Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SMP005-14 Room:201B Time:May 23 18:15-18:30

Geochemistry of subduction-related volcanic rocks from south Ardestan, central UDMA, Iran

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Urumieh-Dokhtar Magmatic Arc (UDMA) is formed by the subduction of the Neotethyan oceanic slab beneath central Iran. The magmatic activity in the south Ardestan, central UDMA, has been classified into Eocene, upper Miocene and Plio-Quaternary sequences. The Eocene sequence comprises volcano-sedimentry strata, which are interlyered with the basaltic and andesitic lavas. It is noted that the last Eocene magmatic event occurred as basaltic dyke that cut through the Eocene sequence and as tabular basaltic lavas on the top of Eocene sequence. The basaltic rocks in the upper and lower Eocene sequence have porphyritic texture with phenocrysts of plagioclase, clinopyroxene and olivine, in decrease order. Their major element compositions indicate high alumina characteristic (SiO2=48-53 wt% Al2O3>17.5 wt%, CaO>8.5 wt%, MgO<9 wt%); MORB-normalized trace element patterns exhibit a typical continental arc signature with characteristic enrichment in LILE and depletion in HFSE. LILE show temporal variations from lower to upper Eocene, for example Rb and Th decrease from 56 to 8 ppm and 1.95 to 0.50 ppm respectively. Similarly, the rare earth element (REE) patterns of the basalts become progressively less fractionated toward upper Eocene. The temporal variation in trace elements appears to reflect decrease in subduction components in their source mantle at the end of the subduction period. The Miocene volcanic rocks occur as basaltic andesite to andesite lava flows. Most basaltic andesites contain phenocrysts of plagioclase, olivine, pyroxene and magnetite. The andesite lavas contain plagioclase, orthopyroxene, clinopyroxene, and opaque minerals. The Pliocene dacitic lava domes intruded Miocene lavas, and they belong to the last volcanic activity in this region. They are composed of plagioclase, orthopyroxene, amphibole, quartz, and opaque minerals. Miocene basaltic andesites have a high Mg composition (SiO2 =54.39 wt %, Al2O3 =16.2 wt %, MgO =6.79 wt %, Mg# =61, Ni =121 ppm, Cr =256 ppm). In contrast, the Pliocene dacites have adakitic signature with low Mg# (47.7- 45.4), high Sr/Y (88-71; Sr =558-816 ppm, Y=7-9 ppm) and low HREE concentrations. Such adakitic signatures suggest that they were generated by partial melting of basaltic protoliths. Based on geochemical variations of south Ardestan volcanic rocks, we infer that subduction of the Neotethyan oceanic plate beneath central Iran was ceased at upper Eocene and volcanism has resumed at Miocene under the post collision environment. The co-existence of Miocene high Mg andesite and Pliocene adakite can be accounted for by the model of delamination of lower continental crust.

Keywords: Urumieh-Dokhtar Magmatic Arc, Iran, calc-alkaline, adakite, high Mg andesite