Petrography and Mineralogical reactions relating skarn zones at the Kuh-e-Gabbri, Northwestern Kerman

Z. Abedpour, J. Tarrah

Islamic Azad University Bandar Abbass branch
Z_a131@yahoo.com- j.tarah@yahoo.de

Abstract

The analysis of 12 skarn samples from metamorphic aureole around the kouh-e-Gabbri granitic pluton has been examined using petrography, XRF and XRD Techniques. Results show that the skarns of Kouh-e- Gabbri are calcic skarn. These skarns composed of minerals such as garnet, pyroxene, wollastonite, vesuvianite, chlorite, epidote and etc. Textures and minerals at the petrography studies show that formation of garnet, wollastonite and pyroxene occurred in the prograde metamorphism and vesovianite, chlorite and epidote formed in the retrograde metamorphism. Paragensis of minerals show 7 mineralogical zones in the studied area. These zone represent that in addition of heat and pressure, fluids infiltration is important in formation of minerals. Respect to mineral reactions we can say that Kouh-e- Gabbri skarns are formed at 2kbar pressure and 400-750c tempreture.

Keywords: *Petrography, reaction minerals, Gabbri skarn, Kerman*

Introduction

Skarns are silicate or calcium, Fe, Mg aluminosilicate rocks formed during contact metamorphism and or contact metasomatic process related to plutonic igneous rocks. These rock have doubly influence on the host rocks:1) by to heat rocks, recrystallised consequently; and 2) caused metasomatic process by released volatile materials and fluid of plutonic igneous as a result appeared skarns. Mineralogical skarns are including calc-silicate and par agenesis minerals.

Skarn of kuh-e-gabbri occurred in the limestone and conglomerate by influence granitic stock. Thermal metamorphism result to recrystallization minerals and formation garnet, wollastonite and clinopyroxene during prograde metamorphism. Such minerals formed example of epidote, vesovinite and chlorite by retrograde in the metamorphic aureole.

Geological setting

The kuh-e- gabbri region is located at 42km east of Rafsanjani in Kerman province. This region is a small part of urumieh- Dokhtar magmatic belt of Iran. Its geographical coordinates are as follows: latitude 56° 22´- 56° 28´ and longitude 30° 20´ - 30° 23´ (figure 1). In the area, intrusive of small granitic pluton of kuh-e-gabbri with granite and alkali-granite composition into upper cretaceous limestone and lower Paleocene polygenetic conglomerates, produced contact metamorphism (2) and formation calcic skarn. Evidence such as assemblage and zonation of minerals represent prograde and retrograde metamorphism in the area metamorphic aureole. In order to investigation of mineralogical and geochemistry skarns performed systematic sampling from contact plutonic to external part. Then of petro graphical studies, have been analyzed by XRD and XRF patterns.

Metamorphism

In order to appraise metamorphic condition and minerals reaction in the skarn different zones, minerals considered with petro graphical and XRD process. Based on studies, skarns formed of minerals such as garnet (grossular-andradite), wollastonite and clinopyroxene (diopside – hedenbergite), epidote, vesovianite and chlorite. The zoned skarn listed from the granitic plutone to the external side (table 1). Skarn I, garnet skarn, skarn 2, garnet- magnetite skarn, skarn 3, garnet – wollastonite skarn, skarn 4, wollastonite – garnet skarn- clinopyroxene skarn, skran 5, garnet- clinopyroxene skarn, skarn 6, epidote skarn and skarn 7, garnet – vesovianite skarn. Studies show that minerals formation in the skarns 1, 2,3,4,5 was intermediate product with progressive development of the zones and skarns 6 and 7 formed in the retrograde metamorphism. We focused on the prograde metamorphism.

Garnet

Garnet is abundant and important of minerals. Based on petro graphical and chemical analysis shoe that garnet composition is ugrandite series and have grossular- andradite composition . Reaction 1 represents formation garnet (figure 3):

$3\ CaCO_3 + Fe_2O_3 + SiO_2 \rightarrow Ca_3Fe_2Si_3O_{12} + 3\ CO_2$ (deer and ET. al, 1982) (1)

Above reaction occurred in the contact granitic pluton up to host rock in the skarn 1 but if FeO exit in environment in addition andradite formed hedenbergite. However if silica isn't enough formed magnetite furthermore hedenbergite. Formation magnetite observed in the skarn2.

$Fe_2O_3 + 2\ FeO + SiO_2 + Cal \rightarrow Ca_3Fe_2Si_3O_{12} + CaFeSi_2O_6 + Fe_3O_4 + 4\ CO_2$ (barker,1990) (2)

According to the Leeve, s studies (1973); andradite concentration is resulting increasing X_{CO2} pressure and f_{O2} furthermore high Salish in the hydrothermal fluid flows. But formation grossular is result decrease f_{O2} in those.

So based on studies and filed observation distinct majority of garnets is andradite and grossular is lesser expanding. Garnets that exist in the internal part are andradite (brown color) and grossular (green color) exists inside part (table 2). Observations show that concentration X_{CO2} pressure and f_{O2} and saltish fluid in the internal than external parts. Solid-solution grossular – andradite can be formed of reaction 3:

$3Cal + 3SiO_2 + Fe_2O_3\ (Al_2O_3) \rightarrow Ca_3\ (Fe,Al)_2Si_3O_{12} + 3CO_2$ (Best, 1982) (3)

Wollastonite

Wollastonite is else abundant mineral that found in the area. It's formation dependent with X_{CO2} pressure (reaction 4). Based on figure (4) wollastonite stability limit's decrease by increasing X_{CO2} pressure (Best, 1982).

$CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$ (Best, 1982) (4)

Wollastonite and grossular formed as vein and massive in the skarn 3, 4 zones (figure 5). Because fractures decline X_{CO2} pressure. Resulting increase garnet grossular and wollastonite formation.

Observation show that wollastonite don't exist in the metamorphic rocks that have formed at the low temperature (400-500c°) and low pressure (Winkler, 1976). Respect to upper subject, wollastonite occurred at the 400 – 750 c° in the skarns. Therefore such thermal exist emplacement of plutonic igneous and metamorphism of host rock.

Clinopyroxene

This mineral occurred during prograde metamorphism. Composition's changed within diopside and hedenbergite in the area skarn. But majority clinopyroxene is hedenbergite. It can be formed in the skarn 4, 5 zones such as reaction (5)

$4Ca_3Fe_2Si_3O_{12} + 4SiO_2 \rightarrow 2CaSiO_3 + 4CaFeSi_2O_6 + O_2$ (Kurshakova, 1971) (5)

In figure (6) garnet corroded margin around wollastonite and clinopyroxene represent that garnet exchange whit wollastonite and clinopyroxene. Else probable reaction in the area, reaction (6):

$2\ Ca_3Fe_2Si_3O_{12} + 2\ CaSiO_3 + 4CO_2 \rightarrow 4\ CaFeSi_2O_6 + 4CaCO_3 + O_2$ (Pertsev, 1977) (6)

If accept upper can be said wollastonite and andradite formed together in the skran 4 than accrued clinopyroxene end..

These reactions occurred during prograde stages and resulting primarily garnet secondly wollastonit and clinopyroxene in the metamorphic highest point (figure 6). Respect to form condition garnet and wollastonite, they exist in the zones majority.

Based on petro graphical and chemical analysis distinct in the formation minerals to influence: a) X_{CO2} pressure b) f_{O2} c) hydrothermal fluid d) granitic pluton and host rock.

Result

Emplacement of Gabri pluton made contact metamorphic rocks composed of metacoglomerat, marble and skarn. Based on mineralogical classification skarns in this region are calcite skarn. According to mineral paragenesis Skarns of kuh – e - Gabri classified into 1) garnet skarn 2) Garnet-magnetite skarn 3) Garnet – Wollastonite skarn 4) Wollastonite- garnet – clinopyoxene skarn 5) Garnet – clinopyoxene skarn 6) Garnet – vesuvianite skarn 7) Epidote skarn. The different mineral distribiution in these skarns could be related to specefic fluid flow pattern in the aureole. Fluid flow in open system has special effects on distribution of heat, mass, XCO_2, fO_2 and pH. Presence of wolastonite in skarns of Gabri could be due to high XH_2O in this area. Skarns in the area formed during contact-infiltration with fluid circulation in three steps including, thermal metamorphism, metasomatism and retrograde alteration

Refrence

-Aftabi, A., Abbasnejad, A., (1986). Geology, mineralization of skarn and ore mineral potential in the kuh-e- Gabbri of Rafsanjan, shahid bahonar university puplication, 104 p.

- Barker, A.J, 1990, Introduction to metamorphic textures and microstructures, blackie and Sons, Glasgow, 162 p.

Best, M.G., 1982. Igneous and Metamorphic Petrology. New York: W.H. Freeman and Company, 630P.

- Deer, W.A., Howie, R.A. and Zussman, I., 1982, an introduction to the rock forming minerals.

- Kraus Kopf, K.B., 1967, Introduction to geochemistry, 721p.

- Pertsev, N.N., 1991, Magnesian skarn. In Skarns – Their Genesis and Metallogeny (A. Barto – Kyriakidis, Ed.) Theophrastus Publishing & Proprietary Co., S.A., Athens, Greece, pp. 299-324.

- Winkler, H.G.F., 1976, Petrogenesis of Metamorphic Rocks, 4 Th Ed. Springer-Verlag, New York onc.

Table 1- XRD analysis result of gabbri samples

Skarn type	minerals	sample
Garnet skarn	anderadite	**K10**
Garnet-magnetit skarn	Anderadite,hematite, magnetite	**K12-7**
Garnet-wollastonite skarn	Grossular, wollastonite, qurtz, calcite	**K17-3**
Garnet – wollastonite clinopyroxene skarn	Grossular, wollastonite, hedenbergite, diopside	**K19-1**
Garnet - clinopyroxene skarn	Andradite, grossoular, hedenbergite, diopside	**B1**
Vesovianite- garnet skarn	Vesovianite, grossular	**H16**

Table 2: garnet's skarn composition and mineralogical in the study area (Aftabi et. Al 1986)

Location of garnet	Oxide percent	Percent of garnet
Adjacent to granitic plotun	SiO_2 = 35.42	Anderadit= 92.8 Uvarovite= 4.6 Grossular= 0.4 Spessartine= 0.2 Pyrope= 2
	Al_2O_3 = 0.29	
	Fe_2O_3 =22.15	
	CaO =32.06	
	MgO = 0.	
	MnO = 0.09	
	Cr_2O_3 = 1.45	
External margine of granitic plotun	SiO_2 =40.1	Grossular= 56.2 Anderadit= 38.6 Almandine= 2.5 Pyrope= 2.5 Spessartine= 0.2
	Al_2O_3 =14.65	
	Fe_2O_3 =11.98	
	FeO = 1.56	
	CaO =30.95	
	MgO =0.88	
	MnO =0.16	
Adjacent to marble	SiO_2 =35.16	Anderadit= 77.6 Grossular= 22.2 Spessartine= 0.2
	Al_2O_3 =7.74	
	Fe_2O_3 =24.08	
	CaO =33.6	
	MgO , MnO =undetected	
	Cr_2O_3 =0.06	

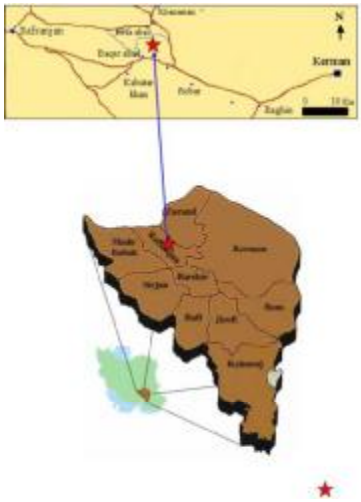

Figure 1: location of kuh –e- gabri

Figure 2: metamorphic aureole around granitic plotun in the study area

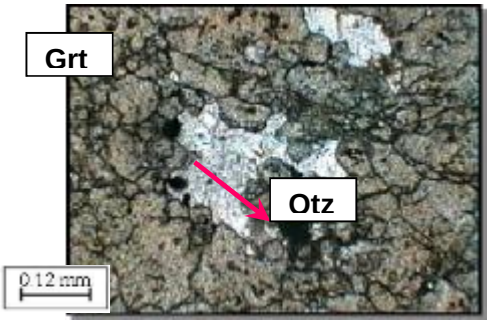

Figure 3: microscopically picture of garnet

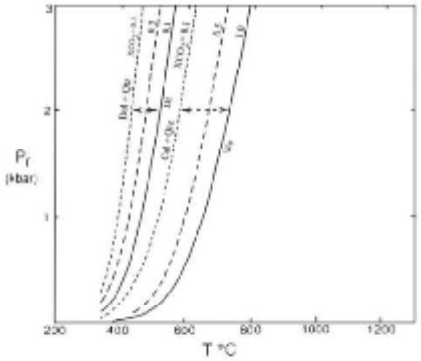

Figure 4: stability limite wollastonite on the p-t diagram

Figure 5: formation garnet and wollastonite as vein

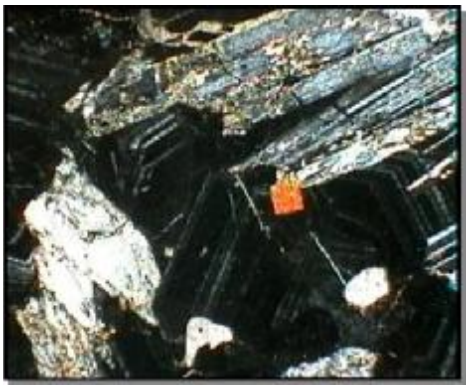

Figure 6: : microscopically picture garnet, wollastonite and clinpyro xene