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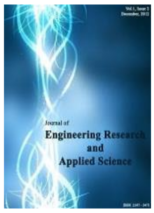

Petrographical, geochemical and petrological characteristics of Eocene volcanic rocks in the Mescitli area, Eastern Pontides (NE Turkey)

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Abstract
Mineralogical, petrographical and geochemical data are presented for the Eocene aged Mescitli volcanics in the Eastern Pontides (NE Turkey). The studied rocks are composed of basaltic andesitic, andesitic, basaltic trachyandesitic, trachyandesitic and minor dacitic and rhyolitic lavas associated with their pyroclastics. These rocks contain plagioclase, K-feldspar, quartz, hornblende, augite and biotite phenocrysts. They show calc-alkaline affinities and have medium to high-K contents. The volcanic rocks are enriched in large ion lithophile and light rare earth elements, with pronounced depletion of high field strength elements. The chondrite-normalized REE patterns (LaN/LuN=5-14) show low to medium enrichment, indicating similar sources for the rock suite. The main solidification processes involved in the evolution of the volcanics consist of fractional crystallization with minor amounts of crustal contamination ± magma mixing. All evidences support the conclusion that the parental magma(s) of the rocks probably derived from an enriched lithospheric mantle, which was previously modified by subduction induced metasomatism in a post-collisional geodynamic setting.

Keywords: Geochemistry; petrology; Eocene; Mescitli volcanic rocks; Eastern Pontides

1. Introduction

The Eastern Pontides are characterized by three volcanic cycles developed during Liassic, Late Cretaceous and Eocene times [1-2]. Although many authors have addressed the evolution of the Eocene volcanic rocks in the Eastern Pontides [3-19], petrological studies are limited in the Mescitli area [20-21]. In this study, mineralogical, petrographical and geochemical data for volcanic rocks in the Mescitli (Torul/Gümüşhane) area are reported that contribute to the formation and magmatic evolution of the Eastern Pontide Eocene volcanism.

2. Regional Geology and Stratigraphy

The Eastern Pontides orogenic belt is located within the Alpine–Himalayan orogenic belt. This belt is commonly subdivided into northern and southern zones, based on structural and lithological differences. The study area is located within the southern zone of the Eastern Pontides.

The basement of the Eastern Pontides consists of Early Carboniferous metamorphic rocks [22] and crosscutting granitoids of Late Carboniferous age [23-28]. Early and middle Jurassic volcanic and volcanoclastic rocks in Eastern Pontides lay unconformably on a Paleozoic basement. Jurassic volcanism occurred in an extension setting is possibly related to rifting and is consistent with the general geochemical characteristics of a volcanic arc setting [29-30]. Early and middle Jurassic volcanic and volcanoclastic rocks are conformably overlain by middle–late Jurassic–Cretaceous carbonates [31-32]. Late Jurassic granitoids are interpreted as the products of an arc-continent collision event [33-35]. The Late Cretaceous series that unconformably overlie these carbonate rocks consist of sedimentary, volcanic and plutonic rocks [36-42]. Cretaceous arc-type volcanics and intrusive rocks were emplaced into the Eastern Pontide crust [34, 43]. These volcanic rocks mainly belong to the tholeiitic and calc-alkaline series, which display typical island arc characteristics [1, 29, 44-45]. Plutonic rocks were also emplaced between the Jurassic and Paleocene

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periods. Early Paleocene plagioleucitites were considered final subduction products [46]. From Paleocene to Early Eocene, Eastern Pontides was above sea level [31, 47]. Eocene rocks in the Eastern Pontides lie with a major angular unconformity over all older units, with age ranging from Early Carboniferous to Early Paleocene. In the northern part of the Eastern Pontides, post-collisional middle Eocene to Miocene volcanic and volcanoclastic rocks with coeval granitoids crop out in restricted areas [2, 6, 48-51]. However, tertiary magmatic activity in the southern part of the Eastern Pontides is restricted to post-collisional middle Eocene volcanic rocks, calc-alkaline to tholeiitic affinities [3, 10-11,13-14, 52], and granitoids [53-56], except for Paleocene plagioleucitites [46], as well as early Eocene adakitic-like granitic [12, 53, 57-58] and andesitic-dacitic rocks [12, 38]. Middle Eocene volcanic and volcanoclastic rocks are intruded by calc-alkaline granitoids of similar ages [59]. During Late Eocene, the region remained largely above sea level, with minor volcanism and terrigenous sedimentation that have continued to the present [31].

In the Mescitli region, the Eocene sequence (Alibaba Formation) consists mainly of andesite with minor dacite, rhyolite and associated pyroclastics (Figure 1). The unit, which is underlain by the late Cretaceous rocks consisting of limestone, marl, sandstone, siltstone and tuff alternation, starts with volcanic breccia, agglomerates and tuff level in the basement. These basement units are overlain by a thick volcanic sequence including hornblende/augite andesite, quartz andesite and tuff intercalating limestone and sandstone. The top of the unit consists of rhyolite, dacite and their pyroclastic equivalents. Andesitic rocks are the dominant lithology within the seqeunce. Basaltic rocks are also minor constituents of the sequence. Dacitic and rhyolitic rocks make up volumetrically minor constituents of the sequence. The pyroclastic rocks are mainly represented by andesitic agglomerates, and then continues into medium to thick bedded tuffs and andesitic-rarely basaltic breccias. Andesitic-dacitic-rhyolitic tuffs and tuffites are volumetrically minor with respect to the other members within the sequence. They exhibit abrupt thickness changes within short distances as in most pyroclastic successions. The total thickness of the Eocene sequence is more than 600 m in the Mescitli area (Figure 1).

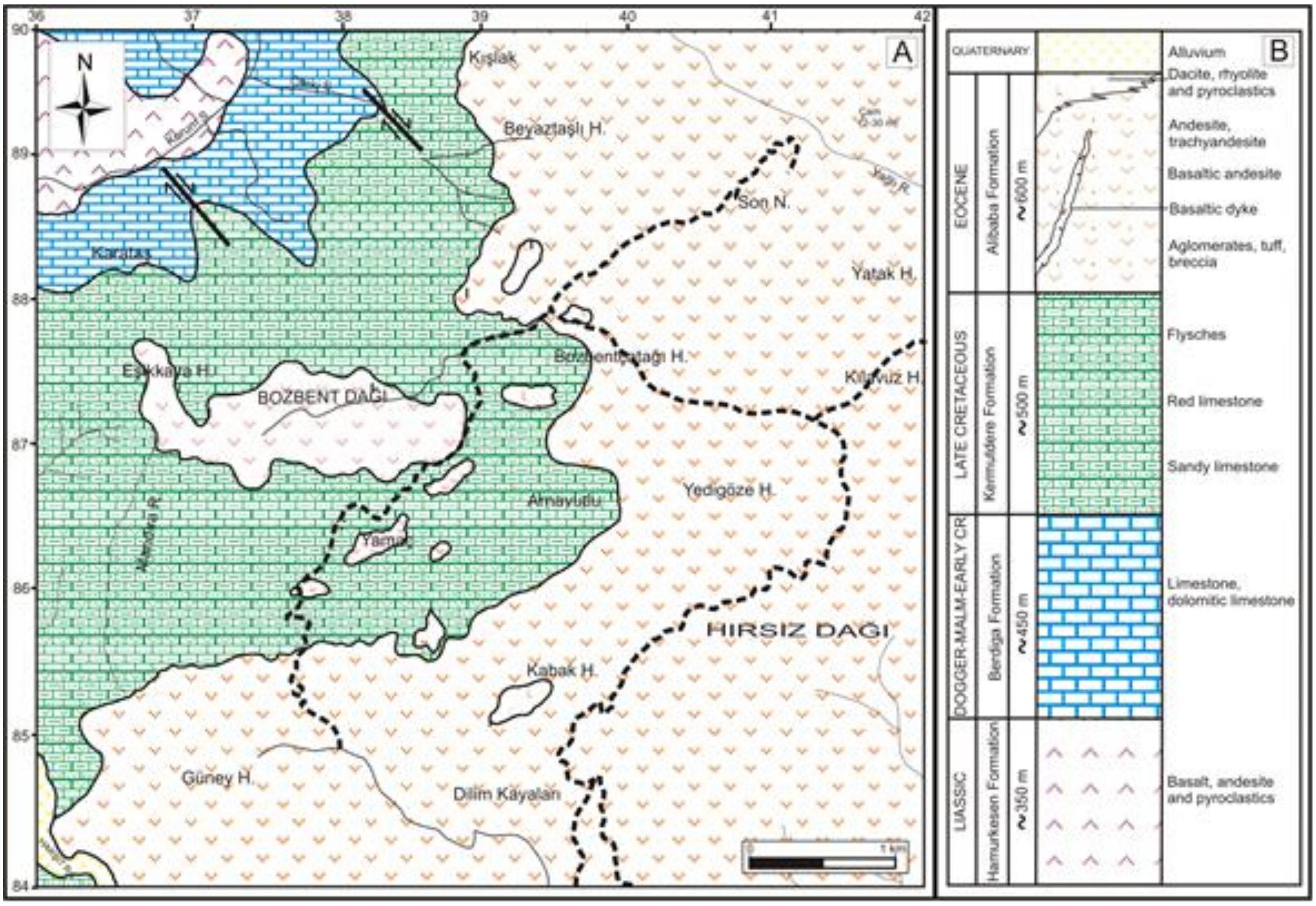


Figure 1. Geological map of the study area. Modified after [20].

3. Analytical Techniques

A total of 120 rock samples were collected from the volcanic rocks in the Mescitli (Gümüşhane) area. Their mineralogical compositions and textures were studied by using a binocular polarizing microscope. Based on these studies, 14 of the freshest and most representative rock samples were selected for whole-rock major and trace element [including rare earth elements (REE)] analyses.

Major and trace element contents were determined at the ACME Laboratories Ltd. (Vancouver, Canada). Major elements were measured by ICP-AES after fusion with LiBO2. For trace elements and REE analyses, 0.2 g of sample powder and 1.5 g of LiBO2 flux were mixed in a graphite crucible and subsequently heated to 1050 °C for 15 min. The molten sample was then dissolved in 5% HNO3. Sample solutions were aspirated into an ICP-MS (Perkin-Elmer Elan 600). The detection limits ranged from 0.001 to 0.04 wt.% for major oxides and from 0.01 to 0.5 ppm for trace elements and REEs.

4. Petrography

Based on their mineralogical, petrographic and textural characteristics, the volcanic rocks of the Mescitli area are mainly basaltic andesites, andesites, trachyandesites, and minor dacites and rhyolites. Basaltic andesites have microlitic to microlitic–porphyric textures with plagioclase, clinopyroxene and hornblende phenocrysts. Their groundmass has an intergranular texture and contains plagioclase, clinopyroxene, hornblende, Fe–Ti oxide, and volcanic glass. Andesites exhibit hypocrystalline porphyritic and glomeroporphyritic textures with phenocrysts of plagioclase, hornblende, clinopyroxene and biotite (Figure 2a).

Their groundmass has a hyalopilitic texture and includes plagioclase microlites, hornblende, clinopyroxene, biotite, Fe–Ti oxide, and volcanic glass. Trachyandesites have microlitic–porphyric textures with plagioclase, K-feldspar, hornblende and clinopyroxene phenocrysts. Their groundmass has an intergranular and trachytic texture and contains plagioclase, hornblende, clinopyroxene, Fe–Ti oxide, and volcanic glass. Dacites and rhyolites display holocrystalline- and microgranular textures characterized by plagioclase, K-feldspar, quartz, biotite and hornblende phenocrysts set in a groundmass of microlites of plagioclase, biotite, hornblende, Fe–Ti oxide, and glass (Figure 2b).

Plagioclase is the most common phenocryst phase and occurs in all rock types. It mainly forms euhedral to subhedral, normal and reverse zoned phenocrystals and microlites. Crystals show oscillatory zoning (Figure 2a) and prismatic-cellular growth. Some samples have poikilitic textures, in which large plagioclase crystals may contain small crystals of plagioclase and opaque minerals. Sanidine is found in trachyandesitic, dacitic and rhyolitic rocks as anhedral to subhedral microphenocryst. Hornblende occurs as subhedral to euhedral phenocrystals and microlites in groundmasses.

Larger crystals may contain small plagioclase and opaque minerals. Clinopyroxene forms euhedral to subhedral crystals, and occurs in glomeroporphyritic aggregates together with plagioclase and Fe-Ti oxides. Biotite and quartz are found in dacitic rocks as euhedral to subhedral crystals. Embayed quatz crystals are common (Figure 2b).

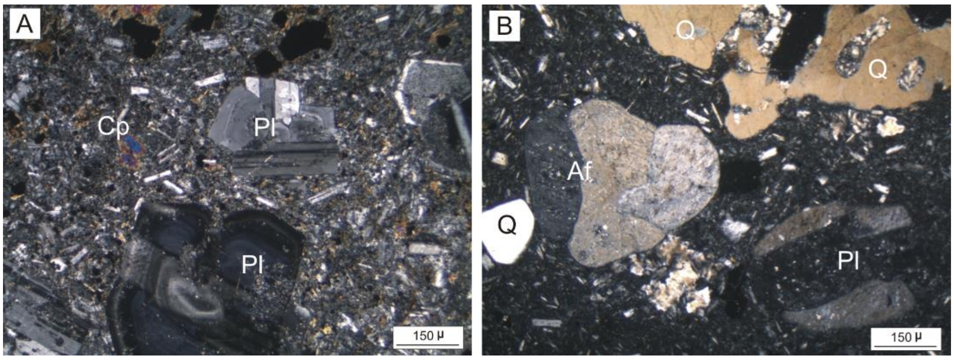


Figure 2. Microphotographs showing textural features of the Mescitli volcanic rocks: a- oscillatory zoning; b- embayed quartz crystals (Pl: Plagioclase, Q: Quartz, Cp: Clinopyroxene, DN).

5. Whole-Rock Geochemistry

Major and trace element analyses, including REE, of the representative whole rock samples from the Mescitli volcanic rocks are given in Table 1. All rocks display a wide compositional range with SiO2 contents ranging from 52 to 73 wt% (Table 1). Mg-numbers range from 9 to 39. K2O/Na2O ratios of samples range from 0.4% to 1.4% (Table 1).

In the total alkali-silica diagram, the rocks plot mainly in the basaltic andesite, basaltic trachyandesite, trachyandesite, andesite, dacite and rhyolite fields (Figure 3a). On the ternary AFM diagram (Figure 2b), the samples define a calc-alkalen trend.

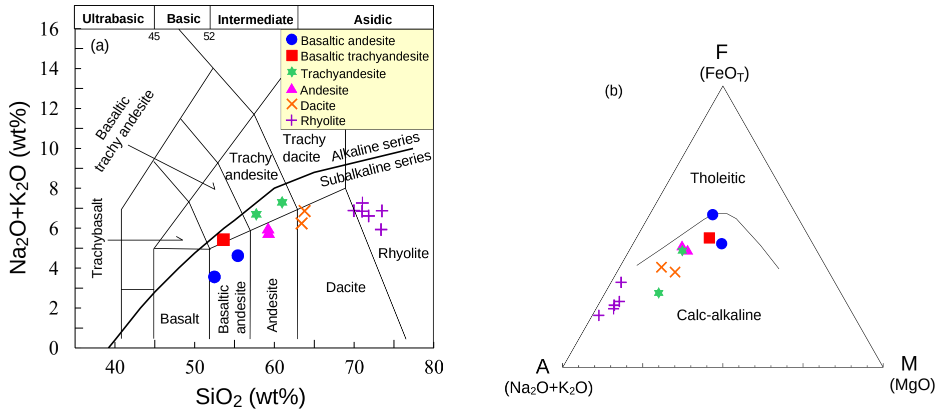


Figure 3. a- Chemical classification diagram [60], b- AFM plot. Alkaline-subalkaline and tholeiitic-calcalkaline dividing lines are from [61].

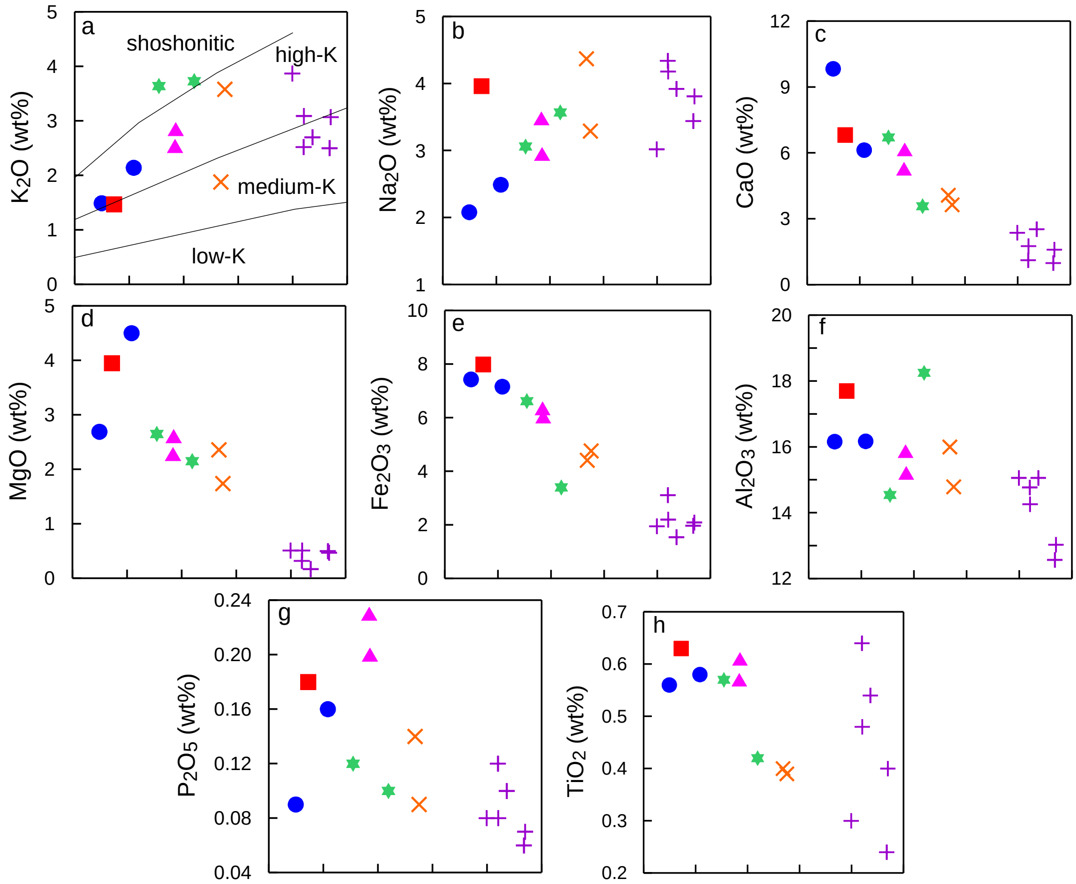


Figure 4. a- K_2O vs. SiO_2 diagram [62], b- SiO_2 (wt%) versus major oxides (wt %) variation diagrams for samples from the Mescitli volcanic rocks. For symbols, see Figure 3a.

In the Harker diagrams (Figure 4), analyzed samples generally exhibit negative correlations between SiO2 and CaO, MgO, Fe2O3T, Al2O3, P2O5 and TiO2 and positive correlations between SiO2 and K2O, Na2O3. According to the diagram of Figure 3a [62], the dacites and rhyolites belong to medium- to high-K series, whereas the basaltic andesites, basaltic trachyandesites, trachyandesites and andesites fall in the field of high-K series.

Table 1. Whole-rock major (wt%), trace (ppm) and rare earth (ppm) elements analyses from the Mescitli volcanic rocks

Rock type	**Basaltic andesite**		**Bazaltic Trachyandesit**		**Andesite**		**Trachyandesit**		**Dacite**		**Rhyolite**			
Sample	B11	B46	B58	B41	O12	B33	M19	M4	B24	B4	M27	M17	M26	M13
SiO_2	52.4	55.4	53.35	53.6	59.1	59.2	57.71	60.95	63.3	63.7	69.9	70.9	73.3	73.4
TiO_2	0.56	0.58	0.63	0.63	0.57	0.61	0.57	0.42	0.4	0.39	0.3	0.64	0.24	0.4
Al_2O_3	16.1	16.1	16.06	17.7	15.8	15.2	14.54	18.25	16	14.7	15.0	14.7	12.5	13.0
$Fe_2O_3^T$	7.43	7.16	8.22	7.99	6.35	6.04	6.62	3.4	4.41	4.76	1.95	3.11	1.97	2.09
MnO	0.12	0.13	0.14	0.16	0.1	0.11	0.09	0.11	0.08	0.07	0.14	0.06	0.05	0.07
MgO	2.69	4.5	4.7	3.95	2.28	2.61	2.65	2.15	2.36	1.74	0.51	0.32	0.5	0.47
CaO	9.83	6.13	6.11	6.82	5.28	6.16	6.71	3.58	4.08	3.64	2.37	1.12	0.99	1.6
Na_2O	2.08	2.49	3.28	3.96	3.48	2.95	3.06	3.57	4.37	3.29	3.02	4.34	3.44	3.81
K_2O	1.49	2.14	2.36	1.47	2.54	2.85	3.64	3.73	1.88	3.58	3.87	2.52	2.5	3.07
P_2O_5	0.09	0.16	0.24	0.18	0.23	0.2	0.12	0.1	0.14	0.09	0.08	0.12	0.06	0.07
LOI	6.9	4.9	4.1	3.3	3.4	3.7	3.7	2.9	2.6	3.5	2.5	1.9	3.6	1.8
Total	99.8	99.7	99.19	99.7	99.2	99.6	99.41	99.16	99.7	99.6	99.7	99.8	99.2	99.8
Ga	14.5	16.2	15	17.6	16.1	13.4	11.9	8.5	15.9	14.3	12.9	10.7	8.9	9.6
Ni	13.5	8.2	8.6	6.8	3.5	8.1	8.3	3.8	13.6	3	1.4	2.1	1.1	0.8
V	182	212	226	206	213	171	157	76	106	85	34	20	18	12
Cu	68.8	14	87.9	86.2	23.2	208.	16.2	12.4	44.1	23.2	7.1	2.9	2.8	1.4
Pb	12.5	3.7	5.5	8.1	12.7	7.1	5.7	15.6	14.3	17.6	27.4	16.3	26.1	18.7
Zn	53	52	37	58	40	34	53	79	64	48	51	90	29	30
W	1.5	0.7	1.1	0.5	0.9	0.9	2.9	1.4	0.5	1.5	4.2	1.5	3.7	1.9
Rb	32.7	40.8	71.2	32.5	33.8	62.5	87	72.8	35.5	77.4	86.1	53.9	84.1	78.5
Ba	680	620	742	481	608	722	936	1064	799	980	1250	525	335	560
Sr	341.	534.	529.4	709.	414.	613.	214.7	213.4	629.	185.	225.	155.	95.3	141.
Ta	0.3	0.2	0.2	0.2	0.3	0.2	0.7	0.4	0.3	0.4	0.5	0.6	0.6	0.8
Nb	3.5	2.7	2.7	2.9	4.8	4.1	7.7	4.9	4.3	4.7	7.2	8.5	7.8	9.1
Hf	2.3	2.1	2.2	2.2	3.3	2.8	3.5	2.4	2.1	3.7	2.8	4.9	3.1	4.9
Zr	76.5	76.5	76.8	77.5	118	107.	106.4	101.9	91.1	115.	113.	188.	116.	168.
Y	16.5	14.3	15.6	19.8	16.2	17	20.1	14.7	10.8	15.5	16	18.1	17.9	29.7
Th	6.7	4.9	6	2.2	8.6	6.7	13.3	10.2	5.1	11	11.7	7.3	15.3	11.5
U	2.2	1.3	1.8	0.6	2.8	1.8	3.6	2.3	1.2	2.3	3.3	2.3	4.4	3.1
La	17.7	16.5	19.9	14.6	27	21	27.5	25.8	20	23.7	28.2	21.5	30.5	30.1
Ce	30.3	27.6	35.9	28.6	49.7	39.9	51.6	42.5	35.5	40.4	49.5	44.1	51	53.1
Pr	3.43	3.23	4.06	3.49	5.5	4.52	5.62	4.58	4.02	3.98	4.93	4.68	5.12	6.17
Nd	14.1	12.7	15.3	15.9	21.3	19.1	20.7	15.9	15.2	15.3	19.2	17.9	17.9	22.5
Sm	3.05	2.68	3.4	3.03	4.19	3.83	4.31	2.94	2.8	2.47	3.12	3.89	2.98	4.9
Eu	0.87	0.82	1.02	1.05	1.1	0.97	1.09	0.65	0.85	0.79	0.99	1.19	0.65	1.16
Gd	3.12	2.63	3.38	3.26	3.99	3.39	4	2.71	2.24	2.68	3	3.9	2.28	4.88
Tb	0.47	0.37	0.45	0.5	0.6	0.47	0.62	0.45	0.32	0.4	0.46	0.59	0.43	0.81
Dy	3.2	2.49	3	3.48	3.3	2.93	3.69	2.52	1.78	3	2.7	3.18	2.47	4.84
Ho	0.62	0.49	0.54	0.73	0.65	0.6	0.78	0.6	0.32	0.51	0.61	0.77	0.61	1.04
Er	1.82	1.29	1.43	2.02	1.86	1.79	2.27	1.63	0.97	1.74	1.84	2.11	1.72	2.88
Tm	0.26	0.19	0.21	0.29	0.27	0.24	0.33	0.32	0.14	0.26	0.32	0.3	0.28	0.45
Yb	1.8	1.28	1.55	1.92	1.75	1.73	2.23	2.31	1.05	1.9	1.99	1.75	1.98	3.21
Lu	0.28	0.21	0.24	0.28	0.27	0.26	0.35	0.34	0.15	0.3	0.32	0.31	0.33	0.49
Mg#	26.5	38.5	36.38	33.0	26.4	30.1	28.59	38.74	34.8	26.7	20.7	9.33	20.2	18.3
K_2O/Na_2O	0.72	0.86	0.72	0.37	0.73	0.97	1.19	1.04	0.43	1.09	1.28	0.58	0.73	0.81
(La_N/Lu_N)	6.55	8.14	8.59	5.4	10.3	8.36	8.14	7.86	13.8	8.18	9.12	7.18	9.57	6.36
Eu=Eu/Eu	0.85	0.93	0.91	1.02	0.81	0.81	0.79	0.69	1.01	0.93	0.98	0.92	0.73	0.72

LOI is loss on ignition; Mg# (mg-number) = 100xMgO/(MgO+$Fe_2O_3^T$). $Fe_2O_3^T$: Total iron, Eu*=$(Sm+Gd)_N/2$

In the Harker diagrams (Figure 5), the Sr and Ni contents show a negative correlation with SiO2 content, whereas Zr, Ba, Rb, Nb and Th contents exhibit a positive correlation.

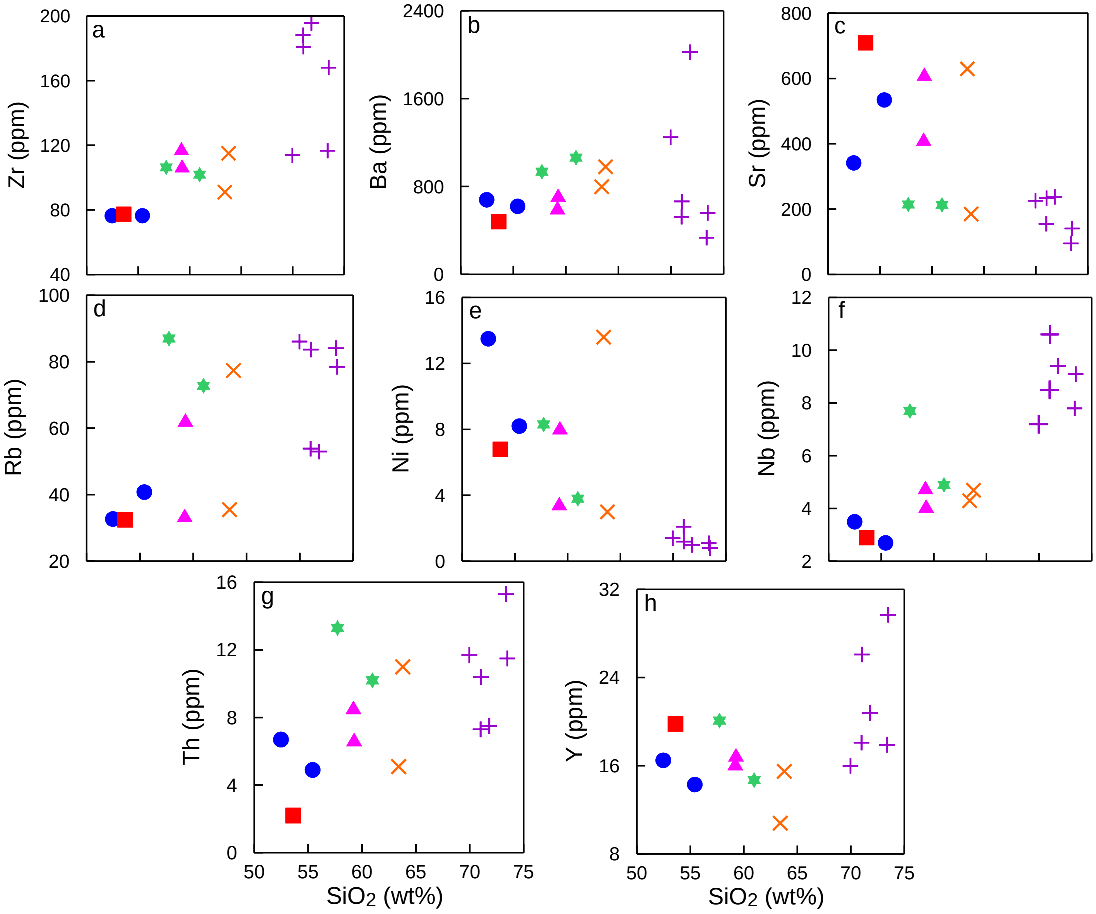
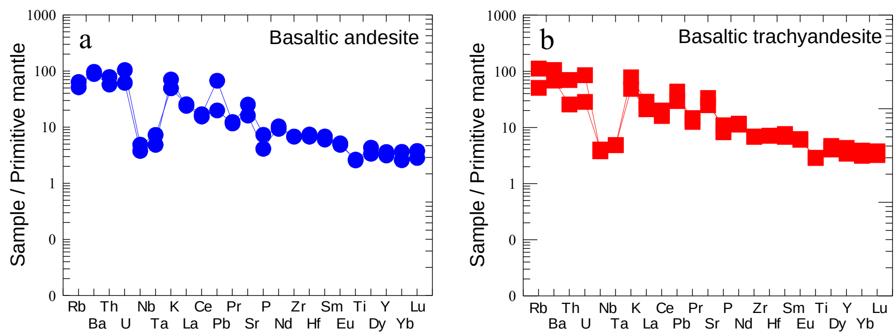


Figure 5. SiO_2 (wt%) versus trace elements (ppm) variation diagrams for samples from the Mescitli volcanic rocks. For symbols, see Figure 3a.

Primitive mantle-normalized spider diagrams are shown in Figure 6. All rocks exhibit significant enrichment in large ion lithophile elements (LILE) (Rb, Ba, Th, and K) relative to some high field strength elements (HFSE, such as Nb, Ta, Ti and P) and prominent positive Pb anomalies.

Chondrite-normalized REE patterns are shown in Figure 7. All samples show moderately fractionated chondrite-normalized REE patterns, parallel to each other, indicating a similar source(s) for basaltic andesites, andesites, basaltic trachyandesites, trachyandesites, dacites and rhyolites. The (LaN/LuN) ratios vary between 5.4 and 13.8 in the samples (Table 1). The basaltic andesites show weak negative Eu-anomalies (EuN /Eu*=0.85–0.93). The slight increase of the negative Eu-anomaly from these rocks towards the rhyolites (EuN /Eu*=0.72–1.12) indicates a genetic link between the mafic and felsic rock types.



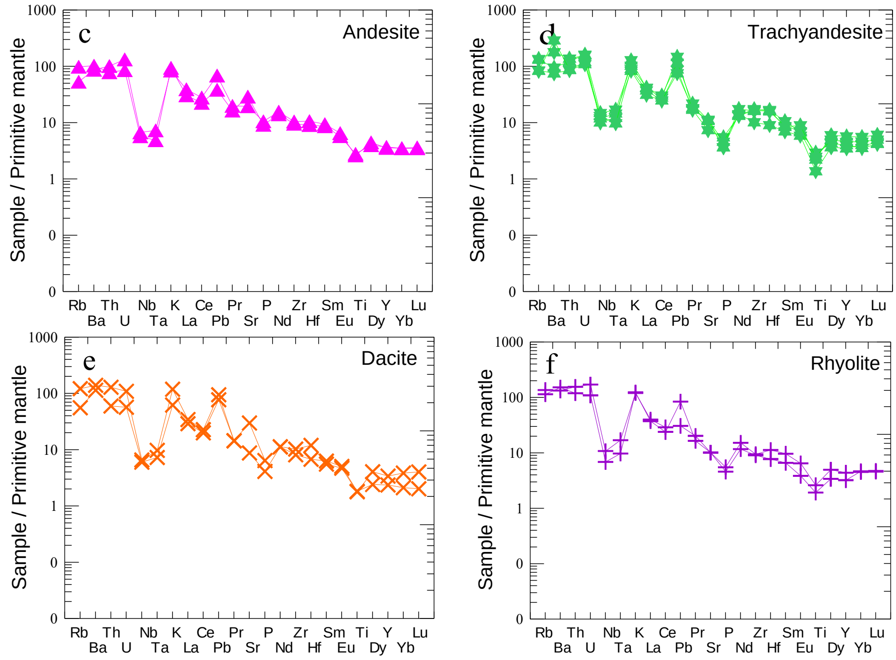


Figure 6. Primitive mantle normalized trace element patterns [63] for samples from the Torul volcanic rocks. For symbols, see Figure 3a.

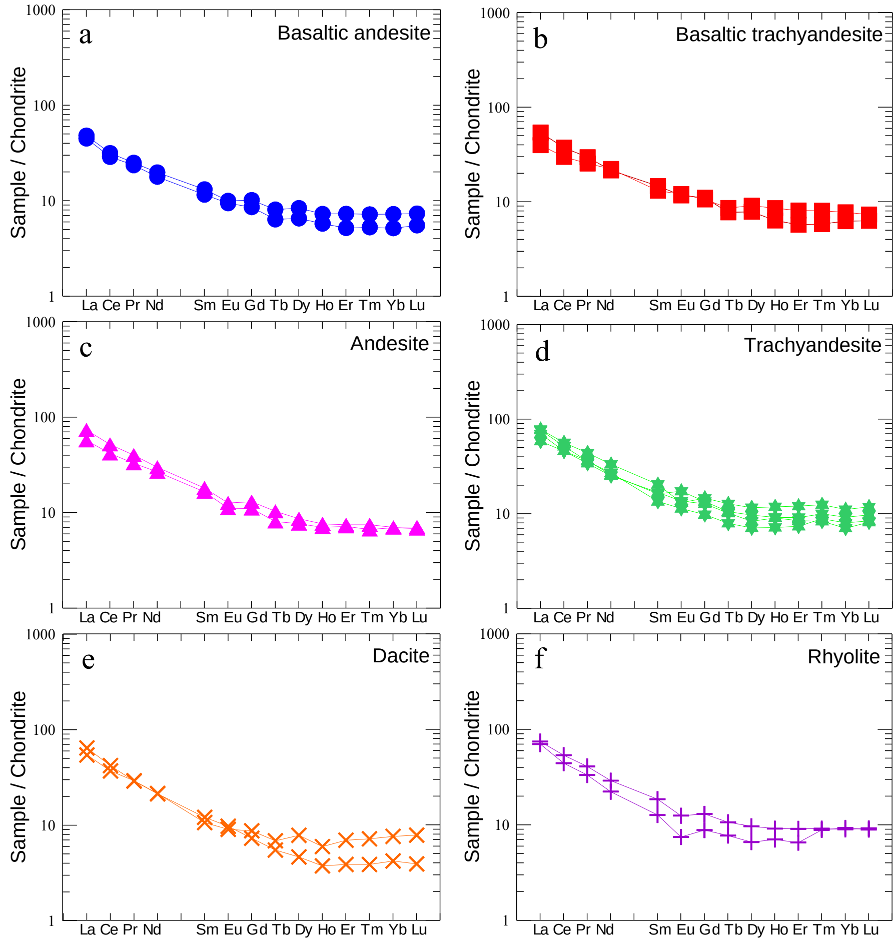


Figure 7. Chondrite normalized rare earth element patterns [64] for samples from the Mescitli volcanic rocks. For symbols, see Figure 3a.

6. Discussion

6.1. Fractional Crystallization

The Mescitli volcanic rocks have similar petrographical and geochemical features, and define a typical K-rich calc-alkaline trend from basaltic andesites to rhyolites. Major and trace-element abundances vary along continuous trends of decreasing CaO, MgO, Fe2O3T, Al2O3, TiO2, P2O5, Ni and Sr, and increasing K2O, Na2O, Zr, Ba, Rb, Nb and Th with increasing SiO2 (Figure 4 and 5). Normalized REE patterns of the Mescitli volcanics are parallel to each other and total REE contents increase from basaltic andesite to rhyolite (Figure 7).

The increases in SiO2, K2O, Rb, Ba and decreases in CaO, MgO, Fe2O3T, Al2O3, TiO2 and P2O5 contents shown in the basaltic andesites and rhyolites are compatible with their evolution through fractional crystallization processes (Figure 4). The negative Eu anomalies and the decrease in Sr with increase in SiO2, all assert that plagioclase was an important fractionating phase. Decrease in P2O5 may results from removal of apatite during fractional crystallization. The increases in K2O and Rb with increasing SiO2 content indicate that K-feldspar and biotite were not amongst the early phases of fractionation. Additionally, the downward-concave shape of the REE pattern suggests a significant role of hornblende and clinopyroxene fractionation in the evolution of the rocks, as also confirmed by petrography (Figure 7).

The Y content of the samples exhibits a near-constant to positive correlation with increasing Rb contents (not shown), which can be explained by clinopyroxene and plagioclase fractionation. In the CaO versus Y plot (not shown), nearly all rocks plot on the Y enrichment side (high-Y content) of the standard calc-alkaline trend, defining an L-type trend. This trend suggests that pyroxene and plagioclase played an important role in the evolution of the studied volcanic.

6.2. Crustal Assimilation

[65] argued for contamination of the primary melt by arc crust as an important feature in Tertiary lavas of the Eastern Pontides. The Mescitli volcanic rocks were erupted through a thickened arc crust making them more susceptible to modification by crustal assimilation. The continental crust has highly fractionated and enriched LREE, flat HREE, and a positive Pb anomaly but negative anomalies at Nb–Ta [64]. The Mescitli volcanic rocks are characterized by pronounced negative Nb–Ta and positive Pb anomalies (Figure 5a), recording that subduction signature and possible minor amount of a crustal contribution in their evolution.

6.3. Source Characteristics

The overall enrichments in LILE and LREE and the negative Nb–Ta–Ti anomalies are features of subduction-related magmas and are commonly attributed to a mantle source that has been modified by metasomatic fluids derived from the subducted slab or sediments [66-68]. It is suggested that the trace element characteristics of the Mescitli volcanics originate from melting of an enriched subcontinental mantle, which was modified by earlier (pre-Eocene) subduction processes.

The Mescitli volcanics show relatively high and flat HREE patterns (Figure 7), pointing to the absence of garnet and presence of spinel in the mantle source. The depletion in Ti, Nb and Ta can be explained by retention in Ti-rich residual mineral phases [69-70]. The negative P and Zr anomalies in the primitive mantle-normalized diagrams (Figure 6) could reflect the presence of residual zircon and apatite in the mantle source region [71] or fractionation of these mineral phases during later petrogenetic processes. Furthermore, the relative HFSE depletion with respect to LILE may also be explained with a mantle source modified by subduction-related fluids, and thus LILE enriched. This may explain Nb, Ta, Ti and Zr depletion in the studied volcanics.

The Th/Yb vs. Ta/Yb [72] (Figure 8) diagram, the Mescitli volcanic rocks form a trend sub-parallel to the mantle array but shifted to higher Th/Yb ratios. This suggests melt derivation from a source, which had been previously enriched (or metasomatized) by fluids derived from an earlier (i.e., pre-Eocene) subduction processes.

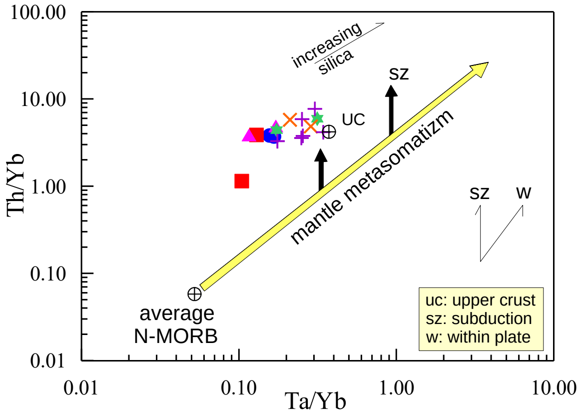


Figure 8. Th/Yb vs. Ta/Yb plots of the rock samples from the Mescitli volcanic rocks [63-64, 72] (For symbols, see Figure 3a)

In the Ce/Pb vs. Ce diagram (Figure 9a) all samples plot in the arc volcanic subfield. The average low Ce/Pb ratios (□2) of the most primitive samples are considerably different from those of oceanic basalts (□25) [73], suggesting that these rocks are not derived from normal asthenospheric mantle. [74-75] suggested that, since HFSE (such as Nb and Ta) are depleted in the lithospheric mantle relative to the LREE, high Nb/La ratios (□>1) indicate an OIB like asthenospheric mantle source for basaltic magmas, and lower ratios (□□0.5) indicate a lithospheric mantle source. The Nb/La (0.2) ratios of the most basic samples in the Mescitli area suggest a lithospheric mantle source (Figure 9b).

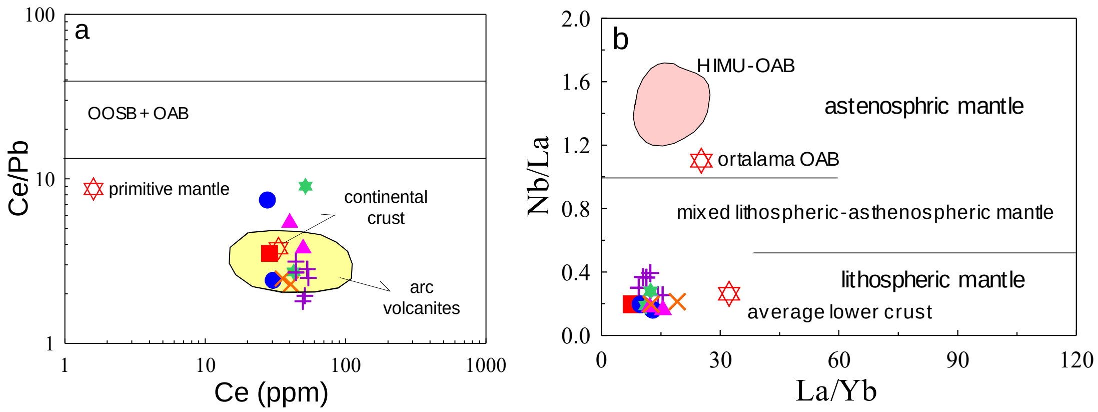


Figure 9. a- Ce/Pb vs. Ce; b-Nb/La vs. La/Yb plots of the rock samples from the Mescitli volcanic rocks [73, 75-79]. For symbols, see Figure 3a.

However, low Nb/La ratios can derive from a lithospheric source, but also from a La-enrichment in the source, given the metasomatization of mantle source by subduction fluids, and given that La mobility in fluids is notably higher that Nb mobility. Therefore, it can be suggested that low La/Nb ratios in Mescitli volcanics are here due to fluid-driven La enrichment in the mantle source, modified by slab-released fluids.

[80] suggested that Tertiary volcanism is closely related to lithospheric thinning induced by slab break-off. Thus, melting of the lithospheric mantle beneath Eastern Pontides during the Eocene seems more likely to have occurred by decompression melting of an enriched subduction modified mantle, which was metasomatized by fluids derived from subduction zone processes during pre-Eocene time [11, 80-81]. Subsequently, these melts underwent considerable degree of fractional crystallization along with minor amounts of crustal assimilation, generating a wide variety of the rock types ranging from basaltic andesite to rhyolite.

7. Conclusions

The studied Mescitli volcanic rocks vary from basaltic andesite to rhyolite defining a calc-alkaline series. All samples from the Mescitli volcanic series display similar geochemical features. They are characterized by enrichment of LILE and LREE and depletion of HFSE suggesting similar sources and petrogenetic processes. Fractional crystallization with minor amounts of crustal contamination processes was operative during the evolution of the volcanic rocks. Clinopyroxene, hornblende, plagioclase and Fe-Ti oxides are the most important fractionating mineral phases. The Mescitli volcanic rocks were derived from an enriched mantle source, which was previously modified by subduction fluids in a post-collisional geodynamic setting.

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