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Large-Scale Segregation of Immiscible Liquids in the 1780 Ma Taihang Dykes to Produce the Bimodal Xiong'er Volcanics (North China)

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It is yet unclear whether large-scale segregation of immiscibile liquids and eruption of high-Si lavas exist in nature (Charlier et al., 2013). We present a possible case of segregation of immscible liquids in the 1780 Ma Taihang dykes (North China), which produced the high-Fe-Ti-P dykes and the acidic dykes, as well as acidic lavas in the coeval Xiong'er volcanic province (Peng et al., 2015). Non-reactive microstructures including conjugated interstitial granophyric and ilmenite-rich intergrowths and reactive microstructures including the olivine coronas and stepped grain boundaries (c.f. Holness et al., 2011) in the dykes, and especially the Si- and Fe-Ti-rich globules in the volcanics, provide petrological evidence for the presence of two coeval, coexisting liquids in equilibrium separated by a miscible gap. A modeling with a starting composition obtained from melt inclusions in plagioclase megacrysts of dykes suggest that the large compositional variations in the dykes could be resulted from density-driven mineral sorting during the plagioclase- and clinopyroxene-dominated fractional crystallization. This has also been resulted in a Ca-Al-poor but Fe-Ti-P-K-rich trend in the liquid. The highly differentiated compositions are chemically similar to those immiscible liquids from experiments (Charlier and Grove, 2012). We conclude that the sustained plagioclase- and clinopyroxene-dominated fractional crystallization and the low fO2 were likely responsible for the immiscibility. The segregation probably took place during the ascent of the liquid in the pumping system (feeder dykes), which can produce denser high-Fe-Ti-P dyke roots and relatively lighter high-Si dyke upper parts and lavas at a same time. The dacite and rhyolite lavas in the Xiong'er volcanic province are potentially the high-Si counterparts of the high-Ti dykes, and the basalt and andesite lavas are the erupted equivalents of the relatively fractionated liquids. This is possibly a natural example of large-scale (crust-scale) immiscibility from which similar amounts of high-Ti dykes and silicic lavas were segregated and subsequently intruded/extruded in an areal scale of ~1000 km. It also provides a possible case that a silicic large igneous province (e.g., the Xiong'er volcanic province) could be potentially related to a mafic large igneous province (e.g., the Taihang giant dyke swarm).

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