Petrology and Geochemistry of Volcanic Rocks in Hoz-e-Soltan Area

A.Y. Chatroodi [1], H. S. Karizaki [2], M. Ghorbani[3]

Abstract**—**the studied area is located in 40 Km north-east of Qom province. In Iran's geological classification, it lies in the Oromeieh-Dokhtar zone. This collection consists of intermittent of lava flows (mainly basalt, basaltic andesite, tracy-andesite, dacite, rhyo-dacite and rhyolite) and pyroclastics (tuff). These lavas are composed essentially of quartz, plagioclase, alkfeldspar, amphibole, biotite, clinopyroxene and olivine, set in a matrix of the same minerals associated with apatite, opaque mineral. Based on the geochemical data, trace and REE element diagrams, these rocks are calc-alkaline. The study of volcanic rocks shows a selective enrichment of large ion lithophile elements (e.g., K, Rb, Pb) and a depletion in elements having high field strength (HFSE) as Nb, Ce, Y compared to chondrites and primitive mantle. Trace element patterns show similarities with volcanic continental arc magma. Therefore, geochemical characteristics of the rocks indicate volcanic rocks of south-west of Hoz-e-Soltan are products of volcanism of lithosfric mantle.

Keywords**—**Petrology, volcanic rocks, Qom, Hoz-e-Soltan.

I. INTRODUCTION

THE study area is located in the north-east of Qom province and south Hoz e Soltan Lake with geological coordinate $50^0 30'$ to $50^0 00'$ eastern length and $34^0 49'$ to $35^0 00'$ northern width. This area is located in East Old Road Tehran-Qom. Volcanic rocks of the region, part of an important tectonic unit as Oromeieh-Dokhtar magmatic belt is based on studies in this area by the Iran Geological organization Survey of Eocene to Quaternary age equivalent to is running. Considering the geological situation in the area to determine the origin of tectonic - magmatic it can be said to understand how the structural development of Oromeieh-Dokhtar belt to help. Therefore, Lithology and geochemistry and tectonic environment of volcanic rocks of south east Hoz e Soltan Lake can be helpful in this regard.

II. METHOD OF DISCUSSED AND EVALUATED

In this study, first by libraries Initial studies were done, after that Reviews field and obtaining laboratory studies samples of the area, microscopic and chemical analysis was performed on these samples and finally the analysis integration of results with the results of previous studies, offered in this paper.

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A. Geological of area

The studied area is located in the West of the central Iran zone and the part of the belt Oromeieh-Dokhtar. The main area covered rocks that about 90 percent of the area to be included Eocene volcanic rocks are formed. This area generally consists of two species of different lithology, including volcanic rocks and pyroclastic rocks. Originally rocks outcrop in this area with Eocene volcanic rocks are formed (old stones covered by Eocene rocks). And other rocks in the area are outcrop owned Oligocene, Pliocene and Quaternary sedimentary rocks that are often be. Eocene volcanic rocks include wide range with combination basaltic andesite, andesite to trachy andesite, quartz andesite, rhyolite and rhyo-dacite and Dacite are to be. The most of pyroclastic rocks are made of tuff that they have been located in beneath the volcanic rocks in the studied area.

B. Petro graphic and chemical naming rocks

The study area generally rocks can be divided into two categories: the volcanic rocks, small intrusion rocks and Dikes. Based on this classification of volcanic rocks including andesite, basalt, acidic volcanic rocks, Pyroclastic rocks; types andesitic volcanic rocks include (andesite, hornbland andesite, andesite to trachy andesite, andesite to quartz andesite) and types basaltic volcanic rocks include (basalt, basaltic andesite, basalt to andesitic basalt), acidic volcanic rocks (in the area include the following stones is: quartz andesite to dacite, to rhyo-dacite, dacite, rhyolite), Pyroclastic rocks (made of tuff) and small intrusion igneous rocks and Dike (with gabbro diorite composition, diabase and dolerite).

C. Magma mixing

Sample distribution of some oxides charts could be indicated partial melting process and alteration. But in this region scattering moving elements such as sodium and potassium oxide are can be related to magma mixing. Litho logy studies also evidence of this claim and show that mixture and magma mixing caused by the diversity of litho logy. Mineralogy unbalanced construction fig (2), Existence quartz in the vicinity olivine fig (3), trace of extermination in pyroxene and there glass shard of basic opacitization fig (1), the microscopic observations would be confirmed this claim. Considering the above and the type of rocks, these rocks can be formed due to be seen the differentiation of mantle-derived basaltic magma.

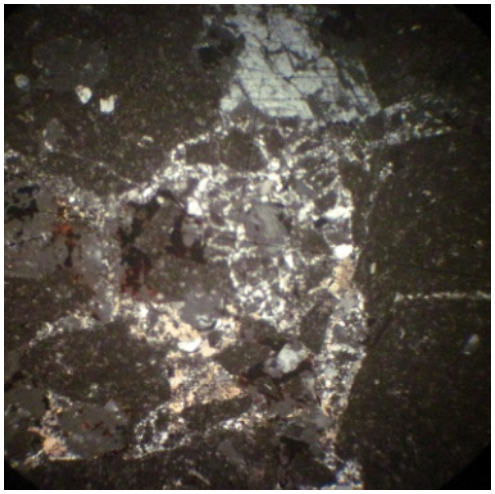

Fig. 1 Glass shared by basic opacitization

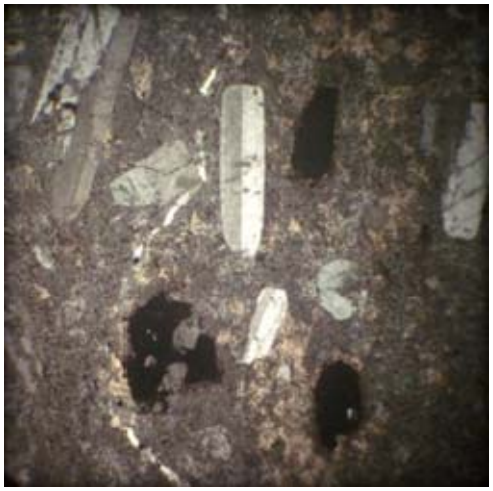

Fig. 2 The perfect plagioclase and alteration plagioclase together

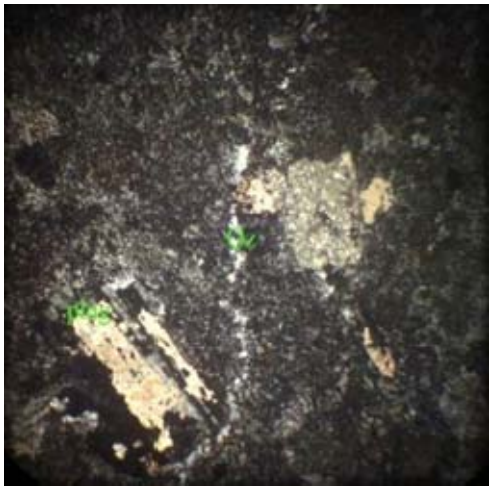

Fig. 3 The existence of quartz in the vicinity of olivine

Based on geochemical data and diagrams Lee Bass et al (1986) and Cox et al (1979) rocks area was evaluated according to the diagrams alkali weight percentage than the percentage of silica in the rock named said. Based on fig (4) and (5), the petrography studies with name those through which chemical data were obtained, showing good agreement. More Pyroclastic rocks are to be type crystalline tuff, glass tuff and Lithic tuff.

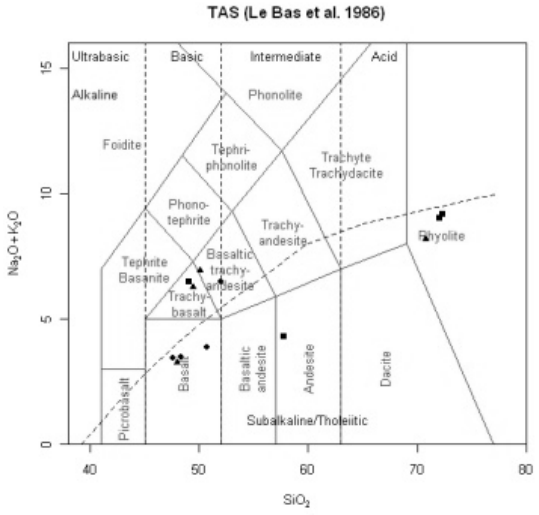

Fig. 4 (TAS) Lee Bass alkali diagram.

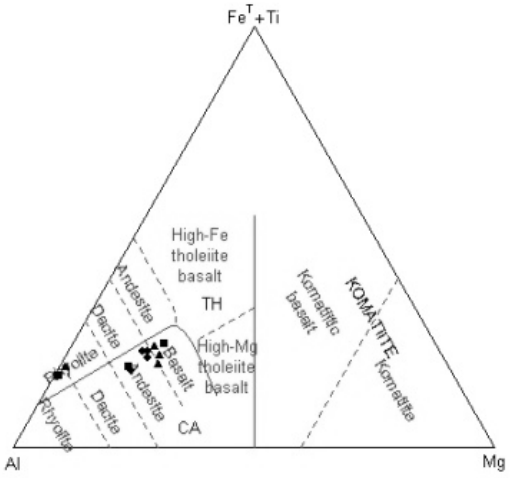

Fig. 5 Jensen diagram with the elements Al, Mg and Ti.

D.Geochemistry of area

Evaluate and determine the chemical composition, type of magmatic series and regional environment magmatic tectonic some sample of chemical analysis of volcanic rocks was analysis XRF method, Table (1). The position of volcanic rocks in the magmatic series of charts to show that most alkaline volcanic rocks are put in the range of sub- alkaline and type of calc-alkaline series.

1) The chemical composition of magma

Chemical analysis of samples the amount of SiO_2 show that rocks in the area are put limited in basic to medium. To study changes in elements and their genetic relationships and understanding the process of crystallization, crystallization part, digestion and magmatic contamination in these studies is used diagrams of major elements oxides than silica. Explain

these cases in magma tables by chemical analysis graphs Harkr is considered, fig (6).

Statuses of this oxide are in the form below graphs: Aluminum oxide with increasing silica in the rocks of medium to basic decline is almost. The oxide structures are plagioclases enter. Titanium oxide samples with increasing silica dispersion showed, but increases almost are. Titanium in the structure of pyroxene, biotitic and horn bland participates. Iron oxide decreases with increasing silica and reagent consumption is it in olivine, pyroxene and biotitic. Structure of manganese iron ores of iron are replaced with to. Therefore, manganese oxide such as iron oxide is a decline. Magnesium oxide like iron oxide is a decline. The more oxidized olivine and pyroxene to enter.

TABLE I
CHEMICAL ANALYSIS RESULTS OF MAJOR AND MINOR ELEMENTS

SAMPLE	MN11	MN12	NL4	MN2	EP8	EP10	MN7	MN 4
SiO2	48.57	51.64	47.36	47.97	48.39	50.24	47.37	47.89
AL2O3	20.19	19.31	20.89	19.83	17.35	19.48	20.84	20.81
FE2O3	8.44	7.63	11.53	10.66	9.80	10.53	9.80	10.56
CAO	10.69	9.75	10.76	6.22	8.24	10.08	10.82	10.69
NA2O	5.27	4.93	2.62	3.75	4.06	2.90	2.54	2.64
K2O	1.12	1.51	0.81	2.33	2.63	0.94	0.68	0.78
MGO	3.48	3.57	4.50	5.18	4.03	3.90	5.54	4.63
TIO2	0.765	0.645	0.737	0.759	1.196	0.698	0.769	0.665
MNO	0.155	0.154	0.178	0.103	0.264	0.177	0.129	0.171
P2O5	0.220	0.162	0.172	0.161	0.596	0.192	0.185	0.153
SO3	0.003	0.002	0.003	0.004	0.001	0.003	0.005	0.003
L.O.I	0.64	0.32	0.16	2.63	3.24	0.42	0.92	0.48
CL	135	73	110	123	118	87	99	109
BA	380	270	176	309	632	182	152	214
SR	556	449	371	358	765	444	395	330
CU	31	39	60	24	12	105	18	116
ZN	75	73	69	107	397	76	91	64
PB	9	12	12	10	18	6	9	3
NI	37	38	59	38	110	41	44	51
CR	10	14	14	4	120	15	25	29
V	184	170	221	212	208	199	238	205
CE	16	2	42	20	37	12	2	18
LA	7	1	20	11	17	6	1	10
W	1	1	1	1	1	1	1	1
MO	8	24	2	5	11	1	1	2
NB	3	4	4	2	13	2	3	1
ZR	121	95	79	64	160	81	67	72

Calcium oxide shows dispersion with increasing silica. This oxide in pyroxene structure is entering to plagioclases. Norm is using the presence of these minerals can be true in the stone proved. Norm is using can also confirm the names mentioned was thus determined that after Norm by using diagrams that specify the name of the stone in order to confirm its authenticity has been named samples.

2) Process changes based on trace elements spider diagrams

One of the most important issues concerning the principles governing subtraction and crystallization of the component part, the stain of the magma, magma mixing and digestion, to study the behavior of trace elements can be during different stages of magmatic transformations.

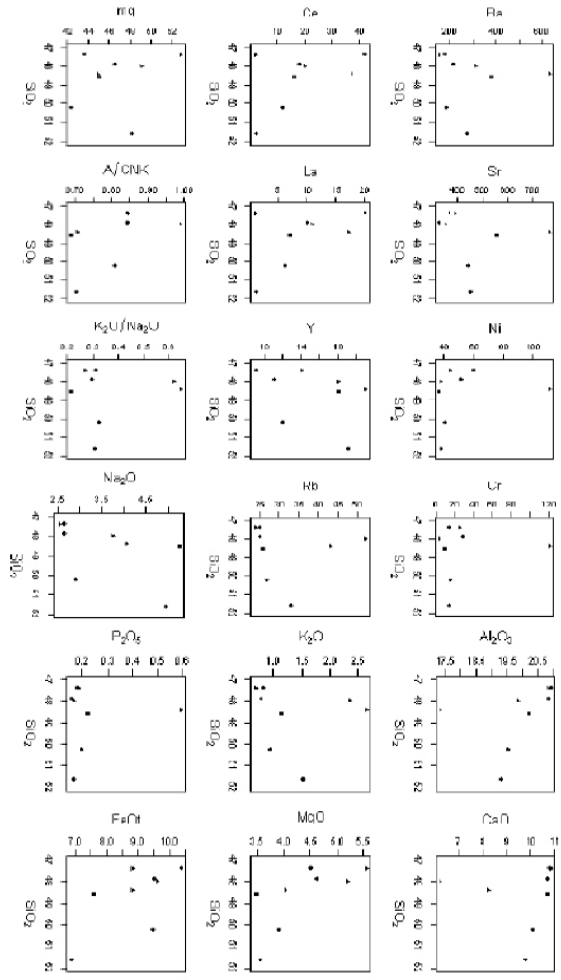

Fig. 6 Harkr diagrams show the magma subtraction

Hence the diagram specific as spider diagrams (Wood et al 1979, Sun 1980, Thompson et al 1984) can be named. In which the frequency of a bunch of incompatible trace elements abundance of land estimated in the primary, are normalized to. These charts - fig (7) and fig (8) - This shows, that region to volcanism mantle lithosphere has been melting.

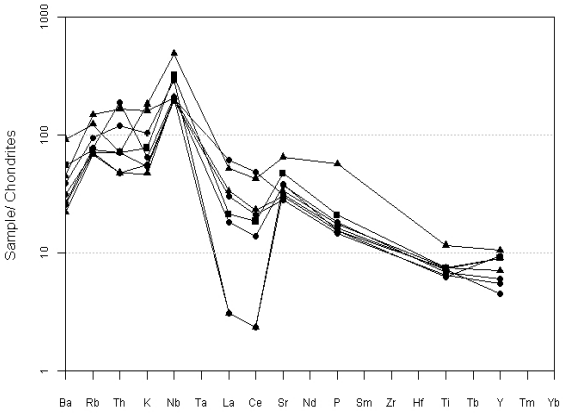

Fig. 7 Process traces elements changes in Chondrites

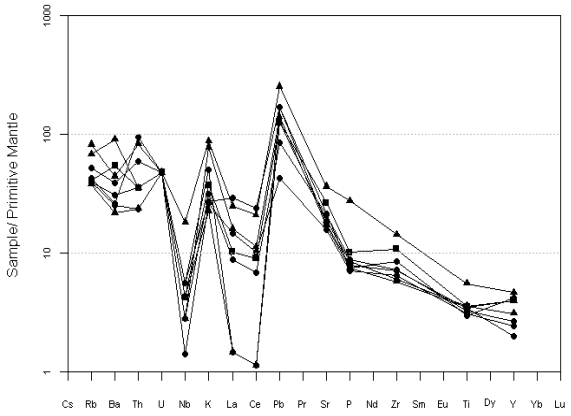

Fig. 8 Process traces elements changes in the primitive mantle.

3) To determine the magmatic series

To determine the magmatic series of graphs are used percent alkaline oxides than silica and AFM diagrams. As noted in the chart is andesite and andesitic basalt in the territory of sub-alkaline and it put in calc-alkaline series, fig (10). Potassium-rich magma mixing of basic magma and under saturated within the continental with the magma calc-alkalin know the percentage of high K can reason on the origin of the crust is also a proof of subduction zones can know. In terms of the geochemical elements based on the Co-Th fig (9) this is verifiable.

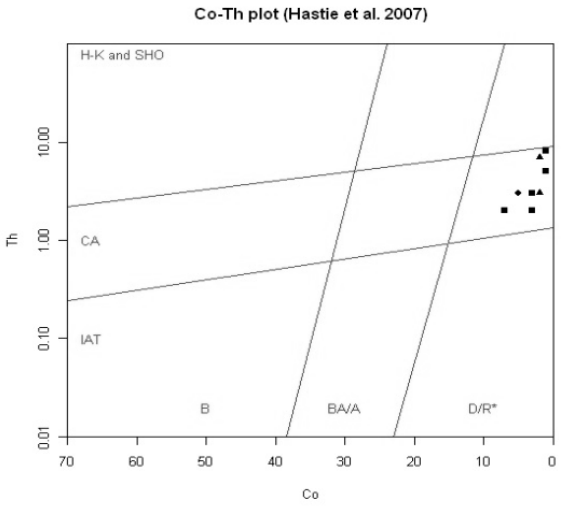

Fig. 9 Hastie diagram for determining the magmatic series

4) Tectonic environment

This type of magma is formed in two tectonic environments: island arc and active continental margins. It is believed that the amount of K_2O than SiO_2 a way that in the islands arc all of the samples located on the one line, fig (13). However, active continental margin be seen scattering in these diagrams. In the triangular diagram $FeO+Fe_2O_3$, MgO, Al_2O_3, put rocks in orogenic zone fig (12).

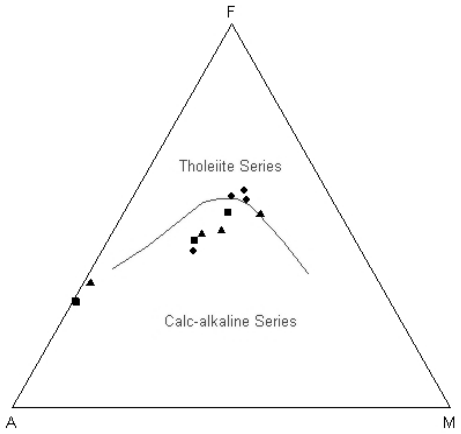

Fig. 10 The determination of the magmatic series by Baragar Irvin

So enrichments in such as samples of basic region is also observed and in Reviews geochemical also according to Pierce and Kan (1973), contains to be three regions A, C, B but more samples are in the region instead of C, fig (11). Therefore, these rocks can be related to active continental margin.

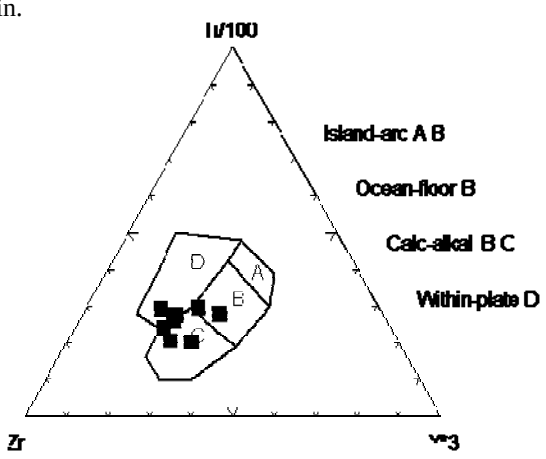

Fig. 11 Pierce and Kan diagram shows the environment in terms of a continent tectonic magmatic

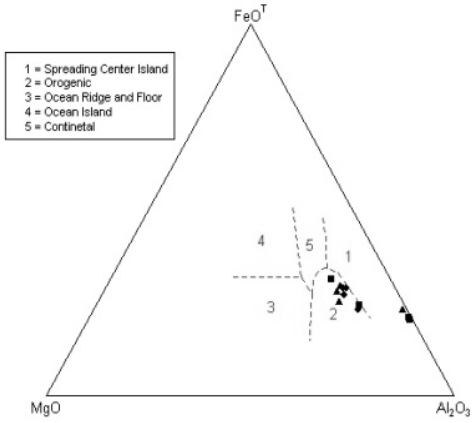

Fig. 12 Diagram shows the presence of orogenic Basalts

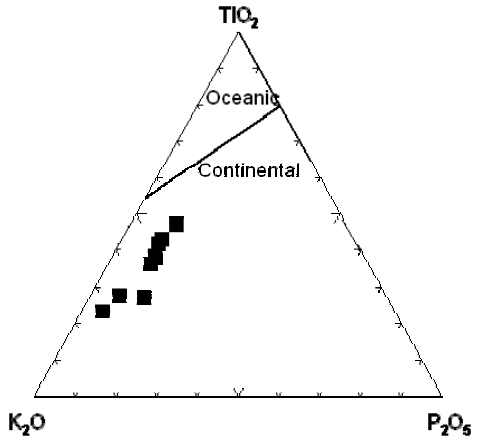

Fig. 13 Pierce et al 1975 diagram shows the region being a continent

III. CONCLUSION

According to microscopic studies to be achieved these results that the studied area from the viewpoint of petrography includes two sets of rocks, volcanic rocks and small intrusion masses and Dikes that volcanic rocks include andesine, basalt, acidic volcanic rocks, Pyroclastic rocks and small intrusion masses, can be including gabbros diorite, diabase and dolerite composition. In some samples being of evidence of magma mixing including the presence of two types of plagioclase together, to be seen opacitization of basic glass and to be depleted pyroxene. According to geochemical rocks in this area is in accordance with diagrams Harkr subtractive process medals that two elements potassium and sodium dispersion testament is considered magma mixing. Rocks in this region be considered in the alkaline series and according to tectonic is a component of subduction zones in the continental crust. Based on to be achieved these results, the origin of these rocks are mantle lithospheres.

ACKNOWLEDGMENT

The authors are grateful to Pars Geology researcher center for their continual support to the present results. We would also like to thank Dr. M. Ghorbani for their assistance in preparing this paper.

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