

Multiple magma storage regions and open system processes revealed by chemistry and textures of the Datong tholeiitic lavas, North China Craton

RONGHAO PAN¹, TONG HOU¹, XUDONG WANG¹, JOHN ENCARNACIÓN² AND ROMAN BOTCHARNIKOV³

¹China University of Geosciences, Beijing

²Saint Louis University

³Johannes Gutenberg Universität Mainz

Presenting Author: 3001190016@cugb.edu.cn

Geochemistry and textural constraints of lavas can provide important information about magmatic processes occurring at inaccessible depths. Here we conduct a detailed textural and geochemical study on 0.23 Ma contemporaneous and adjacent Qiulin, Longbao and Dayukou volcanoes in the intraplate Quaternary Datong Volcanic Field (DVF) in the North China Craton. Lavas from them have similar tholeiitic compositions, however, their textures are distinct. Qiulin is poorly-phyric (<10 vol.%) containing orthopyroxene, plagioclase, and olivine phenocrysts and scarce glomerocrysts set in a groundmass of plagioclase, clinopyroxene, orthopyroxene and Fe-Ti oxides. In contrast, samples from both Longbao and Dayukou are highly-phyric (up to ~50 vol.%), and consist plagioclase, orthopyroxene, clinopyroxene, and olivine phenocrysts with mm- to cm-sized glomerocrysts enclosed in a groundmass comprising plagioclase, clinopyroxene, olivine and Fe-Ti oxides. Notably, these pyroxenes are always characterised by corona textures containing orthopyroxene cores mantled by clinopyroxene and never contacting the groundmass. The relatively low Mg# (75-85) and Ca content in the cores indicate that the orthopyroxenes from all three volcanoes are crystallised early from the magma rather than being mantle xenocrysts. Thermobarometry indicates that orthopyroxenes in all three volcanoes initially crystallised at ~7 kbar (23 km depth), whereas clinopyroxenes crystallised at ~4 kbar (13 km) with a final pressure of ~3 kbar (10 km). Thermodynamic modelling by COMAGMAT also suggests the destabilization of orthopyroxene is induced by the dramatic changes in pressure and temperature during decompression. The larger proportion of phenocrysts over glomerocrysts in Qiulin samples implies the magma reservoir was only partially turned into mushes at the periphery. Magma ascending via the melt-rich interior of the reservoir formed the crystal-poor Qiulin lava. In contrast, those ascending through the peripheral mushes of the deeper reservoir and discrete shallower mushes formed the highly-phyric Longbao and Dayukou lavas. We thus conclude open system processes involving mush disaggregation and magma recharge in multi-level plumbing systems are essential in the petrogenesis of these intracontinental tholeiites. Moreover, the important role of orthopyroxene in the petrogenesis of these tholeiites distinguishes them from many other tholeiite suites like MORB, and those erupted through thickened oceanic crust like in Iceland and the Shatsky Rise.