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Magmatic processes in the genesis of volcanic rocks in south Langrood

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Abstract

Under studied region is located in Gilan province, in south of Langrood city, Amlash town, among 50° 00' and 50° 30' Eastern longitudes and 37° 00' and 37° 15' Northern latitudes. Its area is about 450 km². According to classification of Iran structural zones, this region is located in Alborz-Azarbaijan zones (Nabavi, 1977). In this region the upper part is formed of an Ophiolite Complexes that its uplifting time is upper Cretaceous. Constitutive rocks of this part are rocks of old ocean crust and totally consist of carbonate cretaceous sedimentary rocks, pillow basalts (include basalt, basaltic andesite, andesite and trachyte terms), delorite and gabbro dikes. According to various geochemical and petrological diagrams, the rocks in the study area are tholeiitic, calc-alkaline, calc-alkaline rich in potassium and shoshonitic (two samples) and the degree saturation of alumina located in the range of metaluminous. Magmatic differentiation can also be inferred by crystallization, metasomatism and magma contamination in the crust. In the rift basalts. The differences in the detection of tectonic environment can accrue to alteration and pollution basaltic magma with continental crust, so in total it can be said the conclusions of the tectonic setting is not possible at present And the integration of research done on the remnants of oceanic crust in the Gilan province to reach the conclusion that there will be relatively strong..

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Introduction

On the basis of petrography evidences, Langrood volcanic rocks have been beard alteration, the resulted mineral of such alteration mostly are hydrous and alteration is observed in the format of various phenomenon such as Chloritization, albitization of plagioclase margin, serpentinization of olivine, clayelization, epidotization. Such paragenesis mostly was at the level of green schist face and is formed under the pressure lower than 3 kb and affected by passing fluids that pass through break downs and joint (that was appeared by function of main fault of Amlash- Otaghvarand as a result of inconsistency of some minerals such as plagioclase, pyroxene and olivine). Structural geology of the study area in the view of the Alborz - Azerbaijan (Nabavi, 1977) is located. This zone includes areas on the coast of the Caspian Sea and at the northern limit is the fault of the Alborz. Much of the present age by sediments (river - sea - delta) is covered. Segmentation Eftekhar-Nejad's (1981) Much of the subsidence zone, the Caspian Sea region is listed. Darvish Zadeh, (1992). Magmatism, as the most important influence on the development of geological phenomena governing region including thin. For petrographic study of thin to thick layers sandstones, dark gray shales along with coal signs. Light gray, gray, yellow and green, thin to medium Layhand.

In this study aim is divided igneous rocks to external igneous rocks (volcanic) and pyroclastic rocks. As volcanic rocks are grained and glassy, exact identification of their mineralogy components is not possible, but using microscopic studies is unavoidable.

Materials and methods

Regional Geology

Langrood in rock units consists mainly of volcanic units that constitute parts of the region. In general, based on the geological map Langrood hundred thousand square, stone sculptures sedimentary and igneous body comprises two main areas [Fig. 1]. These figs. are all belong to the Paleozoic and later. Figs. include sedimentary conglomerate, tuff rock lime green marl Sardargul to the body of igneous rock consisting of basic volcanic basalt to andesite composition - a rare alkali layers of limestone and shale and sandy shale gray. Light gray, gray, creamy, yellow and green, thin to Rare Between layers. Igneous body consisting of basic volcanic rocks of basaltic andesite in composition - alkali basalt to basaltic andesite and basaltic lavas and pyroclastics with pillow structure and dacitic-andesitic are acidic and basic dykes. Mineralogical and chemical components of Igneous rocks form in the source location (mantle, crust) and change when magma moves toward the Earth's surface and places in surface layers; therefore, main and rare components are controlled by some factors such as melting, wall rock reaction, crystallization etc.

Analysis method

The results of field observations, petrology and geochemical data were used to investigate the geochemical volcanic and magmatic evolution of volcanic rocks that can be found south Langrood Chemical analysis of XRF, ICP and EPMA (X-Ray Probe Micro Analyzer) pyroxene and plagioclase 15 types of minerals, rocks and using the results in the chemistry laboratory of the Geological Survey country By using software and petrological GCDkit & Igpet been processed.

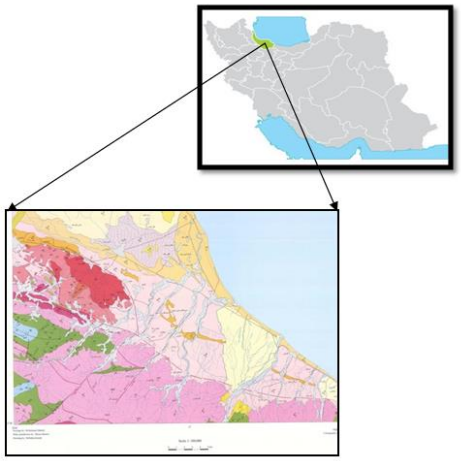


Fig. 1. Geological map of understudied region (adopted from geology map 1:100000Langroodpage). Understudied region has pink color.

Results and discussions

Petrography of volcanic rocks

Petrographic studies

Microscopic studies showed that the studied rocks composed of basalt, andesite basalt, andesite, trachyandesite and Gabbro are a few samples. the basaltrocksare in the area. Plagioclase is the most abundant mineral in the volcanic rocks phenocrysts and Microlite In essence, there are two ways. Phenocrysts are subhedral page and grain shape and duplicate twins (polysynthetic Macle) and they appear in Karlsbad Macle, Based on the maximum extinction angle, phenocrysts plagioclase composition of andesine to labradoritemicrolitic plagioclase composition varies, but in essence is acidic. Sieve texture in plagioclase [fig. 2- a], twining polysynthetic Macle [fig. 2- b], sericiteof [fig. l2- c], respectively, which may be signs of physico-chemical imbalance in the magmatic system. In this case, some intense hydrothermal alteration of plagioclase has been, while some of the plagioclase remains intact. Selective alteration of the injection pulse (Pulse) multiple magma, molten magma mixing or when a mafic magma with felsic magma hybridization (hybrid) created, formed (Shelley, 1993). The most important minerals in mafic volcanic rocks contain clinopyroxene (augite), amphibole (green hornblende) and are olivine. Opaque minerals in the rocks seen in both primary and secondary (decay and decomposition product of other minerals) and the amount are abundant in the area. In most cases the alteration of sericite (sericite) and the sericite (chlorite, epidote and calcite) in feldspar and chlorite. Most of the stones have been investigated, including porphiritic, Hyaloporphyritic, glomeroporphyritic and is interested. Therefore it can be concluded that glomeroporphyritic texture samples obtained in the volcanic rocks is indicated by fractional crystallization.

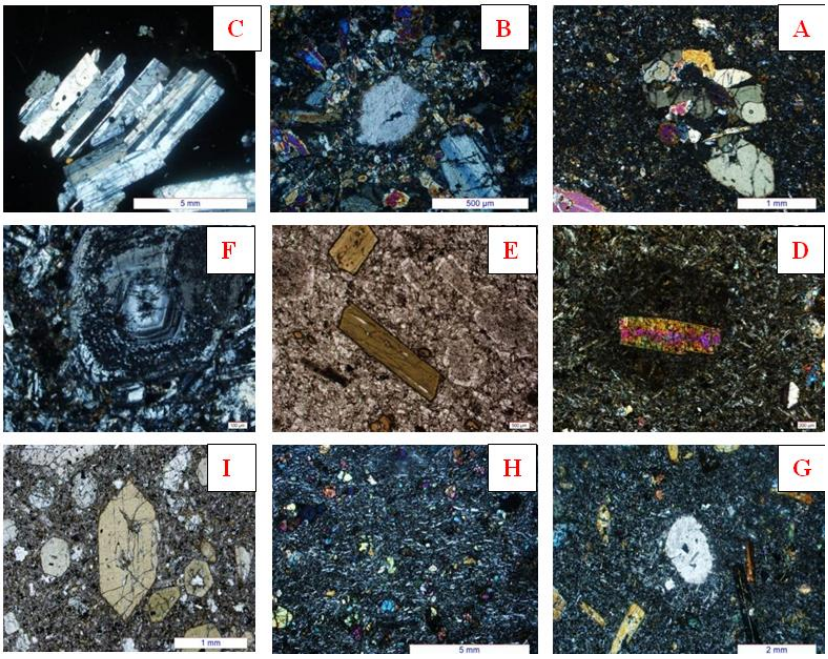


Fig. 2.(A). Accumulation in andesite teriyaki Basalt glomeroporphyritic phenocrysts pyroxene and create texture. (B) texture Amygoeydal in Basalt, secondary calcite filled cavity. (C) phenocrystsplagioclase and texture accumulation of trachy andesite basalts glomeroporphyric. (D) crystals of clinopyroxene and basaltic andesite lava field in Microlite. (E) SEM image of green hornblende crystals polecroeism burned with a green margin. (F) Zoning in phenocrysts of plagioclase andesite teriyaki. (G) with a cavity filled by calcite crystals pulled amphibole andesite. (H) themicrolitic plagioclase and clinopyroxene in Olivin rounded phenocrystsmicroliticlava flow andesite teriyaki and create texture. (I) green Hornblende porphyry texture with porphyritic that contain Enclove of minerals and apatite are opaque (in XPL light).

Nomination this volcanic rocks

To name the volcanic rocks in the study area of Na_2O + K_2O diagram of the SiO_2 (Middlemost, 1994) and diagram ((Le Bas *et al*. was used. The sample plots within the dacite, andesite teriyaki, andesite and basalt placed (fig 3- a) and (fig3- b).

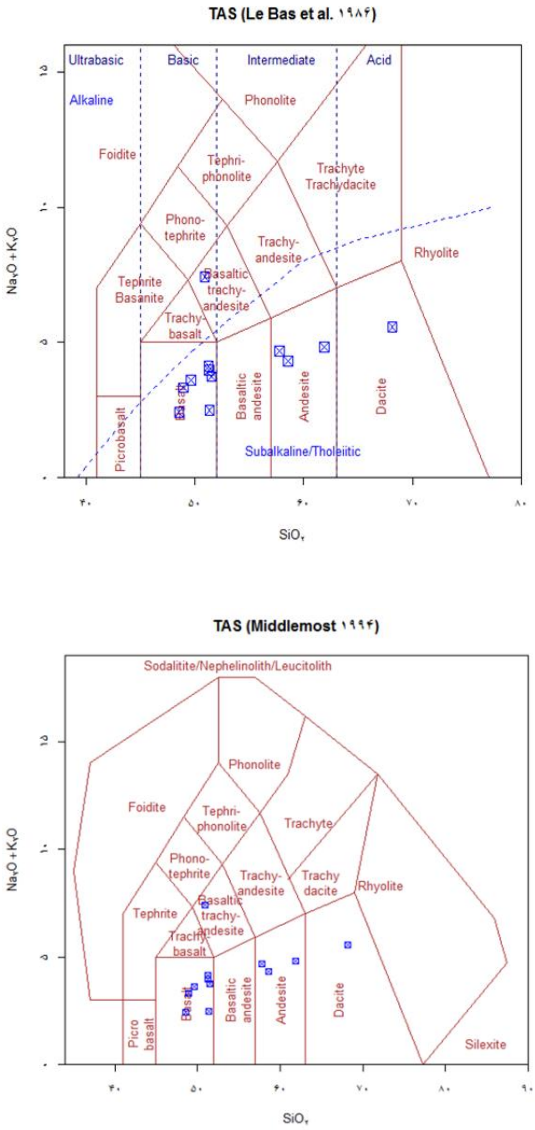


Fig. 3. Charts for naming igneous rocks, a) diagram of Na_2O + K_2O to SiO_2 (Middlemost, 1994), b) diagram of Na_2O + K_2O to SiO_2 ((Le Bas *et al*).

Determination of magmatic series

Geochemical data indicate that the volcanic rocks of calc-alkaline magmatism and active continental margins are related. In this study, to determine the nature of the magmatic rocks of the volcanic area of the diagram K_2O versus SiO_2 (Peccerillo & Taylor, 1970) and the triangular diagram (Norry, 1973 & Pearce) was used (fig4), observed the volcanic rocks are mainly in the spheres of calc-alkaline and calc-alkaline potassium are high.

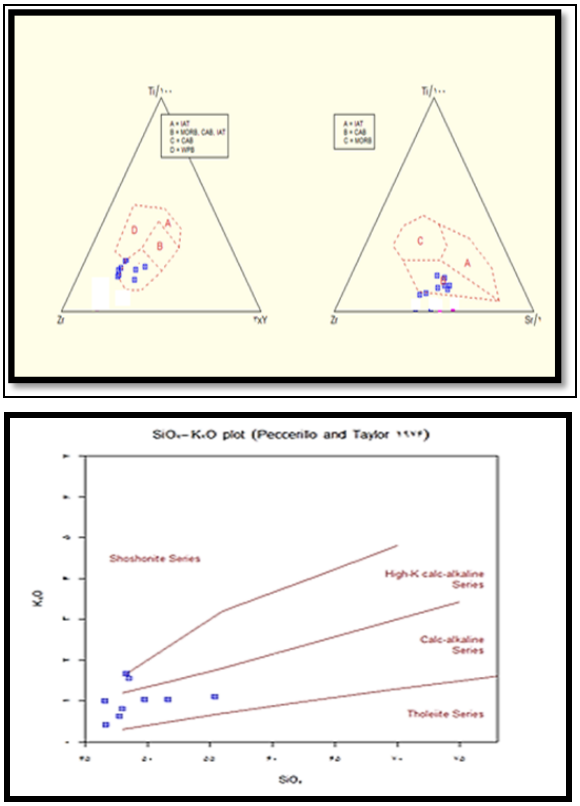


Fig. 4. Graph of K_2O by SiO_2 (Peccerillo & Taylor, 1970) and the triangular Norry, 1973 & Pearce Ti/100-Zr-3×Y,Ti/100-Zr-Sr/2()(to determine the nature of the magma, volcanic rocks.

Major and trace element geochemistry

To investigate the changes of major and trace elements in the Harker diagrams of magma crystallization (Harker, 1909) was used. Harker diagrams partially revealing rational relationship geochemical make the most use out of this diagram in geological formations of volcanic magmatic differentiation processes such as digestion and the melting part. General processes that have a positive or negative linear relationship Fractional crystalli-zation controlled , but Dispersion may be due to changes in the type of contamination, magma with

crust, alteration or crystal concentrations (percentage phenocryst) are (Wilson, 1989).

The main elements such as MgO, FeO, TiO_2 and CaO show a decreasing trend with increasing SiO_2 during magmatic differentiation (Fig. 5). Crystallization of mafic minerals (such as olivine and pyroxene from) apart from residual magma magma decrease in MgO and FeO, TiO_2 trend of the crystallization of titanium oxide (Ilmenite and titanite) and CaO on crystallization trend and classic plagioclases clinopyroxene during magmatic differentiation attributed. K_2O and Na_2O are part of incompatible elements during magmatic differentiation increased with increasing SiO_2 show with little scattering, and dispersion of the movable element oxides such as K and Na are largely due to the alteration sericite and clay . Element Al_2O_3 SiO_2 with a slight decline in the face of increasing dispersion is displayed. Changes in the amount of Al_2O_3 are usually attributed to the separation of plagioclase. Dispersion observed in the graph can be associated with the presence of large crystals of plagioclase feldspars and microliti phosphatase in the sample. The trend toward SiO_2, Al_2O_3 can be associated with separation and crystallization of the minerals plagioclase and CaO (Wilson, 1989).

In general, among Large Ion Litophil elements (LILE) in magmas rise with increasing SiO_2 during magmatic differentiation, but in this study the trends of the different elements. Rb has been an increasing trend with Dispersion while Sr is a downtrend. Sr trend reflects the changes that have occurred in the magma, so that this element during magmatic crystallization process is not your usual behind.

Among the trace elements, compatible elements such as Co and V show a decreasing trend with increasing SiO_2 (fig 5), which could be associated with differentiation ferromagnesian such as olivine, pyroxene and magnetite is (Mason and Moore, 1982).

Zirconium has a high load and high ionic radii (0/7 Angstrm) and entered the common minerals in the rock is not the degree of concentration of the element in Subtractive process end result is more abundant. Often substitutes containing titanium, niobium and titanium oxides, and sometimes in buildings titanite, zircon, biotite and hornblende entered.

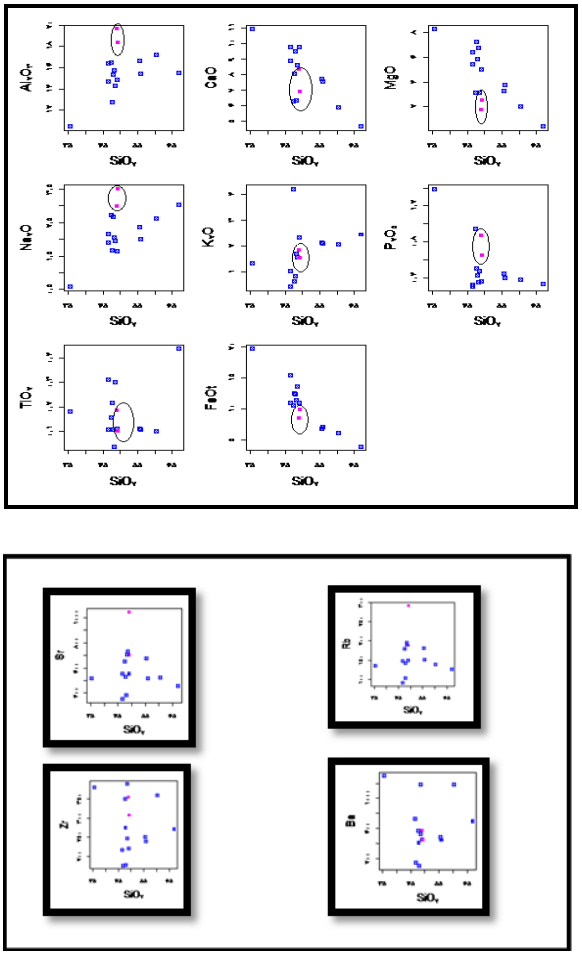


Fig. 5. Charts for the major oxides and trace elements than the number of SiO_2 in the volcanic rocks.

Tectono-magmatic setting igneous rocks studied pattern formation

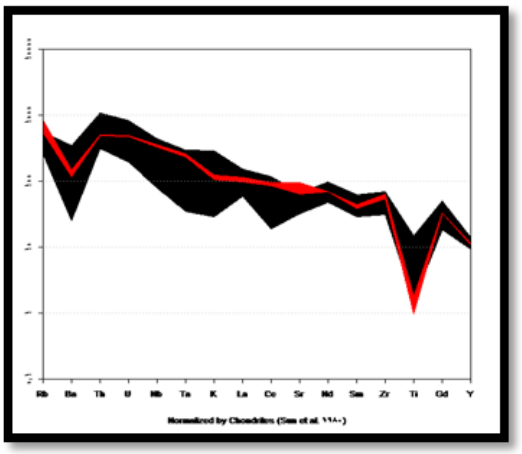
Wilson (1989), within continental extensional environments-which is divided into three parts:

Extensional basins back-arc (Back arc basins). Extensional basins separated by tensile forces associated with the fault (Pull apart basins).Extensional basins trapped (Trapped marginal basins).

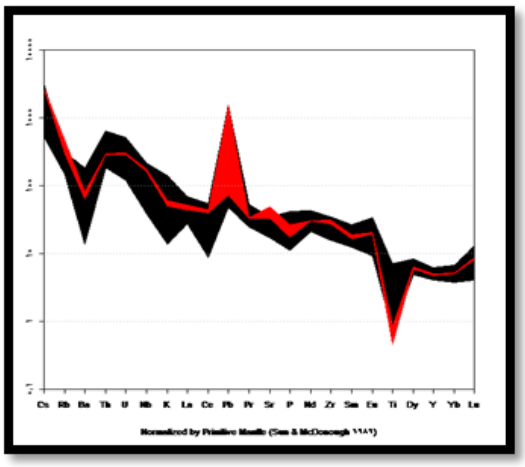
In the first case, the subject is discussed, developed Continental basins, beyond Arc volcanic island arcs and active margin related to subduction of oceanic lithosphere Continental basins face lie and skins. The short basins long life (about 15 million years) after stopping or reducing tension and heat flow, a large thickness of clastic sediments are buried beneath the basin floor fitted. The sediments of the continental characteristics of mature (adult), and the Volcanic arc, has been proved that the back-arc approximately basins been established in areas where young oceanic lithosphere thickness, or expression was high angle subduction zone (Nishevera, 2002). According to Smith *et al* (2006), the slope can be subducted oceanic slab under Affectedfactors such as rapid move towards the pit and subduction of oceanic lithosphere low density and Young occur.

This approach led to the displacement of the magmatic arc subduction in the sections The internal parts of the continentor subduction-related magmatism in, stop TPU, resulting in the development and back-arc tectonic compression within the screw. But steep subduction under the influence of several factors such as slow motion oceanic plates, subduction of oceanic crust and dense low rate convergence and the old corn. The subduction of expanded Arcs magmatic and tectonic stretching Tremblay within walking distance to the hole and back into the melt will reduce magmatic arc. In systems with high dip direction of subduction of oceanic plate being driven by forces under Continental page, so that the horizontal compressional force on the upper plate subducted lithosphere is less than the weight of the vertical tensile force.

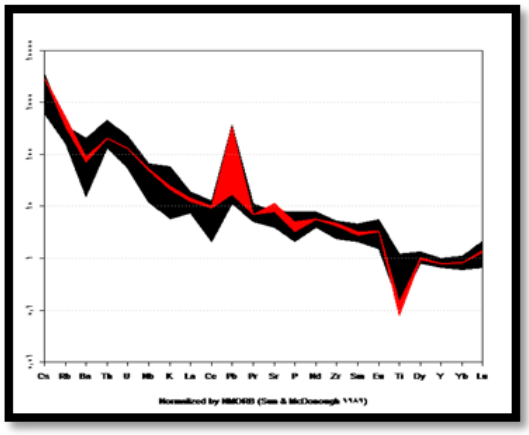
Incompatibility in the spider diagrams elements decreases from left to right, moving to the left so that incompatible elements, rare earth elements in the style and medium, and heavy rare earth elements are curved to the right.



(A)



(B)



(C)

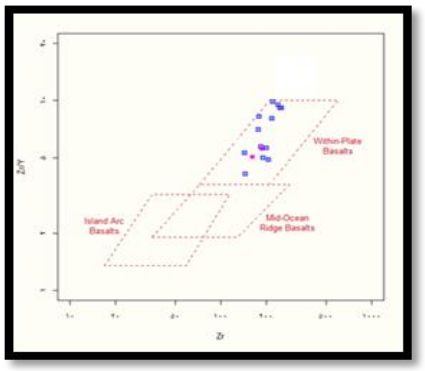
Fig. 6. A diagram of andesite and basalt and gabbro Amlash with chondrite normalized by Sun *et al*, 1980 B charts andesite and basalt and gabbro Amlash normalized to primitive mantle Sun & MacDonough, 1989 C. andesite and basalt and gabbro graph norm Amlash with normal diagonal Sun & MacDonough, 1989.

The concentration of trace elements (Cs, Rb, K, Ba, Eu) LIL who are moving may be a function of the behavior of a fluid phase, while focusing elements (Y, Hf, Zr, Ti, Nb, Ta) HFS by Chemistry origin and processes of melt / crystal stone that occurs during development is controlled. Some of the elements are controlled by certain minerals, such as zircon minerals may be in Zr, P in apatite, Sr in plagioclase, Ta, Nb, Ti in ilmenite, rutile and titanite focus.

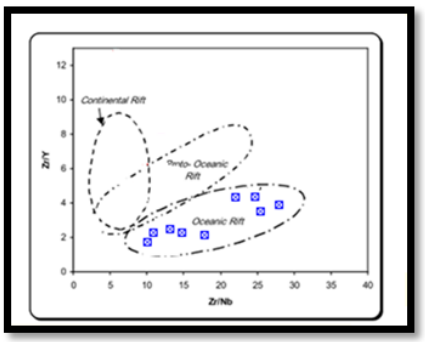
Samples studied in the graphs of normalized to chondrite (Sun *et al*, 1980) and primitive mantle (Sun & Mac Donough) and skew normal Sun & Mac Donough, 1989) (fig 6 a to c), concentration is relatively high and incompatible elements Litophil large ion (LILE) and light rare earth elements (LREE) and a relatively low concentration of heavy rare earth elements (HREE) and high field strength elements (HFSE) Specifically, Ta, Nb, Ti show deals with the characteristics of subduction-related magmas is.

Before the end of the Triassic orogenic tectonic event caused significant changes in the region. In the event of an interruption of sedimentation and erosion phases formed by volcanic activity and bauxite horizons and Laterite is associated, the platform has been completed. The Upper Triassic clastic deposits Shemshak start and deposition of sediment deposition in a delta environment - Lagoon has continued to Middle Jurassic. In the southeast of the study area on the top row and Middle Jurassic Triassic clastic, carbonate unit Middle Jurassic Lower Cretaceous clastic JK1 to go. Tizkvh Formation (Upper Cretaceous) with a base damage on the carbonate unit - damage. Indicating the discontinuity at this time.

Mineralogical composition of the metamorphic rocks are poorly developed in this transformation of greenschist facies metamorphic rocks, so that the intensity is not high.



(A)



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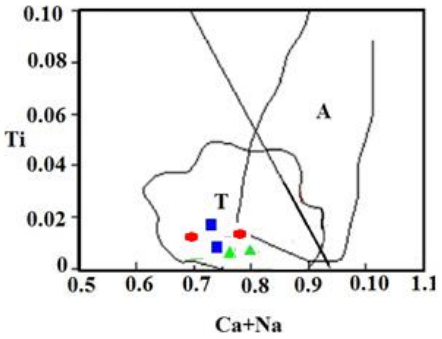
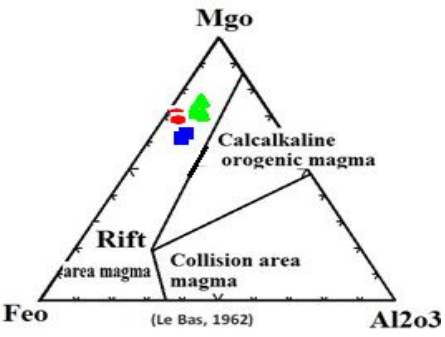


(C)



(D)

Fig. 7. A plot of distinguishing basic rocks based on the variables Zr / Y-Zr (Norry, 1979 & Pearce. The samples of mafic basalts within the pages are rather distinctive tectonic setting new computerized diagram

(b) and Moore (1991) in this diagram more Pacific Rift area, are examples. c. the use of clinopyroxene mineral to determine the tectonic environment (Leterrier *et al*., 1982) more samples in volcanic arc. D. clinopyroxene mineral used to determine the tectonic environment (Le Bas, 1962), more samples are located in the Rift Continental.

Conclusion

Much of the area of volcanic and sedimentary Langrood and less intrusive rocks are formed. Petrology of volcanic rocks in this area are mainly andesite, trachyandesite, are basalt. Magma is The geochemical investigations dispersion of points in some diagrams of trace elements and rare than SiO2 elements such as P_2O_5, FeOT, TiO_2, MgO, CaO, Al_2O_3 of basic rocks in the acidic rocks negative trend of Na_2O, K_2O trend indicates that the process of differentiation Magma is consistent. In addition, some processes can be seen in this fig. Dispersion such alteration or contamination and pollution volcanic magma manufacturer Amlash attributed to crustal material. Moreover, the increasing trend of elements with large ionic radius (LFS) as Rb, Cs and sedentary incompatible elements such as Zr relative to the SiO2 from acidic rocks to basic rocks and scattering of these elements on the diagram may be due to chance contamination of the magma in the upper crust is interpreted.

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