Plagioclase hosted melt inclusion in hypabyssal rocks in Torud-Amad Abad magmatic belt.

FazilatYousefi[1*], Papadopoulou Lambrini[2], Mahmoud Sadeghian[1], Christina Wanhainen[3], Glenn Bark [3]

(1)Faculty of Earth Sciences, Shahrood University of Technology, Shahrood, Iran. Email: f.yousefi87@gmail.com
(2) Department of Mineralogy-Petrology-Economic Geology, Aristotle University of Thessaloniki, Thessaloniki, Greece
(3) Department of Civil, Environmental and Natural Resource Engineering, Lulea University of Technology, Lulea, Sweden

In this study, we investigated the melt inclusions (MI) that are hosted in constituent minerals of the hypabyssal rocks in in Torud-Ahmad Abad magmatic rocks in south-southeast of Shahrood (Northern part of central Iran structural zone) for the first time (Figure 1). Based on previous studies, the composition of hypabyssal rocks in Torud-ahmad Abad are andesite, dacite and basaltic andesite (Yousefi et al., 2016a). The mineral assemblages and the composition of minerals in magmatic rocks are related to the composition and evolving conditions of the melt during crystallization (Yousefi et al., 2016b).Melt inclusions represent liquids that were trapped along growth zone (primary) or healed fractures of mineral phases, which crystallized from the silicate liquid as it cooled. Based on SEM analysis of these melt inclusions, their compositions are dacite, andesite and basaltic andesite. The chemical composition of these melt inclusions is determined by the Scanning Electron Microscope Laboratory, using a SEM (JEOL JSM-840A) equipped with an energy dispersive spectrometer (EDS, Oxford INCA 250) at Aristotle University of Thessaloniki. Thus, with the use of melt inclusions in the volcanic rocks of Torud-Ahmad Abad magmatic belt, we show the compositional evolution and origin of magma. The effective factors on evolution of these magma, are magma mixing, fractional crystallization and crustal contamination. Melt inclusions are hosted in many, virtually all, igneous-related minerals, but are mostly studied in those minerals where they are more abundant and/or better preserved and or/more visible. It follows that common host minerals are quartz and plagioclase in felsic igneous rocks, and olivine, pyroxene and plagioclase in mafic/ultramafic igneous rocks (Cesare et al., 2015). Our results best fit a model in which similar basaltic andesites and andesite rocks are repeatedly generated from mantle magma batches during their ascent as they mix with resident magmas, fractionate, and recycle older crystals and the dacite rocks, which have more silica than the others, originate from melting of Neo-TethyanOceanic crust (Figure 2).In figure 3, backscattered electron image of melt inclusions is shown.

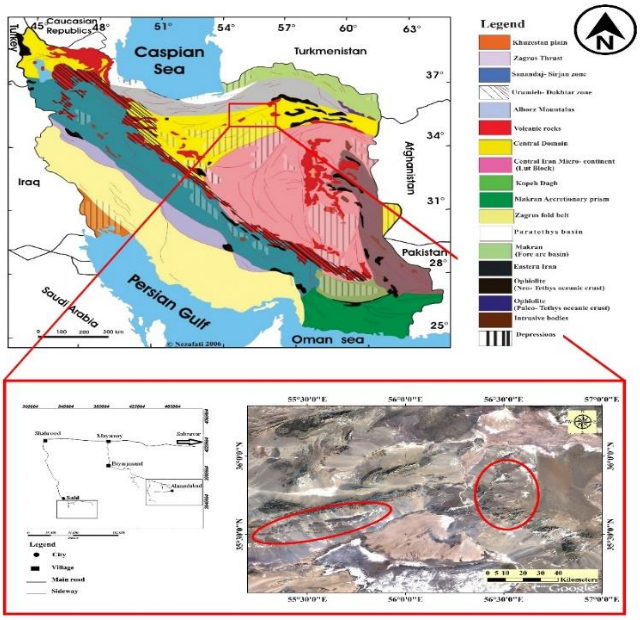

Figure 1. Distribution of Middle and late Eocene hypabyssal rocks of TAMB (Torud-Ahmad Abad Magmatic Belt).

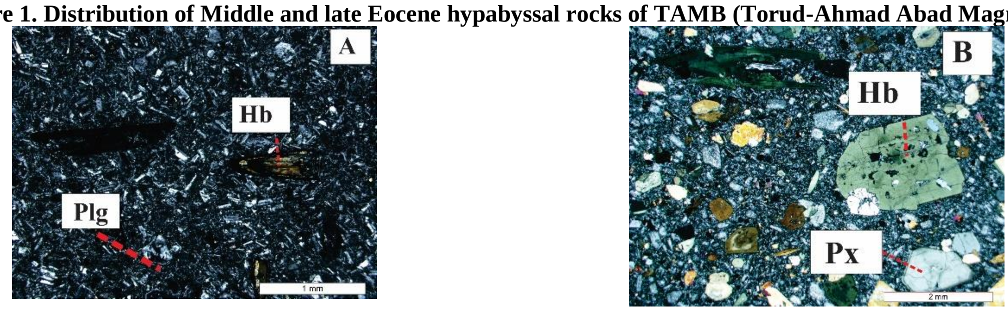

Fig 2: Photomicrographs of the studied rocks. A: Trachydacite rock; B: Porphyritic texture within basaltic andesite.

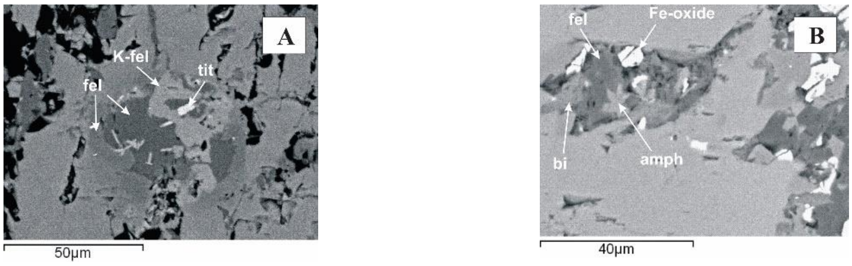

Fig 3: Backscattered electron image of melt inclusion in host mineral of plagioclase and amphibole.

Based on analysis of melt inclusions in these dacite, andesite and basaltic andesite rocks, their composition are andesite, basaltic andesite and dacite (Figure 4). The melt inclusions in these rocks were trapped during the simultaneous growth of the host minerals. We came to this result based on the chemical composition of these melt inclusions after analysis by SEM and drawing the classification diagram. The Harker diagrams of melt inclusions illustrate negative correlation of Al_2O_3 and CaO vs. SiO_2 that can be due to crystal differentiation during crystallization of magma (Figure 4). In figure 4 the classification diagrams of rocks and melt inclusions are shown (Le Bas et al., 1986).

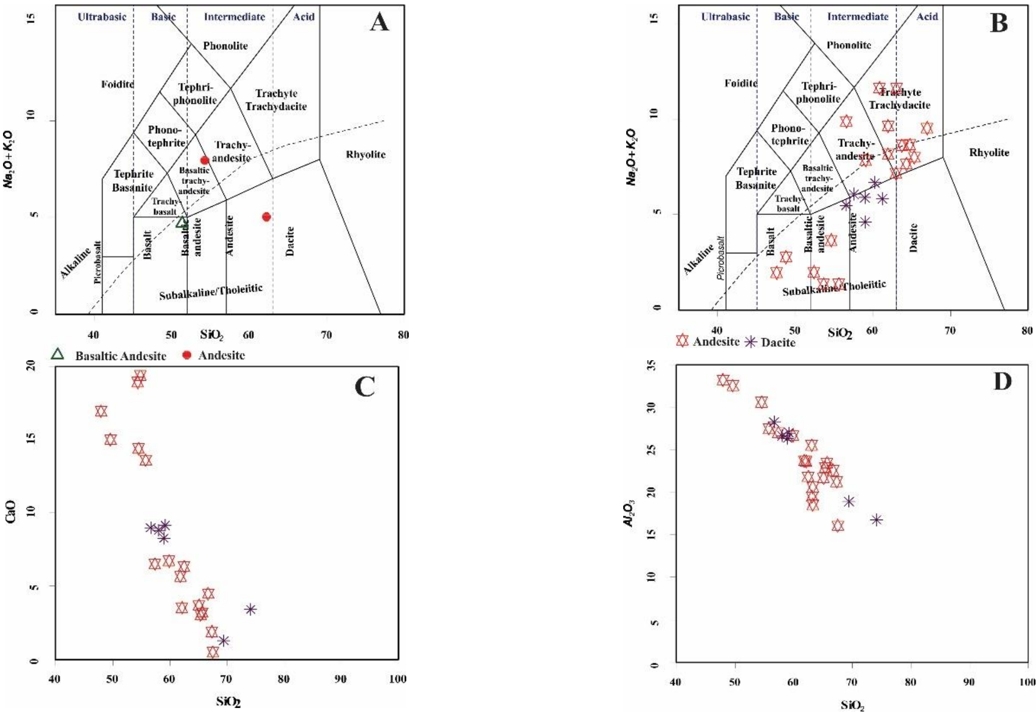

Fig 4: A: Composition of whole rocks. B: Composition of MI in plagioclase in andesite, dacite, basaltic andesite.

In general, the results are: 1) based on the obtained results of geochemical analysis, the studied rocks have chemical compositions varying from andesite, trachyandesite, basaltic andesite and dacite. 2) The composition of melt inclusions is andesite, basaltic andesite and dacite. 3) The melt inclusions in these rocks are small droplets of melt that are trapped in minerals.

Acknowledgements

Dr Papadopoulou Lambrini is acknowledged for doing SEM analysis at Aristotle University of Thessaloniki and presenting the article. Authors wish to thank Professor Christina Wanhainen and Dr Glenn Bark for providing favorable residence conditions for Fazilat Yousefi in Sweden and conducting the whole rocks and microprobe analysis at Lulea University of Technology.

References

Cesare, B., Acosta-Vigil, A., Bartoli, O., Ferrero, F., 2015. What can we learn from melt inclusions in Migmatites and granulites? Lithos, 186-216.

Harker, A., 1909. The Natural History of Igneous Rocks. 255 p. Methuen, London.

Le Bas, M.J., Le Maitre, R.W., Streckeisen, A., Zanettin, B., 1986. A chemical classification of volcanic rocks based on the total alkali-silica diagram. Journal of Petrology, 27, 745-750.

Yousefi, F., Sadeghian, M., Wanhainen, Ch., Ghasemi, H., Frei, D., 2016 a. Geochemistry, Petrogenesis and tectonic setting of middle Eocene hypabyssal rocks of the Torud-Ahmad Abad magmatic belt: An implication for evolution of the northern branch of Neo-Tethys Oceanic in Iran. 1-15. Journal of Geochemical Exploration, 178, 1-15.

Yousefi, F., Sadeghian, M., Wanhainen, Ch., Ghasemi, H., Lambrini, P., Bark, G., RezaiKakhhaei, M., Koroneos, A., 2016b. Mineral chemistry and P-T conditions of the adakitic rocks from Torud-AhmadAbad magmatic belt, S-SE Shahrood, Iran. 110-120. J.G.E., 182, DOI: 10.1016/j.gexplo.2017.09.006.