 1. Location and geological setting of the study area within the geological features of the Central Anatolian Crystalline Complex (CACC) and surrounding region. (1: Granitoids, 2: Ophiolites, 3: Metamorphics, 4: Fault, 5: Thrust, 6: Strike-slip fault). Inset shows the first order paleotectonic elements, i.e continental blocks and suture zones in the area, after Görür *et al.* (1984)

The aim of this paper is to present the geological, petrological and geochemical features of Late Cretaceous granitoids from Ekecidağ and discuss their tectonic setting.

GEOLOGICAL SETTING

Ekecikdağ Granitoids, together with associated ophiolitic and metamorphic rocks, occur to the east of Tuzgölü Basin (Fig. 2). They from the central part of (Fig. 1) a NW-SE trending zone which can be traced for more than 200 km. along the

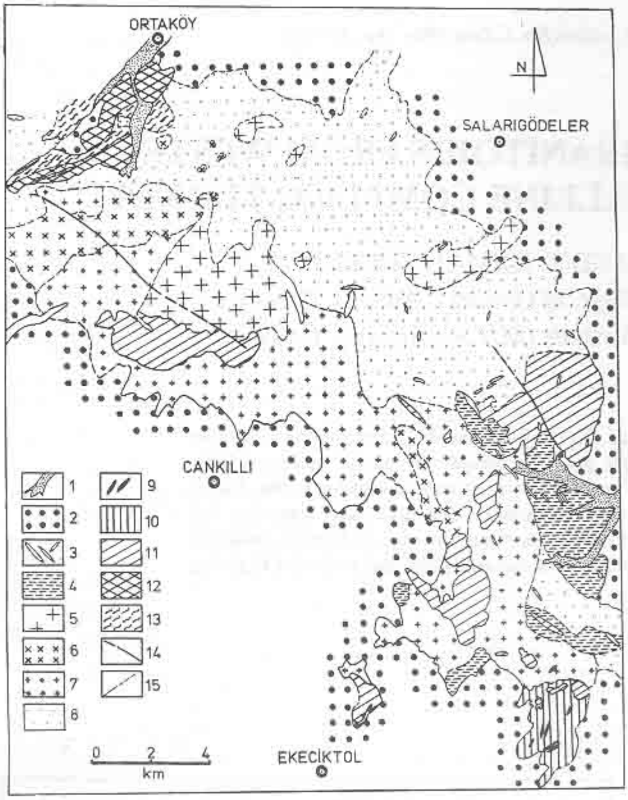

Fig. 2. Geological map of Ekecikdağ region (simplified after Türeli, 1991), 1: Alluvium, 2: Tertiary Cover, 3: Aplite - Pegmatite, 4: Kalebalta Leucogranite, 5: Hisarkaya Porphyritic Granite, 6: Sinandı Microgranite, 7: Borucu Granodiorite - Monzogranite, 8: Altered Granitoid, 9: Karaağıl Tepe Trondhjemite, 10: Dolerite - Basalt, 11: Dede Tepe Gabbro, 12: Ortaköy Marble, 13: Ortaköy Gneiss, 14: Fault, 15: Contact.

western edge of CACC. Orographically Ekecikdağı represents a ridge which is controlled by pre-Miocene extensional faults parallel to the Tuzgölü Fault.

The metamorphic rocks in Ekecidağ area consist of sillimanite-garnet paragneisses, two-mica gneisses and cordierite bearing gneisses, with interlayers of marbles and calc-silicate marbles. Minor bands of quartzites and amphibolites occur within the upper part of the sequence, which consists of marbles with metachert bands. An Early Triassic-Early Cretaceous age is suggested to the metacarbonate dominated upper part of the sequence (Göncüoğlu, 1986).

The metamorphics are overthrusted by an ophiolitic unit constituting different types of gabbros, dolerites and diabases with minor plagiogranites (Göncüoğlu and Türeli, 1993). The Turonian-Santonian age of the ophiolitic rocks is based on fpraminiferal determinations carried out on pelagic mudstones from the pillow-lava sequences to the east of Ekecikdağ (Göncüoğlu *et al.*, in prep.).

Granitoids intrude both the metamorphic and ophiolitic rocks. They occur in the northern part of Ekecikdağ as roofpendants within the monzogranitic-granodioritic main phase and cut by late stage aplitic granites. The contact zone with gabbroic rocks is characterized by the presence of enclaves and hornblende-biotite rich reaction zones. The quartz-dioritic composition of the enclaves gradationally change into quartz bearing gabbro and hornblende gabbro towards the main gabbroic body.

On the basis of their field occurrencess, Ekecikdağ Granitoids are divided into five groups (from the oldest to the youngest): 1) Borucu granodiorite-monzogranite, 2) Sinandı microgranite, 3) Hisarkaya porphyritic granite, 4) Kalebalta leucogranite and 5) Aplitic granites. Rb/Sr whole-rock and K/Ar data (Ataman, 1972; Erkan and Ataman, 1981) suggests an Early Maastrichtian intrusion age for the granitoids in the region. This is consistent with the geological data; because, Late Maastrichtian terrestrial calstics to the northwest of Ekecikdağ conisists mainly of boulders and pebbles of Ekecikdağ-type granitoids.

PETROLOGY

Rock Types

Average modes of the different subtypes of Ekecikdağ granitoid is given in Table 1. Borucu granodiorite-monzogranite is the dominating and earliest intrusive unit in the area. Medium-coarse grain size, presence of orthoclase megacrysts up to 15 cm length, relatively high content of biotite and hornblende are the characteristic features.

% Mineral	N : 3 +	N : 29 o	N : 8	N : 8 0	N : 4
Quartz	8.50	28.51	31.59	32.01	34.93
Plagioclase	57.83	39.09	34.25	30.30	24.20
K-Feldspar	2.37	22.41	24.60	33.30	38.80
Hornblende	10.97	2.84	---	---	---
Biotite	20.33	7.15	9.56	4.18	1.90
Muscovite	---	---	Acc.	0.21	0.17

Table 1. Average modal mineralogical composition of the different subtypes of Ekecikdağ granitoid (+: Enclave, o: Borucu Granodiorite - Monzologranite, A: Sinandı Microgranite, D: Hisarkaya Porphyritic Granite - point counting could not be carried out because of the inequigranular texture, O: Kalebalta Leucogranite, A: Aplite Granite, N: Number of analysed samples.

Sinandı microgranite forms medium to fine grained, dark colored small intrusions, less than 1 km in diameter. The absence of hornblende and megacrystic K-feldspar as well as its relatively dark color are characteristics. The contact with Borucu main type is diffuse.

Hisarkaya porphyritic granite occur as thick leucocratic dykes or elongated intrusions within the Borucu type. their porphyritic-aphanitic texture and relatively smaller grain size as well as presence of quartz phenocrysts are the distinctive features.

Kalebalta leucogranites are recognised by their uniform grain size and pinkish color. They cross-cut Borucu and Sinandı with sharp contacts. Dominance of perthitic K-feldspar over plagioclase, absence of megacrystic orthoclase, coexistence of biotite and muscovite and the presence of garnet and biotite-rich xenolites are characteristics of this subtype.

Aplitic granite occur as NW-SE trending dykes especially in the eastern part of Ekecikdağ. It resambles the Kalebalta leucogranites, the late products of the intrusive complex. All subtypes of Ekecikdağ granitoid fall in the monzogranite-granodiorite field in QAP Diagram (Streckeisen, 1976) shown on Fig. 3. Mafic mineral, plagioclase content and anorthite composition slightly decreases towards the late products while quartz and K-feldspar contend relatively increases (Table 1). Hornblende completely dissappeares allready in early products and the muscovite content slightly increases in the K-richer late phases. The almost continuous range from granodiorite to monzogranite imply a genetic relationship between the subtypes of Ekecikdağ granitoids (Fig. 3).

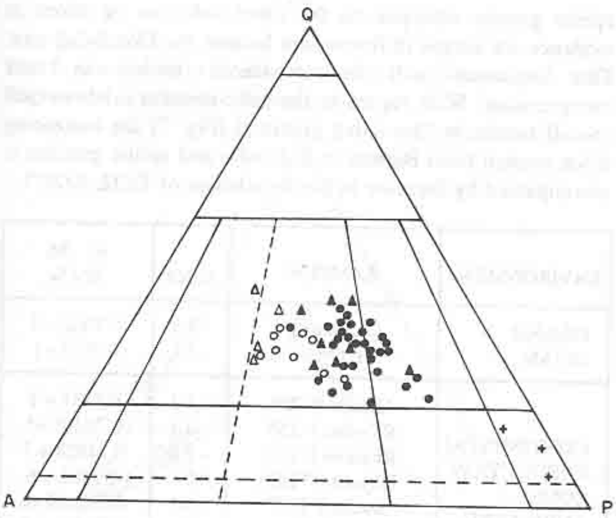

Fig. 3. Distribution of Ekecikdağ Granitoid in Streckeisen (1976) QAP diagram (+: Enclave, o: Brucu Granodiorite - Monzogranbite, ▲: Sinandı Micrograrite, O: Kalebalta Leucogranite, Δ: Aplite Granite).

GEOCHEMISTRY

Major and trace element analyses of 41 samples from Ekecikdağ granitoid with CIPW norms and molecular aetios of Al2O3 / CaO + Na2O + K2O are presented in Table 2. Major elements were analysed in Mineral Research and Exploration Institute of Turkey (MTA). Trace element contents were determined by XRF in Utrecht University-Nederlands. Instrumental neutron activation analyses were performed at Interuniversitair Reactor Delft-Nederlands. Nd and Sr isotopic ratios were measured by Finnigan in U.K. using Finnigan MAT 261 Mass spectrometer.

The alumina balance and distribution of samples on characteristic mineral diagram of Ekecikdağ subunits is shown on Fig. 4a. Borucu granodiorite-monzogranite samples are slightly metaaluminous with biotite + amphibole combination. A few samples plot in sector III which are slightly peraluminous with biotite + subordinate amphibole. Except one sample from each subgroup Sinandı and Hisarkaya units falls in sector III. They are peraluminous rocks with biotite alone or biotite + amphibole combinations. The late phases

Table 2. Major element percentages, trace element amounts, A/CNK = Molecular ratio of Al2O3/CaO + Na2O + K2O and CIPW norms of the Ekecikdağ granitoid (For symbols see Table 1). N: Number of analysed samples, A: Obtained minimum and maximum values in the samples, B: Mean values.

Element	o N : 19 A	 B	 N : 5 A	 B	 N : 7 A	 B	 N : 7 A	 B	 N : 3 A	 B
SiO2(%)	64.40 71.45	69.12	68.23 70.95	69.99	69.22 73.20	71.33	71.63 74.60	73.45	75.26 76.33	75.80
TiO2	0.22 0.58	0.36	0.24 0.37	0.32	0.16 0.30	0.33	0.08 0.24	0.13	0.02 0.05	0.03
Al2O3	12.64 15.28	13.78	14.31 14.60	14.50	13.30 14.21	13.73	13.10 13.96	13.50	12.62 12.86	12.77
Fe2O3	4.05 6.12	4.71	3.05 4.31	3.51	2.93 4.58	3.47	1.80 3.07	2.35	1.51 1.96	1.72
MnO	0.07 0.13	0.10	0.06 0.10	0.08	0.08 0.17	0.11	0.05 0.09	0.07	0.02 0.08	0.06
MgO	0.83 2.09	1.19	0.41 0.87	0.59	0.41 0.83	0.64	0.07 0.49	0.26	0.00 0.00	0.00
CaO	2.29 4.00	2.98	1.81 2.78	2.37	1.48 2.31	1.99	0.75 1.80	1.31	0.67 1.03	0.86
Na2O	2.05 2.96	2.54	2.46 3.22	2.75	2.98 3.35	3.13	2.46 3.82	3.02	2.66 3.76	3.27
K2O	3.22 4.65	4.08	3.82 4.71	4.23	4.07 4.65	4.36	4.43 5.00	4.81	3.70 5.90	4.99
P2O	0.44 0.11	0.08	0.09 0.15	0.12	0.03 0.06	0.04	0.00 0.05	0.02	0.00 0.01	0.00
Rb(ppm)	128 186	165	124 199	146	188 282	221	198 369	268	250 292	265
Sr	104 169	125	164 213	193	102 133	112	29 152	77	13 31	21
Ba	199 626	417	599 807	709	369 590	469	81 623	284	22 75	57
Zr	111 195	141	131 183	153	103 186	129	56 143	98	68 71	70
Y	22 38	28	24 35	28	25 60	33	25 62	37	26 51	37
Nb	8 14	10	12 17	13	11 21	13	8 28	16	6 26	14
U	2 8	5	0 5	3	5 16	9	3 19	9	6 16	10
Th	9 27	18	8 20	13	19 40	26	16 43	26	25 32	28
Cs	5 10	7	4 14	8	5 10	7	7 11	9	8 10	9
Zn	44 80	56	48 59	56	31 72	45	24 36	31	19 41	28
Cu	11 79	25	9 20	12	9 19	13	4 20	10	9 30	19
A/CNK	0.93 1.04	0.98	1.05 1.09	1.08	1.00 1.06	1.02	1.03 1.14	1.08	1.02 1.05	1.03
Q CIPW	21.16 33.30	28.60	28.67 32.89	30.49	26.07 32.79	29.58	30.39 35.37	33.13	32.57 37.21	34.94
Or	19.03 27.48	24.26	22.57 27.83	25.02	24.05 27.48	25.79	26.18 29.55	28.43	21.86 34.86	29.46
Ab	17.35 25.05	21.78	20.82 27.25	23.29	25.22 28.35	26.49	20.82 32.32	25.59	22.51 31.82	27.64
An	10.97 19.00	13.17	8.39 13.07	10.95	7.15 11.07	9.61	3.64 8.80	6.35	3.32 5.04	4.26
C	0.00 0.84	0.14	1.17 1.64	1.38	0.05 0.73	0.34	0.65 1.64	0.99	0.28 0.58	0.43
Di	0.00 2.07	0.44	0.00 0.00	0.00	0.00 0.00	0.00	0.00 0.00	0.00	0.00 0.00	0.00
Hy	6.24 11.55	7.79	4.31 6.76	5.16	4.29 7.18	5.41	2.30 4.43	3.27	1.75 2.38	2.04
Mt	1.20 1.77	1.36	0.88 1.25	1.02	0.85 1.33	1.01	0.52 0.89	0.68	0.44 0.57	0.50
İl	0.42 1.10	0.68	0.46 0.70	0.61	0.30 0.57	0.44	0.15 0.46	0.27	0.04 0.09	0.06
Ap	0.09 0.30	0.18	0.21 0.35	0.29	0.07 0.14	0.10	0.00 0.12	0.05	0.00 0.02	0.01

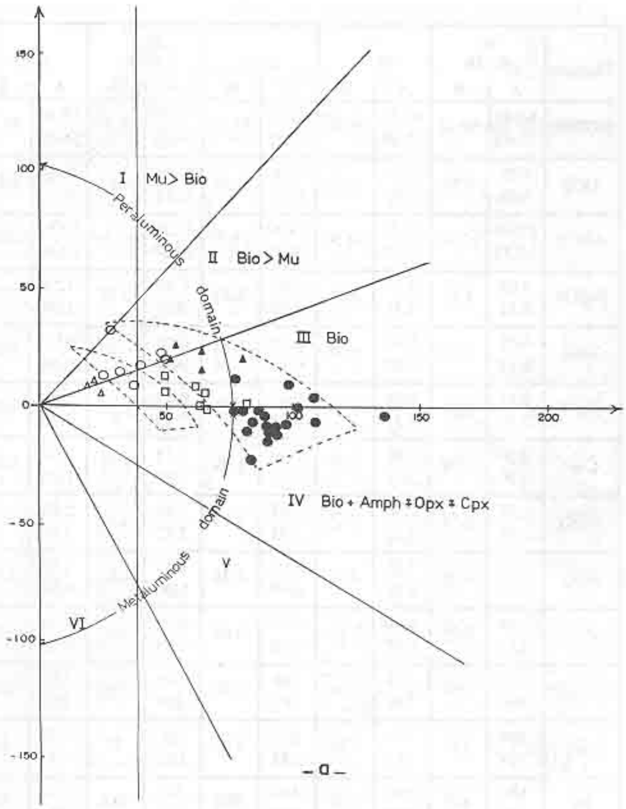

Fig. 4a. The alumino balance and distribution of Ekecikdağ granitoid samples on characteristic minerals diagram.

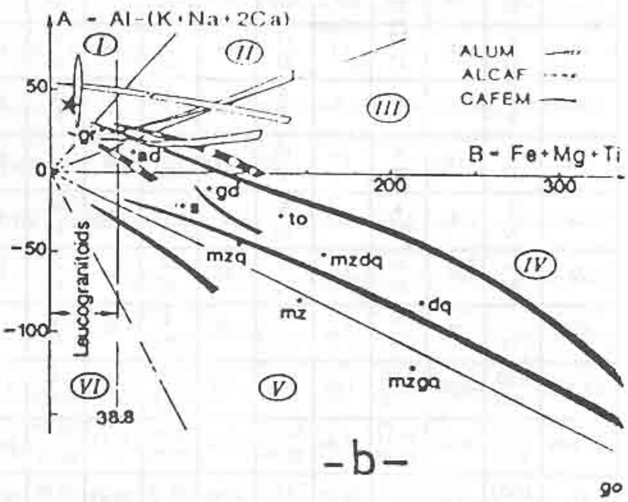

Fig. 4b. General trends of ALUM, ALCAF, and CAFEM associations (after Debon and Le Fort, 1988, ◘: Hisarkaya Porphyritic Granite, for other symbols see Figure 3).

(Kalebalta and aplitic granites) are peraluminous rocks with biotite > muscovite. Based on alumina balance the magmatic association trend of Ekecikdağ unit correspond to typical trend of alumina cafemic type (ALCAF) association proposed by Debon and Le Fort (1988) (Fig. 4b.) This trend characterises the intermediate rocks between I and S type of granitoid rocks of Chappel and White (1974). Total alkalies versus silica plots as well as AFM diagrams of Ekecikdağ units (Figs. 5 and 6) show that they are mainly calc-alkaline in composition. The AFM diagram, of with a well defined trend from Borucu to

Sample Number	143 / 144 Nd 2 sigma	87 / 86 Sr 2 sigma
9 Borucu Gr	0.512321 + 12	0.715534 + 27
12 Borucu Gr	0.512325 + 17	0.715459 + 50
13 Borucu Gr	0.512274 + 14	0.715723 + 21
206 Hisarkaya Gr	0.512329 + 13	0.722029 + 37

Table 3. Isotope data of neodymium and strontium in Ekecikdağ granitoid.

aplitic granite subtypes on the other side can be taken as evidence for simple differentation between the Ekecikdağ unit. This argument will be considered further in later interpretation. With regard to the inter-element relations and overall trends, in Ekecikdağ granitoid (Fig. 7) the increasing silica content from Borucu to Kalebalta and aplitic granites is accompanied by decrease in the abundances of TiO2, Al2O3,

ENVIRONMENT	SAMPLE	ΣoNd	87 86 Sr / Sr
ISLAND JAPAN	Gr. Okue 2	- 3.3	0.7062 + 1
	Gr. Owe 2	- 3.1	0.7077 +1
CONTINENTAL SUBDUCTION ZONE. ANDS. PERU	Granite P 293	- 5.1	0.7235 + 1
	Rhyolite P 255	- 3.1	0.70705 +5
	Rhyolite P 293	- 1.4	0.73928 + 7
	Rhyolite P 292	- 5.1	0.7484 + 6
	Dacite P 254	- 4.1	0.706189 +6
	Andesite 290	- 4.3	0.70551 + 5
	Andesite 289	- 4.9	0.70574 + 4
SOUTHERN CALIFORNIA COMPLEX SUBDUCTION	San Marcos 6.60.5	+ 2.9	0.7040
	Rubidouw G. El 38	- 1.4	0.7121
	Lakeview Tonalite	- 9.9	0.7058
AREAS SIERRA NEVADA	R 5075	- 7.0	0.7072 +2
	R 5085	- 3.3	0.7106 + 1
	R 5079	- 5.3	0.7106 + 1
	R 4602	- 8.6	0.7083 + 2
HİMALAYA	Nepal 22 D.Manuslu	- 15.8	0.74332 + 40 0.82131 + 50
CONTINENTAL COLLISION ZONES	Paiung A 404	- 13.1	
	Makulu	- 10.3	
FRENCH HERCYNIAN QUERIGUT	Quartz Diorite QT8	- 2.7	0.7085 + 9
	Monzonitic Gr QT 12	- 6.6	0.7214 + 2
	Granodiorite QT 52	- 8.4	0.7136 + 7
	Calc alkaline Gr QT 15	- 10.9	0.7458 + 10
EKECİKDAĞ GRANITOID	Borucu 9	- 6.2	0.715534 + 27
	Borucu 12	- 6.1	0.715459 + 50
	Borucu 18	- 7.1	0.715723+ 21
	Hisarkaya 206	- 6.1	0.722029 + 37

Table 4. Σ° Nd and 87 Sr / 86 values of granitoids from various geodynamic environments. Data from Allegra and Othman (1980).

Fe2O3, MgO, CaO and increase in the abundances of K2O and Na2O. This is clearly consistent with general differentiation trend in calc-alkaline suits, indicating a differentiation of

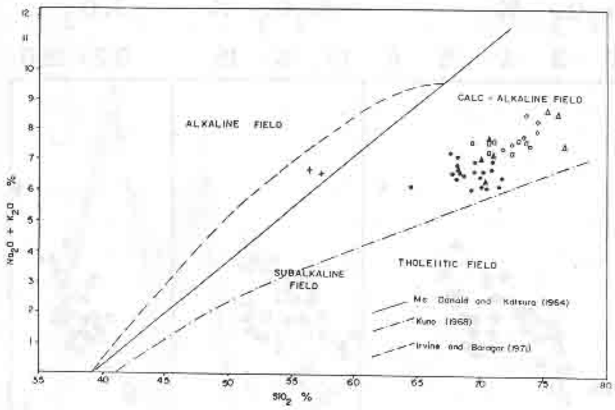

Fig. 5. Distribution of Ekecikdağ Granitoid samples on alkali silica diagram (for symbols see Figures 3, 4).

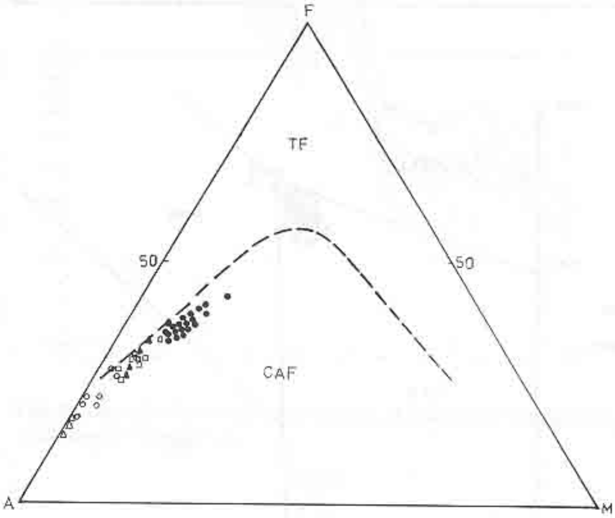

Fig. 6. Distribution of Ekecikdağ Granitoid samples on AFM diagram (for symbols see Figures 3, 4).

Ekecikdağ units from a common source.

TRACE ELEMENT and ISOTOPE DATA FOR TECTONIC SETTING and SOURCE MATERIAL

Trace element characteristics of granitoids formed in contrasting tectonic settings have been illustrated on Rb - (Y + Nb) diagram (Fig. 8a) of Pearce *et al.* (1984). The Ekecikdağ samples plot near the triple junction between VAG - Syn COLG - WPG fields (Fig. 8b). Pearce *et al.* (1984) do not define a separate field for post-collisional granites but indicate that this location is typical for post-collisional granites examplified by Oman, Adamello, Querigut and Grandes Rausses (Pearce et al., 1984). The ocean rigde normalised trace and REE plots of Ekecikdağ on the other hand (Fig. 9) fits well with the post collision granite pattern of Pearce et al. (1984). The same conclusion could be drawn by the application of Rb-Ta-Hf triangular diagram of Harris et al. (1986) shown on Fig. 10. The age difference between the 95 my old syn-collisional S-type granitoids, located within sillimanite grade metamorphic rocks showing insitu anatexsi in Niğde Area (Göncüoğlu, 1986) and the ekecikdağ Granitoids yielding Early Maastrichtian (71 my) ages (Erkan and Ataman, 1981) is a further evidence for the postcollisional character of the latter.

Element	A	B	C	Element	A	B	C
SiO2	54.4	66.0	69.12	Cs	0.1	3.7	7
TiO2	1.0	0.50	0.36	Pb	4.0	20	26
Al2O3	16.1	15.2	13.6	Zn	83	71	56
Fe2O3	10.6	4.5	4.7	Cu	90	25	25
MgO	6.3	2.2	1.2	La(REE)	11	30	31
CaO	8.5	4.2	3.0	Ce	23	64	67
Na2O	2.8	3.9	2.5	nd	12.7	26	30
K2O	0.34	3.4	4.1	Sm	3.17	4.5	4.8
Rb(ppm)	5.3	112	165	Eu	1.17	0.88	0.71
Sr	230	350	125	Tb	0.59	0.64	0.59
Ba	150	550	417	Dy	3.6	3.5	10.2
Zr	70	190	141	Yb	2.2	2.2	2.8
Y	19	22	28	Lu	0.29	0.32	0.48
Nb	6	25	10	Hf	2.1	5.8	4.8
U	0.28	2.8	5	Ta	0.6	2.2	1.5
Th	1.06	10.7	18				

Table 5. Major, trace and rare earth element (REE) mean abundances of the A: Lower Continental Crust, B: Upper Continental Crust, C: Borucu Granodiorite - Monzogranite (Abundances in A and B are from Taylor and Mc Lennan, 1985).

The present day Nd and Sr isotopic ratios of four Ekecikdağ samples are listed in Table 3. A correlation with Precambrain and Phanerozoic granitoids of continental crust origin from different areas indicates that (Fig. 11) Ekecikdağ samples plot in the central part of quadrant IV, showing similarities to South Australia, France-Hercynian and Scotland-Caledonian granitoids. The calculated Nd and 87Sr / 86Sr values of Ekecikdağ is higher than Japanese type Island arcs and Andino-type continental sobduction zone rocks of mantle source, but lower than Himalayan-type collisional granitoids of crustal origin. Ekecikdağ rocks, however, show similarities to post tectonic Querigut and Nevada types. Compared with lower and upper continental crust, on the other hand, Ekecikdağ main phase (Borucu) (Table 5) is consistent with major, trace and REE abundances of upper continental crust with minor contamination.

GEODYNAMIC IMPLICATIONS

On the basis of field, trace element and isotope data, Ekecikdağ rocks mainly show characteristics similar to post-collisional granitoids. This data is against previous regional geodynamic approaches of Şengör and Yılmaz (1981) and Görür et. al. (1984), who proposed an Early Tertiary Andean type arc magmatism, related to eastward subduction of a speculative oceanic crust beneath the CACC. The presented geochemical data as well as the Late cretaceous radiometric ages of the granitoids (95 my, Göncüoğlu, 1986; 71 my, Ataman, 1972) are inconsistent with the arc model.

The following regional features are considered to explain the collision related magmatism in Ekecikdağ area:

a) The geochemistry of trondhjemitic rocks within the Central Anatolian Ophiolites (Türeli, 1991) and the occurrence of

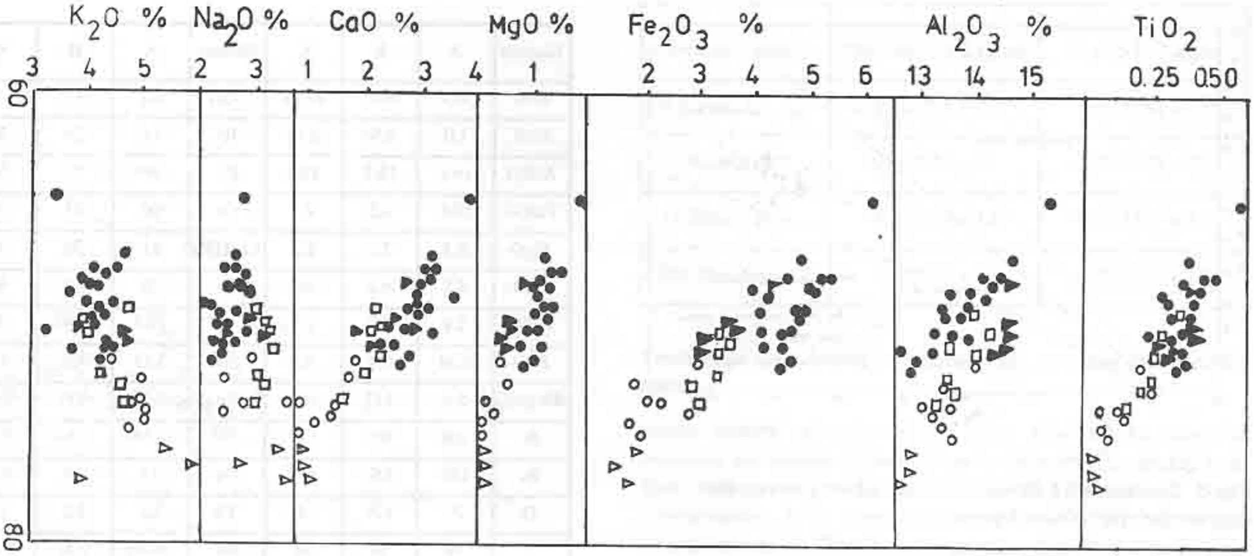

Fig. 7. Distribution of Ekecikdağ Granitoid samples on Harker diagrammes (for symbols see Figures 3, 4).

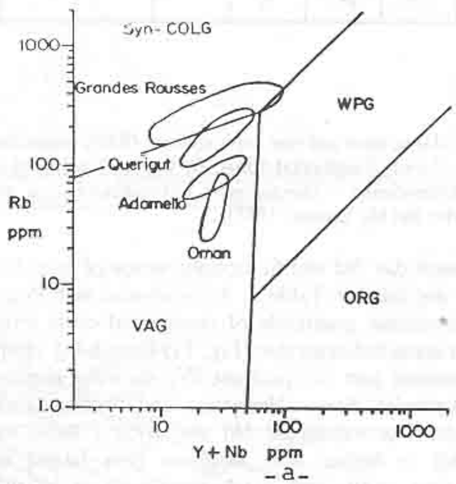

Fig. 8a. Rb-(Y+Nb) Discriminant diagram, after Pearce *et. al.* (1984).

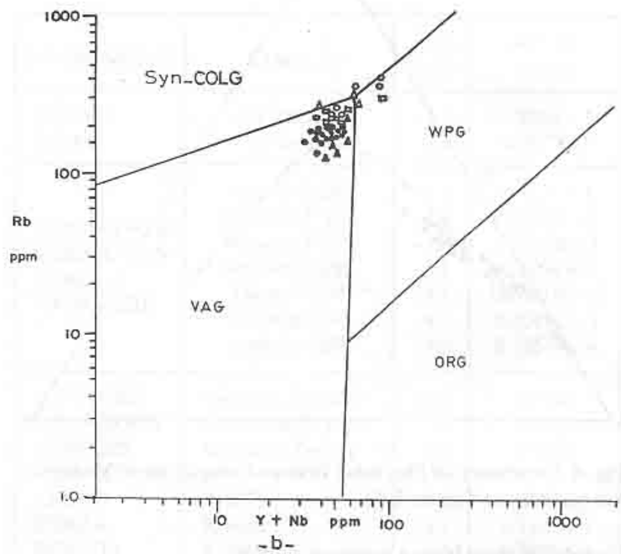

Fig. 8b. Distribution of Ekecikdağ Granitoid samples on Rb - (Y+Nb)Discriminant diagram, after Pearce *et. al.* (1984), for symbols see Figures 3, 4.

subophiolitic matemorphics accompanying them (Göncüoğlu et al., 1991) point to an intraoceanic subduction to the north of the CACC (İzmir-Ankara ocean). This event gave way to the formation of an ensimatic island-arc, which collided with and overthrusted on the CACC. The following crustal thickening resulted in generation of S-type syn-collisional granitoids (Gümüşler Granitoid; Göncüoğlu, 1986) of Early Upper Cretaceous age. The presence of anatectic gneisses (Erkan, 1976; Göncüoğlu, 1977) and residual granulitic gneisses (Seymen, 1982) in CACC support this interpretation.

b) The time of the initial collision of Tauride-Anatolide Block (and CACC as a part of it) with the Sakarya Continent and the closure of İzmir-Ankara segment of the northern branch of Neotethys is Early Upper Cretaceous (Okay, 1989) and not Late Paleocene-Early Eocene as suggested by Şengör and Yılmaz (1981). This main collision caused partial melting of the lower crust. The heat and volatiles transfered to late Upper Cretaceous upper crust may have interacted with S-type granitic bodies generating Ekecikdağ granitoids which show mainly characteristics of upper continental crust with minor contamination. Although speculative, our model is consistent with regional geology, geochemical data and available radiometric ages.

CONCLUSIONS

Ekecikdağ Granitoid, consisting of genetically related Borucu granodiorite-monzogranite, Sinandı microgranite, Hisarkaya porphyritic granite, Kalebalta leucogranite and Aplite-granite subtypes, is calc-alkaline in character. The main phase, Borucu subtype, is metaluminous, whereas the late products are typically peraluminous, corresponding to typical trends of aluminacafemic type associations. Trace element discrimination diagrams for the tectonic interpretation of Ekecikdağ granitoid suggest post-collision type of origin. Nd and Sr isotope data, as well as geochemical considerations, reveal that Ekecikdağ granitoid was essentially derived from continental crust with minor contamination from lower crust/mantle.

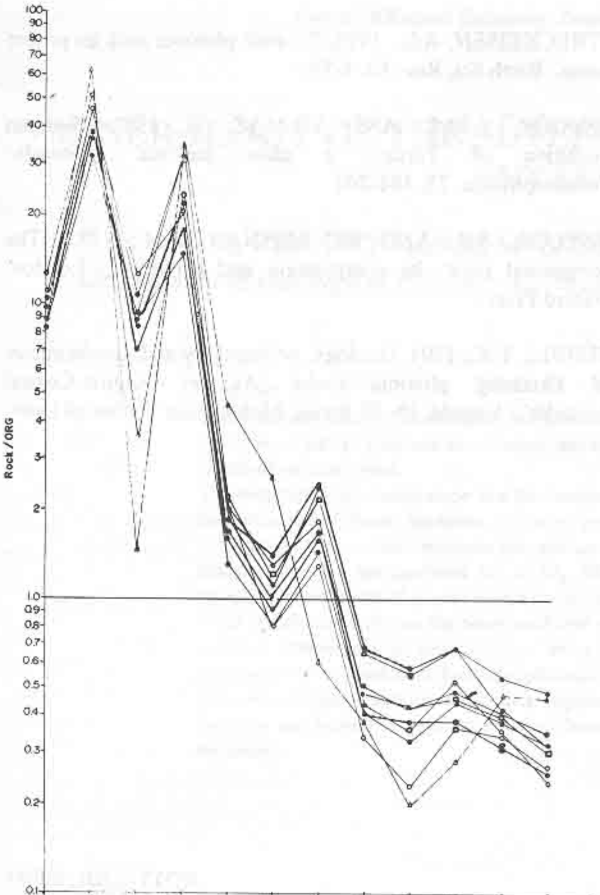

Fig. 9. Trace element distribution pattens of Ekecikdağ Granitoid (for symbols see Figures 3, 4).

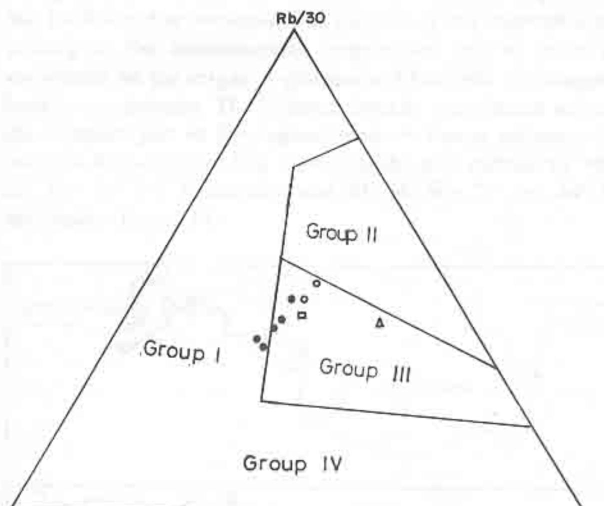

Fig. 10. Rb-Hf-Ta triangular plot of Ekecikdağ granitoid. Group I Field: Volcanic arc type intrusions, Group II Field: Syn-collision intrusions, Group III Field: Later or Post-collision intrusions, Group IV Field: Within plate intrusions, after Harris *et al.* (1986). For symbols see Figures 3, 4.

Regional geological constraints related to the closure of the İzmir-Ankara branch of Neotethys suggest that the collision of CACC with the Sakarya Continent during Early Upper Cretaceous could be the main triggering event for the generation of Ekecikdağ granitoid. The presence of a granitoid dominated belt to the west of CACC thus is not necessarly related to the subduction of a highly speculative Intra-Tauride Ocean as proposed by Şengör and Yılmaz (1981) and Görür et al. (1984), but can be attributed to Tertiary uplifting and block rotations of the CACC.

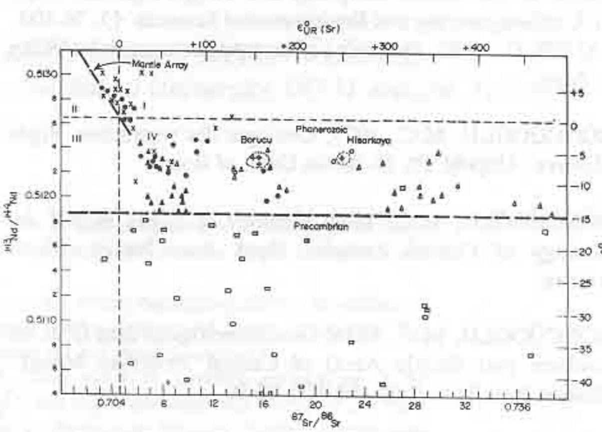

Fig. 11. Nd-Sr isotopic ratios of continental crust granitic rocks (renormalized and corrected data from Faure, 1986) and the distribution of Ekecikdağ samples (o: Sierra Nevada, California, x: Peninsular Ranges, California and Baja California, Δ: South Australia, o: Hercynian granites, France, ▲: Caledonian granites of Scotland, □: Precambrain granitic gneisses and metasediments, +: Ekecikdağ granitoid).

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