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# GEOCHEMICAL CHARACTERISTICS OF THE MAFIC ENCLAVES AND THEIR HOSTS FROM NEOGENE ERENLERDAGI VOLCANITES, AROUND YATAGAN VILLAGE AND SAĞLIK TOWN (KONYA), CENTRAL TURKEY

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**Abstract**

*Late Miocene to Pliocene volcanism is represented by development of lava domes, nuée ardentes and pyroclastic fall and flow (ignimbrites) deposits in the WSW and NW of Konya city. The lava dome contains various mafic microgranular enclaves (MMEs), which have various size (a few cm to a few meters), shape (ellipse/sphere to rounded), with a well-developed chilly zone. The MMEs samples are situated on mostly basaltic andesite and andesite, and a few MME samples on basaltic trachy-andesite area while the host rocks are concentrated on dacite and andesite areas. The felsic samples have more fractionated chondrite-normalised REE pattern ($La/Yb_N$: 9.5-18.1) than MMEs (6.7-16.0) ones, but both have slightly developed negative Eu anomaly (Eu/Eu*: 0.67-0.89 in felsic rocks, 0.68-0.87 in MMEs). In primitive mantle-normalized spider diagram, the MMEs and felsic rocks have negative Nb, Ta, P and Ti anomalies, indicating some subduction component in their genesis. Based on geochemical data, the MMEs are suggested to have been formed by hybridization of basic magma mingled with partially crystallized felsic magma.*

***Keywords:*** *Erenlerdagı, volcanism, Mafic enclaves.*

## 1. Introduction

Widespread volcanic activity developed in Turkey during the Neotectonic period, producing volcanic rocks covered an area of about 85,000 $km^2$ in East, Central and West Anatolia (Ketin, 1983). In Central Anatolia, calc-alkaline volcanic units are exposed in large areas situated in the WSW and NW of Konya city (Figure 1), in where transtensive and transpressive tectonic regimes have been effective since the Late Miocene (Kempler and Garfunkel, 1991). The volcanism took place between Late Miocene 11.9 Ma. to Pliocene 3.35 Ma (Keller *et al.*, 1977).

Pre-Mesozoic basement is represented by ophiolitic complex, phyllite, schist, quartzite and dolomi tic limestone, metavolcanic rocks, diorite, diabase, gabbro, peridodite and serpantinite (Özcan ve d iğ., 1990; Eren, 1993; Kurt, 1994). It is unconformably overlain by Upper Miocene-Lower Pliocen e Ulumuhsine formation (Eren, 1993), which is made up by limestone, limestone-mudstone alterna tion and marl. The pyroclastic rocks, which consist of volcanic breccia, agglomerate, tuffite and tuf fs, conformably overlaid the Ulumuhsine formation. The youngest volcanic rocks are andesite, dac ite, and basaltic andesite. Lower Pliocene Yürükler formation overlies unconformably volcanic roc ks, and contains red conglomerate and caliche nodulled mudstone deposits.

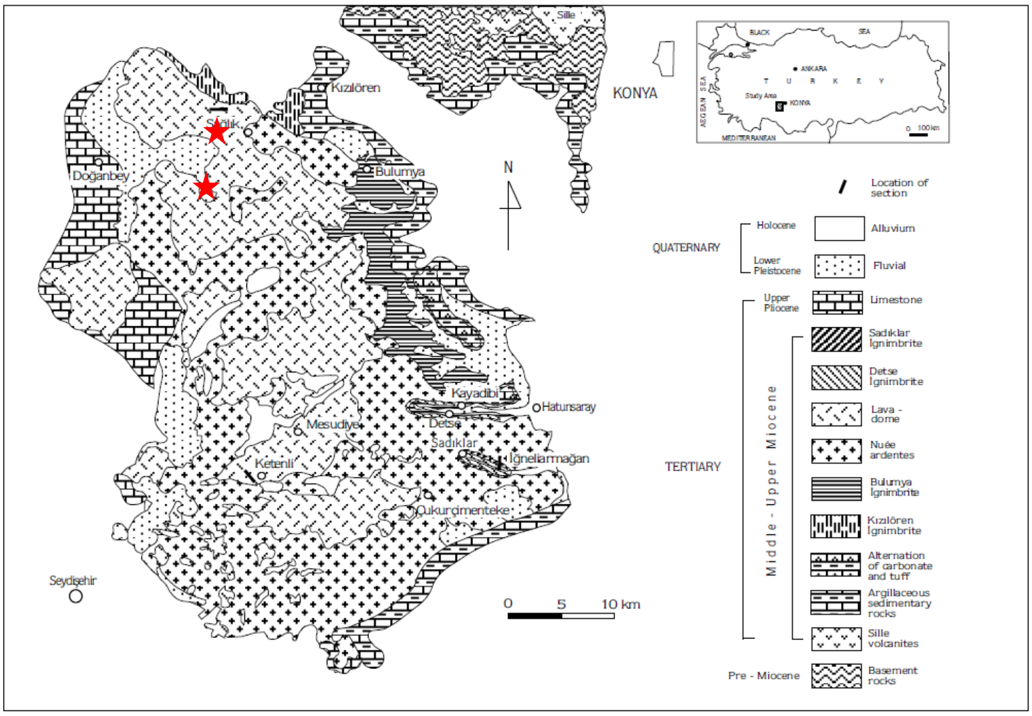


**Figure 1 - Location and geological map of the study area (modified from Keller *et al*., 1977).**
**★: Rock quarries studied.**

The study aims to explain the origin of and importance of mafic magmas In Erenlerdagi volcanics. To do so, the study was performed at a rock quarry, in where mafic and felsic magma interactions can be observed very well. The dom contains various mafic microgranular enclaves (MMEs), which have various size (a few cm to a few meters) and shape (ellipse/sphere to rounded).

## 2. Materials and Methods

The MMEs samples were analyzed to determine contents of major oxides, trace and rare earth elements (REE) by ICP-MS at ACME Analytical laboratories in Canada.

## 3. Geochemistry

Bulk rock chemical analyses of the MMEs and three additional MMEs from previous studies (Temel *et al.*, 1996) are presented in Table 1, with host lava samples (Table 2, Kocak and Zedef, 2016). In an AFM ternary diagram (Figure 2a), the samples clearly define a calc-alkaline trend.

The samples are concentrated on high K calc-alkaline series (Figure 2b), but some MME samples were also found on calc-alkaline areas in a $SiO_2$ vs $K_2O$ diagram. In a $Na_2O$+$K_2O$ vs $SiO_2$ diagram, the MMEs samples are situated on mostly basaltic andesite and andesite areas, and a MME sample on basaltic trachy-andesite area while the host rocks are found on dacite and andesite areas (Figure 3a). In Figure 2 and 3a, there is almost no compositional gap between mafic and felsic rocks. In Harker diagram, the $SiO_2$ increases generally with decreasing $TiO_2$, FeOt, MgO, CaO and Co (not shown), suggesting fractional crystallization of pyroxene (±olivine), ilmenite and magnetite. Primitive mantle normalized spider trace element diagram of the samples from Sağlık lava domes, the MMEs (Figure 3b) are characterized by an enrichment in large ion litophile elements (LILE), particularly Cs, Ba and Th, and depletion in high field strength elements (HFSE). The rocks show progressively decreasing negative Nb, Ta, P and Ti anomalies, which are typical of subduction-related magmas (Pearce, 1983). Chondrite-normalized REE patterns (Figure 4a) for the three rock groups usually exhibit a strongly fractionated REE pattern with high LREE/ HREE for the rocks. In general, all samples are LREE enriched with $(Ce / Sm)_N$=2.54-4.54, which are similar to those of subduction-related magmas (Pearce 1982, 1983). The more fractionated and LREE-enriched character of the volcanic rocks indicates that the evolution of the rocks involved continental crust (Watters and Pearce, 1987). Plagioclase fractionation is evident from the slight-moderate development of a negative Eu anomaly $((Eu/Eu^*)_N$:= 0.68-0.86, Figure 4a ). The MMEs have les fractionated REE pattern than their hosts. Figure 4 b-c shows that both MMEs and their hosts have mostly volcanic arc geotectonic setting.

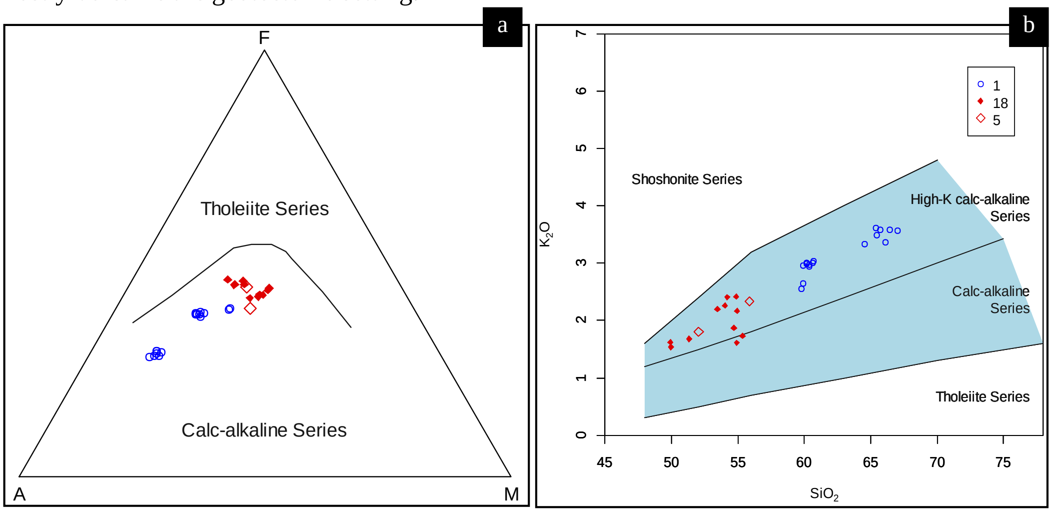


**Figure 2 - a) AFM classification of the samples (Irvine and Baragar, 1971), b) $SiO_2$ vs $K_2O$ diagram of the samples (after Peccerillo and Taylor, 1976). Symbols; 1: Sağlık lava domes, 18: MMEs, 5: MMEs (Temel *et al.*, 1996)**

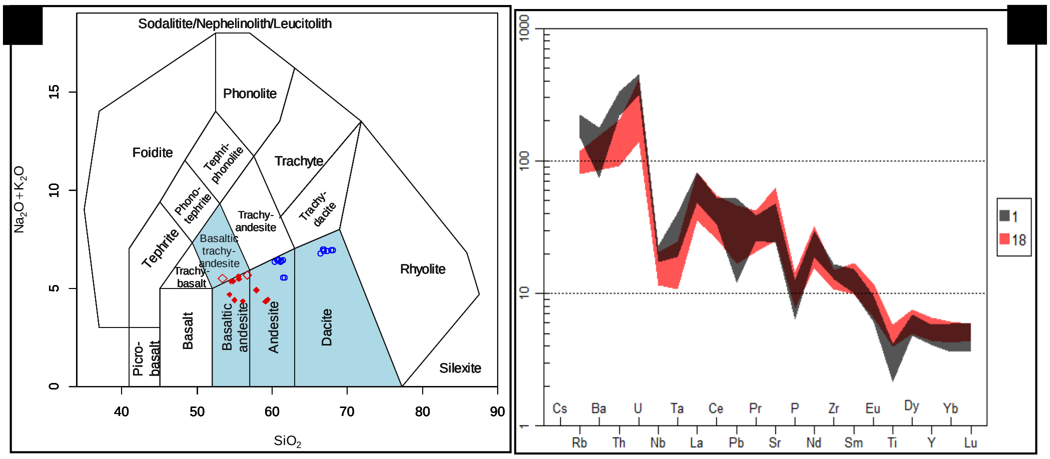


**Figure 3 - a) Total alkaline vs $SiO_2$ diagram (Middlemost, 1994) of the samples b) Primitive mantle normalized spider trace element diagram (McDonough and Sun, 1995). Symbols; 1: Sağlık lava domes, 18: MMEs, 5: MMEs (Temel *et al.*, 1998).**

**Table 1 - Results of the geochemical analyses of the samples from MMEs.**

| Samples | 5A | 8A | 4A | 42A | 43A | 41A | 1A | 40A | 2A | 47A | 9A | Temel *et al.*, 1998 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | KO-39 | KO-50 | KO-53 |
| $SiO_2$ | 49.92 | 49.95 | 51.33 | 53.46 | 54.02 | 54.19 | 54.71 | 54.88 | 54.93 | 54.94 | 55.35 | 55.89 | 52.06 | 50.54 |
| $TiO_2$ | 0.81 | 0.8 | 0.9 | 1.17 | 1.14 | 1.11 | 0.93 | 1.11 | 0.89 | 1.13 | 0.87 | 0.83 | 0.86 | 0.76 |
| $Al_2O_3$ | 14.66 | 14.79 | 15.4 | 17.59 | 17.53 | 17.94 | 16.19 | 17.69 | 16.17 | 17.73 | 16.1 | 16.24 | 16.4 | 14.31 |
| $Fe_2O_3$ | 6.23 | 6.2 | 7.22 | 8.54 | 8.37 | 8.16 | 7.4 | 8.18 | 7.1 | 8.08 | 6.69 | 7.33 | 8.41 | 8.61 |
| MgO | 3.5 | 3.65 | 4.24 | 3.79 | 3.9 | 3.08 | 4.31 | 3.49 | 4.2 | 3.44 | 4.01 | 4.57 | 4.13 | 1.09 |
| CaO | 11.93 | 10.91 | 8.06 | 7.91 | 7.98 | 7.21 | 6 | 7.61 | 5.3 | 7.74 | 5.72 | 7.79 | 9.82 | 9.39 |
| $Na_2O$ | 2.68 | 2.45 | 2.29 | 3.05 | 3.02 | 3.05 | 2.76 | 3.12 | 2.41 | 3.23 | 2.38 | 3.23 | 3.54 | 2.2 |
| $K_2O$ | 1.62 | 1.54 | 1.68 | 2.2 | 2.26 | 2.41 | 1.87 | 2.42 | 1.61 | 2.17 | 1.73 | 2.34 | 1.81 | 1.31 |
| $P_2O_5$ | 0.17 | 0.16 | 0.2 | 0.28 | 0.27 | 0.3 | 0.16 | 0.27 | 0.17 | 0.29 | 0.17 | 0.27 | 0.27 | 0.24 |
| MnO | 0.37 | 0.4 | 0.23 | 0.13 | 0.13 | 0.13 | 0.18 | 0.12 | 0.18 | 0.13 | 0.15 | 0.123 | 0.193 | 0.17 |
| LOI | 7.8 | 8.9 | 8.2 | 1.5 | 0.9 | 2 | 5.2 | 0.7 | 6.8 | 0.7 | 6.5 | 0.98 | 1.87 | 0.83 |
| Sum | 99.74 | 99.75 | 99.72 | 99.58 | 99.55 | 99.58 | 99.71 | 99.58 | 99.73 | 99.58 | 99.73 | 99.59 | 99.36 | 99.25 |
| Ni | 2.2 | 1.4 | 2.3 | 2.6 | 2.9 | 2.2 | 2.9 | 2.4 | 2.8 | 2.1 | 2.4 | 10.8 | 19.1 | 184.5 |
| Co | 14.4 | 13.6 | 15.8 | 21.9 | 21.2 | 20.6 | 16 | 21.3 | 15.5 | 20.1 | 15.2 | 34.4 | 27.6 | 46.9 |
| Pb | 4.4 | 2.7 | 5.5 | 2.9 | 2.6 | 2.9 | 5.4 | 2.5 | 6.1 | 2.9 | 6.9 | | | |
| Rb | 57.3 | 47.9 | 57.2 | 62.2 | 65 | 70.5 | 66.6 | 71 | 50.4 | 63.5 | 52.2 | 62.2 | 51.5 | 25.9 |
| Sr | 615.3 | 548.6 | 577.1 | 1213 | 1221 | 1222 | 635.5 | 1207 | 495.9 | 1249 | 541.5 | 1195 | 637.7 | 1162 |
| Hf | 3.6 | 2.4 | 3.2 | 4.1 | 3.6 | 4.8 | 3.2 | 3.9 | 3.3 | 4.3 | 3.6 | | | |
| Nb | 8.7 | 7.6 | 9.1 | 11.6 | 11.8 | 11.9 | 10.2 | 10.3 | 8.4 | 13.6 | 8.1 | 9.2 | 14.7 | 5.3 |
| Ta | 0.7 | 0.4 | 0.5 | 0.5 | 0.6 | 0.7 | 0.5 | 0.9 | 0.5 | 0.8 | 0.6 | | | |
| Th | 8.5 | 7.5 | 7.3 | 14.4 | 16.2 | 16.4 | 8 | 15.7 | 8.9 | 16.2 | 9 | | | |
| U | 8.3 | 3 | 3.5 | 3.8 | 5 | 4.5 | 4.3 | 4.5 | 2.8 | 5.4 | 2.8 | 175.5 | 153.9 | 164.4 |
| Zr | 128.7 | 113.3 | 125.2 | 148.7 | 152.7 | 156.5 | 116.8 | 149.2 | 115 | 151.7 | 124 | 150 | 113.5 | 127.6 |
| Y | 23.3 | 20.3 | 24.2 | 24.9 | 25.1 | 28.4 | 23.2 | 22.8 | 18.9 | 23.8 | 20.2 | 21.1 | 30.5 | 16.4 |
| La | 25.8 | 24.6 | 28.4 | 47.3 | 49.1 | 53.7 | 25.7 | 46.2 | 22.8 | 49.2 | 25.4 | | | |
| Ce | 46.6 | 43.6 | 53.2 | 81.8 | 86.8 | 91.4 | 50 | 85.3 | 45.9 | 87.4 | 48.1 | | | |
| Pr | 5.39 | 5.25 | 6.29 | 9.8 | 10.11 | 10.73 | 5.87 | 9.82 | 5.25 | 10.28 | 5.66 | | | |
| Nd | 22.7 | 23.3 | 26.6 | 40.6 | 39.7 | 38.7 | 21.6 | 32 | 19.3 | 37.9 | 23.2 | | | |
| Sm | 4.12 | 4.01 | 4.84 | 6.68 | 6.87 | 6.76 | 4.62 | 6.66 | 4.27 | 6.73 | 4.57 | | | |
| Eu | 1.11 | 1.04 | 1.27 | 1.67 | 1.59 | 1.83 | 1.26 | 1.71 | 1.11 | 1.65 | 1.01 | | | |
| Gd | 3.99 | 3.58 | 4.68 | 5.36 | 6.09 | 6.19 | 4.4 | 5.63 | 3.89 | 5.65 | 4.48 | | | |
| Tb | 0.63 | 0.6 | 0.72 | 0.82 | 0.82 | 0.83 | 0.69 | 0.81 | 0.59 | 0.81 | 0.65 | | | |
| Dy | 4.09 | 3.52 | 4.28 | 4.23 | 4.47 | 5.09 | 4.04 | 4.23 | 3.37 | 4.16 | 3.76 | | | |
| Ho | 0.79 | 0.79 | 0.91 | 0.89 | 0.8 | 1 | 0.89 | 0.92 | 0.71 | 0.82 | 0.72 | | | |
| Er | 2.28 | 2.14 | 2.62 | 2.68 | 2.82 | 2.96 | 2.61 | 2.49 | 2.13 | 2.52 | 2.33 | | | |
| Tm | 0.3 | 0.29 | 0.34 | 0.39 | 0.36 | 0.39 | 0.42 | 0.4 | 0.32 | 0.35 | 0.31 | | | |
| Yb | 2.13 | 1.87 | 2.34 | 2.38 | 2.64 | 2.26 | 2.6 | 2.36 | 2.09 | 2.68 | 2.17 | | | |
| Lu | 0.38 | 0.3 | 0.35 | 0.34 | 0.35 | 0.33 | 0.4 | 0.32 | 0.32 | 0.35 | 0.34 | | | |

**Table 2 - Results of the geochemical analyses of the samples from the lava domes (Kocak and Zedef, 2016)**

| **Samp** | **1B** | **2C** | **3B** | **4B** | **5B** | **7B** | **8B** | **9C** | **11B** | **40B** | **41B** | **42B** | **43B** | **44B** | **46B** | **47B** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SiO2** | 66.11 | 59.9 | 67 | 64.57 | 65.75 | 65.44 | 65.39 | 59.76 | 66.46 | 60.18 | 60.35 | 60.69 | 60.38 | 60.67 | 60.15 | 59.89 |
| **TiO2** | 0.45 | 0.8 | 0.45 | 0.47 | 0.47 | 0.47 | 0.48 | 0.83 | 0.43 | 0.8 | 0.79 | 0.79 | 0.78 | 0.79 | 0.8 | 0.83 |
| **Al2O3** | 15.52 | 15.91 | 15.23 | 15.43 | 15.39 | 15.15 | 15.24 | 16.07 | 15.54 | 16.94 | 17.07 | 16.64 | 16.53 | 16.8 | 16.94 | 16.97 |
| **Fe2O** | 3.76 | 6.3 | 3.68 | 3.74 | 3.78 | 3.84 | 3.95 | 6.27 | 3.57 | 6.11 | 5.99 | 5.95 | 6.12 | 6.04 | 6.01 | 6.19 |
| **MgO** | 1.61 | 3.37 | 1.58 | 1.54 | 1.7 | 1.56 | 1.73 | 3.33 | 1.42 | 2.54 | 2.45 | 2.39 | 2.51 | 2.38 | 2.61 | 2.69 |
| **CaO** | 3.73 | 5.26 | 3.44 | 4.73 | 4.1 | 4.48 | 4.01 | 5.38 | 3.51 | 5.93 | 5.77 | 5.68 | 5.88 | 5.77 | 5.78 | 6.04 |
| **Na2O** | 3.39 | 2.73 | 3.26 | 3.22 | 3.27 | 3.26 | 3.23 | 2.84 | 3.19 | 3.39 | 3.39 | 3.3 | 3.33 | 3.33 | 3.4 | 3.34 |
| **K2O** | 3.37 | 2.64 | 3.57 | 3.34 | 3.58 | 3.49 | 3.62 | 2.56 | 3.58 | 2.99 | 2.97 | 3.04 | 2.94 | 3 | 3.01 | 2.96 |
| **P2O5** | 0.17 | 0.13 | 0.16 | 0.17 | 0.18 | 0.18 | 0.18 | 0.16 | 0.16 | 0.25 | 0.24 | 0.24 | 0.25 | 0.26 | 0.25 | 0.25 |
| **MnO** | 0.08 | 0.13 | 0.07 | 0.1 | 0.08 | 0.1 | 0.1 | 0.12 | 0.07 | 0.11 | 0.11 | 0.1 | 0.11 | 0.11 | 0.11 | 0.11 |
| **LOI** | 1.6 | 2.6 | 1.3 | 2.4 | 1.4 | 1.8 | 1.8 | 2.4 | 1.8 | 0.4 | 0.5 | 0.9 | 0.8 | 0.5 | 0.6 | 0.4 |
| **Sum** | **99.75** | **99.79** | **99.75** | **99.75** | **99.75** | **99.75** | **99.75** | **99.74** | **99.75** | **99.64** | **99.65** | **99.67** | **99.66** | **99.66** | **99.65** | **99.65** |
| **Ni** | 3.4 | 2.1 | 3.2 | 3 | 3.4 | 3.2 | 3.5 | 2.6 | 3.2 | 2 | 1.9 | 2.4 | 2.6 | 2.3 | 1.8 | 1.9 |
| **Co** | 6.7 | 12.2 | 7.7 | 8.7 | 8.4 | 7.3 | 7.7 | 14.3 | 8 | 14.6 | 13.7 | 12.8 | 14 | 14.7 | 13.8 | 14.1 |
| **Hf** | 4 | 4 | 4.1 | 3.5 | 4.7 | 4.1 | 4.8 | 4.3 | 4.2 | 3.9 | 5 | 4.5 | 4.4 | 5.2 | 5.2 | 4.1 |
| **Nb** | 13.9 | 12.8 | 14.6 | 14.1 | 15 | 14.1 | 13.4 | 12.2 | 13.3 | 12.5 | 13.5 | 13.1 | 12.1 | 12.6 | 13.8 | 11.4 |
| **Rb** | 125.9 | 93.4 | 130.5 | 115.2 | 131.6 | 122.7 | 130.4 | 99.6 | 135.3 | 92.3 | 91.9 | 95.5 | 94.4 | 96.9 | 93 | 90.3 |
| **Ba** | 1024 | 490 | 1027 | 984 | 1015 | 980 | 988 | 621 | 981 | 1151 | 1103 | 1055 | 1120 | 1176 | 1134 | 1087 |
| **Sr** | 529.2 | 524.9 | 501.8 | 514.5 | 503.7 | 541 | 479.4 | 577.4 | 518.8 | 949.5 | 906.7 | 858.2 | 906.4 | 878.4 | 900.7 | 925.6 |
| **Pb** | 3.2 | 5.4 | 3.5 | 2.4 | 2.8 | 3.5 | 2.5 | 5 | 7.8 | 2.3 | 1.9 | 1.8 | 1.8 | 1.9 | 2 | 2.1 |
| **Zn** | 27 | 35 | 23 | 30 | 31 | 25 | 26 | 39 | 35 | 19 | 15 | 17 | 20 | 18 | 16 | 14 |
| **Ta** | 1.3 | 1 | 1.5 | 1.1 | 1.4 | 1.2 | 1.3 | 1 | 1.2 | 1 | 0.7 | 1.2 | 1 | 1 | 0.9 | 0.9 |
| **Th** | 23.3 | 20.4 | 26.8 | 23.7 | 26.7 | 24.4 | 24.6 | 17.7 | 25.7 | 21.2 | 21.3 | 20.7 | 22 | 22.3 | 21.3 | 20.7 |
| **U** | 7.7 | 6.3 | 8.8 | 7.7 | 9 | 8.9 | 9 | 7.3 | 8.1 | 6.6 | 6.3 | 6.3 | 6.2 | 6.5 | 6.5 | 6.4 |
| **Zr** | 151.2 | 133.7 | 166.7 | 143.6 | 168.6 | 155.5 | 170.3 | 146.1 | 157.6 | 173.2 | 168.1 | 164.1 | 174.5 | 175.2 | 170.2 | 164.5 |
| **Y** | 17.5 | 21.2 | 18.5 | 18.6 | 19.1 | 18.2 | 18.6 | 23.2 | 17.8 | 23.9 | 24.9 | 21.6 | 22.1 | 25.1 | 21.9 | 22.8 |
| **La** | 42.5 | 31.6 | 46.9 | 42.8 | 46.6 | 44.1 | 41.4 | 32 | 42.1 | 49.1 | 51.4 | 46 | 49 | 53 | 51.4 | 49.8 |
| **Ce** | 71.5 | 56.7 | 80.9 | 75.2 | 82 | 76.9 | 72 | 58.8 | 73 | 86.4 | 84.6 | 83.1 | 84.4 | 86.7 | 88.4 | 85 |
| **Pr** | 7.3 | 6.32 | 8.32 | 7.83 | 8.47 | 7.96 | 7.56 | 6.49 | 7.38 | 9.6 | 9.35 | 9 | 9.26 | 9.75 | 9.51 | 9.41 |
| **Nd** | 28.6 | 23.7 | 26.8 | 26.9 | 29.8 | 26.8 | 25.8 | 23.9 | 27.3 | 37.1 | 33.8 | 34.6 | 34.1 | 35.5 | 35.5 | 36.3 |
| **Sm** | 4.41 | 4.25 | 4.48 | 4.41 | 4.79 | 4.09 | 4.7 | 4.48 | 4.2 | 5.94 | 5.54 | 5.71 | 5.78 | 6.16 | 5.82 | 5.69 |
| **Eu** | 1.04 | 1.1 | 0.97 | 0.97 | 1.03 | 0.96 | 0.97 | 1.02 | 0.95 | 1.42 | 1.37 | 1.38 | 1.42 | 1.49 | 1.45 | 1.4 |
| **Gd** | 3.88 | 4.07 | 4.22 | 4.14 | 4.49 | 3.86 | 4.09 | 4.32 | 3.64 | 5 | 5.07 | 4.95 | 5.3 | 5.22 | 5.08 | 5.08 |
| **Tb** | 0.54 | 0.64 | 0.59 | 0.56 | 0.6 | 0.57 | 0.58 | 0.68 | 0.53 | 0.7 | 0.7 | 0.67 | 0.72 | 0.77 | 0.7 | 0.73 |
| **Dy** | 3.3 | 3.71 | 3.76 | 3.46 | 3.21 | 3.43 | 3.47 | 4.18 | 3.3 | 3.84 | 3.93 | 4.15 | 3.58 | 4.68 | 3.62 | 3.79 |
| **Ho** | 0.6 | 0.88 | 0.58 | 0.56 | 0.65 | 0.64 | 0.68 | 0.84 | 0.56 | 0.8 | 0.86 | 0.69 | 0.79 | 0.98 | 0.81 | 0.77 |
| **Er** | 1.96 | 2.32 | 2.03 | 1.92 | 1.91 | 1.74 | 1.92 | 2.63 | 1.91 | 2.23 | 2.74 | 1.98 | 2.29 | 2.36 | 2.49 | 2.42 |
| **Tm** | 0.27 | 0.4 | 0.27 | 0.29 | 0.29 | 0.34 | 0.3 | 0.33 | 0.26 | 0.31 | 0.37 | 0.31 | 0.36 | 0.38 | 0.32 | 0.36 |
| **Yb** | 1.6 | 2.2 | 1.99 | 1.69 | 1.87 | 1.88 | 1.77 | 2.12 | 2 | 2.31 | 1.91 | 2.23 | 2.21 | 2.59 | 2.23 | 2.3 |
| **Lu** | 0.29 | 0.41 | 0.33 | 0.31 | 0.33 | 0.29 | 0.28 | 0.39 | 0.25 | 0.32 | 0.33 | 0.32 | 0.3 | 0.35 | 0.33 | 0.39 |

## 4. Discussions and Conclusions

The MMEs have relatively low $SiO_2$ content (50-56%) and intermediate to high molar Mg# (20-55), which is inconsistent with partial melting of the mafic lower crustal rocks, and requires a mantle-derived component. As a whole, existence of colinear variations in Harker diagrams and minor Eu anomaly indicate that fractional crystallization was substantial in the petrogenesis of the Erenlerdagi Volcanites. In contrast, in A/CNK and Y vs $SiO_2$ diagrams (Figure 5) two distinct group appears, which is evident also in Lu vs La, vs #mg diagrams (not shown). Existence of MMEs suggests mafic–felsic interaction and mingling (Barbarin and Didier, 1992; Kocak, 2006) by injection hot mafic magma injected into felsic magma. Accordingly, Temel *et al.* (1998) suggest a mix of mantle and crustal sources for the Erenlerdagı volcanites based on an isotopic study.

The Konya volcanites are characterized by intermediate to high $K_2O$ (1.31-3.62 wt.%), Rb (26-135 ppm), Ba (490-1176 ppm), $K_2O/Na_2O$ (0.5-1.1) and FeOt/MgO (1.44-7.11) ratios, which is similar to Andean type andesites series formed in relation with subduction event, which is evident in some geotectonic setting diagrams. It is likely that the volcanics may have been produced by assimilation-fractional crystallisation process in relation with the collision of Eurasian and Arabian plates.

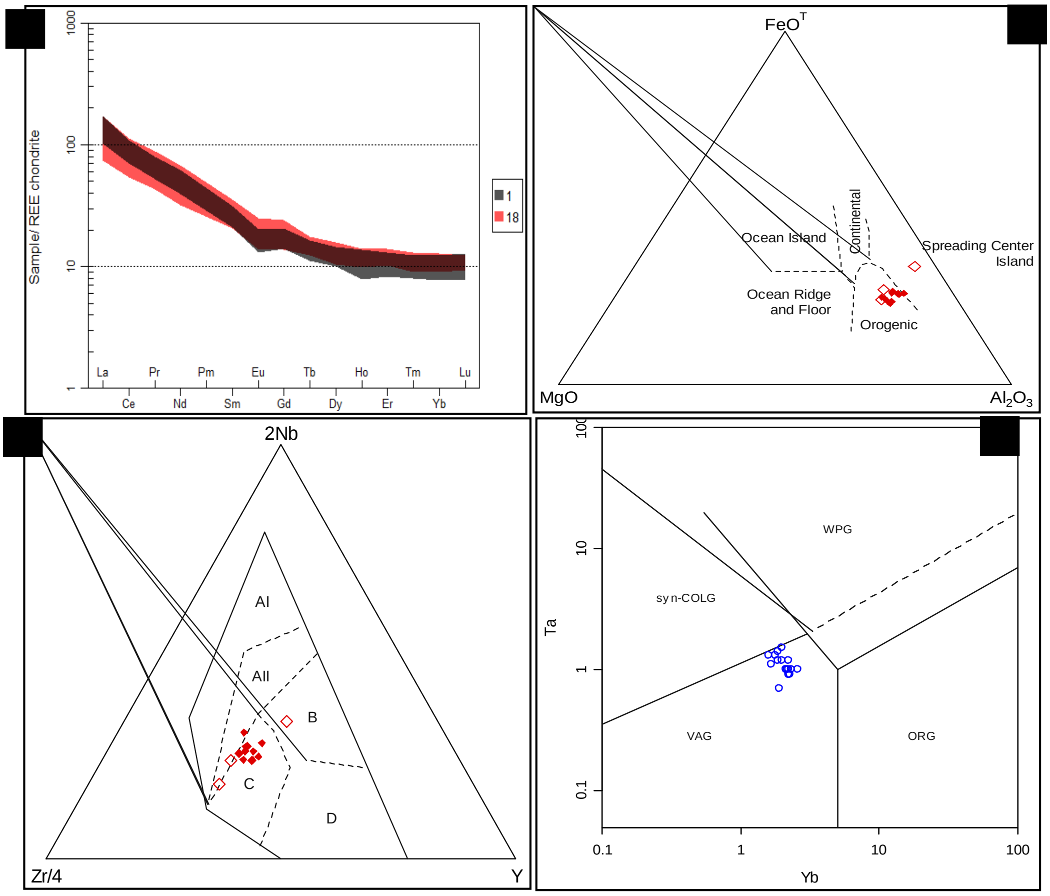


**Figure 4 - a) Chondrite normalized REE pattern of the Sağlık lava domes (1), Takkeli tepevolcanics (2) and sill (3). Normalized values are from Boynton, 1984, b)FeOt-MgO-$Al_2O_3$ ternary diagram (Pearce *et al.*,1977), c) Zr/4-Y-2Nb (Meschede, 1986) (samples with high SiO2(>55) are excluded). AI-II: WP alkaline, AII-C: WP Tholeiitic, B: E-MORB, D: N-MORB, C-D: VAB, d) Ta vs Yb diagram (after Pearce *et al.*, 1984). Symbols; 1: Sağlık lava domes, 18: MMEs, 5: MMEs (Temel *et al.*, 1996).**

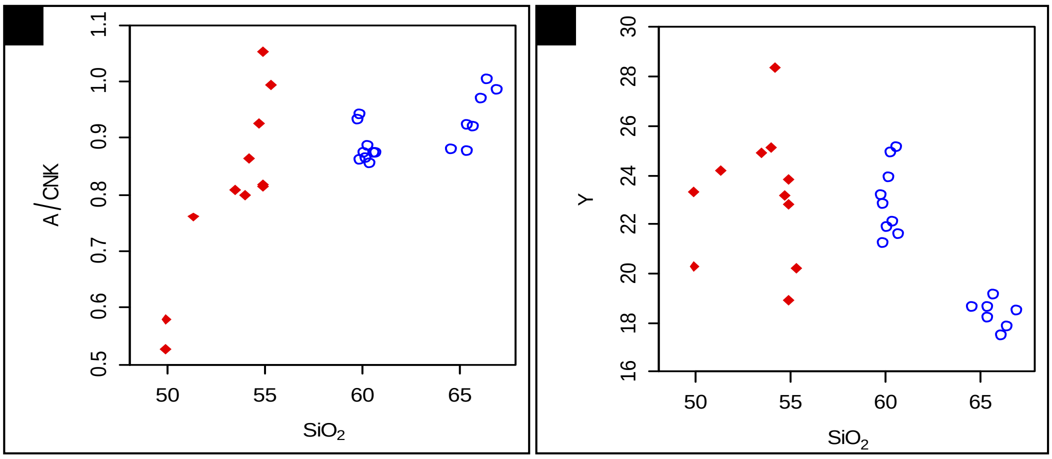


**Figure 5 - a)A/CNK vs $SiO_2$, b) Y vs $SiO_2$. Symbols; 1: Sağlık lava domes, 18: MMEs, 5: MMEs (Temel et al., 1996).**

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