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# **RESEARCH PAPER**

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Petrography and geochemistry of volcanic rocks of GhezelcheKand (NE Ghorveh), Iran

# S. J. Sheikhzakariaee\*, H. Kazemi kohbanani, M. Vossoughi Abedini, M. H. Emami<sup>1</sup>

Department of Geology, Science and Research Branch, Islamic Azad University (IAU), Teheran, Iran

<sup>1</sup>Department of Geology, Science and Research Branch, Islamic Azad University, Eslamshahr (Tehran), Iran

Key words: Ghezelche-Kand region, Geochemistry, Petrography, Pyroclastic sections, Volcano.

## Abstract

Ghorveh town is part of Sanandaj-Sirjan area. GhezelcheKand volcano is part of volcanic basin of Ghorveh-Takab extending from North West to South East. This volcano is one of the greatest volcanos of Gharineh Mountain which is located 25 km far from Ghorveh in south west part of Gharineh mount. The volcano's crater that was collapsed during last volcanic eruption is formed as a side crater and is located in north east. The slope of scoria pyroclastic deposits create a domain with approximate slope of 24°, this is one of the features of Stromboli eruption cones. Volcanic rocks include host magmas and strange rocks that are divided to three groups and two sub groups. These three groups are: 1) scoria magmas with basalt compounds 2) Granitoidic zeolite or felsic and 3) mantle zeolites. Group's rock are magmas and scoria pyroclastic magmatic sections (tefra), basaltic olivine rock (scoria) with porphyric texture with microlitic dough to vacuolar glassy rocks (scoria), this rock contains pyroxene and olivine phenocrysts, subsidiary amphibole deposits and dough. In geochemical graphs of Ghezelche-Kand, rocks are located in the compound zone of tephrite and phonolitictephrite, one of the samples is located in the area of tephritic phonolite. Moreover, in the magmatic series determination graph, the rocks are located in the alkaline area and in tectonic zone graph samples are in inter plate area.

\*Corresponding Author: S. J. Sheikhzakariaee 🖂 j.sheikhzakaria@gmail.com

#### Introduction

Volcanism is the phenomenon of eruption of molten rock (magma) onto the surface of the Earth, where lava, pyroclastics and volcanic gases erupt through a break in the surface called a vent. It includes all phenomena resulting from and causing magma within the crust or mantle of the body to rise through the crust and form volcanic rocks on the surface.

Volcano is one of the natural phenomenons which can give important information about inside the Earth and magmatic evolutions. Studying volcanoes is important because they are formed in different tectonic environments such as inter plate and plate boundaries. Volcanoes are divided into various groups according to their eruption types. One of the volcanoes' types is Stromboli. In Stromboli magmatic layers and pyrcolastic sections are formed. In some zones, volcanoes are expanded linearly with different contaminations. Understudied volcano in Ghorveh town is one of the linear volcanoes extending North East- South West which is located between Ghorveh and Takab. Regarding this, a detailed petrography and geochemical study can be helpful in determination of rocks' types and identification of tectono-magmatic environment.

Ghorveh region is part of Sanandaj-Sirjan zone (Fig. 1). Ghezelcheh-Kand volcano is part of the Ghorveh-Takab volcanic basin extending north west-south east. This volcano is one of the biggest volcanos in Gharineh mount which is located 25km far from Ghorveh, in south west of Gharineh mount. Understudied volcano has following coordinates 32°21'20.30N and 47°57'46.60E as a large cone with cutting edge crater that its height is 2102 m from sea level. The volcano's crater was collapsed by last eruption and has formed as lateral crater in North West. The slope of scoria pyroclastic deposits create a domain with approximate slope of 24°, this is one of the features of Stromboli eruption cones. Pyroclastic deposits have made different rocky faces during continuous eruptions in limited time. Magmas with low dispersions and not hard pyroclastic deposits (tefra) with high frequency are creators of this volcanic cone. In addition to pyroclastic segments, the strange rocks that were carried by host magma can be seen. One of the main and most frequent strange rocks is granitoidic zeolites. Other segments are peridotitic zeolites and metasomatic amphibole. The aim of this paper is study of petrography and geochemistry of volcanic rocks of GhezelcheKand (NE Ghorveh), Iran.



**Fig. 1.** Satellite view (Google earth) from understudied volcanoes (red circle and Yellow Square).



**Fig. 2.** Close view of conical volcano of Ghezelchehkand with approximate slope of 24° (red dotted). View to North West.

### Material and methods

### Field Survey and analysis

In present study, first detailed and systematic sampling was done from granitoid mass of Ghezelcheh-kand region. Fifty thin segments were prepared from the samples, and were studied by polarizing microscope. Eleven samples were analyzed chemically in Acme-Lab laboratory of Canada and main, subsidiary and rare elements of soil (ICP and XRF) were studied (Table 1). The results of analysis

were considered Gcd Kit and Excel software.

Rock name	SiO <sub>2</sub>	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K20	P2O5	Cr2O3	LOI
2435-FAG48	48/96	1/47	13/10	7/16	0/11	7/51	7/51	7/51	3/45	1/50	0/031	1/1
2436-FAG13	48/84	1/50	13/18	7/26	0/11	7/45	10/37	4/82	3/44	1/50	0/027	0/7
2437-FAG17	46/95	1/62	13/04	7/81	0/11	8/03	11/18	5/06	2/63	1/50	0/030	1/2
2438-FCG2	49/25	1/48	13/16	7/27	0/11	7/47	10/20	5/44	2/44	1/50	0/028	1/0
2439-FAG28	47/82	1/56	13/23	7/76	0/11	7/76	10/98	4/76	3/07	1/50	0/042	0/6
2440-FAG19	46/97	1/65	13/05	7/98	0/11	8/07	11/26	4/78	3/31	1/50	0/029	0/4
2441-FAG30	45/68	1/66	12/39	8/28	0/11	9/40	, 11/41	4/51	3/12	1/50	0/030	1/0
2442-FCG1	49/34	, 1/49	13/00	, 7/27	0/11	7/39	10/52	5/20	2/49	1/50	0/029	0/9
2443-FAG34	46/84	1/66	12/88	8/04	0/11	8/01	11/37	5/26	2/13	1/50	0/027	1/3
2444-FAG29	49/37	, 1/49	13/20	7/08	0/11	, 7/26	10/17	4/81	3/43	1/50	0/030	0/8
2445-FAG35	49/14	1/49	13/32	7/20	0/11	7/36	10/25	4/72	3/42	1/50	0/031	o/8
	V	Cr	Со	Ni	Cu	Zn	Ga	Rb	Sr	Y	Zr	Nb
2435-FAG48	126	133	34/1	180/5	54/57	106/6	18/91	64/3	2044	22/4	310/8	45/64
2436-FAG13	127	116	33/3	164/8	55/04	107/3	18/58	64/4	2030	22/4	306/9	44/48
2437-FAG17	139	131	36/9	168/0	53/32	104/5	17/41	44/3	2050	23/2	293/1	46/80
2438-FCG2	119	119	31/9	170/4	50/75	96/4	17/93	53/4	1915	20/7	284/7	42/83
2439-FAG28	123	119	34/8	165/7	53/02	100/9	18/86	51/1	2021	23/4	291/1	45/46
2440-FAG19	140	126	36/1	170/4	55/85	101/0	17/55	58/1	2067	23/4	298/2	47/62
2441-FAG30	143	139	38/8	233/9	63/09	106/0	17/50	51/9	1994	22/5	293/1	45/79
2442-FCG1	113	140	31/4	157/9	47/70	96/5	16/98	49/8	1929	21/0	282/5	40/48
2443-FAG34	126	126	35/5	166/8	56/69	103/5	18/26	81/8	2128	22/5	295/3	46/15
2444-FAG29	124	142	33/0	165/8	52/16	106/0	18/92	64/6	2046	21/6	301/3	44/70
2445-FAG35	129	147	31/6	165/8	53/56	105/4	19/55	69/4	2081	22/1	318/9	46/41
110 00	-		- /	<b>U</b> ,				~		,	· · ·	
	Ba	Pb	Th	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Cs
2435-FAG48	<b>Ba</b> 1555	<b>Pb</b> 24/78	Th 25/9	La 147/4	Ce 273/93	<b>Nd</b> 119/4	<b>Sm</b> 16/5	Eu 4/0	<b>Tb</b> 1/2	<b>Yb</b> 1/4	Lu 0/2	Cs 1/7
2435-FAG48 2436-FAG13	Ba 1555 1529	<b>Pb</b> 24/78 24/59	Th 25/9 25/6	La 147/4 144/2	Ce 273/93 277/28	Nd 119/4 116/0	Sm 16/5 17/7	Eu 4/0 4/3	Tb 1/2 1/1	Yb 1/4 1/6	Lu 0/2 0/2	Cs 1/7 1/7
2435-FAG48 2436-FAG13 2437-FAG17	<b>Ba</b> 1555 1529 1480	Pb 24/78 24/59 21/98	Th 25/9 25/6 23/7	La 147/4 144/2 142/4	Ce 273/93 277/28 275/93	Nd 119/4 116/0 118/3	<b>Sm</b> 16/5 17/7 16/2	Eu 4/0 4/3 4/5	Tb 1/2 1/1 1/3	<b>Yb</b> 1/4 1/6 1/7	Lu 0/2 0/2 0/2	Cs 1/7 1/7 1/4
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2	Ba 1555 1529 1480 1481	Pb 24/78 24/59 21/98 24/31	Th 25/9 25/6 23/7 24/1	La 147/4 144/2 142/4 137/5	Ce 273/93 277/28 275/93 258/52	Nd 119/4 116/0 118/3 106/4	Sm 16/5 17/7 16/2 14/4	Eu 4/0 4/3 4/5 3/8	Tb 1/2 1/1 1/3 0/9	Yb 1/4 1/6 1/7 1/7	Lu 0/2 0/2 0/2 0/2	Cs 1/7 1/7 1/4 1/6
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28	<b>Ba</b> 1555 1529 1480 1481 1456	Pb 24/78 24/59 21/98 24/31 24/24	Th           25/9           25/6           23/7           24/1           23/6	La 147/4 144/2 142/4 137/5 141/4	Ce 273/93 277/28 275/93 258/52 271/37	Nd 119/4 116/0 118/3 106/4 111/5	<b>Sm</b> 16/5 17/7 16/2 14/4 17/2	Eu 4/0 4/3 4/5 3/8 3/9	Tb 1/2 1/1 1/3 0/9 1/3	Yb           1/4           1/6           1/7           1/7           1/7           1/4	Lu 0/2 0/2 0/2 0/2 0/2 0/2	Cs 1/7 1/7 1/4 1/6 1/4
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19	<b>Ba</b> 1555 1529 1480 1481 1456 1502	Pb 24/78 24/59 21/98 24/31 24/24 22/36	Th           25/9           25/6           23/7           24/1           23/6           23/9	La 147/4 144/2 142/4 137/5 141/4 149/7	Ce 273/93 277/28 275/93 258/52 271/37 283/25	Nd 119/4 116/0 118/3 106/4 111/5 120/6	<b>Sm</b> 16/5 17/7 16/2 14/4 17/2 16/0	Eu 4/0 4/3 4/5 3/8 3/9 4/4	Tb 1/2 1/1 1/3 0/9 1/3 1/3	Yb           1/4           1/6           1/7           1/7           1/4	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs 1/7 1/7 1/4 1/6 1/4 1/4
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30	<b>Ba</b> 1555 1529 1480 1481 1456 1502 1476	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51	Th 25/9 25/6 23/7 24/1 23/6 23/9 23/1	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7	Sm 16/5 17/7 16/2 14/4 17/2 16/0 17/8	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4	Tb           1/2           1/1           1/3           0/9           1/3           1/3           1/2	Yb           1/4           1/6           1/7           1/7           1/4           1/8           1/7	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs 1/7 1/7 1/4 1/6 1/4 1/4 1/4
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1	<b>Ba</b> 1555 1529 1480 1481 1456 1502 1476 1464	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06	Th 25/9 25/6 23/7 24/1 23/6 23/9 23/1 23/4	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6	Sm 16/5 17/7 16/2 14/4 17/2 16/0 17/8 18/2	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 3/9	Tb           1/2           1/1           1/3           0/9           1/3           1/3           1/2           1/1	Yb           1/4           1/6           1/7           1/7           1/4           1/7           1/4           1/8           1/7           1/3	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs 1/7 1/7 1/4 1/6 1/4 1/4 1/4 1/2 1/6
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34	Ba           1555           1529           1480           1481           1456           1502           1476           1476           1473	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06 24/69	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4	Sm 16/5 17/7 16/2 14/4 17/2 16/0 17/8 18/2 16/3	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 3/9 4/5	Tb           1/2           1/1           1/3           0/9           1/3           1/2           1/1           1/1	Yb           1/4           1/6           1/7           1/7           1/4           1/7           1/4           1/7           1/4           1/7           1/4           1/7           1/7           1/7	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs           1/7           1/7           1/4           1/6           1/4           1/4           1/6           1/4           1/6           1/7
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2444-FAG29	Ba           1555           1529           1480           1481           1456           1502           1476           1464           1473           1591	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06 24/69 25/38	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9	Sm 16/5 17/7 16/2 14/4 17/2 16/0 17/8 18/2 16/3 16/0	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 3/9 4/4 4/5 4/2	Tb           1/2           1/1           1/3           0/9           1/3           1/3           1/2           1/1           1/2	Yb           1/4           1/6           1/7           1/7           1/4           1/8           1/7           1/3           1/7           1/7	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs           1/7           1/7           1/4           1/6           1/4           1/2           1/6           1/7
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2444-FAG29 2445-FAG35	Ba           1555           1529           1480           1481           1456           1502           1476           1464           1473           1591           1625	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06 24/69 25/38 26/20	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5 147/9	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9	<b>Sm</b> 16/5 17/7 16/2 14/4 17/2 16/0 17/8 18/2 16/3 16/0 16/3	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 3/9 4/5 4/2 3/9	Tb           1/2           1/1           1/3           1/3           1/3           1/2           1/1           1/2           1/1	Yb           1/4           1/6           1/7           1/7           1/4           1/8           1/7           1/3           1/7           1/7           1/7	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs           1/7           1/7           1/4           1/6           1/4           1/2           1/6           1/7
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2444-FAG29 2445-FAG35	Ba           1555           1529           1480           1481           1456           1502           1476           1476           1476           1464           1473           1591           1625           Hf	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06 24/69 25/38 26/20 Ta	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2           Dy	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5 147/9 Er	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84 Gd	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9 Pr	Sm 16/5 17/7 16/2 14/4 17/2 16/0 17/8 18/2 16/3 16/0 16/3 Sn	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 3/9 4/4 4/2 3/9 4/2 3/9 Tm	Tb           1/2           1/1           1/3           0/9           1/3           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1	Yb           1/4           1/6           1/7           1/7           1/4           1/8           1/7           1/3           1/7           1/3           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs           1/7           1/7           1/4           1/6           1/4           1/2           1/6           1/7           1/6           1/7           1/6           1/7           1/8
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2444-FAG29 2445-FAG35	Ba           1555           1529           1480           1481           1456           1502           1476           1464           1473           1591           1625           Hf           7/20	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06 24/69 25/38 26/20 Ta 2/4	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2           Dy           5/8	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5 147/9 Er 1/3	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84 Gd 10/2	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9 Pr 32/7	Sm           16/5           17/7           16/2           14/4           17/2           16/0           17/8           18/2           16/3           16/0           16/3           16/3           11/4	Eu           4/0           4/3           4/5           3/8           3/9           4/4           4/9           4/4           3/9           4/4           3/9           4/5           3/9           4/5           3/9           4/5           3/9           0/3	Tb           1/2           1/1           1/3           0/9           1/3           1/3           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           2	Yb           1/4           1/6           1/7           1/7           1/4           1/8           1/7           1/3           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs           1/7           1/7           1/4           1/6           1/4           1/2           1/6           1/7           1/6           1/7           3/655
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2444-FAG29 2445-FAG35 2435-FAG48 2436-FAG13	Ba           1555           1529           1480           1481           1456           1502           1476           1464           1473           1591           1625           Hf           7/20           6/72	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06 24/69 25/38 26/20 Ta 2/4 2/4	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2           Dy           5/8           4/4	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5 147/9 Er 1/3 1/7	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84 Gd 10/2 8/3	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9 Pr 32/7 32/6	Sm           16/5           17/7           16/2           14/4           17/2           16/0           17/8           18/2           16/3           16/0           16/3           16/0           16/3           16/0           16/3           16/3           1/4           1/8	Eu           4/0           4/3           4/5           3/8           3/9           4/4           4/4           4/5           4/5           4/5           3/9           4/5           4/5           3/9           0/3           0/3	Tb           1/2           1/1           1/3           1/3           1/3           1/2           1/1           1/2           1/1           1/2           1/1           1/2           2           2           2           2	Yb           1/4           1/6           1/7           1/7           1/4           1/8           1/7           1/3           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           10/3           10/8	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs           1/7           1/7           1/4           1/6           1/4           1/2           1/6           1/7           1/6           3/655           3/563
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2443-FAG34 2445-FAG35 2435-FAG48 2436-FAG13 2437-FAG17	Ba           1555           1529           1480           1481           1456           1502           1476           1464           1473           1591           1625           Hf           7/20           6/72           6/71	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06 24/69 25/38 26/20 Ta 2/4 2/4 2/4	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2           Dy           5/8           4/4           5/7	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5 147/9 Er 1/3 1/7 1/9	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84 Gd 10/2 8/3 9/1	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9 Pr 32/7 32/6 32/0	Sm           16/5           17/7           16/2           14/4           17/2           16/0           17/8           18/2           16/3           16/0           16/3           16/0           16/3           16/0           16/3           16/0           16/3           1/4           1/8           1/7	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 3/9 4/5 4/2 3/9 Tm 0/3 0/3 0/2	Tb           1/2           1/1           1/3           1/3           1/3           1/2           1/1           1/2           1/1           1/2           1/1           1/2           2           2           2           2           2           2           2           2           2           2	Yb           1/4           1/6           1/7           1/7           1/4           1/8           1/7           1/3           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           10/3           10/8           12/1	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs 1/7 1/7 1/4 1/6 1/4 1/4 1/4 1/2 1/6 1/7 1/6 1/7 1/6 1/7 Na 3/655 3/563 3/745
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2443-FAG34 2444-FAG29 2445-FAG35 2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2	Ba           1555           1529           1480           1481           1456           1502           1476           1476           1464           1473           1591           1625           Hf           7/20           6/72           6/71           6/42	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06 24/69 25/38 26/20 Ta 2/4 2/4 2/4 2/4 2/4 2/4	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2           Dy           5/8           4/4           5/7           4/7	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5 147/9 Er 1/3 1/7 1/9 1/7	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84 Gd 10/2 8/3 9/1 9/0	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9 Pr 32/7 32/6 32/0 30/5	Sm           16/5           17/7           16/2           14/4           17/2           16/0           17/8           18/2           16/3           16/0           16/3           16/0           16/3           16/0           16/3           1/4           1/8           1/7           1/7           1/7	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 3/9 4/5 4/2 3/9 Tm 0/3 0/2 0/3	Tb           1/2           1/1           1/3           1/3           1/3           1/2           1/1           1/2           1/1           1/2           1/1           1/2           2           2           2           3	Yb           1/4           1/6           1/7           1/7           1/4           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           10/3           10/8           12/1           10/7	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs           1/7           1/7           1/4           1/6           1/4           1/2           1/6           1/7           1/6           1/7           3/655           3/563           3/745           3/951
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2443-FAG34 2445-FAG35 2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28	Ba           1555           1529           1480           1481           1456           1502           1476           1476           1476           1464           1473           1591           1625           Hf           7/20           6/72           6/71           6/42           6/36	Pb           24/78           24/59           21/98           24/31           24/24           22/36           22/51           23/06           24/69           25/38           26/20           Ta           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/2	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2           Dy           5/8           4/4           5/7           4/7           5/5	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5 147/9 Er 1/3 1/7 1/9 1/7 1/7	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84 0/1 10/2 8/3 9/1 9/0 11/7	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9 Pr 32/7 32/6 32/0 30/5 30/9	Sm           16/5           17/7           16/2           14/4           17/2           16/0           17/8           18/2           16/3           16/0           16/3           16/0           16/3           1/4           1/7           1/7           1/7           1/7	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 3/9 4/5 4/2 3/9 Tm 0/3 0/2 0/3 0/2 0/3 0/3 0/3	Tb           1/2           1/1           1/3           0/9           1/3           1/3           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           1/2           3           4	Yb           1/4           1/6           1/7           1/7           1/4           1/8           1/7           1/3           1/7           10/3           10/7           11/7	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs 1/7 1/7 1/4 1/6 1/4 1/4 1/2 1/6 1/7 1/6 1/7 1/6 1/7 Na 3/655 3/563 3/745 3/951 3/478
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2444-FAG29 2445-FAG35 2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19	Ba           1555           1529           1480           1481           1456           1502           1476           1464           1473           1591           1625           Hf           7/20           6/72           6/71           6/42           6/36           6/62	Pb           24/78           24/78           24/59           21/98           24/31           24/24           22/36           22/51           23/06           24/69           25/38           26/20           Ta           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2           Dy           5/8           4/4           5/7           4/7           5/5           5/1	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 145/7 146/1 145/7 142/5 147/9 Er 1/3 1/7 1/9 1/7 1/7 1/8	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84 Gd 10/2 8/3 9/1 9/0 11/7 8/5	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9 Pr 32/7 32/6 32/0 30/5 30/9 33/5	Sm           16/5           17/7           16/2           14/4           17/2           16/0           17/8           16/3           16/0           16/3           16/0           16/3           16/0           16/3           16/0           16/3           11/4           1/8           1/7           1/7           1/7           1/8	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 4/4 3/9 4/5 4/2 3/9 Tm 0/3 0/3 0/3 0/3 0/3 0/3 0/3 0/3	Tb           1/2           1/1           1/3           0/9           1/3           1/3           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           1/2           3           4           2           3           4           2	Yb           1/4           1/6           1/7           1/7           1/4           1/7           1/4           1/7           1/3           1/7           1/3           1/7           1/7           1/7           1/7           1/7           1/7           1/7           10/3           10/8           12/1           10/7           11/7           12/9	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs           1/7           1/7           1/4           1/6           1/4           1/2           1/6           1/7           1/6           1/7           3/655           3/563           3/745           3/951           3/478           3/445
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2443-FAG34 2444-FAG29 2445-FAG35 2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30	Ba           1555           1529           1480           1481           1456           1502           1476           1464           1473           1591           1625           Hf           7/20           6/72           6/71           6/36           6/62           6/40	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06 24/69 25/38 26/20 Ta 2/4 2/4 2/4 2/4 2/4 2/4 2/4 2/4	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2           Dy           5/8           4/4           5/7           4/7           5/5           5/1           5/4	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5 147/9 Er 1/3 1/7 1/9 1/7 1/7 1/8 2/0	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84 Gd 10/2 8/3 9/1 9/0 11/7 8/5 10/7	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9 Pr 32/7 32/6 32/0 30/5 30/9 33/5 33/3	Sm           16/5           17/7           16/2           14/4           17/2           16/0           17/8           16/3           16/0           16/3           16/0           16/3           16/0           16/3           16/0           16/3           16/0           16/3           1/4           1/8           1/7           1/7           1/8           1/5	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 3/9 4/5 4/2 3/9 Tm 0/3 0/3 0/2 0/3 0/3 0/2 0/3 0/2	Tb           1/2           1/1           1/3           1/3           1/3           1/3           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           Be           2           3           4           2           2           3           4           2           2	Yb           1/4           1/6           1/7           1/7           1/4           1/7           1/3           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           10/3           10/8           12/1           10/7           11/7           12/9           13/0	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs 1/7 1/7 1/4 1/6 1/4 1/4 1/2 1/6 1/7 1/6 1/7 1/6 1/7 Na 3/655 3/563 3/55 3/543 3/745 3/951 3/478 3/445 3/300
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2443-FAG34 2444-FAG29 2445-FAG35 2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1	Ba           1555           1529           1480           1481           1456           1502           1476           1464           1473           1591           1625           Hf           7/20           6/72           6/71           6/42           6/36           6/62           6/40           5/56	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06 24/69 25/38 26/20 Ta 2/4 2/4 2/4 2/4 2/4 2/4 2/4 2/4 2/4 2/4	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2           Dy           5/8           4/4           5/7           4/7           5/5           5/1           5/4           4/8	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5 147/9 Er 1/3 1/7 1/9 1/7 1/9 1/7 1/8 2/0 1/4	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84 Gd 10/2 8/3 9/1 9/0 11/7 8/5 10/7 9/9	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9 Pr 32/7 32/6 32/0 30/5 30/9 33/5 33/3 29/8	Sm           16/5           17/7           16/2           14/4           17/2           16/0           17/8           18/2           16/3           16/0           16/3           16/0           16/3           16/0           16/3           1/4           1/8           1/7           1/7           1/7           1/7           1/7           1/5           1/5	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 3/9 4/5 4/2 3/9 Tm 0/3 0/3 0/2 0/3 0/2 0/2 0/2	Tb           1/2           1/1           1/3           1/3           1/3           1/3           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           1/2           3           4           2           3           4           2           3	Yb           1/4           1/6           1/7           1/7           1/4           1/7           1/3           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           10/3           10/3           10/7           11/7           12/9           13/0           12/1	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs           1/7           1/7           1/4           1/6           1/4           1/2           1/6           1/7           1/6           1/7           3/655           3/563           3/745           3/951           3/445           3/300           3/769
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2443-FAG34 2445-FAG35 2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34	Ba           1555           1529           1480           1481           1456           1502           1473           1591           1625           Hf           7/20           6/72           6/71           6/42           6/36           6/62           6/40           5/56           6/37	Pb 24/78 24/59 21/98 24/31 24/24 22/36 22/51 23/06 24/69 25/38 26/20 Ta 2/4 2/4 2/4 2/4 2/4 2/4 2/4 2/4	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2           Dy           5/8           4/4           5/7           4/7           5/5           5/1           5/4           4/8           4/9	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5 147/9 Er 1/3 1/7 1/9 1/7 1/9 1/7 1/7 1/8 2/0 1/4 2/0	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84 6d 10/2 8/3 9/1 9/0 11/7 8/5 10/7 9/9 8/3	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9 Pr 32/7 32/6 32/0 30/5 30/9 33/5 33/3 29/8 33/2	Sm           16/5           17/7           16/2           14/4           17/2           16/0           17/8           18/2           16/3           16/0           16/3           16/0           16/3           16/0           16/3           16/0           16/3           16/0           16/3           16/0           16/3           1/7           1/8           1/7           1/7           1/7           1/5           1/5           1/6	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 3/9 4/4 4/4 3/9 4/5 4/2 3/9 Tm 0/3 0/2 0/3 0/2 0/3 0/2 0/2 0/2 0/2 0/3	Tb           1/2           1/1           1/3           1/3           1/3           1/3           1/2           1/1           1/2           1/1           1/1           1/1           1/1           1/2           1/1           1/2           3           4           2           3           4           2           3           3	Yb           1/4           1/6           1/7           1/7           1/8           1/7           1/3           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           1/7           10/3           10/3           10/7           11/7           12/9           13/0           12/1           12/1	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs           1/7           1/7           1/4           1/6           1/4           1/2           1/6           1/7           1/6           1/7           3/655           3/563           3/745           3/951           3/478           3/300           3/769           3/861
2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2444-FAG29 2445-FAG35 2435-FAG48 2436-FAG13 2437-FAG17 2438-FCG2 2439-FAG28 2440-FAG19 2441-FAG30 2442-FCG1 2443-FAG34 2444-FAG29	Ba           1555           1529           1480           1481           1456           1502           1476           1464           1473           1591           1625           Hf           7/20           6/72           6/71           6/42           6/36           6/62           6/40           5/56           6/37           6/70	Pb           24/78           24/78           24/59           21/98           24/31           24/24           22/36           22/51           23/06           24/69           25/38           26/20           Ta           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/4           2/3           2/4           2/4           2/3           2/4           2/3	Th           25/9           25/6           23/7           24/1           23/6           23/9           23/1           23/4           23/7           25/7           26/2           Dy           5/8           4/4           5/7           4/7           5/5           5/1           5/4           4/9           4/0	La 147/4 144/2 142/4 137/5 141/4 149/7 146/1 136/1 145/7 142/5 147/9 Er 1/3 1/7 1/9 1/7 1/7 1/8 2/0 1/4 2/0 1/5	Ce 273/93 277/28 275/93 258/52 271/37 283/25 280/06 255/94 279/91 276/76 280/84 Gd 10/2 8/3 9/1 9/0 11/7 8/5 10/7 9/9 8/3 9/6	Nd 119/4 116/0 118/3 106/4 111/5 120/6 118/7 111/6 123/4 114/9 123/9 Pr 32/7 32/6 32/0 30/5 30/9 33/5 33/3 29/8 33/2 31/2	Sm           16/5           17/7           16/2           14/4           17/2           16/0           17/8           16/3           16/0           16/3           16/0           16/3           16/0           16/3           16/0           16/3           16/0           16/3           16/0           16/3           1/4           1/8           1/7           1/8           1/7           1/8           1/5           1/5           1/6           1/6	Eu 4/0 4/3 4/5 3/8 3/9 4/4 4/4 4/4 3/9 4/5 4/2 3/9 Tm 0/3 0/2 0/3 0/2 0/3 0/2 0/2 0/2 0/2 0/2 0/2	Tb           1/2           1/1           1/3           0/9           1/3           1/3           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           1/2           1/1           Be           2           3           4           2           3           3           3	Yb           1/4           1/6           1/7           1/7           1/4           1/7           1/4           1/7           1/3           1/7           1/3           1/7           1/7           1/7           1/7           1/7           1/7           1/7           10/3           10/8           12/1           10/7           12/9           13/0           12/1           9/8	Lu 0/2 0/2 0/2 0/2 0/2 0/2 0/2 0/2	Cs           1/7           1/7           1/4           1/6           1/4           1/2           1/6           1/7           1/6           1/7           3/655           3/563           3/745           3/951           3/478           3/445           3/300           3/769           3/861           3/608

 Table 1. The result of major and trace element analysis of the GhezelcheKand area (ICP-MS).

#### Geology of the region

Scoria magmas mostly are black and gray and in oxidized sections they have red color. The size of cavities at the middle part of magmas is bigger than marginal parts. Around understudied volcano gray magmas without cavities can be seen. The average thickness of these magmas is 50 cm. Other features of these magmas are separation of bread crust on the surface, extension of cavities and the welding of pyroclastic segments to lower part of magmas as a result of flowing (Fig 3).



**Fig. 3.** A view of magmas with bread crust in their external surface and welded scoria segments to lower magmas. The size of hammer is 30 cm.

In pyroclastic sequence of understudied volcano, projectile fragments of volcano's eruption are seen as bombs with various sizes and shapes. These fragments mostly are fusiform to round shapes and their sizes varied between centimeters to meters. The most manifest feature of these bombs is having strange rock fragments in their central parts. The material of these strange rocks is granitoid rocks. Some of these bombs have thin covers with average thickness of 1.5 cm and some others have thick covers that their average thickness is 20 cm. Because of high temperature, magmas including granitoid nucleus are really. Larger bombs (larger than meters) mostly are observable around the crater (Fig 4).



**Fig. 4.** A view of bombs with various sizes and shapes having granitoid strange rocks in the middle part. The size of hammer is 30 cm.

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Along with magmas and pyroclastic fragments, strange rocks with various components and sizes can be seen. One of the most major strange rocks is granitoid zeolites and one of the rarest strange rocks is prioditic zeolites. Granitoid zeolites have round shape to angled form and their sizes varied between centimeters to smaller than 1 m and have high frequency. One of the features of this type of zeolites is preferred orientations as a result of truncating zones (Fig 5).



Fig. 5. A view of Granitoid and periodite strange rocks existed in magmas and pyroclastic fragments.

#### **Results and discussions**

#### Petrography of region's rocks

After studies on thin segments of all rocks such as host magma and strange rocks were completed, they were classified in to 3 groups and 2 sub-groups. These 3 groups are: 1) scoria magmas with basalt compounds 2) Granitoidic zeolite or felsic and 3) mantle zeolites.In present study petrography of magmas group and scoria pyroclastic magmatic segments (tefra) are explained with details. One of the rocks of this group is basaltic olivine (scoria) that has porphyric tissue with microlitic to pitted glassy (scoria) dough; this rock has pyroxene and olivine phenocrysts besides amphibole and dough subsidiary deposits.

The form of Pyroxene phenocrysts varied between unshaped to shaped and their sizes ranged between 350µm to 1.5 mm, in some cases they are seen along with binary mackles in the rocks' context. These pyroxenes are Augite regarding their optical properties and refractive index (Fig 6). These deposits are seen in two total forms of phenocryst and single crystal oraggregated crystal microphenocryst, and in some cases they are seen as needle-like aggregates. One of the properties of pyroxenes is sieve microstructures in the central part, resorbed edges and embayment microstructures. Scattering of these types of pyroxene is relatively low (Fig 7).

Olivine is one of the other most frequent microphenocryst to phenocryst deposits existed in basaltic dough of understudied volcano. These deposits are seen as shaped or unshaped (broken) deposits that are both single crystal and aggregated, their sizes varied between 120µm-1.4mm (Fig 8). According to geochemical analysis on the basis of electron prob micro analyzer data (EPMA), the olivine in understudied volcano is forstrite type. Magmatic olivine mostly has determined crystographical surfaces, in balance with host magma, has relatively equal ratios in phenocrysts and doesn't show any magmatic disruption to other deposits (Winter et al., 2005, Brenna et al., 2010). Smaller olivine crystals in comparison with strange crystals or pre formed phenocrysts show tha they were formed at the later stages of differentiation (Holness&Bunbury, 2006). Totally, the source of olivine crystals is related to following items; 1) mantle structure, specifically as depleted rests that have been carried upward by magma, 2) birth from host magma as magmatic cumulates and 3) following by magma's permeation in to containing rock , it falls to magmatic reservoir with mafic compounds (Farahat*et al.*, 2006).



**Fig. 6**. A view of first type of pyroxene as single crystal blade, in optical situation of XPL.



**Fig.** 7. Another view of first type of single and aggregated crystal pyroxenes (the red dotted area), in optical situation of XPL.

Presence of olivine primocrysts shows filling of magmatic cavities for two or more times which are involved in differentiation phenomenon of basalts that is occurred by enriched mafic magmas (Giocada *et al.*, 2003).

In some cases, the olivine is along with advanced resorbed and embayment textures and skeleton growth (Fig 9).Resorption in the edges happens because of chemical and thermal inconstancy dominating on magmas. Presence of such olivines with inconsistent texture is because of changes that happen as a result of mixting and amalgamating between two magmas and also crystal floating (Holness *et al.*, 2006).



**Fig. 8**. Other view of a first type shaped single crystal olivine that its edges is in consistent with host magma, optical situation is XPL.



**Fig. 9.** A view of second type olivine with extreme resolved edges and embayment texture, optical situation is XPL.

One of the existed subsidiary deposits in these rocks is amphibol. This deposit is scattered as shaped to semi shaped form that its sizes varied between 350  $\mu$ m to 2.5 mm (Fig 10). Inconsistent microstructures in these amphibols are resorbed zones, overgrowth, and sieve and embayment tissues. Some of the amphibols have several periodic resorbed margins. Sieve tissues are seen at the central part of amphibols. Existed incorporations in these amphibols are opaque, apatite and pyroxene minerals. Regarding presence or absence of consistent tissues, these amphiboles can be classified as: 1) as phenochryst (Am-1), 2) microphenocryst (Am-2) (fig 11), 3) external and internal amphiboles along with blade aggregated pyroxenes (Am-3).



**Fig. 10.** A view of amphibol shaped phenocryst (first type) in optical situation of XPL.



**Fig. 11.** A view of amphibol shaped microphenocryst (second type) in optical situation of XPL.

Another subsidiary mineral in these rocks is phlogopite. This mineral is found as shaped to unshaped single crystal form with average size of 820  $\mu$ m in the understudied volcano.Among inconsistent micro tissues inphlogopites, resorbed edges and among achieve balance micro tissues, overgrowths can be mentioned. Regarding this, phlogopites can be classified as: 1) phlogopites with inconsistent tissues (Phl-1), this type has inconsistent tissues such as sieve tissues, resorbed zone and embayment corrosions, 2)phlogopites with sieve tissues (phl-1-1) probably these crystals have middle central and marginal element changes, such inconsistent falls indicate magmatic mixture (Prelevic *et al.*, 2004). 3) phlogopites with overgrowth (Phl-1-3) (Fig 12).

The main difference of dough in the rocks of understudied volcano is concentration of microcrystals, amount and size of vesicles and types of glass. Regarding petrography results dough has bimodal textures (Fig 13). Regarding this, they can be classified to two types of dough: 1- full of micro crystals (microlite) and 2- glass with fewer amounts of micro crystals.



**Fig. 12.** A view of first type of phlogopites with resorbed edges. Optical situation is XPL.

Dough full of micro crystals has bright color ad few vesicles and glassy dough with fewer amounts of micro crystals has black color and is in tachylite group. In most of the cases these two types of dough have been mixed with different ratios. In some samples, low level fusion or incomplete fusion indicate the transition boundary between two magmas with different compositions. Full micro crystal dough contains different minerals such as microlite plagioclases, prismatic pyroxenes, olivine, opaque minerals etc., and glassy dough with few micro crystals consists of pyroxene, olivine and opaque minerals etc.



**Fig. 13.** Tachylite dough of understudied basalts (scoria) with small vesicles. In A point optical situation is XPL and in B it is PPL.

#### Geochemistry of region's rocks

Researchers have offered various methods for naming igneous rocks on the basis of their main and rare elements, one of these methods is using TAS graph. In this method the total number of Na<sub>2</sub>O, K<sub>2</sub>O by SiO<sub>2</sub> that achieved by chemical analysis of the rock is used as weight percentage of oxide. In TAS graph offered by Le Maitre *et al.*, (1989) GhezelcheKand rocks are classified in the compound range of Tephrite, fenolite rich tephrite and in one case in the range of tephrite rich fenolite (Fig 14).



**Fig. 14.** The situation of region's rock samples on TAS graph (Maitre *et al.*, 1989) (Oxides are reported in terms of weight percentage).

To determine magmatic nature of region's rocks, Irvine and Baragar's (1971) graph is used which is one of the most important graphs for determination of magmatic series. Regarding determined boundary in this graph, understudied rocks are located in the range of alkaline (Fig 15 a). In addition, on the basis of Kuno's (1968) graph, that separated 3 ranges of alkaline, calc-alkaline and toleity, under studied samples are in the range of alkaline (Fig 15b).



**Fig. 15.** (a) The situation of rock samples in alkaline graph of Irvine and Baragar (1971) to separate alkaline and sub alkaline series, (b) graph of  $Na_2O+K_2O$  by SiO<sub>2</sub>, to separate alkaline, calc-alkaline and toleity series offered by Kuno (1968).

To identify tectonic zone of rocks formation, various graphs are used. In the diagram of Ti/Y-Nb/Y offered by Pearce (2006) and triangular graph of Zr/4-Nb\*4-Y offered by Meschede (1986) region's samples are located in the range of within plate basaltic alkaline. In addition, on the basis of Muller and Groves's (1979) graph, TiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub> and the diagram of Th/Yb (Pearce, 1982) by Ta/Yb, which have separated within plate and arcrelated zones, region's samples, are located in the range of within plate (Fig 16).

It is supposed that, after collision of Iran plate with Arabic plate in lower myosin rollback condition and tensile environment have been made. The function of strike-slip faults has led to creation of tensile places and pullapart basins in the zone. In quaternary time, bazik magmas of understudied zone, have reached to the surface of the Earth along with these tensile places.



Fig. 16. Various diagrams for determination of tectonic zones.

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### Conclusion

Volcanic rocks include host magmas and strange rocks that are divided to three groups and two sub groups. These three groups are: 1) scoria magmas with basalt compounds 2) Granitoidic zeolite or felsic and 3) mantle zeolites. Group's rock are magmas and scoria pyroclastic magmatic sections (tefra), basaltic olivine rock (scoria) with porphyric texture with microlitic dough to vacuolar glassy rocks (scoria), this rock contains pyroxene and olivine phenocrysts, subsidiary amphibole deposits and dough. In geochemical graphs of Ghezelche-Kand, rocks are located in the compound zone of tephrite and phonolitic tephrite, one of the samples is located in the area of tephritic phonolite. Moreover, in the magmatic series determination graph, the rocks are located in the alkaline area and in tectonic zone graph samples are in inter plate area.

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