西南日本，北陸地域東部に分布する中新世アダカイト質火山岩の岩石学的・地球化学的特徴
Petrological and Geochemical features of Miocene adakitic volcanic rocks in eastern part of Hokuriku region, SW Japan

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Miocene volcanic rocks are widely distribution from the eastern part of Toyama prefecture to the northern part of Fukui prefecture in Hokuriku region, Central Japan. These volcanic rocks are broadly classified in to mafic volcanic rocks and felsic volcanic rocks, and in this study the petrological and geochemical features of mafic volcanic rocks are considered. Mafic volcanic rocks of the Hokuriku region consists of various types that have characteristic petrologic and geochemical features; tholeiitic volcanic rocks, calc-alkaline volcanic rocks, high-magnesia andesite and adakitic andesite (Takahashi and Shuto, 1999; Ishiwatari and Ohama, 1997).

The present study area is in the eastern part of the Miocene volcanic rocks. Volcanic rocks of this study area can be classified into four groups; Group-1 basalts, bulk rock chemical composition of group-1 indicate low SiO_2 (<53 wt %) composition and Nd and Ta depletion. Group-2 tholeiitic andesites, bulk rock chemical composition of group-2 indicate increasing FeO*/MgO ratio with increasing SiO_2. Group-3 calc-alkaline andesites, bulk rock chemical composition of group-3 indicate stable FeO*/MgO ratio with increasing SiO_2. Group-4 Hornblende-bearing andesites, Bulk rock chemical composition of group-4 indicate low FeO*/MgO ratio, high Sr, MgO, Cr, Ni concentration and low LILE and HFSE concentration. All types of volcanic rocks are distributed in Iwaine formation except in Fukuhira formation, only group-1 and group-2 are distributed.

The volcanic rocks of this study area can be classified two types by their isotopic features. First type have nearly bulk earth isotopic composition (SrI=0.7040-0.7060, NdI=0.5125-0.5129) whereas the second type have very enriched isotopic composition (SrI=0.7085-0.7100, NdI=0.5119-0.5125). In terms of rock types Groups-1 to 3 shows both the isotopic composition, whereas only group-4 rocks have only bulk earth isotopic composition.

Here, we focus on petrological and geochemical features, because these features of group-4 is different from other groups. Group-4 have hornblende, plagioclase, clinopyroxene and olthopyroxene phenocrysts. Pyroxene phenocrysts have a wide range of composition (Mg#= Cpx 70-86; Opx 69-85).

It is difficult to explain the petrological features of group-4 by crystallization differentiation of magma that formed group-1 to 3 rocks types. This study uses trace element composition of clinopyroxene phenocryst for magma genesis of group-4. The results indicate that the group-4 magma is a product of magma mixing of high Mg# magma that have adakitic signatures (Defant and Drummond, 1991) and low Mg# magma that have enriched isotopic signature. In general, adakitic volcanic rocks are formed by partial melting of subducted oceanic crust, and so adakitic magma usually have depleted isotopic composition like a subducted oceanic crust (MORB; Castillo, 2012). However, adakitic rocks in this study area has more depleted isotopic signatures. Previous study indicated a model that involves the addition of sediment on subducted basaltic crust melt during slab melting (Sato et al., 2013). However, this model cannot explain the observed isotopic compositions. Therefore, this study proposes a model that involved an enriched component of magma mixing that resulted in the observed isotopic features.

In general, adakitic magma genesis needs heat source for slab melting. Previous studies suggest that heat source is hot asthenospheric upwelling preceding Japan sea opening (Takahashi and Shuto, 1999). Petrological features of group-4, for example, high MgO, Cr, Ni concentration are similar to bajaite (Rogers et al., 1985). Previous studies suggest that magma genesis of bajaitic magma result from ridge subducting (Tsuchiya et al., 1995). But this study area doesn’t show evidence of ridge subducting. It is necessary to discuss from more various view point.

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