Study of Central Iranian Granitoids (Esfordi-Zarigan District) with special emphases on metasomatic processes

by

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The area of Esfordi-Zarigan in Central Iran is located in Bafq metallogenic province where most the rock units belong to Precambrian, Infracambrian and Cambrian periods. Although the sedimentary and volcanic rocks are widely distributed, this research is mainly focused on petrogenesis of plutonic rocks. From stratigraphic point of view sedimentary and volcanic rocks can be classified in five major units: Lower Dolomite Unit, Lower Volcanic-Sedimentary Unit, Middle Dolomite Unit, Upper Volcanic Unit and Aqda Limestone. Based on the carbonate lithology and their fossil assemblages, the sequence set forth above may be correlated with the Infracambrian Soltaniyeh Formation and the PC-C boundary can be placed at the base of the Middle Dolomite Unit. Ore mineralization took can be seen only in the Lower Volcanic-Sedimentary Unit and the Upper Volcanic Unit seems to be barren. Plutonic bodies are mainly consisting of granite, granodiorites, gabbros, syenites which granites are most spread (e.g. Zarigan pluton). Two types of syenites can be identified: pyroxene syenites and biotite syenites, which the latter being older. All the plutonic bodies in the studied area were intruded in the Precambrian-Infracambrian sequences.

Effects of several orogenic phases since the emplacement of plutons, extensive mineralization and prolonged chemical weathering caused intensive mineralogical and chemical changes in all rock types, especially intrusive. Presence of cataclastic and metasomatic textures along with intruded feldspatic and iron veinlets are the main evidences for the above mentioned changes. Calculated alteration degree and study of elemental changes deduced from mass balance calculations reveals the effect of alkaline metasomatism and weathering in Arash syenite. Identical gain in K2O (and Rb) and Al2O3 (hallic alteration of plagioclase rich mineral assemblage) with parallel loss in Fe2O3, CaO, Na2O, Ba and Sr are seen in the samples from Arash syenite. Relative increase in Nb and Zr in the samples is probably due to leach of the mobile cations in this pluton. Chemical index of alteration for Zarigan and western Mishdovan plutons shows the primary stage of weathering although the Zarigan pluton is affected by sodic metasomatism.

Geochemistry of the major elements indicates the all of the studied samples are meta-aluminous. Samples are plotted in the calc-alkaline series and with the exception of syenites, they show a sub-alkaline affinity. It is hard to consider an evolution path from gabbro to granite using major and trace elements discrimination diagrams. Decrease in Zr and Nb with parallel increase in SiO2- which is one of the most identical factors for the calc-alkaline differentiation- is remarkable in Arash syenite and Zarigan granite. There is a clear change in Y, Th, and Nb relative to Zr in Arash syenite, and based on constant ratio of Zr/Nb, the role of country rock contamination and assimilation is insignificant in the petrogenesis of this pluton. Nb negative anomaly suggests a subduction-related origin for the Arash syenite. Evolution path for the meta-aluminous Zarigan granite is clearly in consistent with that of calc-alkaline trondjemite series. Pattern of some trace elements such as Y, Nb, and Rb are suggesting the volcanic arc setting for Zarigan granite. Low H2O pressure is implied by hypersolvus and absence of aqueous minerals (e.g. biotite) for this granite. Temperatures between 720-760 °C are estimated for the formation of Zarigan Granite in 2kbar water pressure.

Study of apatite samples from Esfordi iron-apatite ore shows high concentration of REEs in the samples. Zonal distribution of some REEs such as La is also identified in the single apatite crystal. Negative anomaly of Eu can not be seen in Esfordi apatite which makes it distinctive from the igneous type apatites; however, similarities in REE patterns with Kirouna type apatites may suggest a hydrothermal origin for Esfordi apatite.