Asymmetrical effect of fluid on the mineralogical, geochemical and fabric changing of perlites and bedded rocks of NW of Iran (SE of Mianeh Area)

Amin Kamali*, Ali Ameri1, Mohssen Moayyed1, Hadi Pirooj, Mohammad Mehri3, Tahere. Nickhah4

* Student of M. Sc of Petrology ,Geology Department, University of Tabriz, 51664, Iran

1,3, Geology Department, University of Tabriz, 51664, Iran

4, Chemistry Department, University of Kashan, Iran.

E-mail address: Aminkamali63@yahoo.com

Abstract

There are differences of silica dome (rhyolitic) in a Ghale Dokhtar SE of Mianeh. The lowerPart of these dome are occupied by perlite and upper parts are bedded extrusive rocks. This conditions show after eruption of lava the lower part of the domes affected by fluid and hydrated, In which the lower part (obsidian component) produced perfect, whereas the upper portion remained bedded with flow fabric. Two types of perlites have been recognized as hyaline perlite and granular perlites. The hyaline perlites are related to obsidian and they are trapped by them. Existence of this condition can prove the hypothesis that the obsidian to produce perlites. The perlites are altered to clay mineral, opal and chalcedony which is the typical condition for young rhyolitric volcanic rocks (limited to tertiary). The main structures and textures of perlites are perlitic, and these are in the form spherical cracks. Their colors are black with vitreous lusters which are indicators for classic perlites. Based on geochemical analysis the perlites of the studied area have an ideal chemical composition. The field mineralogy and geochemistry studied of perlites show that those volcanic rocks of the area is\hydrated to produced the perlites. These processes caused the formation of homocentric fracture and increase of volume in perlites. The main factors of perlitization of these rocks are post heat lava flow; PH, suitable chemical compositions to change; surfaces contacted with fluid and time availability of fluids in the rocks of the studied area .

Keywords: *Domes; Mianeh, fluids; perlite; lava*

Introduction

Perlites are volcanic hydrous glass, in hand specimen and thin section they contains concentric fracture. The prelites can produced by silicate lava domes, lava flow, ash flow, welded tuffs, glass plugs, laccoliths and dykes [1]. Perlitic domes can be about 2km long as well as vertically up to 100 meters [2]. Two main factors can be as a reason for perlite which being hydrous. The primary hydration is along the formed rock which is happening before and secondary is produced after cooling of the rock [3].The primary water of magma for obsidian is less than one percent, in some placec are more than 5 percent. Increasing of this secondary waters are either by surface or underground water [4], [5], [6].

General geology of the area

The studied area is located in Azarbaijan province, Myneh district (Ghale Dokhtar). According to structural classification the area of study is belong to part of centeral Iranian Zone [7]. These are igneous units of basalt, dacite, rhyolite, ignimbrite and perlite.The youngest units of the area is ignimbrite and rhyolite.(fig 1).

Discussion and review

There are varieties of silicic domes in the study area and most of them having rhylitic composition, with iginimbitic and spherulitic texture (fig 2A, 2B). The lower part of these dome are occupied by perlite and upper parts are bedded extrusive rocks. Emplacement of perlite in the lower part of domes, shows the reality that after eruption of lava in the shape of silicia dome, the water caused these domes changes into obsidian, and also changed it to perlite.Those portion which is out of water remains unchanged, shows bedded lava and flow fabric. Actually the perlites of the studied area are obsidian which is hydrated, and by concentrated fractures (perlitic fractures) shows concentric appearances (fig 2A, B, C and D). In the field, at the surface which are weathered it shows they area clay minerals with white colors. Field and prtographical investigation expresses that the white, light grey, dark grey, pink, grayish green are rhyolitic tuffs and lava. In hand specimen, nodules of perlite up to size of 2cm with silica composition has been observed (fig 3 A and B) .Some of scientists, believes secondary hydration in joints, fractures, and empty space of volcanic glass can be the main factors for the formation of perlites. Other hypothesis is that the perlitic rocks are formed as a result of rapid cooling of acidic magma in a special pressure and humidity condition. According to texture the perlite of the study area divided into granular and glassy .The granular textures are observed at depth of the perlitic unit and compared with glassy textures, they are more alkaline and light color appearances. The glassy textures are grey, dark grey or dark green, conchoidal with pearly luster. These rocks are often having glass matrix and their main textures are perlitic (fig2E, F). Those textures are spherical, concentric or crescent/ shaped. Around of the fractures devitrification has taken place and often obsidian can be observed in these perlites, which is proving the hypothesis of hydration of rhyolitic glasses (obsidian changing to perlite). Consistence of different texture in perlites is related to depth of emplacement. Whereas at the outer part of the domes perlitic texture is pumicic and toward the center the texture gets compact, changing to granular, glassial and at the end the lithic parts are observed. The concentric ring around of each obsidian nodule probably is as a result of increase of volume by hydration, which is progressed only at distance under the cover of perlite and obsidian. Table (1) shows analysis of some samples of typical perlites of the study area. According to geochemical analysis the ratio of SiO_2 comparatively is varies between 62.2 - 74.4, TiO_2 is comparatively low 0.35 – 0.69 percent, which is normal for rhyolitic rocks. The higher ratio of CaO (2.87) shows this element mostly filled the cavities. The average ratio of TiO_2 and Fe_2O_3 for the study area is 0.45-3.88, where as the world average ratios are 0.7-0.8 percent. To classify the rhyolite and perlites of the area, the diagrams of SiO_2 - Na_2O + K_2O and also (Zr/ TiO_2 – SiO_2) have been used, the samples fall on rhyolite, rhyodacite and andesite field (fig 4), also shows these rocks are calc-alkaline. High amount of alkaline elements In glass component which is wash out by the water caused exchanges ion and produced high PH in the study are. In this case (high PH) PH<9 cause

rapied dissolve of SiO_2 and reduces the resistance of it to alteration. There are not enough literature about alteration of perlites, but three stages of producing alteration recognized for perlite as dissolved, a) washed out part /or whole glass fragment and producing empty cavities, b) in outer part forming fractures and c) autogenic precipitation mineral, specially zeolite in these cavities. According to petrographical of alteration zone and field investigation the perlites of the studied area is belong to type a and b, it means, it produced chalcedony and clay minerals in the area. The main factors of perlitization of these rocks are post heat lava flow; PH, suitable chemical compositions to change; surfaces contacted with fluid and time availability of fluids in the rocks of the studied area.

Conclusion

The volcanic rocks of Ghale Dokhtar, Myaneh, is located in the central zone of Iran. Based on petrological and geochemical investigation, the perlites contain spherolitic, ignimbritic textures, they are acidic and belongs to rhyolitic rocks. Nature of the magma is calc- alkaline and probably produced in volcanic arc syncollision tectonic with active continental margin environment. Perlite of the study area having concentric fracture,which is observed as concentric structures. High amount of alkaline elements is glassy component which is washed out by the water caused exchanges of ion and produced high PH in the area. In this case (high PH) PH<9 caused rapid dissolve of SiO2 and reduces the resistance of it to alteration.

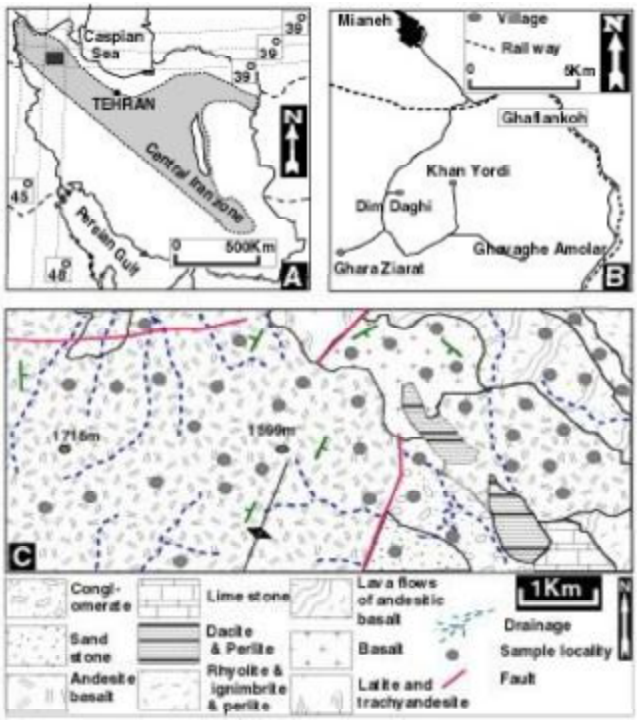

Fig.1A) Classification of structural zone of Iran. B) Road access area. C) Geological map of the study area.

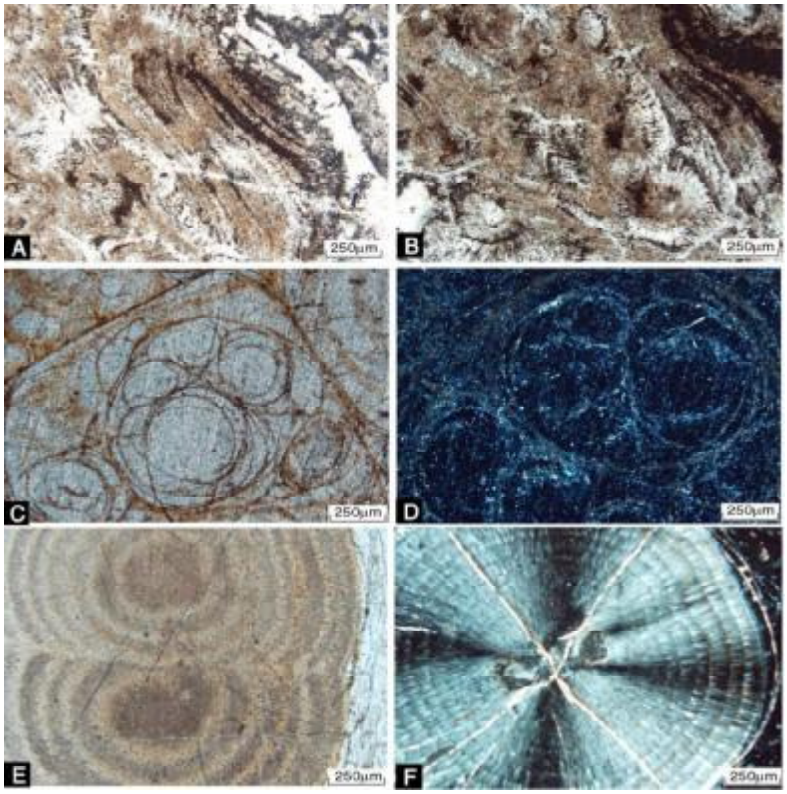

Fig.2 A) ignimbrite texture in rhyolite B) spherolitic texture in rhyolite C,D) perlite texture (PPL ,XPL) E, F) concentric texture in perlites (PPL ,XPL),

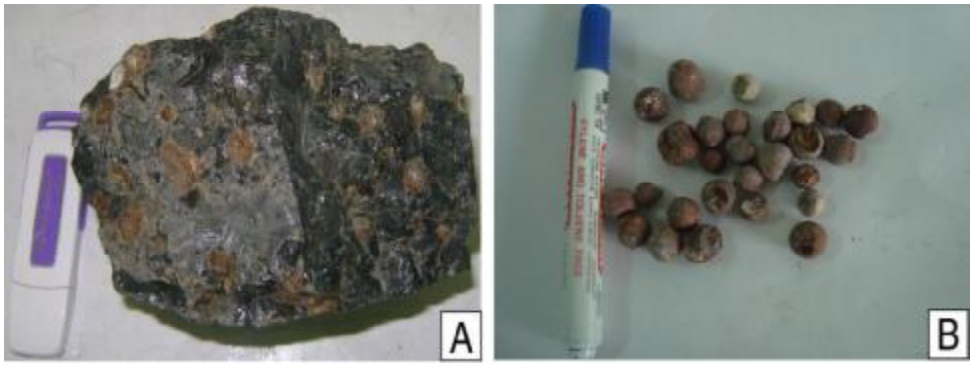

Fig.3 A) perlite B) Nodules of perlite

Table-1 Geochemical analysis of perlite and rhyolite of the study area

Element	l-4	k8	k6	index	kp1	kp2
SiO2	68.5	62.2	66.9	72.76	74.7	71.4
TiO2	0.35	0.69	0.35			
Al2O3	15.85	16.1	16.05	11.17	12.7	12.3
Fe2O3	1.84	5.93	3.27	5.4	5.85	4.96
MnO	0.05	0.13	0.04			
MgO	0.48	1.98	0.88	0.5-2.0	0.62	1.06
CaO	2.69	4.88	2.31	2.9	2.49	2.78
Na2O	4.42	3.71	4.06	0.5-1.5	1.74	1.52
K2O	3.21	2.05	3.25	0.1-0.5	0.23	0.25
P2O5	0.14	0.28	0.15			
LOI	2.32	2.12	2.61			
Y	10.8	26	10.2			
Zr	200	186	183			
Nb	20.6	14.6	21.4			
Th	9.81	9.04	9.67			
V	13	75	23			
Ba	989	654	965			
Hf	4.8	5	4.1			

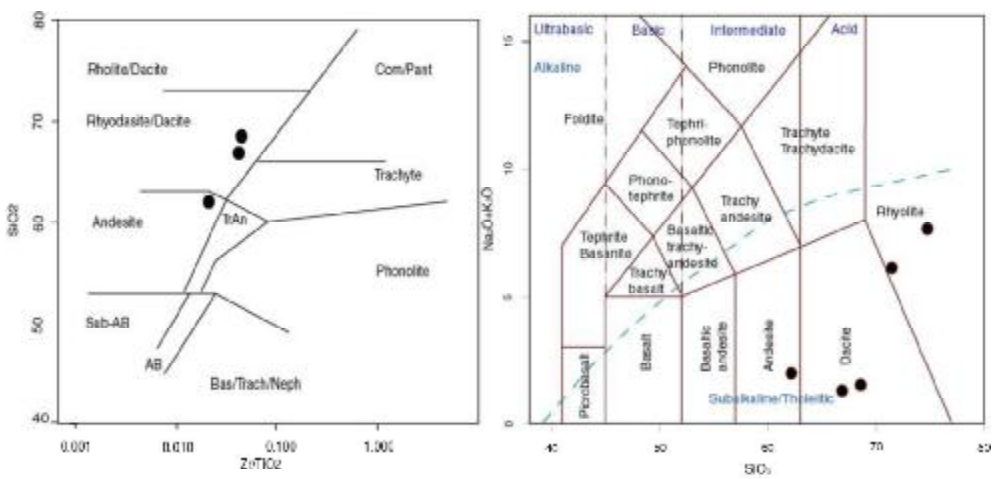

Figure 4. (Zr/TiO2 - %SiO2) discrimination diagram for volcanic rocks. Abbreviations: Com = comendite, Pan =pantellerite, TrAn = Trachy Andesite, Ab = andesite basalt, Bas-Trach-Neph = basalt/trachite/nephelinite[8]. diagram {%SiO2 - (%Na2O+%K2O)} discrimination diagram for volcanic rocks,[9]

References

[1] Breese, R.O.Y., and Barker J.M (1994): Perlite; *In*: Industria lMinerals and Rocks, 6th Edition, *Society fo rMining, Metallurgy, and Exploration Inc.*, pages 735-749.Chesterman,

[2] McPhie, J., Doyle, M., and Allen, R. (1993): Volcanic Textures :A guide to the interpretation and textures in volcanicrocks; *Center for Ore Deposit and Exploration Studies*, University of Tasmania, 198 pages.

[3] Nasedkin, V.V. (1988): Hydration Types, Minerals and Geologyof Volcanic Glasses; *in:* J. Konta, Editor, *Second International Conference on Natural Glasses, Prague*,pages 65-71.

[4] Ross, C.S., and Smith, R.L. (1955): Water and Other Volatiles in Volcanic Glasses; *American Mineralogist*, Volume 40, pages 1071-1089.

[5] Friedman, I., Smith, R. L., and Long, W. D. (1966): Hydration of Natural Glass and Formation of Perlite; *Geological Society of America*, Bulletin, Volume 77, pages 323-328.

[6] Lofgren, G. (1971): Experimentally Produced Devitrification Textures in Natural Rhyolitic Glass; *Geological Society of America*, Bulletin, Volume 82, pages 111-124.

[7] Stoklin, J (1968): Structural history and tectonics of Iran; a review, American Association of petroleum Geologists Bulletin, 52,(7), pp.1229-158.

[8] Winchester, J.A., and Floyd, P.A. (1977): Geochemical Discrimination of Different Magma Series and their Differentiation Products Using Immobile Elements; *Chemical Geology*, Volume 20, pages 325-343.

[9] Cox, K.G., Bell, J.D., and Pankhurst, R.J. (1979): The Interpretation of Igneous Rocks; *George Allen and Unwin*, London.