GEOLOGY AND GEOCHEMISTRY OF THE KARADAĞ VOLCANIC SUCCESSION, POLIOCENE - QUATERNARY, CENTRAL ANATOLIA, TURKEY

ŞUKRÜ KOÇ

INTRODUCTION

The karstic formation, developed in Antalya, Turkey, during Neogene and Quaternary periods represents an important example of the volcanics related to continental collision (Pasquale et al., 1988) and is not regarded merely as a sector of present volcanic activity. Karatoğlu (1973) established the petrographical characteristics and obtained radiometric results that are of important significance (Sarac, 1984). In this context, the publication presents the geological and petrographical characteristics of the volcanics developed during Neogene and Quaternary periods in the Karadağ area. Karatoğlu (1973), Pasquale et al., 1988). The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey. The main difficulty is to explain the volcanic characteristics of the area is the lack of a comprehensive volcanological survey. The authors have developed a comprehensive volcanological survey.
GEOLOGY AND GECOCHEMY OF THE KARADAĞ VOLCANIC SUCCESSION, PLOIOCENE - QUATERNARY, CENTRAL ANATOLIA, TURKEY

SÜKRÜ KOÇ

Department of Geological Engineering, Faculty of Science, University of Ankara, TURKEY

(Received January 11, 1990; Accepted May 15, 1990)

ABSTRACT

The Karadağ volcanic succession of Pliocene and Quaternary represents typical continental volcanism of central Anatolia. It consists of mainly lava flows and pyroclastic deposits. Overall, they were produced by magmato-phreatic explosions in four periods through the ploio-ene and Quaternary times. The product of each period can be easily distinguished by weathering surfaces and locally eroded surfaces. Petrographical and geochemical analysis show that they are mostly andesitic and dacitic rocks, originated from partial melting of continental crust.

INTRODUCTION

The volcanic activity, developed in Anatolia (Turkey) during Neogene and Quaternary periods represents one of the most outstanding examples of arc volcanism, related to continental collision (Pasquare et al., 1988), and it has been investigated in several previous works, mainly dealing with its petrographical characteristics (e.g. Jung and Keller, 1972; Innocenti et al., 1975; Keller et al., 1977; Baseng et al., 1977; Buş, 1985; Tankut, 1985). In few studies, this volcanism from stratigraphical and tectonical points of view were discussed (Savaş, 1982; Ercan, 1983; Pasquare et al., 1968). The main difficulty to explain the volcanic evolution of Anatolia is the lack of a complete volcanic succession developed during Neogene and Quaternary. Volcanic fields are quite away from each other. Additionally, characteristics and products of volcanism differ from area to area. There is only one locality in Anatolia, where volcanism of Neogene and Quaternary were superimposedly developed: Karadağ volcanic succession, which is described in this paper. It provides a unique example in order to examine the complete volcanic activities of these times. Generally, it is thought that
the volcanism has been related to moving of Afro-Arabian plate to
the northward direction.

In this paper, the Pliocene and Quaternary volcanic evolution in
Konya-Karaman region (central Anatolia, Turkey) is reported, with
particular reference to the stratigraphy and geochemical analysis of
Karadağ volcanic succession.

THE KARADAĞ VOLCANIC SUCCESSION

The Karadağ volcanic succession, situated in the northwest of Ka-
raman city, covers an area of approximately 600 km². It rests on alluvial
sediments and fresh-water carbonates of Miocene, however, it is largely
underlain by Upper Jurassic and Lower Cretaceous limestones (Birand,
1950; Koç and Kılıç, 1987). Recent alluvium and soils locally superim-
pose the volcanic wits.

The Karadağ volcanic succession forms an important topographic
relief in the large Konya-Karaman plain. The elevations are 1100 m at
the plain and 2288 m at the highest point. Deep recent valleys, incised
the succession radially, provide good cross-sections. Overall, the Kar-
dağ volcanic succession consists of four volcanic sequences (VS), each
of which represents separate volcanic periods (Fig. 1 and 2). The volcanic
sequences are distinguished from each other by placosoi-layered and/or
intensely weathered surfaces. Erosive surfaces are locally developed.
In general, the volcanic sequences are two-partite, comprising volca-
niclastic and lava units. They are described below separately.

Volcanic Sequence 1 (Mercik Sequence):

This is the basal sequence which is situated in Mercik area, some
3 km for away from the volcanic body. It has a core-like geometry and
represents monogenic volcanic center. This sequence consists of mainly
lava flows and subordinate pyroclastics. Units of lava flows are 1 to 3
m thick. Microscopically, they comprise some phenocrysts of plagi-
oclase, biotite and hornblende in a porphyric texture. According to ra-
diometric dating of Besang et al., (1977) lavas emplaced 3, 2 Ma ago.
Probably, it occurred with effusive explosions. The other volcanic cen-
ters might be capped by later explosions.

Volcanic Sequence 2 (Sizak Sequence):

This is one of the main sequences of the Karadağ volcanic succe-
sion. It emplaced largely in NE side of the succession, around Sizak, Kar-
Fig 1. Geological map of the Karadağ area.
Fig. 2. Generalized columnar section of the Karadağ volcanic succession.
talhıkdağ and Kızıldağ areas. Volcanic sequence 2 is composed of at least three monogenic centers which have two subsequences as volcanioclastics in its lower section and lava flows in its upper section.

Stratigraphically, the lowermost part of the first subsequence is composed of pumice-rich deposits, which indicates sedimentary structures of bare surge deposits. Pumice layers are also included. There, relatively finer-grained layers are overlain by very thick, up to 100 m. block-and-ash flow deposits. Average size of blocks is 45 cm. Welding is locally present. All pyroclastics are superimposed and or interfingered by reworked pyroclastic deposits, such as lahars and volcanic mudflows. Thicknesses of the reworked pyroclastic units increase relatively towards the flanks of the VS2.

The second subsequence of VS2 is lava flows with assymmetric dome-like geometries. Units of the subsequence, 1 to 3 m thick, are inclined towards the south, probably due to original topography. Unit thicknesses decrease also in the same direction dating indicates that they emplaced within 2.65–1.95 Ma ago (Besang et al., 1977). Petrographically, lava flow units are composed of augitethornblende-biotite types of andesite.

Volcanic Sequence 3 (Merkez Sequence):

Rocks of this sequence form the main body of the succession, emplacing in the central areas, particularly around Bahar Tepe and Bozdağ. Rock facies and their stratigraphical pattern are similar to VS2, however, volcanioclastics are much more spreaded than VS2's. Pyroclastic surge deposits are typical at the base of the sequence, and they pass laterally and vertically into pyroclastic flow deposits. Pumice-rich and ignimbritic layers are interbedded with coarse-grained, probably block-and-ash flow units. Non-erosional to erosional bases of coarse-grained beds and irregularities in bed geometries suggest that block-and-ash flow units had been deposited as mass flows.

Vertically, pyroclastic units grade up to the flow breccias in addition to lava flows. Lava flow thicknesses reach occasionally up to 5.8 m. Breccias are very coarse-grained and mean size of individual grains is 35 cm in diameter. Lava flow units are in homogene texture, however, flowage structures are locally observed. Radiometric dating of Besang et al., (1977) indicated they occurred 1.1 Ma ago.
Volcanic Sequence 4 (Degle Sequence):

This is the youngest sequence of the Karadağ volcanic succession, mostly situated in SW of VS3, around Bozdağ and Degle dâğ. It includes some dome-like relief, suggesting monogenic volcanic centers.

Pyroclastic units of the sequence are dominantly fine-grained, and locally welded. They are covered by flow breccias and lava flows. The lava units have radial distribution with inclination sometimes up to 45°.

VS4 is not only the youngest sequence, but also the highest level of the Karadağ volcanic succession, creating picturesque morphology due to modern erosion. According to stratigraphic position, lava flows of the sequence (SS4) emplaced at the end of Pleistocene time.

Overall, the four volcanic sequences seem to have been formed by magmatophreatic eruptions, containing abundantly coarse-grained pyroclastics. Block, cobbles, and pebble size fragments are volumetrically dominated with the sequences. Neogene volcanoclastics of central Anatolia, which occurred near and/or in lacustrine environments are relatively finer-grained resulted by phreatic explosions, as tuff or andesites. Consequently, this type of volcanism might be related to Neogene pleogeography of central Anatolia.

GEOCHEMISTRY

Petrographically, the rocks of the Karadağ volcanic succession have rather homogeneous composition. In particular, autolastics and lava flow units of the four sequences are composed of andesite and dacite. Totally 21 rock samples (Tab. 1), collected from the lava units and flow breccias, were analyzed and their C.I.P.W. norms was $\text{Fe}_2\text{O}_3/\text{FeO} = 0.15$ and the results were checked and interpreted by various methods.

As it is seen in Table 2, the rocks of the succession are generally silisium-rich volcanics and their $\text{SiO}_2$ contents are between 59–66 %. According to Pecerillo and Taylor (1975)'s classification, 6 samples are potassium-rich andesites, 12 samples are identified as dacite, 3 samples are andesites (Fig 3). According to another interpretation of this diagram, 7 samples are silisium-rich andesite ($\text{SiO}_2 = 59–62 \%$), while the 14 ones are silisium-rich dacite ($\text{SiO}_2 = 62–66 \%$), and all of them are in calc-alkaline category. Moreover, according to Streckeisen (1967)'s classification (Fig 4), 17 samples are described as dacite while three are referred to latite-andesite and one sample latite.
Table 1. Location and petrographical description of the studied samples.

<table>
<thead>
<tr>
<th>Sample No</th>
<th>Location</th>
<th>Volcanic sequence</th>
<th>Rocky Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>Karaburun Tepe</td>
<td>V84</td>
<td>Dacite</td>
</tr>
<tr>
<td>58</td>
<td>Deliahmet Dere</td>
<td>V83</td>
<td>Dacite</td>
</tr>
<tr>
<td>63</td>
<td>Kuzülepe</td>
<td>V81</td>
<td>Dacite</td>
</tr>
<tr>
<td>68-a</td>
<td>Kuzülepe (SE of Mercik)</td>
<td>V81</td>
<td>Dacite</td>
</tr>
<tr>
<td>68-b</td>
<td>Kuzülepe (SE of Mercik)</td>
<td>V81</td>
<td>Dacite</td>
</tr>
<tr>
<td>72</td>
<td>Bahar Tepe</td>
<td>V84</td>
<td>Andesite</td>
</tr>
<tr>
<td>74</td>
<td>Kuzukulak Dere</td>
<td>V82</td>
<td>Dacite</td>
</tr>
<tr>
<td>75</td>
<td>Mahlaç Tepe-Ulu Çukur</td>
<td>V83</td>
<td>Andesite</td>
</tr>
<tr>
<td>77</td>
<td>Deve Düzü-Sınırlık Tepe</td>
<td>V83</td>
<td>Andesite</td>
</tr>
<tr>
<td>78</td>
<td>South of Sızak Tepe</td>
<td>V82</td>
<td>Andesite</td>
</tr>
<tr>
<td>79</td>
<td>Kartallık Tepe-Sivri Tepe</td>
<td>V82</td>
<td>Dacite</td>
</tr>
<tr>
<td>80</td>
<td>East of Değle Dağ</td>
<td>V84</td>
<td>Dacite</td>
</tr>
<tr>
<td>81</td>
<td>Yassı Tepe</td>
<td>V84</td>
<td>Dacite</td>
</tr>
<tr>
<td>82</td>
<td>North of Kartallık Tepe</td>
<td>V82</td>
<td>Andesite</td>
</tr>
<tr>
<td>85-a</td>
<td>Around Bahar Tepe</td>
<td>V83</td>
<td>Andesite</td>
</tr>
<tr>
<td>85</td>
<td>&quot; &quot; &quot;</td>
<td>V83</td>
<td>Andesite</td>
</tr>
<tr>
<td>85-d</td>
<td>&quot; &quot; &quot;</td>
<td>V83</td>
<td>Dacite</td>
</tr>
<tr>
<td>86-a</td>
<td>&quot; &quot; &quot;</td>
<td>V84</td>
<td>Andesite</td>
</tr>
<tr>
<td>90</td>
<td>South of Uluçukur</td>
<td>V83</td>
<td>Andesite</td>
</tr>
<tr>
<td>103</td>
<td>North of Halıhoca Ağlı</td>
<td>V83</td>
<td>Dacite</td>
</tr>
<tr>
<td>104</td>
<td>South of Halıhoca Ağlı</td>
<td>V83</td>
<td>Dacite</td>
</tr>
</tbody>
</table>

The charges in total alcaline content of the rocks against SiO₂ content are illustrated in Figure 5. Kuro (1966) classifies the rocks into 3 groups as pigeonitic (tholeitic) - , hipersthenic (high Al) - and alcaline rocks by using the above mentioned changes. Except one sample of Karadağ volcanies, all the others are in calcacaline fields (Fig. 5). The same results are also obtained by using McDonald (1968); and Irwinand Baragar (1971)'s criteria (Fig. 5).
<table>
<thead>
<tr>
<th>J</th>
<th>A</th>
<th>W</th>
<th>Y</th>
<th>1</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
<th>R</th>
<th>S</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>35</td>
</tr>
<tr>
<td>36</td>
<td>37</td>
<td>38</td>
<td>39</td>
<td>40</td>
<td>41</td>
<td>42</td>
<td>43</td>
<td>44</td>
<td>45</td>
<td>46</td>
<td>47</td>
</tr>
<tr>
<td>48</td>
<td>49</td>
<td>50</td>
<td>51</td>
<td>52</td>
<td>53</td>
<td>54</td>
<td>55</td>
<td>56</td>
<td>57</td>
<td>58</td>
<td>59</td>
</tr>
</tbody>
</table>

Table 2: Whig elements and ChRv host cell volume ratios.
Fig. 3. Classification of the Karadağ volcanic rocks in $K_2O$—$SiO_2$ diagram of Peccerillo and Taylor (1976).

Fig. 4. Classification of the Karadağ volcanic rocks according to Streckeisen (1967).
Fig. 5. Alcali—SiO₂ diagram for the samples. The heavy line and the dashed-line classify the alcaline fields (AB) and the subalcaline fields (CA) [After MacDonald, 1968 and Irvine and Baragar, 1971]. The dotted-line classifies also high Al Series (CA) and theoleitic series (TH) [After Kuno, 1966].

No rock samples of the succession, which are found in subalcaline field of Figure 5, show any increase in the content and hence they are in calcalkaline fields in AFM diagram (Fig. 6). The correlation of normative color index (NCI) and normative plagioclase composition (NPC) [the diagram of Irwin and Baagar (1971)] indicates that the studied samples are grouped on the line of andesite-dacite and particularly 11 samples are referred as dacite and 10 samples on andesite field (Fig. 7). Here, in the Ab'-An-Or triangle diagram, concluded from CIPW norms, all rocks are seen mostly potassic composition (Fig. 8). According to Irwin and Baragar (1911)'s classification based on normative plagioclase composition and Al₂O₃ contents, the samples are mostly in calc-alkaline area (Fig. 9).

The \( \tau \) values (\( \tau = Al₂O₃ - Na₂O/TiO₂ \)) of rocks are generally greater than 10, hence, they indicate sialic origin (Rittman, 1968). What is more, the same results is emphasised by the log \( \tau - \log \delta \) diagram (Fig. 10).
DISCUSSIONS AND CONCLUSIONS

a) Petrogenesis of the Karadağ Volcanics:

From geochemical point of view, the rocks of Karadağ succession have an intermediate acidic calc-alkaline characteristics and they are sialic origin. Additionally, some of them are andesite and some are dacite in petrographical definitions. Similar results are also reported by some previous works on the different volcanic areas of Turkey (e.g. Keller and Villari, 1972; Baş, 1979; Erean, 1983; Terzioğlu, 1986).
Acidic volcanics may be originated by various ways, for example, by the contamination of basic magma with crustal material (Kuno, 1950) or by differentiation of basic magma (Kuno, 1968), or by anatexis of crustal material (Winkler, 1974), or also by partly melting of upper mantle components in high-water phase (Kuso, 1970). Origin of the Karadağ volcanic rocks seem to be rather complex. Both their mineralogical and geochemical compositions match to crustal rocks (granite, granodiorite). Consequently, this concordance may suggest partial melting of continental crust. On the other hand, presence of lamprophyrized Ti-augite minerals within the studied rocks may also indicate a magmatic contamination. However, no basic magmatic rock is observed in hybridisation in the study area. Their presence in the crust may have been masked by the complex tectonic regime, at least since Late Miocene. So far, hybridisation was mentioned for volcanics emplaced in northern part of central Anatolia (Tankut, 1985; Terzioglu, 1986). Further systematic studies on thin sections are necessary to clarify the view.

b) Volcanic evolution:

On the basis of stratigraphy of the Karadağ volcanic succession, four main periods can be distinguished in the Pliocene and Quaternary.
volcanic activity of Konya-Karaman region, separated by paleosoil layers and local erosion surfaces. Figure 2 illustrates a possible serial evolution of the volcanic activity in this area. The internal stratigraphy of individual sequences are typical with the comprising pyroclastics at the base as explosive products and lava units at the top as effusive products.

The oldest period of volcanism is mainly represented by Mercik volcanic sequence (VSI), predominantly formed by lava flows. This period, before 3.2 Ma (Besang et al., 1977), is characterized by mostly effusive activity. It has a mesogenic center placed at the southmost tip of the succession (Fig. 1).
Fig. 9. Plots of wt % Al$_2$O$_3$ — normative plagioclase compositions of the Karadağ volcanic succession [Irving and Baragar, 1971].

Fig. 10. The Log$_{10}$-Log$_T$ diagram of Karadağ volcanic rocks.
The second period has occurred about 2.05 to 1.95 Ma ago (Besang et al. 1977). It has mostly explosive characteristics. At least three monogenic centers developed representing present Kartalhık dağ, Sizak dağ and Kızıldağ elevations (dağ in Turkish means hill, mountain) The third period (1.1 Ma ago) was probably the greatest volcanic activity, giving a caldera 2 km long and 1.5 km wide in the Merkez area (Fig. 1). This monogenic center produced mainly pyroclastic deposits (Fig. 2). The last period (late Pleistocene) is represented by the formation of Bozdağ and Değdéladag volcanics which include very thick units of lava flows and flow breccias. The volcanics of this period were produced by at least two monogenic centers at the northern side of the succession (Fig. 1).

Beginning of the volcanic activity in Konya-Karaman region should be related to geological setting of the central Anatolia, possibly collision of Afro-Arabian plate and Anatolian plate (Pasquare et al. 1988). However, its evolution varies locally. The characteristics of the Karadağ volcanic succession is the presence of large lava flow units (Fig. 2). During each period, pyroclastic deposits were predominantly produced by explosive activities, and then lava emplaced. This sequential development suggests that volcanic activity of each period has been extinguished in time and resumed in the next period. We suggest that this two-partite stratigraphy and/or extinction of volcanism might be related to not only regional tectonics, but also to paleogeography. In areas of central Anatolia where pyroclastics are common deposits, synchronous lacustine deposits are also widespread and volcanism seems to have been influenced by large Neogene lakes. The lack of Plio-quaternary lacustine environment around the study area (Fig. 1), suggests effusive magmatophreatic eruptions giving thick lava units.

ACKNOWLEDGMENTS

The author would like to acknowledge the support of Mineral Research and Exploration Institute of Turkey (M.T.A.), which made this study possible. Thanks are to S. Sancar, Z. Gözler, N. Aydoğ'an for providing logistic supports, to Poyraz for petrographical description of samples and N. Kazanci for critically reviewing the manuscript.
REFERENCES


