Optical Evidences for Magmatic Mixing – Contamination in First Phase of Savalan Volcanic Eruption, NW of Iran

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Abstract
Savalan volcano is located in North West of Iran. This huge stratovolcano is consisted of various terms of andesite-trachyte and pyroclastics. There are a great caldera collapising, 3 main peaks and different craters in this volcanic system. Petrographic evidences indicated that, there are many factors for magmatic mixing and contamination for Savalan first phase volcanic rocks. The existence of many xenoliths in macro & microscopic scals is one of them. Besides, zoning in plagioclase, corroded edges in mafic and felsic minerals, sieve textures and etc., are main evidences of magmatic mixing.

Key Words: *Andesite; mixing; petrography; Savalan; volcanism; xenoliths.*

Inroduction
According to structural zoning of Iran [1] & [7] the studied area is a part of volcanic rocks zone in Western Elborz-Azerbaijan, and located in South East of MeshkinShahr, NW of Iran. (Fig.:1-A&B). Savalan is a large stratovolcano consisted of 3 summit named Sultan(4811m), Heram 1, Heram 2, Heram3 (av.>4650m) and Agandagi (4573m). The stratovolcano was created on a possible Oligocene horst in latest time. Caldera collapsing has caused depression about 400m height and 12 km diameter. The lava flows consisted of trachy andesite, andesite and dacite and finally pyroclastic deposits. (Fig.:2-A). The Savalan volcanism includes four volcanic-eruption stages and their subordinate stages. The studied case is the first eruption phase productions. This phase made the main body of Savalan volcano mass. They have prismatic column, some alteration observation and AA lava flows. The main rock term in this stage is andesite and latite-andesite. This rock term is characterized by its dark grey-dark red color and porphyrtic-vitrophyric textures. Additionally, the microlithic porphyry (with plg micro needles), glomeroporphyry, glomerovitrophry (plg aggregations), poikilitic (biotite crystals on plg phenocrystals), mesh-texture, sieve texture, rapakivi and anti-rapakivi textures are in secondary stage.

Discussion
According to field and petrographic observations, there are many xenoliths in savalan volcanic rocks which the dioritic xenoliths are main part of them. These diorite particles are similar to Oligocene plutons which their out crops are observable in East part of studied case. (Fig.:2-B)
For chemical classification of the studied rocks some data's from [3] have used and their data processing on diferrent diagram like as [6] (Fig.:3-A) indicates trachy-andesite term for them which is comparable with petrographic rock term identification. The investigation of alkaline series in studied area showed high potassium calk-alkaline series for them [8] (Fig.:3-B). The

mentioned alkaline series probably has a reasonable relation with penetration of Savalan volcano in a thicked crust, because increasing of potassium rate, as an effective alkaline increasing factor in magmatic rocks, has direct relation with thickness of crust in which crust the magma is penetrated.

Based on petrographic observations, the main mineralogy of these rocks is consisted of plagioclase, biotite, rarely pyroxene, and amphibole and viteric maters. Optical evidences indicate an An_{42}-An_{50}% composition for plgioclase phenocrystals.

The sieve texture and corroded edges are main indicators of mixing phenomenon in magmatic rocks. These events are observable in Savalan trachy andesite rocks. It indicates the reaction of primitive phenocrystals with later melt magma. There are many plagioclases (Fig.:4-A) and some mafic minerals, like pyroxene (Fig.:4-B) in studied rocks that endured these phenomenon.

The zoning of plagionclases is an abundant event in Savalan volcanic rocks. (Fig.:4-C). Based on [2] the oscillated and simple zoning in plagioclase crystals, it can be characterized by magma composition variations, which is possible in crystal growth period length. The over growth of plagioclase around of a primitive plagioclase caused oscillated zoning. In this condition, the calcium content plagioclase is growing on primitive mass. According to [11], zoning of plagioclase is a reasonable magma mixing evidence in igneous rocks. Besides, the sieve texture in plagioclases is a good factor for mixing, too. The existence of dusty zones (honey combed) in some big altered plagioclase crystal beside of fresh plagioclase crystals are observable, too. (Fig.:4-D) The warming of plagioclases led to existence of megacrystic-glomoroporphyritic aggregates.

The opacity border, as an important factor for the oxidant-land environment for magma crystallization is happened as an abundant event in maphic crystals like biotites (Fig.:4-E) and amphiboles (hornblendes) (Fig.:4-F). The corrosion edges for felsic and mafic minerals are observable.

Conclusion

According to existence of mentioned textures, corrosion event on phenocrystals edges, dusty view-honey combed and the zoning event of plagioclases, high potassium calk alkaline personality of magma, opacity, sieve texture and finally the field-tectonically evidences indicate a widespread mixing and contamination events into studied rocks. The contamination can be characterized with the intrusion of magma diapir into a ticked continental crust. The mixing evidences can indicate some reactions of phenocrystals with secondary melted materials.

The sieve texture, corrosion, resorption, simple & oscillated zoning, the location of abnormal altered mega-crystals of plagioclase with dusty zones (honey combed) [10] beside of fresh crystals, opacitized biotite, amphiboles with burned and corroded egeds are some magma mixing factors in Savalan volcanic rocks[5].

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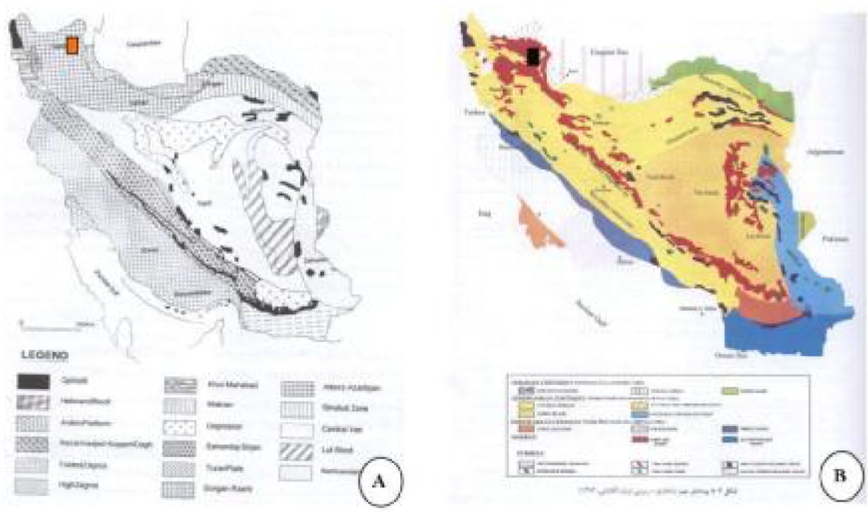


Figure 1: Structural zoning maps of Iran and location of studied area. (A) [7] (B) [1].

Figure 2: (A) A view form Savalan volcano (B) A diorite xenoliths into volcanic rock.

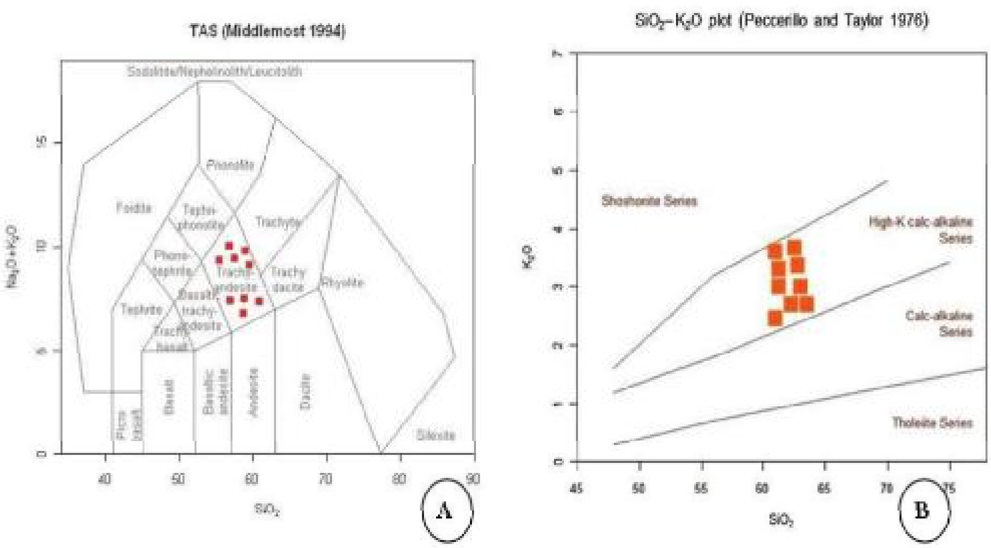
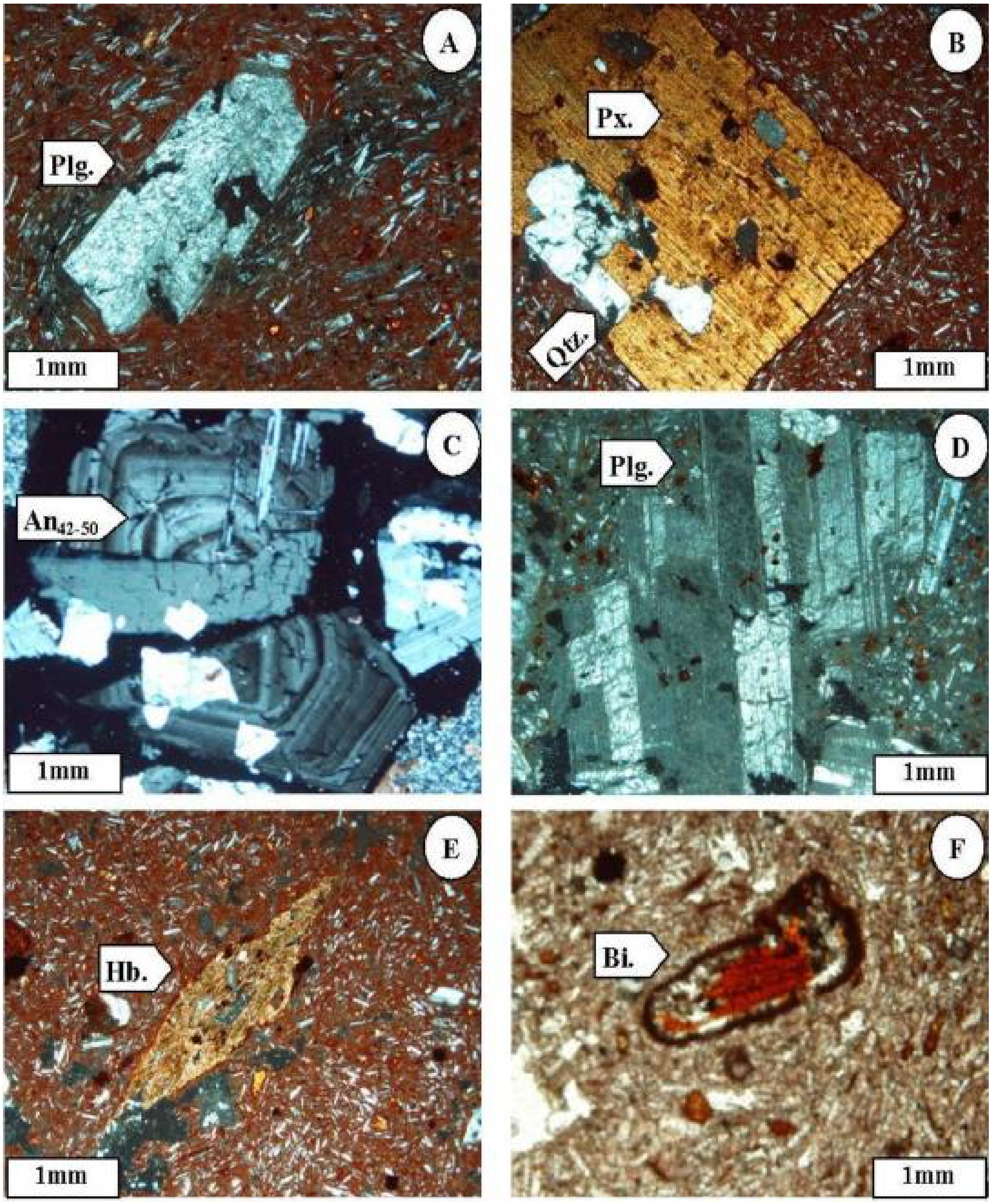


Figure 3: (A) Chemical classification [6] & (B) Alkaline Series [8] of Savalan volanics, (After from [3] datas).



Figuire 4: Some petrographic mixing evidences:

4-A: Corroded edges and sieve textures on plagiockase crystals. (X40 – XPL).

4-B: Sieve texture and its filling with secondary quartz and corroded edges of a sub-hedral pyroxene crystal in reaction with melted materials. (X40 – XPL).

4-C: Zoned plagioclases glomoroporphyry aggregates. (X40 – XPL).

4-D: dusty zones (honey combed) of some big altered plagioclase crystal beside of fresh plagioclase crystals. (X40 – XPL).

4-E: A eu-hedral sieve textural and corroded edge hornblende crystal with opacity marine. (X40 – XPL).

4-F: Opacity event in sub-hedral biotite crystal. (X40 – XPL).