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**GEOCHEMICAL AND PETROLOGIC STUDY OF GRANITE SHEETS IN
GERDAKANE REGION IN NORTH OF SONQOR**

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ABSTRACT

Geographical location of studied region with area of 35km² in north of Sonqor City is between eastern lengths from 47°.34' to 47°.37' and in northern widths from 35°.00' to 35°.04'. The area is located in Sanandaj-Sirjan Zone. In terms of petrography, rocks in this region include types of granite, granodiorite and quartz-rich granitoid and Monzodiorite. In addition, metamorphic marble and schist rocks have been also resulted from intrusion in these sheets. Based on XRF analyses on 8 samples, geochemical nature of this sheet has been Sub-Alkaline (Middle Moust, 1975) and calc-alkaline (Arvin and Baragar, 1971). It has also pro-alumina nature (Shand, 1943) and based on Harker (1909) diagrams, fractional crystallization phenomenon is dominant. In addition, based on spider diagrams, no depletion of elements is observed in specimens and the total pattern is negative ramp mode, which is in consistency with pattern of subduction zones. Based on tectono-magmatic diagrams, the zone has been appeared as a result of orogeny crashes. In general, it seems according to all above mentioned evidences that magmatic activity of studied area has been resulted from subduction of oceanic crust below the continental crust.

Keywords: Sanandaj-Sirjan, Metamorphic, Fractional Crystallization, Subduction, Magmatism

INTRODUCTION

Sonqor zone has been located among some formations of Zagros Mountains, which are extended from northwest to southeast of Iran. Zagros Mountains are young in terms of geology history. Due to its geology,

Sonqor Region is located in divided zone and is also located in Sanandaj-Sirjan Zone in terms of geological divisions. The oldest formation of the region is associated with Jurassic and the newest one is related to

Quaternary Young Alluvial Deposits. Sanandaj-Sirjan Zone in this region has been mostly formed of metamorphic and zone rocks resulted from fraction of limestone and Marley limestone (**Hassani Pak, 2002**). Syncline holes of Sonqor have been located in northwest corner of Sanandaj-Sirjan Zone, which is known as Zagros' Metamorphic Zone. Source of appearance of these holes is construction of lands and have been created in form of a simple syncline. This hole is an independent geographical unit, which is one of the oldest infrastructural rocks of this zone in terms of stratigraphy, is belonged to the Jurassic Age. Major part of mountainous margin of north, northeast and eastern parts of Sonqor Zone in Darmorad, Ban Sari and Kamarzard Mountains in south of Dolat Abad have been formed of metamorphic formations of alternating lava and lime and schist from Jurassic Era (**Sarabi, 2003**).

Southeast part of Sonqor City has been formed of Cretaceous Limestone. Many karst phenomena are existed in this limestone body like types of Carens, Gharjaleh, Puljeh, Cave and Karst fountains, which can indicate expansion of karst in this sheet.

The mentioned mountain is in form of an anticline structure, which includes northwest-southeast procedure and is located in Sanandaj-Sirjan Zone.

This city has been formed of several regions including Sarab, Felegary, Colyaei, kionanat and Farsanj. Several villages in this region include Satr, Bavleh, Farsinj, Gerdakaneh, Hossein Abad, Shamsak, Ghorichay, Taperosh, etc (**Shelly, 1995**).

Fountains and catchments

Sonqor city has two catchments, which are considered among branches of two important and water filled rivers in west of Iran. The two branches are known as Gaveh Roud and Gavmishan, which Madian Mountain in north of Sonqor is natural boundary and division line of the two areas. Hence, Sonqor City has been naturally divided to two independent plains and two catchments. A river stems from slope of Kamarzard Mountains in east including Bujar and Hezarkhani and Kan Kabood. In the direction of east-west, the river receives many branches such as Sarab Charmaleh, Gerdakanieh, Mansur Arab and Sayeh Karo from southern slopes of Babr, Parishan and Panjeh Ali Mountains. After entering to Kurdistan, the river sheds in Gheshlagh River and would be then shed to Iraq under new names of Sirvan after passing Kurdistan and Uramanat (**Karim Pour, 1998**).

Southern river of the city, Gavmishan, stems from eastern mountains that for direct line of natural waters of Asad Abad Region and Snqor. The river continues its path in east-

west form after receiving many fountains from northern slope of Dalakhani Mountains, especially Agh Bolagh and Limanj Region (Sonqor Chay). The river passes south of Sonqor after receiving Sarab Gaznahleh and passes then from western slope of Dalakhani and enters finally to Dinvar region in extreme part of southwest part of the plain through attachment of Sarab Gelvich to it. Hence, one of the most important branches of Gamasiab River and Karkheh would be formed, which is known as Simreh in Lorestan (Moust, 1998).

Geomorphology

Sonqor Region is located among some formations of Zagros Mountains and has been extended from northwest to southeast part of Iran. Zagros Mountains are young in terms of geology history. Due to its geology, Sonqor Region is located in divided zone and is also located in Sanandaj-Sirjan Zone in terms of geological divisions. The oldest formation of the region is associated with Jurassic and the newest one is related to Quaternary Young Alluvial Deposits. Sanandaj-Sirjan Zone in this region has been mostly formed of metamorphic and zone rocks resulted from fraction of limestone and Marley limestone. Syncline holes of Sonqor have been located in northwest corner of Sanandaj-Sirjan Zone, which is known as Zagros' Metamorphic Zone. Source of appearance of

these holes is construction of lands and have been created in form of a simple syncline. This hole is an independent geographical unit, which is one of the oldest infrastructural rocks of this zone in terms of stratigraphy, is belonged to the Jurassic Age. Major part of mountainous margin of north, northeast and eastern parts of Sonqor Zone in Darmorad, Ban Sari and Kamarzard Mountains in south of Dolat Abad have been formed of metamorphic formations of alternating lava and lime and schist from Jurassic Era (Sheikh Zakariaei & M, 1992).

Major part of Kermanshah Province located in south of Morvarid Fault has sedimentary and structural properties of northwest part of Zagros, which includes two subzones of High Zagros and Folded Zagros. Distinction between the two zones is not significantly clear and it seems that passing of High Zagros to Folded Zagros is evolutionary. However, structural pattern is significantly different for the two subzones.

Compared part with High Zagros is located in northwest part of the province. In this location, Per Late Cambrian-Early Triassic rocks have no outcrops; although Upper Triassic- Cretaceous rocks include sediments in deep areas, among which sedimentary layers are significantly located such as different types of radiolarite, turbulent carbonates and ophiolite rocks in

Kermanshah's radiolarites, Bisotun limestone, and scene-Harsin ophiolites. Structural pattern of this region of the province is resulted from performance of friction faults, which is along with considerable displacement of rocky outcrops of crust. Displacement resulted from the suppressive action can be depicted in rocks in crunch form (**Moein Vaziri, 1996**).

All heights located in southwest part of the province can be also related to the area of high Zagros. The area is a single part of marginal valley of Arabian Shield, which was being sunk constantly and has been changed into a sedimentary area with orogeny during the Cenozoic. Hence, Mesozoic rocks in this area can depict sedimentary areas with medium depth; although Cenozoic rocks can illustrate sedimentary layers of a retrograde sea towards southern part.

Adjacent mountains of Sonqor Koliaie Province are different from Folded Zagros in terms of method of formation and type of rocks. It means that they are older than Zagros Mountains and have been under effect of volcanic and magmatic activities while folding and formation (**Madani, 2001**).

Literature review

The zone has been studied for the first time in 1996 by Iranian National Oil Company while providing Geological Map of Iran

with scale of 1:250000. At the same year, the region was studied by Iran Geology Organization for purpose of providing map of 1:250000. The first geological experts, who have conducted certain activities in this region by the mentioned year, were Amidi and Bolurchi. These researchers, along with Dr. Sirius Zareian, conducted their study on igneous and metamorphic petrology in east of Gharveh City for purpose of receiving MA degree. Sloiter and Aghanabati, **Hajian and Zahedi (1968)** have also conducted studies on northern part. The mentioned geology perceptions by **Zahedi and Hajian (1966)** have been revised and combined and published in Sanandaj in form of 1:250000 geologic quadrangle maps by 1970. Among other geology works, one can name neogene and quaternary volcanism study of **Bocalti and Inocenti (1977)** in regard with general pattern of Cenozoic young volcanoes from Turkey to West of Iran, which are known as linear volcanoes of Gharveh-Takab. In 1985, the volcanoes were studied in details by Dr. Moein Vaziri and D. Amin Sobhani. Other recent works are listed as follows:

- 1- **Kimia Ghalam, (1985)**, report of geophysical explorations of Antimony Dash Kasan, Ardabil
- 2- **Kimia Ghalam, (1987)**, a review on geological and mineral studies in Kansar Antimony Dash Kasan Baharloo, Ardabil

- 3- **Abedian, (9888)**, preliminary investigation and exploration of construction raw materials in Kurdistan Province by the Bureau of Mines and Metals of Kurdistan
- 4- **J Broud, (1974-1976)** has presented his PhD thesis in Kermanshah and has also provided 1:250000 Geology Map of Kermanshah.
- 5- **Sheikh Zakariaie, (1433)** has presented MA thesis in field of igneous-metamorphic petrology and has also provided 1:20000 geology map of Gharveh City for igneous rocks.
- 6- **Sang Ghale (1995)** has studied petrology of igneous rocks in south of Ghale for purpose of presenting MA thesis.

RESULTS AND DISCUSSION

In view of Iran's Constructional Geology, Sonqor sheet is located in Sanandaj-Sirjan Zone and is just a small part of southwest part of the region in range of Upper-Cretaceous overthrust bodies (with a mountain of Bisotun).

Petrography of igneous

Granite

The rocks are fully crystallized and in yellow to light green color in manual sample. In their context, quartz and feldspar and biotite minerals can be observed. Regardless of secondary tissues and current

structures, granite rocks of this region have 3 types of tissue.

- 1- A homogeneous mixture from shaped to amorphous aggregates
- 2- Tissues, in which there are some megacrysts from potassium feldspar
- 3- Granophyric textures

In these rocks, the main texture is granular and secondary textures are in kind of graphical and poikilitic textures. Size of minerals is usually from medium to small size.

Granodiorite

This type of rock in manual sample is from dark to black color with coarse aggregates. Texture of these rocks is granular and mafic minerals are also existed in it. Biotite mineral can be observed in manual specimen in form of black shale with pearl luster.

Primary minerals

Plagioclase: this mineral is among primary and main minerals. The mineral is colorless and with certain and well appearance; its birefringence is weak and to gray of first series; its twinning is polysynthetic and has weak swell. Most available plagioclases are medium aggregate and semi-shaped. In some sections, the mineral is relatively coarse and semi-shaped and are rarely shapeless and medium. In different sections, the mineral can be observed to 30-48%.

Quartz: quartz is another primary mineral of this rock, which can be observed sometimes in fine form and sometimes in needle shape in field with frequency of 18-35%. The mineral is colorless and has positive weak swell. Its prolongation is positive and its birefringence is weak with gray color of first series.

Ortosa: another primary mineral of this rock is ortosa, which is colorless and foggy as a result of analysis. It has a medium appearance and negative weak swell. Its darkness angle is bowed. carlsbad twinning is detectable in it and its birefringence is from gray to yellow in first degree. In most sections, the mineral is medium and semi-shaped. In some sections, it is fined aggregate and shapeless. A few members of the mineral are semi-shaped and fine aggregate and a few ones are also coarse aggregate. Rate of presence of the mineral is between 10 and 20 percent.

Biotite: this primary mineral can be observed in brown and red brown colors. Good appearances can be observed in it. Its twinning is simple and has positive prolongation. Swells can be observed in it. Its birefringence is strong and is in late second series. In some sections, it is appeared in form of medium aggregate and semi-shaped formation. A few members can be also observed in form of fine aggregate

and semi-shaped. This mineral is present in 5-15% of rocks.

Accessory minerals

Opaque: opaque is an accessory mineral, which can be observed using analyzer and in black color and has frequency equal to 4%.

Secondary minerals

Chlorite: the secondary mineral has been resulted from analysis of amphibole and is appeared in green, light green, orchid or pink colors. A series of its good appearance is observable. Simple twinning can be observed in it and some bodies in it have polysynthetic twinning. Its medium swell can be observed. It has also positive or negative prolongation. Its birefringence is weak and white in first series with abnormal colors. It has occupied about 2% of one section in form of fine aggregates.

Epidote: this secondary mineral has been created by analysis of plagioclase and is colorless to yellowish green. It has also strong swells and is multicolored. Its simple twinning is clear and has also a series of good appearance. Birefringence in this mineral is from medium to strong level in late third series. The mineral is appeared mostly in form of fine shapeless to semi-shaped aggregates in about 1% of sections.

Calcite: another secondary mineral is calcite, which is foggy and colorless. Its swell is variable and two series of good

appearance are observable in it. Its birefringence is very strong to white in high levels. In many sections, very fine aggregates of calcite are existed in the texture. Frequency of this mineral is 5-15%.

Quartz-rich granitoid

The igneous rock with porphyritic texture includes primary minerals of quartz, plagioclase and ortosa and accessory minerals. This rock can be observed in yellow to light and very ultra light gray colors in manual specimen. The rocks are also fine aggregated and quartz pieces can be observed in it.

Primary minerals

Quartz: primary mineral in this rock is quartz, which can be observed in form of fine and medium aggregates with frequency of 53%. The mineral is colorless and has positive swell. In addition, positive prolongation, weak birefringence and first series gray are properties of this mineral.

Plagioclase: this mineral is among primary minerals and is colorless with certain and good appearance. Its birefringence is weak and gray of first series. Twinning of the mineral is polysynthetic and has weak swell. Most available plagioclases are medium aggregated and semi-shaped and in some sections, the mineral can be observed relatively coarse and semi-shaped and in little amount is shapeless with medium

aggregates. In different sections, it can be observed to 5%.

Ortosa: ortosa is another primary mineral, which is colorless and foggy as a result of analysis. It has medium appearance and negative weak swell. Its off angle is bowed. Carlsbad twinning can be detected in it and its birefringence is from gray to first degree yellow. In most sections, the mineral is medium aggregated and semi-shaped. In some sections, it is fine and shapeless. A few bodies of the mineral are fine and semi-shaped and fewer ones are also coarse. Presence percentage of the mineral is about 20%.

Accessory minerals

Opaque: opaque is an accessory mineral, which is black with and without analyzer. Its frequency is equal to 6%.

Secondary minerals

Chlorite: the secondary mineral has been resulted from analysis of amfibol and is appeared in green, light green, orchid or pink colors. A series of its good appearance is observable. Simple twinning can be observed in it and some bodies in it have polysynthetic twinning. Its medium swell can be observed. It has also positive or negative prolongation. Its birefringence is weak and white in first series with abnormal colors. It has occupied about 5% of one section in form of fine aggregates.

Epidote: this secondary mineral has been created by analysis of plagioclase and is colorless to yellowish green. It has also strong swells and is multicolored. Its simple twinning is clear and has also a series of good appearance. Birefringence in this mineral is from medium to strong level in late third series. The mineral is appeared mostly in form of fine shapeless to semi-shaped aggregates in about 1% of sections. About 5% of this section is covered by iron layer.

Calicite: another secondary mineral is calcite, which is foggy and colorless. Its swell is variable and two series of good appearance are observable in it. Its birefringence is very strong to white in high levels. In many sections, very fine aggregates of calcite are existed in the texture. Frequency of this mineral is equal to 5%.

Monzodiorite

This rock seems in manual specimen relatively dark and fine aggregated and its texture is porphyric and has fine minerals.

Primary minerals

Quartz: primary mineral in this rock is quartz, which can be observed in form of fine and medium aggregates with frequency of 10%. The mineral is colorless and has positive swell. In addition, positive prolongation, weak birefringence and first series gray are properties of this mineral.

Plagioclase: this mineral is among primary minerals and is colorless with certain and good appearance. Its birefringence is weak and gray of first series. Twinning of the mineral is polysynthetic and has weak swell. Most available plagioclases are medium aggregated and semi-shaped and in some sections, the mineral can be observed relatively coarse and semi-shaped and in little amount is shapeless with medium aggregates. In different sections, it can be observed to 45%.

Ortosa: ortosa is another primary mineral, which is colorless and foggy as a result of analysis. It has medium appearance and negative weak swell. Its off angle is bowed. Carlsbad twinning can be detected in it and its birefringence is from gray to first degree yellow. In most sections, the mineral is medium aggregated and semi-shaped. In some sections, it is fine and shapeless. A few bodies of the mineral are fine and semi-shaped and fewer ones are also coarse. Presence percentage of the mineral is about 4%.

Accessory minerals

Opaque: opaque is an accessory mineral, which is black with and without analyzer. Its frequency is equal to 1%.

Secondary minerals

Calcite: another secondary mineral is calcite, which is foggy and colorless. Its swell is variable and two series of good

appearance are observable in it. Its birefringence is very strong to white in high levels. In many sections, very fine aggregates of calcite are existed in the texture. Frequency of this mineral is equal to 40%.

Marble

The term “marble” can be applied for deformed limestone, in which the priority is with carbonated minerals. Minerals in the scope of study that can be named as crystallized limestone can be found mostly in east and northeast part of the region. In manual specimens, most of them are appeared in dark gray color of a combination of white and gray colors and sometimes milky color. Expansion of marble is high in southern part of Gharveh and can be explored as for purpose of construction and decoration. Gharveh marbles have been created as a result of metamorphism. In external part of metamorphism section, marbles are fine aggregated, which are known as ceramic stone in commercial terms. The more one goes toward intrusive body, the more the size of aggregates would be, which commercial name of coarse aggregated marbles is crystal. In the studied area, marbles can be observed in form of layers with low thickness in alternation with metavolcanics and plate stones. Microscopic analysis indicates that texture of the

mentioned rocks is granoblastic texture with mosaic decoration. Primary mineral in these rocks is calcite, which is usually coarsely crystallized and forms 70-80% of the rock content. Among accessory and secondary minerals in the marble, one can name quartz, epidote, orthosa and chlorite. Epidote is about 1% and has been resulted from interaction between calcite and clay impurities of the rock. Sometimes, specific orientation can be observed in desired scope’s marbles, which is resulted from zone shearing.

QAP diagram

According to Streckeisen diagram (QAP), (k)AB30 specimen have been located in monzodiorite zone; (I)AB37 specimen in quartz-rich granitoid zone; specimens of (F)AB39, (G)AB23, (H)38AB and (P)34AB in granodiorite zone and specimens of (A)AB26, (B)AB35, (C)AB29, (D)AB28, (E)AB24 and (O)AB40 have been locate din granite zone.

Chemical naming of igneous rocks in studied area

Such naming has been conducted using chemical compound of igneous rocks.

Naming rocks based on main elements

$Na_2O + K_2O$ Diagram vs. SiO_2 (Middle Moust, 1994).

Based on classification of Middle Moust (1994), specimen AB37 is located in quartz

syenite zone. $Na_2O + K_2O$ for it is equal to 10.5% and SiO_2 value is about 65%.

Specimens 40AB, AB29, AB28, AB24, AB35, AB34 and AB38 are located in granite zone.

+ K_2O Na_2O Value in these specimens is equal to 7.9% to 9.5% and SiO_2 value is from 69 to 71% for them as it is obvious in **Figure 13**.

Diagram of naming plutonic igneous rocks (Middle Moust, 1985)

Based on classification of Middle Moust (1985), specimens AB24 and AB38 are located in granodiorite zone. Their $Na_2O + K_2O$ value is about 8% and SiO_2 value is about 68%. Specimens AB34, AB40 and AB34 have been located in quartz monzonite zone and their $Na_2O + K_2O$ value is between 9 and 1.5% and SiO_2 value for them is from 65 to 69%. Specimens AB28, AB29 and AB35 have been located in granite zone and their $Na_2O + K_2O$ value is from 8 to 9.5% and SiO_2 value has been from 69 to 72% as it is obvious in **Figure 14**.

TAS diagram (Cox et al, 1979)

One of the main naming methods of plutonic rocks is using chemical compound, which has been for the first time presented by Cox et al in 1979 (Cox & Bell, 1979).

All specimens in studied area have been acidic and are placed in sub-alkaline/tholeiitic group. AB37 has been located in syenite zone and its $Na_2O + K_2O$ value is about 10.5% and SiO_2 value is equal to 65%.

Specimens A38, AB34, AB35, AB24, AB28, AB29 and AB40 are located in granite zone. Their $Na_2O + K_2O$ value is between 7.5 and 9.5% and SiO_2 value is from 68 to 71% as it is clear in figure 15.

Naming igneous rocks based on percent of cations

$R_1 - R_2$ Diagram

Classification of plutonic igneous rocks based on percent of cations (Della Roche et al): in this method, weighted percent of oxides would be divided to their molecular weight and then the result would be multiplied in number of moles:

$$R_1 = [4Si - 11(Na + K) - 2(Fe + Ti)]$$

$$R_2 = (Al + 2Mg + 6Ca)$$

According to Della Roche Diagram (Della Roche, 1980), specimens AB29 and AB40 have been located in granite zone and R_1 value is from 1820 to 1910ppm. Moreover, R_2 value is also about 645-655ppm.

- Specimens AB35, AB38 and AB40 are located in granodiorite zone and R_1 value is

equal to 2000-2130ppm and R_2 value is equal to 658-720ppm.

- Specimen AB37 is in syenite zone and its R_1 value is equal to 780 and R_2 is equal to 800ppm.

- Specimens AB 34 and AB28 are located in quartz monzonite zone. Here, R_1 value is about 1700ppm and R_2 value is about 500ppm.

The diagram depicts basically upward procedure, which increase in R_1 value can cause increase in R_2 value. The process is observable in all groups of quartz monzonite, granite and granodiorite as it is depicted in **Figure 16**.

Debon and Lefort diagram (1988)

The diagram classifies plutonic igneous rocks based on percent of cations (**Debon and Le Fort, 1988**). Reagent of potassium feldspar to plagioclase ratio is as follows:

$$P = K - (Na + Ca)$$

$$Q = si/3 - (K + Na + 2Ca/3)$$

- Specimens AB38, AB24, AB40 and AB29 have been located in granodiorite zone and AB28 is located in diorite quartz zone. AB35 is in tonalite zone and AB34 is in monzodiorite quartz zone.

- Specimen AB37 is located out of defined zone in this diagram.

In specimens in granodiorite zone, P value has been from -160 to -140ppm and Q value is equal to 120-130ppm. In specimens in diorite quartz zone, p value is about -190ppm and Q value is equal to 100ppm; tonalite is about -255ppm and Q value is equal to 125ppm.

P value for monzodiorite quartz zone has been about -150ppm and Q has been equal to 100ppm.

Specimens in the mentioned diagram depict upward process and mainly, increase in P value can cause increase in Q as it is obvious in **Figure 17**.

Naming rocks based on normative percent of minerals

Norm method: in this method, minerals of rock can be calculated using chemical compounds. Normative minerals are depicted in Asterix Diagrams and name of rock has been also specified.

Using frequency of albite, potassium feldspar and anorthite, plutonic igneous rock can be identified (**Okaner, 1965**).

In this diagram, specimens AB34, AB40, AB29 and AB24 have been located in granite zone and specimens AB28, AB37 and AB35 have been in trondhjemite zone.

AB38 has been also in granodiorite zone as it is obvious in **Figure 18**.

Streckeisen diagram (QAP) based on normative

The diagram has been mainly considered for intrusive rocks including quartz pole (Q) alkaline feldspars (A) and plagioclase feldspars.

According to the diagram, specimens AB38, AB24, AB35 and AB29 have been in syenite granite zone; AB34 and AB28 are in alkali-feldspar syenite zone; AB40 is in alkali-feldspar granite zone and AB37 is in alkali feldspar syenite zone as it is obvious in **Figure 19**.

Geochemical changes of magmas

During magma evolutions, many changes in elements are not independent from each other, but also they have logical relations. In other words, if a series of igneous rocks are related to each other in terms of time and place, chemical changes would be also related to each other during process of crystallization and subtraction, which can result in magma evolutions. In order to investigate and determine procedure of changes in primary and secondary elements and also petrologic study of magma processes, different diagrams have been presented by researchers and petrologists, through which one can investigate existence or inexistence of relationship between rocks in a region. The simplest diagram has been proposed by Harker, which includes two formations. One formation would be transferred on Y axis and another on X axis. In these diagrams, weighted percentage of

oxides to silica has been depicted. In addition, percent of different oxides to Larsen Coefficient ratio and oxides to subtraction coefficient ratio have been presented by Thorenton and Tuttle. Moreover, oxides to freeze ratio have been also propose by **Kuno (1957)**.

Binary phase diagrams (Harker)

If sampling is conducted comprehensively, when changes in chemical compounds in a igneous series are evolutionary and changes cover each other and are placed in certain zone, relation between the series members would be proved. However, lack of such attachment among nodes on the diagram and fraction of curve passing points can be a sign for lack of relation among magmas of the rocks.

Analyzing changes of scarce elements against SiO_2

Procedure of adjusted elements such as Ni and Cr, have relatively spread wide of changes; although the process if relatively upward. Process of changes in LILE group, similar to Rb and Ba, is downward and Sr has relatively dispersed range of changes; although it has totally upward process. Changing process for LREE group, similar to La and Ce is downward and Y element from HERR group has relatively dispersed changes, although is totally downward. Moreover, change process of Zr element from HILE group is also upward.

According to Harker diagrams, rocks of studied zone are totally originated in unit magma and the subtraction has been created as a result of denotative crystallization.

In general, elements of HFS group emphasize crystallization process and investigation of scarce elements against SiO_2 is an emphasis on crystallization process.

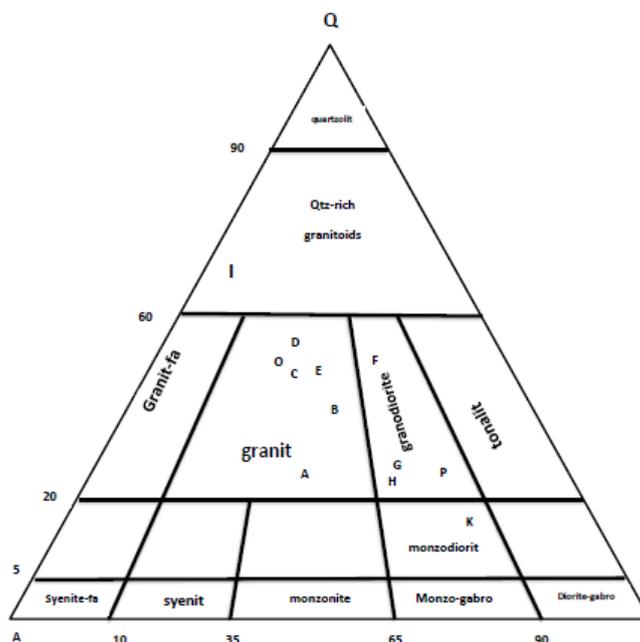
A/CNK changes against SiO_2 (Harker A/CNK)

A/CNK/ SiO_2 diagram is useful for crystallization of section and separation of calcium-rich clinopyroxenes and classic

plagioclases during subtraction and evolution of magma.

Changes of A/CNK with the increase in SiO_2 percent would be relatively horizontal.

In the specimens in studied zone in A/CNK diagram and in middle areas, they have horizontal progress and finally a downward procedure would be observed at the end of crystallization.



Streckeisen diagram (aQAP)



Figure 1: manual specimen of granite

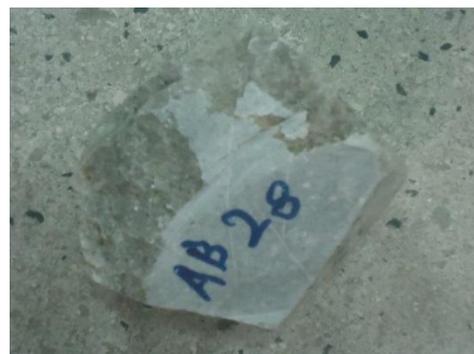


Figure 2: manual specimen of granite



Figure 3: manual specimen of granite



Figure 4: manual specimen of granite



Figure 6: manual specimen of granite

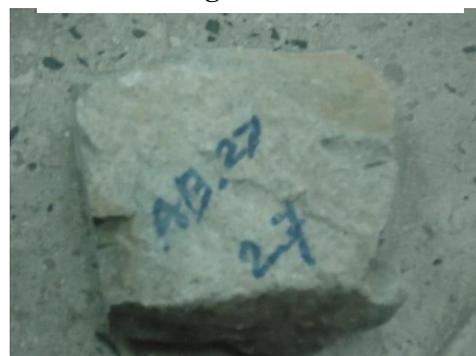


Figure 5: manual specimen of granite



Figure 7: manual specimen of granodiorite



Figure 8: manual specimen of granodiorite



Figure 9: manual specimen of granodiorite



Figure 10: manual specimen of quartz-rich granotoid



Figure 11: manual specimen of monzodiorite



Figure 12: manual specimen of marble stone

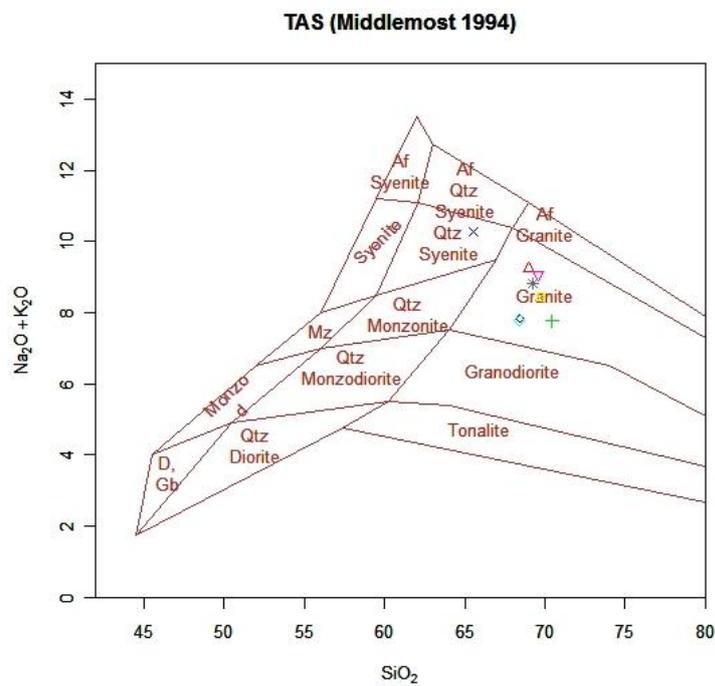


Figure 13: diagram of ranking igneous rocks in studied area

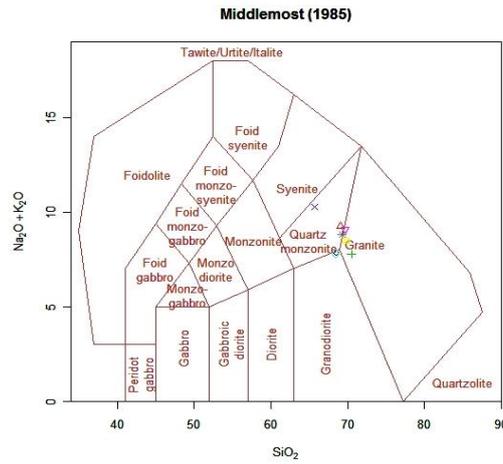


Figure 14: Ranking igneous rocks in studied area in Middle Moust Diagram (1985)

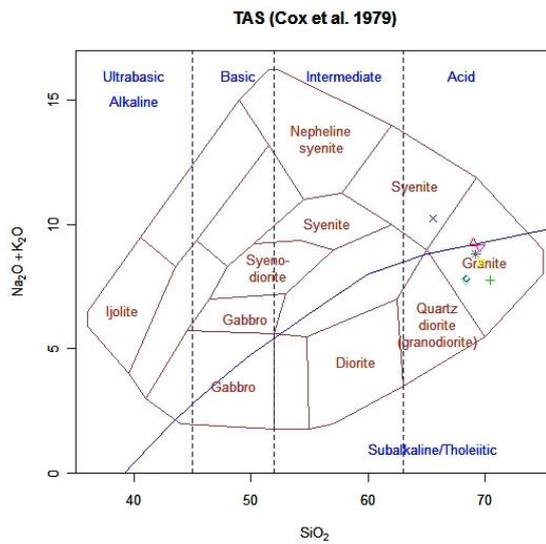


Figure 15: naming plutonic rocks using chemical compound (TAS) Cox *et al* (1979)

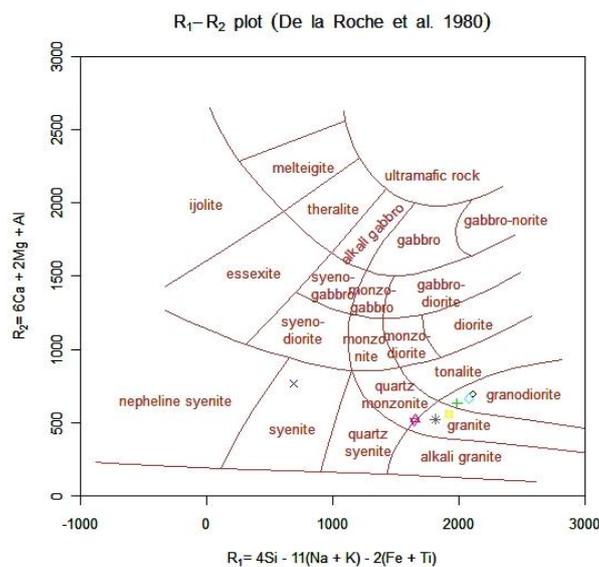


Figure 16: ranking plutonic igneous rocks based on percent of cations (Della Roche *et al*, 1980)

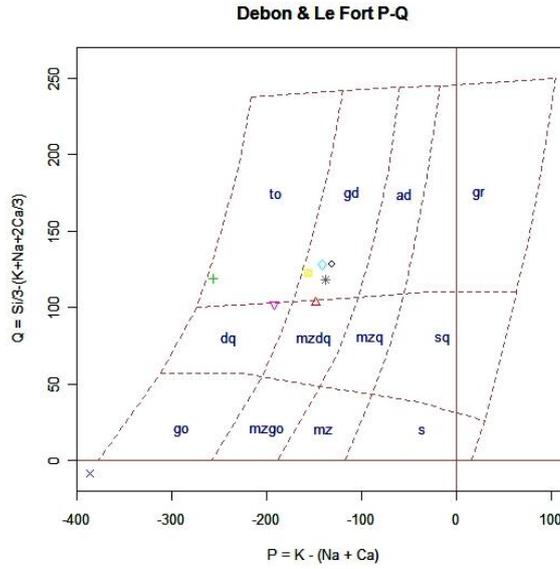


Figure 17: ranking plutonic igneous rocks based on percent of cations (Debon and Lefort, 1988)

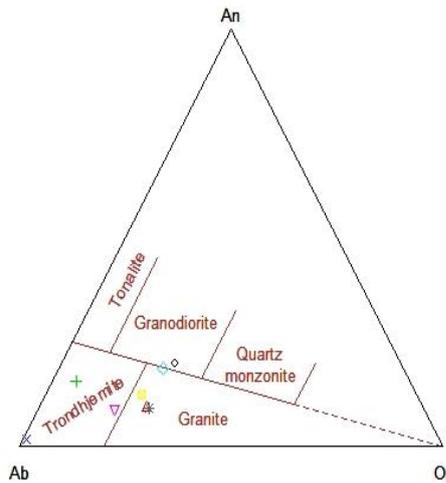


Figure 18: determining name of rock using chemical compound (Okaner, 1965)

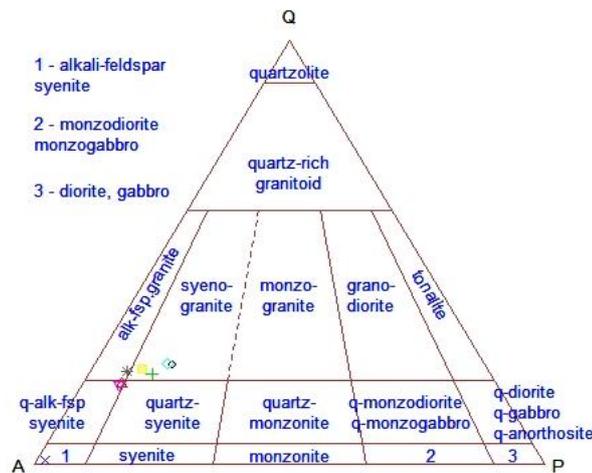


Figure 19: Streckeisen diagram (QAP) based on normative

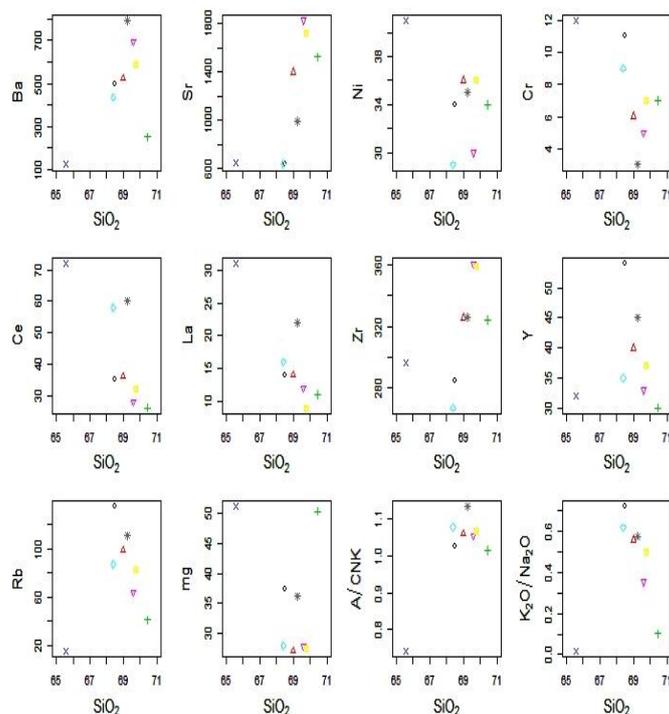


Figure 20: 1) binary phase diagrams of Harker (secondary elements) 2) changes of aluminum against alkalis and Ca based on silica's changes 3) changes of K_2O Na_2O against alkalis based on silica's changes

CONCLUSION

Kermanshah is one of the eastern provinces in Iran and is located in boundary of Iraq country.

Early geology studies on geology map of Kermanshah are about 1:250000 in scale, which have been published by Geology Organization by 1978.

Geology data indicate that the major part of Kermanshah is belonged to sedimentary-structural zone of Zagros. Hence, its northwest part has similar geological properties to Sanandaj-Sirjan Zone.

Sonqor City with 2242km in area is one of the cities in Kermanshah Province located in east of Iran. Center of the city is Sonqor, which has been located in 85-km distance of northeast part of Kermanshah and in

geographical length of 47° and 36° in east and 34° in north.

Sonqor Zone is located in Sanandaj-Srjan Zone in terms of Iran's Geological Divisions including Northern part of Sanandaj-Sirjan Zone and aluminosilicate minerals' zones.

Geographical status of studied area with area of 35km² has been located in north of Sonqor between eastern lengths of 47°, 34' and 47°, 37' and northern widths of 35°, 00' to 35°, 04'.

In Streckeisen based on normative, 4 specimens have been placed in syenite-granite zone; 2 specimens in quartz-alkali-feldspar-syenite zone; one specimen in alkali feldspar granites zone and one

specimen has been located in alkali-feldspar-syenite zone.

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