Evidence of magma mixing and hybrid source on calc-alkaline Sarihan (Bayburt) granitoid, NE Turkey

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The study area is in the South Zone of Eastern Pontides (NE Turkey). The basement is Pre-Permo-Carboniferous aged Pulur Massif which contains greenschist, micaschist, para-amphibole schist, orto-amphibolite, gneiss, marble, quarzite and intruding Middle-Carboniferous aged Saraycik Granodiyorite. Liassic aged Hamurkesen Formation overlying unconformably the massif begins with Dikmetas Conglomerate and continues with volcano-sedimentary rocks containing tuff, sandstone and andesite, all of which are cut by diabase dykes. Malm-Lower Cretaceous aged Hozbirikyayla Formation overlies conformably Hamurkesen Formation and contains limestone and sandy limestones. Hozbirikyayla Formation is overlied by conformably Otlukbeli Melange containing red-limestone, pyroclastics, serpentinite, radiolarite, limestone olistoliths and breciated basalt. Campanien aged Sarihan Granitoid cuts all these lithologies.

Sarihan Granitoid covering an area of km^2 contains quartz-monzodiorite (60%), granodiorite (35%) and quartz-diorite (5%), and is cut by 5 to 10 cm width aplite dykes. These rocks show similar petrographical features. In the center of intrusion, 0.5–1 cm width cracks were filled by black tourmaline. The rocks of the intrusion shows medium-grained, poikilitic, anti-rapakivi and sometimes myrmekitic textures, and contains 43–64% plagioclase, 7–15% orthoclase, 10–29% quartz, 5–20% hornblende, 1–8% biotite and 1–6% opaque oxides.

Plagioclase is subhedral, mainly oligoclase and rare andesite in composition (An_{18-37} Ab_{55-79} Or_{22-9}). Large crystals show generally oscillatory zoning and albite twinning. Crystals with oscillatory zoning range in composition from An_{33} in the core to An_{18} in the rim. Mirmekitic textures developed at the contact of orthoclase. Large plagioclase may contain plagioclase, apatite, magnetite and rare hornblende inclusions.

Orthoclase is subhedral crystals with An_{0-1} Ab_{12-30} Or_{69-87} in composition, and shows rare carlsbad twinning. They may contain abundant quartz, plagioclase, biotite, hornblende and opaque oxide inclusions.

Quartz is subhedral to anhedral crystals with irregular cracks, and shows undaluse extinction.

Hornblende is euhedral to subhedral crystals, varying in composition from edenite to magnesio-hornblend and actinolitic hornblende in some altered ones. Hornblends in the margin of the intrusion are fragmented and generally altered into chlorite. In addition, hornblends at the contact of mafic microgranuler enclaves are abundant and intergrowth with biotites.

Biotite is subhedral crystals, changing in composition from 29–39% phologopite to 60–71% annite component.

Opaque oxides are mainly magnetite and hematite accompanying with biotite and hornblende. In addition, accessory apatite, sphene and zircon, serisite, calsite and chlorite resulted from alteration are present in the rocks.

The Sarihan granitoid contains 0–15 cm in diameter volcanic and silicified limestone xenoliths and mafic microgranular enclaves (MME). Presence of MME may indicate magma mixing process. Some microscopic textures obverted also sypports magma mixing process. In addition to textural features described by Hibbard (1991), a new one was observed in Sarihan Granitiod. The textural features indicating magma mixing are: (1) anti-rapakivi texture, (2) occurrence of poikilitic K-feldspad, (3) lining of hornblende and biotite inclusions in K-feldspad, (4) small plagioclase inclusions in large oligoclase crystals, (5) occurrence of acicular apatite crystals in feldspad, (6) prismatic-cellular plagioclase growths, (7) mantling of biotite by hornblende.

The Sarihan granitoid is metalumineous and show characteristics of cafemic group granitoids (Fig.1).

The geochemical data suggests that the pluton have calc-alkaline character. Major and trace element variations indicate importance of fractional crystallization in the evolution of the pluton. This fractionation is mainly controlled by plagioclase and hornblende phases. However, some irregular

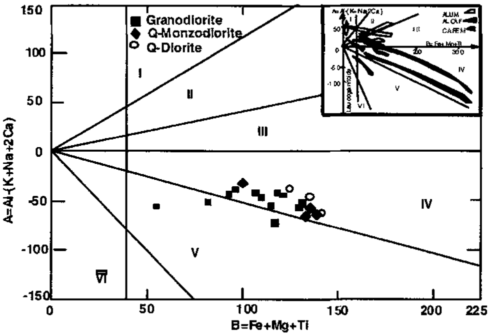

FIG. 1. Chemical trends presenting the main magma associations of the plutonic phases in the A-B characteristic-minerals diagram (Debon and Le Fort, 1983).

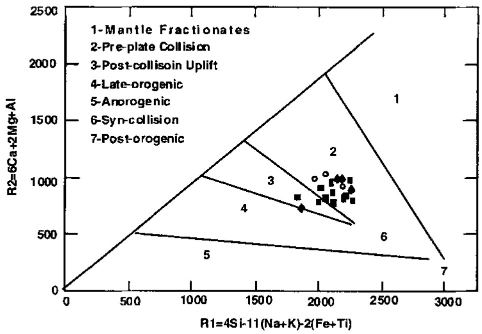

FIG. 2. R1–R2 diagram (Batchelor and Bowden, 1985) of the Sarihan Granitoid.

variations in major and trace elements may be result of magma mixing. The granitoid have A/CNK<1,1, $FeO_t/(FeO_t+MgO)$<0,8 and $^{87}Sr/^{86}Sr$ initial ratio 0,705 which are characteristic of hybrid continental arc granitoids. Therefore, Sarihan Granitoid derived from a hybrid parental source formed by crustal assimilation of upper mantle derived magma. According to tectonic setting discrimination of Batchelor and Bowden (1985), Sarihan Granitoid is a volcanic arc (Pearce *et al.*, 1984), granitoid formed pre-plate collision (Fig. 2).

Q-Ab-Or normative values of the granitoid composed with experimentally obtained pressures, the pluton corresponds 5–15 kb, which reflects mesoson granites, and temperatures of 500–600°C.

Conclusively, field, petrographic and geochemical data together with Rb/Sr isotopic data obtained suggest that Sarihan Granitoid evolud by magma mixing and fractional crystallisation processes. The parent magma derived from a hybrid source containing upper mantle and crustal components.

References

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