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Petrology and petrography consideration of Takestan North West tertiary volcanism (Gharebagh-Nikoieh)

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Key words: Geochemistry, Petrography, Takestan.

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Abstract

Present study considers a part of tertiary volcanism (middle-upper Eocene) in the west page 1:100000 of Takestan (Gharebagh to Nikoie).Regarding petrography studies, igneous rocks of this zone include acid to basic volcanic rocks such as dacite, trachydacite, trachyandesite, andesite, trachybasalt, andesite basalt, pitted andesite basalt, basaltic andesite, basalt (micro gabbro) and pyroclastic rocks include glassy iron released lapilli tuff and tuff *ignimbrite*.In petrology considerations of understudied zone, petrography evidences of magmatic intermixture were seen, among these evidences burned margin around biotite mineral, corrosion margin of plagioclase, oscillatory zoning of plagioclase, glomeroporphyritic texture, and sometimes presence of alkaline minerals such as pyroxene and plagioclase in acid dough can be mentioned.On the basis of geochemical graphs, Takestan volcanic alkaline rocks mostly are locatedin active continental margin and belong to orogenic zone.Dispersion of some chemical elements in Harker graphs can be attributed to some processes such as alteration or contamination and pollution of magmas that are creators of Takestan volcanic rocks with upper crust.

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Introduction

Understudied zone is located in 1:100000 plate of Takestan among eastern longitude of 49°03' to 50° and northern latitude of 36° to 36°30'. This zone is surrounded by Nikoie, Kanshgin and margsin villages from north and Gharebagh and Shinine villages from south. The area of this town is 2430 km² and is located at the west part of Qazvin province, and is 40 km far from center of Qazvin and is linked to it by old road and freeway (Tehran-Zanjan) (Fig. 1). Rock sets of this zone are part of tertiary igneous belt and are counted as Alborz structural area. The aim of present study is petrography, petrology and geochemistry considerations of this zone.

Generally, Takestan region's rocks have mostly bright and very light grayish color and this is due to young acidic rocks which have placed on basic and sometimes neutral rocks. Of course it should be mentioned that Neghraneh mount has been formed of basalts despite of its young age; totally dark basaltic and andesitic rocks are not frequent despite of their young ages. Another important issue from geomorphological aspect is red color of destructive sediments that cover flat and relatively flat segments where is part of the Qazvin great plain.

As the older rocks are mostly basic and neutral and are rich of ferromagnesian elements, the achieved sediments from plain surface mostly are the result of erosion and destruction of such rocks, therefore there is not enough opportunity for erosion, destruction and transference of sediments of acid rocks mostly rhyolitic and tuff rhyolitic rocks that are poor of ferromagnesian elements and probably hardness of such rocks can lead to slow pace of erosion.

During considerations of understudied zone achieved igneous rocks are divided to external igneous rocks (volcanic) and pyroclastic rocks. As volcanic rocks are grained and glassy, exact identification of their mineralogy components is not possible, but using microscopic studies is unavoidable.

Fig. 1. Geological situation of understudied zone regarding around cities and villages.

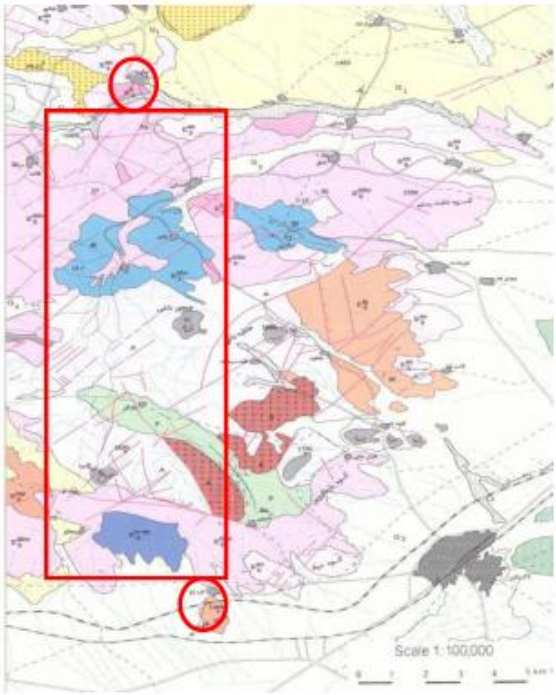

Fig. 2. Geological map of understudied zone petrography studies.

Pyroclastic rocks are less frequent than volcanic rocks and are the result of exploding eruptions and sediments in shallow marine environments.

The most important fault existing in this region, is drift fault of north of Qazvin that is pressurized type that has put Eocene sedimentary- volcanic deposits on equivalent units of Hezardareh. It expands from east to west with a length of about 45km and a slope

of about 30-60 degree toward north-north east. Another existed fault in this region is Ashena fault that has put clastic deposits of Shemshak formation on cretaceous orbitolina lime stones; it expands from east to west and then its direction changes to north east to south west. Its slope is toward south and has 3-6 degree angle. Agha-baba fault which was studied by Barbarian and Ghoreishi (1993) extends from north east to south west and 5 km length and is located at the bottom of young eroded quaternary sediments hills. Shinine fault extends from North West to south east with a slope of 50-60 degree toward south with about 6 km length. Region's stratiforms are fault dependent and can be persuaded in north east to south west (Alai mahabadi and Fonodi, 1993).

The purpose of this study is Petrology and Petrography consideration of Takestan North West Tertiary Volcanism (Gharebagh-Nikoieh) and finds petrography evidences of magmatic intermixture.

Material and methods

Sampling and Analytical techniques

From rock outcrops of understudied zone, 45 samples were gathered and were classified regarding the results of microscopic studies, on this base magmas include (andesite, trachyandesite, andesite-dacite, dacite and riodacite) and plagioclase rocks include (tuff, crystal-vitric tuff, glassy crystal lithic tuff, volcano clastic and ignimbrite). Petrography evidences show magmatic pollution and intermixture in understudied zone. Among these evidences burned margin around biotite mineral, corrosion margin of plagioclase, oscillatory zoning of plagioclase, glomeroporphyritictissue, which is the result of phenocrysts' accumulation and interaction between phenocrysts and hybrid magmas, can be mentioned (Shelley, 1993).

Results and discussion

Petrology

On the basis of petrography evidences, Takestan volcanic rocks have been beard alteration, the resulted mineral of such alteration mostly are hydrous and alteration is observed in the format of various phenomenon such as Chloritization, albitizationof plagioclase margin, *serpentinization of olivine, clayelization, epidotization. Such* paragenesis mostly was at the level of green schist face and is formed under the pressure lower than 3 kb and affected by passing fluids that pass through break downs and joint (that was appeared by function of main fault of Qazvin-Takestan and as a result of inconsistency of some minerals such as plagioclase, pyroxene and olivine).

Fig. 3. A view of Eocene altered basaltic magmas of southern part of Kenshgin village.

Fig. 4. Spherical segment of magma inside the Eocene ferruginous part north east of Nikoie.

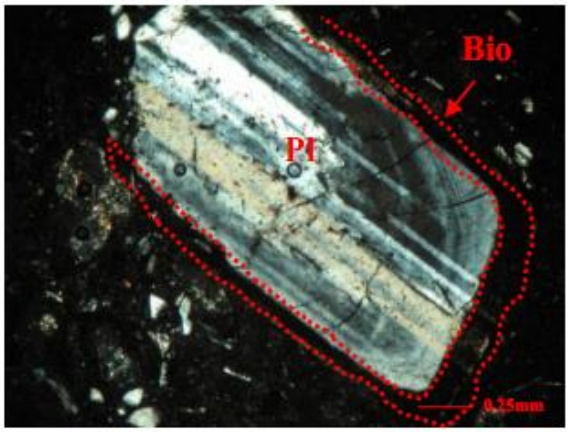

Fig. 5. Oscillatory zoning in the marginal part of plagioclase crystal in the andesite-dacite (under the XPL light).

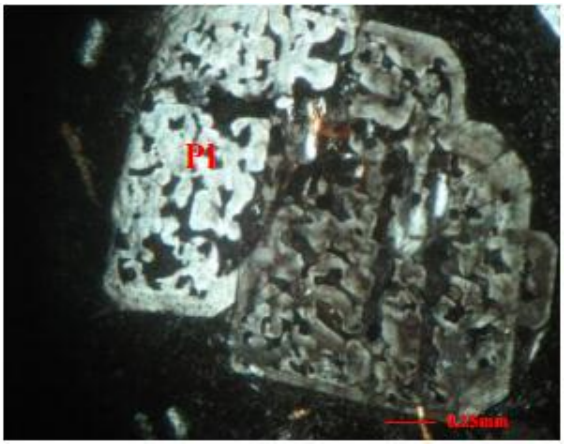

Fig. 6. Ethomoid texture of plagioclase and Oscillatory zoning in its margin in the andesite (under the XPL light).

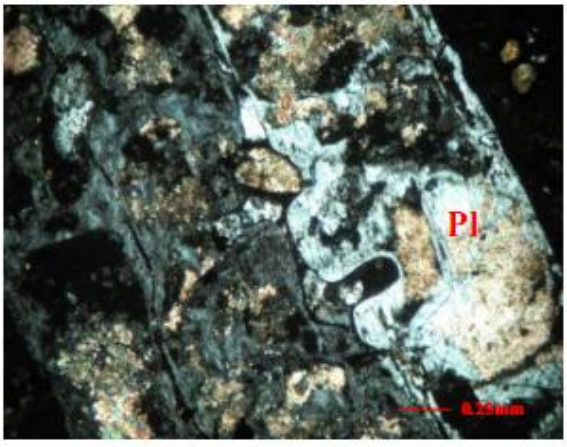

Fig. 7. Alternation of plagioclase crystal with carbonate and opaque in the andesite to altered basaltic andesite (under the XPL light).

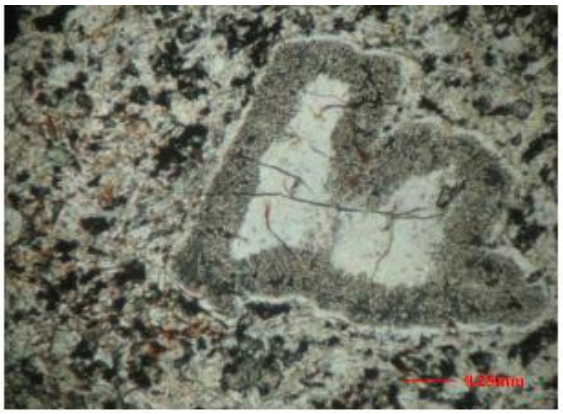

Fig. 8. Pitted porphyritic texture, decomposition of plagioclase phenocrysts to sericite and its transformation from margin to albit in basalt (under the PPL light).

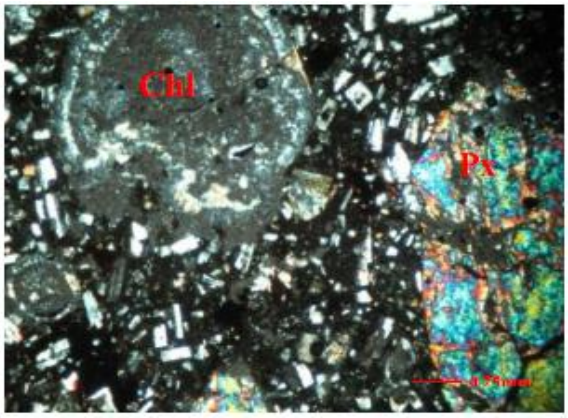

Fig. 9. Pitted porphyritic texture, with filled pits of chlorite and opaque mineral (hematite) in andesite (under the XPL light).

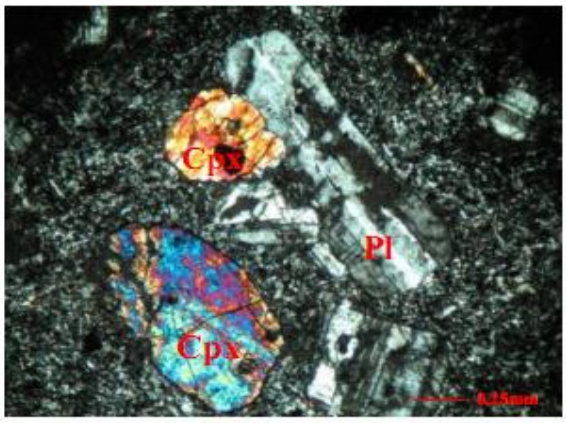

Fig. 10. Microliteporphyritic texture, and porphyritic-glomeroporphyritic texture with accumulation of plagioclase and clinopyroxene in rock's microlite dough (under the PPL light).

Regarding petrographical evidences, Takestan volcanic rocks have been suffered alteration process, achieved minerals of such alteration are aqueous, and alteration is mostly observable as sericitization, chloritization, albitization of the edges of plagioclases, Serpentinization of olivine, clay occurrences, epidotization. This paragenesis is mostly at the level of green schist facies and is formed under the pressure lower than 3kb under the effect of passing fluids from joints and breakages which are appeared because of subsidiary faults, the function of Qazvin, Takestan main fault and inconsistency of some minerals such as plagioclase, pyroxene and somewhat olivine. In addition, in petrology studies on understudied region, some petrography evidences of magmatic mixture and pollution are observable. Some of those evidences are mentioned as follow: burnt opacity margins around biotite, corroded of plagioclase margin, oseillatory zoning in plagioclase mineral and sometimes presence of basic minerals such as pyroxene and plagioclase in an acidic dough and glomeroporphyritic which is the result of phenocrysts accumulation and the reaction between phenocrysts and hybrid magmas (Shelley, 1993).

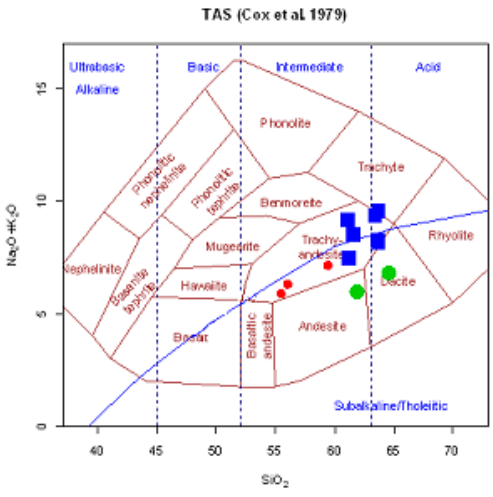

Fig. 11. Naming of Takestan volcanic rocks (Cox *et al.*, 1979).

Geochemistry

There are various methods for naming igneous rocks, which are offered regarding their chemical components. In this section the most relative methods for naming external igneous rocks of Takestan zone between Nikoie and Gharebagh (understudied zone) were used.To do so, TAS graph of Cox *et al.*, (1979), middlemost graph (1994 &1985) were for diversity of naming.

On the basis of these graphs, rocks of understudied zone are classified in the range of dacite to basalt. Totally, naming understudied rocks by various methods led to relatively similar results and showed acceptable conformity with petrography studies.

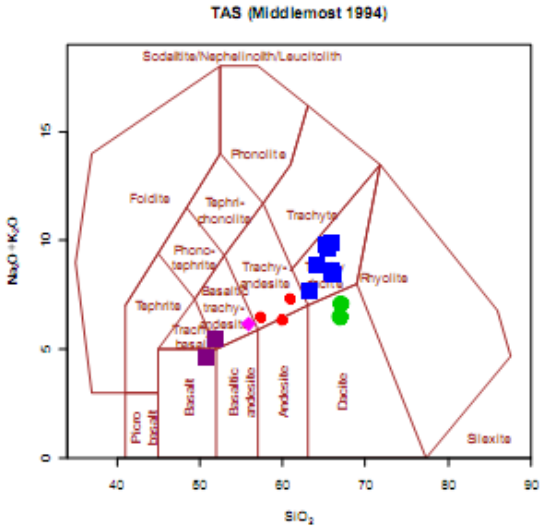

Fig. 12. Naming of Takestan volcanic rocks (Middlemost, 1994).

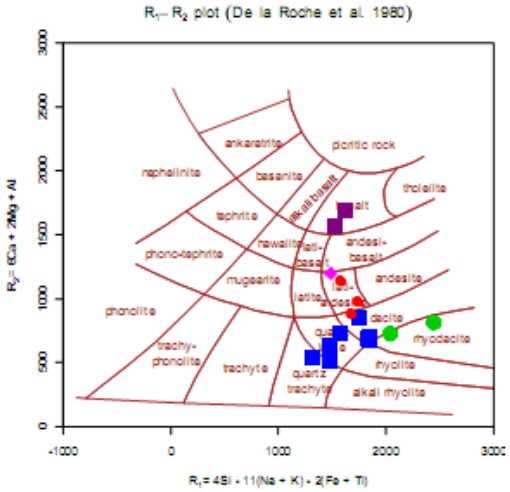

Fig. 13. Cation graph for naming Takestan volcanic rocks (De la Roche *et al.*, 1980) R_1-R_2.

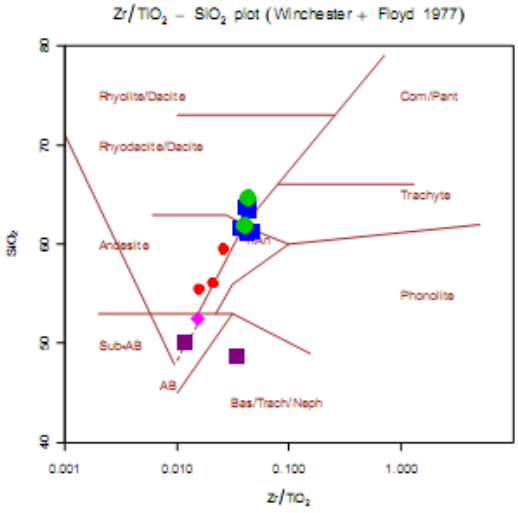

Fig. 14. Naming of Takestan volcanic rocks on the basis of rare elements Winchester & Floyd (1977).

Determination of magmatic series

One of the main aims of petrology study is determination of magmatic series. According to Irvin and Bargar (1971) a magmatic Series contains a set of igneous rocks with various chemical compounds, which has been created by mother magma as a result of crystal differentiation; although on the basis of modern knowledge, the role of other factors such as magma contamination, partial melting in different levels and magmatic intermixture, which can put different rocks in a dependent pseudoaneurysm series, cannot be ignored. In present study, various graphs were used to consider magmatic series of understudied parts. In Irvin and Bargar (1971) graphs two ranges of alkaline and sub-alkaline are separated by weight percentages of SiO_2 by sum of K_2O+Na_2O.

On this base, Takestan sub-alkaline samples mostly have calc-alkaline nature; and as an andesite sample is contaminated by a bit of iron oxide under the effect of alteration, it is located at the border range of *toleitti*-calc alkaline (Fig. 15).

In Peccerillo and Taylor (1970) graph, sub-alkaline samples mostly are in the range of high potassium calc-alkaline, and alkaline-nature samples mostly are classified in the range of shoshoniti series because of enhancement of K_2O level (Fig. 16).

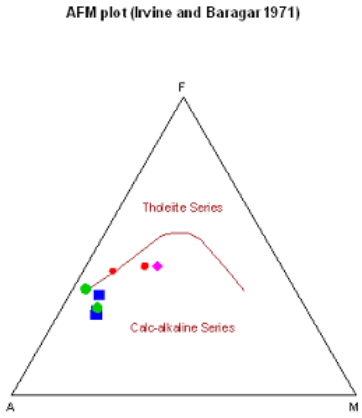

Fig. 15.AFM triangular graph (Irvin and Baragar, 1971) to determine magmatic nature forming Takestan volcanic rocks.

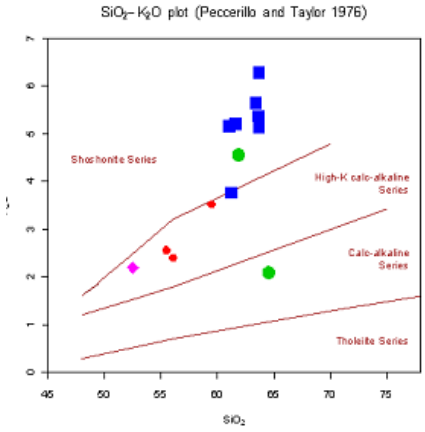

Fig. 16. Peccerillo and Taylor's (1970) graph to determine magmatic nature forming Takestan volcanic rocks.

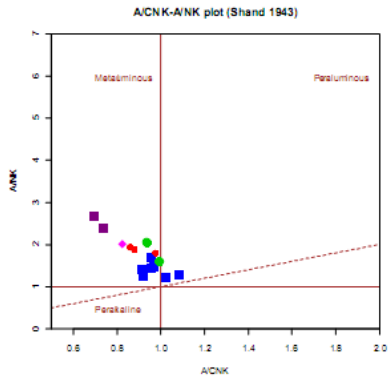

Fig. 17. Determination graph of saturation level of Alumina among Takestan rocks that are mostly categorized in meta-alumina range.

Chemical changes graphs

In the main oxides changes graphs by SiO_2, some elements such as P_2O_5, CaO, MgO, TiO_2, FeOT and Al_2O_3 of middle basic rocks to middle acid rocks followed a descending process and K_2O and Na_2O followed and ascending flow, these flows show that they are correspondent with magmaticdifferentiation. In addition, some of the graph's dispersions can be attributed to some procedures such as alteration or magmatic pollution and contamination of Takestan volcanic rocks with crust materials. Moreover, ascending flow of large Ionicradius elements (LFS) such as Ba, Rb and sedentary incompatible elements such as Zr in comparison with SiO_2 in basic to acid rocks and also dispersion of these elements on the graph are probably because of partial pollution of magma with upper crust.

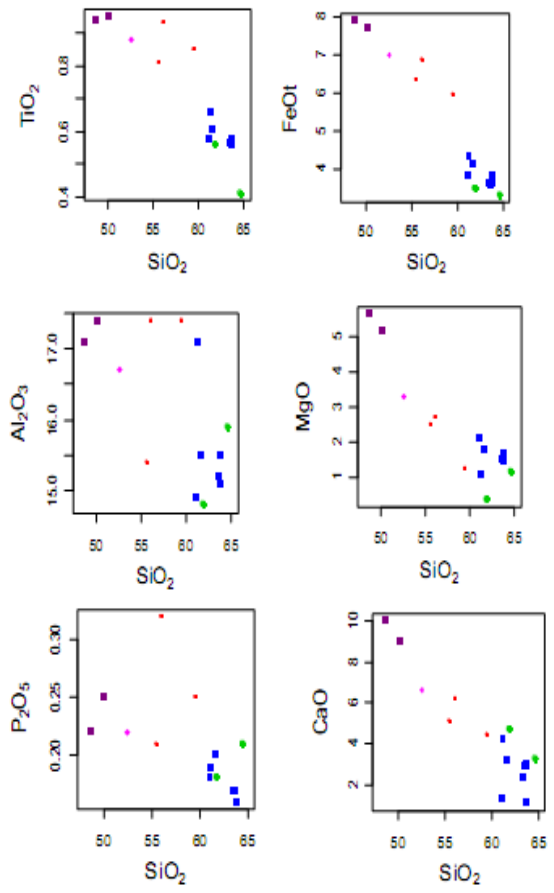

Fig.18. Changes graph of P_2O_5, CaO, MgO, TiO_2, FeOT and Al_2O_3, all six elements show descending process.

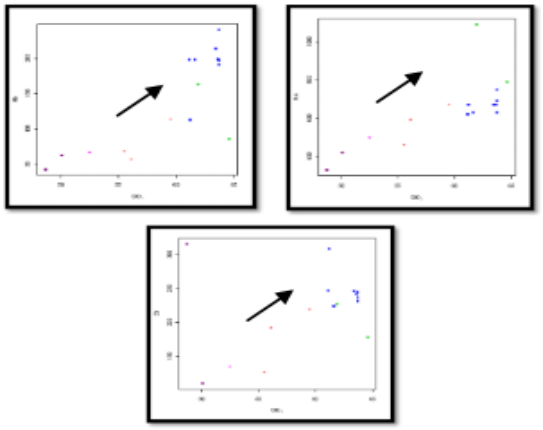

Fig. 19. Changes graph of Ba, Rb and Zr by SiO_2 all three elements show ascending rate.

Determination of tectonic environment

In separating graph of basic rocks' tectonic status (Peareet *al*, 1977), Takestan volcanic rocks such as basalts and basaltic andesits and sub alkaline andesites mostly are classified in the range of Arc Island and continental active margin and belong to orogeny zones (Fig. 20).

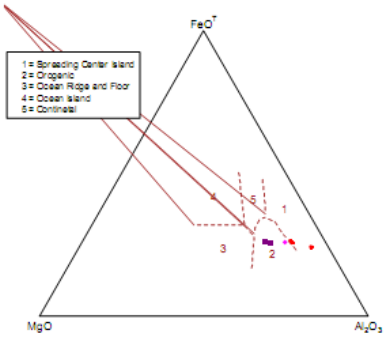

Fig. 20. Pearce *et al.*, (1977) graph shows Takestanbasic volcanic rocks are in the area of Arc Island and continental active margin.

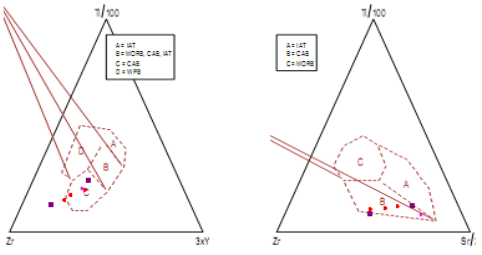

Fig. 21. On the basis of these two graphs Takestan middle-basic rocks are located in the range of calc-alkaline basalts (CAB).

Conclusion

On the basis of petrography evidences, Takestan volcanic rocks have been beard alteration process. *Such* paragenesis mostly was at the level of green schist face and is formed under the pressure lower than 3 kb and affected by passing fluids that pass through break downs and joint (that was appeared by function of main fault of Qazvin-Takestan). The nature of magma forming Takestan volcanic rocks is alkaline and sub-alkaline. Some parts of middle-basic rocks such as basalts have alkaline nature and some other parts have sub-alkaline entity. Sub-alkaline samples are located in toleiti range regarding AFM graph of Irvin and Bargar (1971). In Peccerillo and Taylor (1970) graph, some of the sub-alkaline samples such as middle-acid and basic rocks are in the range of high potassium calc-alkaline and calc-alkaline and even they are classified in the range of shoshoniti series because of enhancement of K_2O level. From tectonic status aspect of Takestan volcanic rocks are allocated to continental active margin and are belonged to orogeny zones.

Dispersion of some chemical elements in Harker graphs can be attributed to some processes such as alteration or contamination and pollution of magmas that are creators of Takestan volcanic rocks with upper crust.

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