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Petrology, mineral chemistry and tectono-magmatic setting of volcanic rocks from northeast Farmahin, north of Arak

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Introduction

The study area is a small part of the Urumieh-Dokhtar structural zone in the Markazi province, located in the northeastern part of the Farmahin, north of Arak (Hajian, 1970). The volcanic rocks studied from the area include andesite, dacite, rhyodacite, ignimbrite and tuff of Middle to Late Eocene age (middle Lutetian to upper Lutetian) (Ameri et al., 2009). It seems that folding and faulting is caused in sedimentary basin and volcanic activities. On the other hand, except of orogeny maybe rifting had rule in eruption so that this case has seen in the other area such as Taft and Khezrabad in central Iran (Zarei Sahamieh et al., 2008). The oldest formation in the studied area is Triassic limestones. The dominant textures of these rocks are porphyritic, microlite porphyritic, microlitic and rarely sieve-texture. Sieve texture and dusty texture (dusty plagioclases) indicates magma mixing. Mineralogically, they contain plagioclases, clinopyroxenes, amphiboles, quartz and biotite as the main constituents and zircon, apatite, and opaque minerals as accessories. Plagioclases in the andesitic and basaltic- andesite rocks are labradorite, bytownite and anorthite (based on electron microprobe) .Moreover, plagioclases in andesitic rocks show that H_2O is lesser than 2.5 precent. Amphibole is found in both plagioclases and groundmass.

Materials and methods

In this article are used different analyses methods such as XRF, ICP-MS and EPMA.

Whole-rock major and trace element analyses were determined with ICP-MS method.

The major and trace element composition of some rock was determined by electron probe micro-analysis (EPMA) using a Cameca SX100 instrument in Iran Mineral Processing Research Center (IMPRC). Moreover, whole-rock major and some trace element analyses for some samples were obtained by X-ray fluorescence (XRF), using an ARL Advant-XP automated X-ray spectrometer.

Results

Chemical data based on electron micro probe studies of minerals indicate the presence of labradorite, bytownite, anorthite as the plagioclases in volcanic rocks, as well as augite, pigeonite and clinoenstatite among the pyroxenes are abundant. Microscopic study of these lavas and pyroclastic rocks show evidences of magmatic contamination in the form of oscillatory zoning, resorption rims in plagioclase and presence of basic inclusions. The presence of oxidized amphibole rims (in hornblende) indicates the high temperature of the magma at the time of eruption.

Based on geochemistry especially the ratio of Eu/Eu* is variable between liquid and solid phases. The calculated of this ratio in studied rocks show negative anomaly (Eu<1) (Tabatabai Manesh et al., 2010).

According to classification diagrams is used of different diagrams for example TAS/SiO_2, R1-R2 and Zr/TiO_2-Nb/Y. TAS/SiO_2 diagram show that the rocks are of basaltic-andesite, andesite and dacite. R1-R2 diagram show these rocks are andesite, andesi-basalt, dacite and rhyodacite. Finally, based on Zr/TiO_2-Nb/Y the rocks in area under study are andesite, basalt, dacite and rhyodacite type.

The geochemical diagrams (such as AFM) for identify of mama series show that the rocks studied are calc-alkaline and A/NK-A/CNK show

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magma is peraluminous to metaluminous in nature. Enrichment of incompatible and LILE elements such as Ba, K and Rb show that contamination of magma with continental crust have been occurred in this area. Similarity between REE patterns in all samples is related to common source for all volcanic rocks in the studied area.

Discussion

The tectonic setting diagrams show that these rocks belong to the continental margin which have been involved in a subduction zone and belong to the orogenic andesite belt.

The position of the samples on the major elements-SiO_2 diagrams indicate that magma differentiation has been occurred. Spider diagrams show depletion and enrichment that the type of rocks in studied area have positive anomalous of Rb and negative anomalous of Nb and Ti, this phenomenon shows contamination between magma and crustal rocks (Ghasemi and Talbot, 2006; Rollinson, 1993). Comparison of spider diagrams normalized to chondrite or MORB also show that the parent magma has been contaminated. It appears that assimilation and fractional crystallization (AFC) were the dominant processes in the genesis of the studied volcanic rocks (Roozbehani and Arvin, 2010). As a conclusion and regarding to what we said in this article ,the area under study are included both lava and pyroclastic rocks such as andesite, dacite, rhyodacite, ignimbrite ,tuff and tuffits that cut by younger dykes and belong to Middle to Late Eocene age(middle Lutetian to upper Lutetian).There is no rocks older than Triassic age. Volcanic rocks have been occurred in two environments, dry and water together. From volumetric point of view, Aciditic and intermediate rocks such as dacite, rhyodacite and andesite are the most in the area under study (Ahmadian et al., 2010). Basitic rocks are a lesser amount than the others.

Regarding to all evidences such as field works, structurally, texturally, mineralogically, geochemically and petrologically show that rocks in studied area belong to subduction zone and magma that created of these rocks have been originated from mantle and contaminated with continental crust during eruption and rising.

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