MINERALOGICAL CHARACTERISTICS OF THE AMPHIBOLES FROM CRETACEOUS HORNBLENDE GABBRO OF CENTRAL ANATOLIAN OPHIOLITES, DEVEDAMI/AKSARAY AREA, CENTRAL TURKEY

DOI: http://dx.doi.org/10.18509/GBP.2019.13
UDC: 552.3/.4:549.08(560)

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ABSTRACT

In Devedamı area, Central Anatolian Ophiolites (CAO) are represented by Late Cretaceous massive hornblende gabbroic rocks, which contain hornblende, plagioclase and clinopyroxene in a holocrystalline granular and rarely holocrystalline porphyric texture. Mineralogical analyses show that the brown-green amphiboles are magnesiohornblende in composition. Geothermobarometer calculation suggests that the amphibole was possibly crystallized from a water-rich magma (H_2O melt: ~5.41 wt.%), with ΔNNO 1.57-2.34 and logfO_2 (-13.59 - -13) in ~2.5 km oceanic depth .

Keywords: Hornblende gabbro, mineralogy, ophiolite, CACC, Turkey

INTRODUCTION

The geological features of several typically east-west oriented of the suture zones across Turkey (Figure 3) exhibit the development of the Late Triassic-Late Cretaceous terranes of the Eastern Mediterranean (Turkey, Cyprus and Syria), which is significant in understanding the Neotethyan development of the area [1].
Central Anatolian Ophiolites (CAO) are represented by isolated outcrop of upper mantle rocks, massive gabbro, plagiogranites, sheeted dykes, volcanic rocks and epi-ophiolitic cover [2] in the Central Anatolian Crystalline Complex (CACC[3]) . In present study, new mineralogical data of amphibole is presented from massive hornblende gabbro at Develi and Devedamı (Ankara, Turkey) area (Figure 3, 2), which occur as representative of CAO.

MATERIAL & METHODS

Thirty petrographic thin sections were studied under the microscope to determine composition and texture. Polished sections (25*46 mm) of representative rock samples were made at the thin-section Laboratory of MTA-Ankara. Polished slides were coated with carbon and then analyzed at the Electron Microprobe Laboratory of McGill University, Montreal, Que´bec, Canada. Mineral analyses were performed on a JEOL JSM35 Electron Microprobe running Link QX2000 energy dispersive analytical software.

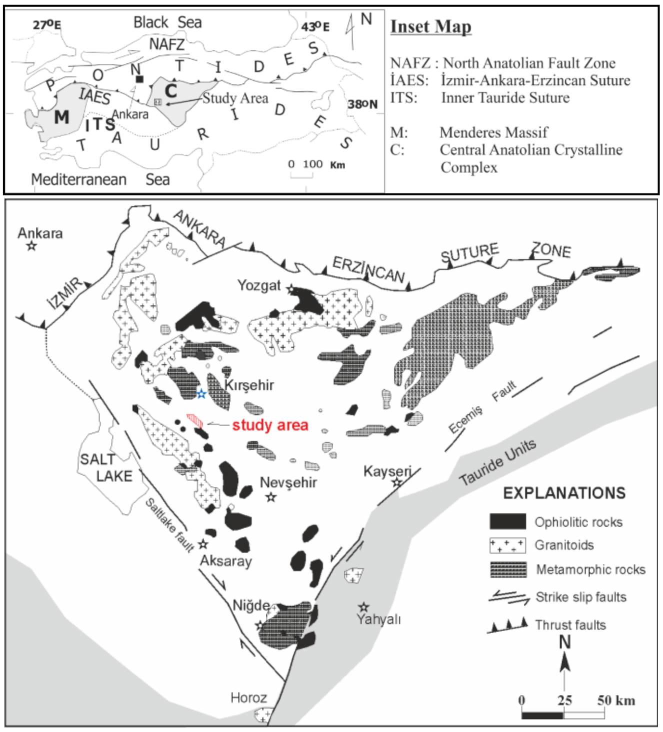

Figure 3: Location of the study area and major tectonic units of Turkey [1].

PETROGRAPHY& MINERAL CHEMISTRY

Major constituents are plagioclase, amphibole and pyroxene in holocrystalline granular, and rarely holocrystalline porphyric texture. Brown-green amphibole forms mostly as subhedral phenocrysts and is locally altered to calcite and chlorite. The colourless-light yellow pyroxene occurs as relict at the core of the amphibole. The plagioclase occurs as subhedral to anhedral phenocrysts, with some zoning texture.

Result of the microprobe analyses (Table 2) show that the amphiboles are of calcic group, $(Ca + Na)_B \geq 1$ and $Na < 0.5$), according to the classification of [4] and magnesiohornblende, in composition (Figure 5). Mg# no in the samples is high, up to 0.81.

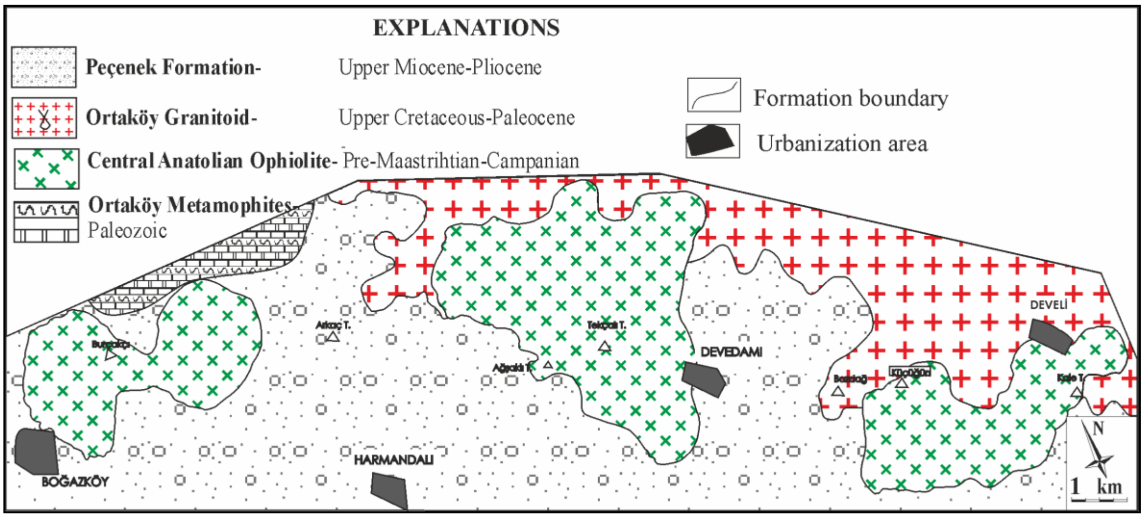

Figure 4: A geological map of the study area [5].

Table 2: Chemical analyses of the representative amphiboles

Sample	1-1hb	1-2hb-a	1-2hb-b	1-3hb-a	1-3hb-b	2-1hb	2-2hb	3-1hb	3-2hb	4-1hb	4-2hb	5-2hb
SiO2	49.330	49.630	50.160	49.880	50.080	50.860	50.260	51.690	49.350	49.750	50.920	48.640
TiO2	0.840	0.610	0.530	0.760	0.620	0.530	0.640	0.440	0.590	0.630	0.390	0.890
Al2O3	5.750	5.010	4.780	5.130	5.270	4.820	5.660	3.590	5.880	5.210	4.390	6.400
Cr2O3	0.000	0.090	0.140	0.110	0.060	0.140	0.120	0.160	0.060	0.060	0.090	0.050
Fe2O3	4.263	4.531	4.402	3.723	3.980	4.080	3.200	5.815	6.686	3.083	6.498	5.903
FeO	9.344	10.193	9.309	9.610	9.229	7.879	8.700	6.728	7.934	11.036	7.073	8.698
MnO	0.220	0.220	0.250	0.210	0.220	0.240	0.190	0.190	0.230	0.220	0.200	0.220
MgO	14.610	14.230	14.900	14.920	15.040	16.000	15.600	16.020	14.460	14.290	15.680	14.200
CaO	12.410	12.510	12.470	12.520	12.440	12.610	12.690	11.770	11.800	12.740	12.010	11.920
Na2O	0.650	0.470	0.570	0.670	0.720	0.540	0.680	0.530	0.820	0.590	0.660	1.000
K2O	0.220	0.200	0.150	0.200	0.200	0.150	0.180	0.070	0.220	0.170	0.100	0.220
Sum	**97.637**	**97.694**	**97.661**	**97.733**	**97.859**	**97.849**	**97.921**	**97.003**	**98.030**	**97.779**	**98.011**	**98.141**
Formula on the basis of 13 cations (Leake et al 1997)												
Si	7.147	7.217	7.259	7.217	7.224	7.285	7.211	7.431	7.113	7.230	7.290	7.029
AlIV	0.853	0.783	0.741	0.783	0.776	0.715	0.789	0.569	0.887	0.770	0.710	0.971
Tsite	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
AlVI	0.129	0.076	0.075	0.092	0.120	0.098	0.168	0.040	0.112	0.123	0.030	0.119
Ti	0.092	0.067	0.058	0.083	0.067	0.057	0.069	0.048	0.064	0.069	0.042	0.097
Cr	0.000	0.010	0.016	0.013	0.007	0.016	0.014	0.018	0.007	0.007	0.010	0.006
Fe3+	0.465	0.496	0.479	0.405	0.432	0.440	0.346	0.629	0.725	0.337	0.700	0.642
Mg	3.156	3.085	3.215	3.218	3.234	3.416	3.337	3.433	3.107	3.096	3.346	3.059
Fe2+	1.132	1.240	1.127	1.163	1.113	0.944	1.044	0.809	0.956	1.341	0.847	1.051
Mn	0.027	0.027	0.031	0.026	0.027	0.029	0.023	0.023	0.028	0.027	0.024	0.027
Csite	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000
Ca	1.926	1.949	1.934	1.941	1.923	1.935	1.951	1.813	1.822	1.984	1.842	1.845
Na	0.074	0.051	0.066	0.059	0.077	0.065	0.049	0.148	0.178	0.016	0.158	0.155
Bsite	2.000	2.000	2.000	2.000	2.000	2.000	2.000	1.961	2.000	2.000	2.000	2.000
Na	0.109	0.082	0.094	0.129	0.124	0.085	0.140	0.000	0.052	0.150	0.025	0.126
K	0.041	0.037	0.028	0.037	0.037	0.027	0.033	0.013	0.040	0.032	0.018	0.041
Asite	0.150	0.119	0.121	0.166	0.161	0.112	0.173	0.013	0.092	0.182	0.044	0.166
Mg/Mg+Fe2+	0.736	0.713	0.740	0.735	0.744	0.784	0.762	0.809	0.765	0.698	0.798	0.744
Physical-chemical conditions*												
T (°C)	767.14	745.72	742.55	755.42	755.06	748.08	768.11	711.62	758.93	753.34	728.27	779.12
uncertanty (σest)	22	22	22	22	22	22	22	22	22	22	22	22
P (MPa)	78.828	66.029	62.042	67.586	69.665	61.891	76.070	46.067	80.786	69.313	55.729	92.088
uncertanty (Max error)	8.671	7.263	6.825	7.434	7.663	6.808	8.368	5.067	8.886	7.624	6.130	10.130
oceanic depth (km)	2.781	2.330	2.189	2.385	2.458	2.184	2.684	1.625	2.850	2.446	1.966	3.249
ΔNNO	1.6979	1.7141	1.8994	1.7967	1.8524	2.1596	1.9336	2.3427	1.7916	1.6276	2.2291	1.5728
logfO2	-12.891	-13.3747	-13.2661	-13.065	-13.0167	-12.8756	-12.635	-13.5872	-12.983	-13.2814	-13.283	-12.743
uncertanty (σest)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
H2Omelt (wt.%)	5.7044	5.5762	5.3513	5.2809	5.3838	5.1937	5.6466	4.6064	5.6635	5.7488	4.9188	5.7387
uncertainty*	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

*: [6]

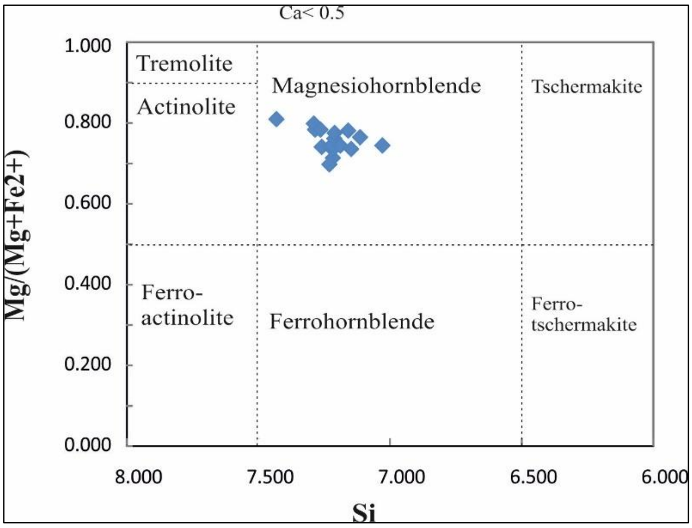

Figure 5: Nomenclature of the amphiboles [4].

DISCUSSION AND CONCLUSIONS

Result of Mineral chemistry shows that the brown-green amphibole in the ophiolitic gabbro is magnesiohornblende in composition, with high Mg# (up to 0.81). The occurrence of widespread hornblendes in the samples indicate high P_{H2O} conditions in the magma [7], and high melt Ca/(Ca+Na) ratios [8]. Oxygen fugacity is important in controling the liquidus temperature, melt and crystals composition [9]. The samples have ΔNNO 1.57-2.34 and log fO_2 (-13.59 - -13). Pressure estimates suggest a crystallisation depth in the ocean, ranging from 1.6 km to 3.2 km, with an average of 2.5 km.

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