Petrogenesis of the high FeO rhyolite in the Tarim Large Igneous Province: The role of immiscibility

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Large Igneous Provinces (LIPs) are characterized by enormous volume of magmas generation (> 0.1 MKm^3) within a short duration (~1-5Ma) [1, 2]. Typically, they are dominated by the mafic components, but sometimes felsic magmatisms are also present, constituting a bimodal nassociation [3, 4]. Traditional views suggested that the felsic magma was commonly derived from the crustal anatexis, or produced by fractional crystallization of the mafic rocks [5, 6], while the immiscibility is also a potential mechnism [7]. Tarim LIP is located in the northwestern China composed of 300,000 km^2 basalt and 48,000 km^2 rhyolite [8]. Recently, we recognized a group of rhyolite therein, which are charaterized by high total FeO (6.96 - 9.05 wt. %), low CaO (0.19 - 0.51 wt. %), low Al_2O_3 (9.16 - 11.25 wt. %) contents and depleted Nd isotopic compositions (ε_{Nd} = -0.63 - -0.08). Both the crustal anatexis and fractional crystallization model cannot fully explain these geochemical data, but these features are consistent with the reported conjugate silica-rich liquid during the immiscibility [7, 9]. Careful microprobe observation reveal two types of melt inclusions in the quartz of the rhyolite: one is iron-rich with dark color, and the other is silica-rich in light color. In addition, magnetite grains with skeleton textures are commonly occuring as inclusions in quartz, indicating the rhyolite magma erupted rapidly and caught the iron-rich components. The coexistence of Fe-rich and Si-rich melts in the quartz of the rhyolite in the Tarim LIP imply that liquid immiscibility may have occurred in the evolved mamgas, which give a stong evidence for the role of immiscibility in generating the bimodal volconic rocks in LIPs.

Reference:

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