Zircon U-Pb geochronology, whole-rock geochemical and Lu-Hf isotopic constraint on the petrogenesis of rhyolites in Loei fold belt and their tectonic implication

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What makes SE Asia today is a number of terranes that were successively rifted off from Gondwana, drifted towards north and accreted to each other. The Indochina Block was originated from eastern Gondwana and was rifted since the Early Devonian (Metcalfe, 2013). The Loei fold belt, situated in the west of Indochina, has been intensely studied regarding the controversy over its regional tectonic evolution (Intasopa and Dunn, 1994; Panjasawatwong et al., 2006; Udchachon et al., 2011; Vivatpinyo et al., 2014). Recently, we find Silurian rhyolites in Loei fold belt. The identification of lower Paleozoic volcanic rocks is of significant importance in studying the geological tectonic evolution and reconstruction of Gondwana. We analysis the U-Pb geochronology and Hf isotope of zircon and the whole rock geochemical contents of the rhyolites.

Zircon grains from Loei rhyolites yielded concordant $^{206}Pb/^{238}U$ ages, with mean of 423.7±2.7 Ma, suggesting the timing of emplacement of Loei rhyolites was Homerian. The Loei rhyolite samples show enriched SiO_2 (75% - 77%), Al_2O_3 (12.10%-13.13%), K_2O (2.97%-3.50%) and low CaO (0.26-0.61%), Fe_2O_3T (0.98%-2.24%) and P_2O_5 (0.05%). The molecular A/CNK ratios of the samples range from 1.19 to 1.34, classified as characteristics of strongly peraluminous. The rhyolites show moderate negative Eu-anomalies (δEu=0.58-0.56). In the primitive mantle-normalised spidergram, all samples are enriched in LILE (eg:Ba, K, Pb) and LREE and depleted in HFSE (eg: Th,Nb, Ta, Zr, Ti).

Although the high A/CNK (1.20-1.34), i.e. features of strong peraluminnous of the Loei rhyolites resemble those of the S-type granites. However, we suggest Loei rhyolites belong to highly evolved I-type rhyolites because the positive εHf(t) of Loei rhyolites indicate that the protolith of Loei rhyolites were juvenile crust which is similar to the I-type granites. Beside, low P granitoids may be highly fractionated I-type granite. On the Rb/Sr vs. Rb/Ba diagram, all samples plot within clay-poor area. In the figures of $(Na_2O+K_2O)/CaO$ and FeOt/MgO vs. Zr+Nb+Ce+Y, all samples fall in Fractionated I-type Granites. The geochemical features of Loei rhyolites are significantly different from A-type granite: (1) A-type granites enrich HFSEs and deplete in Ba and Sr (Wu et al., 2003; Whalen et al., 1987), whereas the Loei

rhyolite show lower HFSEs and higher in Ba, Sr; (2) Low FeO*/MgO (3.73-5.18) are different from A-type granite (FeO*/MgO>10 (Whalen et al., 1987)); (3) In the Nb, Zr, Na_2O+K_2O, K_2O/MgO-Ga/Al diagrams (Whalen et al., 1987), all samples plot without in the field of A-types, combined with relatively low petrogenetic temperatures (Whole rocks Zr saturation temperatures: 791-800 °C) , excluding the possibility of A-type granitoids.

Geochemically, the concentration of LILE of the Loei rhyolite are high (such as Ba, K, Pb). They are relatively depleted in HFSE (such as Th, Nb, Ta, Zr, Ti). These are main features of magmas formed in active continental fringe related a subduction setting (Qi et al., 2014). On the La/Yb vs. Th/Yb tectonic discrimination diagram, all the Loei rhyolites plot within the area of 'continental margin-arc'. According to the regional geological outline of Indochina Block, magmatism, metamorphism and deformation were widespread in Indochina Block during Silurian, suggesting a subduction of ocean plate under Indochina. Therefore, we argue the rhyolites from the Loei fold belt were generated from partial melting of juvenile lower crust related to ocean lithosphere beneath the Indochina Block and then underwent multistage melting and differentiation.

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