

Petrography, metasomatism and mineralization of uranium and other radioactive minerals in the Narigan Area (Central Iran) Islamic Republic of Iran

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The Narigan Zone is a portion of Yazd Province based on geopolitical division. In the Narigan Valley, rocks of zone have experienced a lot of fracturing and faulting events that are caused by different compressional and tensional tectonic processes. Tensional forces by producing fractures and faults have created an appropriate place for migration of magmatic hydrothermal solutions. The assemblage rock of these study area includes of various mineralogical types such as: acidic rocks, basic rocks, sedimentary rocks, rhyolite and rhyodacite, andesite, limestone layers, quartz-porphyry, metasomatic granites and diabasic dikes. On the basis of petrographical and mineralogical studies, various alterations were observed in the Narigan area, such as: gumbeyite or potassic alteration, bresite or phyllic alteration, argillic or clay alteration, propylitic alteration, hornfelsic alteration and hydromica, chlorite, carbonate, magnetite and pyritic alteration. Elevated radiometric counts usually occur in phlogopite-magnetite alteration zone that in this complex usually consists of minerals like biotite, phlogopite, hydromica, magnetite, carbonate, pyrite, chlorite and less commonly apatite. The greatest increase in U content is accompanied by phlogopite-magnetite alteration, sometimes this increase is also observed in the propylitic zone. Respectively, the greatest increases in Th contents were observed by phlogopitic-magnetitic, gumbeyite, bresitic-propylitic intermediate zone and the bresitic and propylitic alteration zones. Increasing amounts of Cu is accompanied by Phlogopitic-Magnetitic, Phyllic, phyllic-propylitic intermediate zone, hornfelsic and propylitic alteration zones. The greatest increase in Mo contents is respectively accompanied by phlogopitic-magnetitic, hornfelsic, bresitic-propylitic intermediate zone, bresitic, propylitic and gumbeyite alteration zones. Respectively, the most increase in amount of Co is associated with phlogopite-magnetite, hornfelsic, phyllic and propylitic alteration zones. Ni shows an adaptable increase in phlogopite-magnetite zone and hornfelsic, propylitic alterations. Uranium mineralization in this study area, is comparable with two uranium ore types: plutogenic and volcanogenic. These matters were indicated by various alteration types that observed in Narigan area.

In plutonic-type uranium mineralization, uranium is present in sulphide-uraninite and arsenide-uraninite types. In the Narigan Zone, the presence of sulphide is seen in minerals like pyrite, calcopyrite, and sphalerite. Existence of arsenide is indicated by a few minerals such as: arsenopyrite & glaukophane and also relative enrichment of elements like Ag, Bi, Co, Ni and U in some veins. These are signatures for sulphide-uraninite and arsenide-uraninite mineralizing type. Presence of brannerite (davidite-brannerite paragenesis) in thin sections is an index signature for volcanogenic uranium-titanium mineralizing type. The secondary titanium-bearing minerals are made by ilmenite and sphene alterations. Relative enrichment of elements like Cu, Mo, Ni, Pb and Zn is made by the effect of high temperature potassic phase on the Narigan volcanogenic rocks. With the consideration of sub-volcanic nature of Narigan zone, metasomatic processes and related hydrothermal phases have been active in shallow environment. On the basis of Bardina and Popov classification the different metasomatic processes at Narigan area have happened in basic to acidic circumstance, with pH 3-9 under temperature range of 150-600° C.

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