

Source and mantle dynamics controlling intraplate diffuse basaltic provinces

HONG-KUN DAI, QING XIONG AND JIAN-PING ZHENG

State Key Laboratory of Geological Processes and Mineral
Resources, School of Earth Sciences, China University of
Geosciences (Wuhan)

Diffuse basaltic province refers to clustering of numerous small-volume magmatic extrusions that display large spatiotemporal variations but comparable compositions. It represents the most common type of basaltic activities within continents, but the source characteristics and mantle dynamics remains poorly constrained. Here, this is explored via careful geochemical and thermodynamic numerical modelling studies on the diffuse basaltic province covering central-eastern Asia continental landmass^[1-4]. This vast basaltic province consisting of many magmatic fields consistently shows a compositional transition at around ~110 Ma. The pre-transition basaltic rocks have major-element compositions straddling the sub-alkaline to alkaline boundary, arc-type trace-element patterns and enriched radiogenic isotopic composition while the post-110 Ma ones are normally low-silica alkaline basaltic rocks characterized by oceanic-island basalt-like trace-element patterns and depleted radiogenic isotopic signatures. They are interpreted to originate from metasomatized lithospheric mantle and silica-deficient pyroxenite-bearing asthenosphere, respectively. Thermodynamic numerical modelling study shows that the melting normally occurs at lithospheric underside steps underlain by moderately warmed (ca. 1400-1500 °C) asthenosphere with various kinds of convective instabilities. Together with the magmatic spatiotemporal variations, the compositional dichotomy of the studied basaltic province likely reflects heat accumulation in the asthenosphere due to the thermal blanketing effect of the coherent central-eastern Asian continental landmass. We suggest that the geochemical and geodynamic interpretations proposed here should have general relevance to many other comparable intraplate diffuse basaltic provinces worldwide.

References

- [1] Dai, Xiong, & Zheng (2025), *Geochemistry, Geophysics, Geosystems* 26, e2024GC012028.
- [2] Dai, Zheng, Xiong, Griffin & O'Reilly (2023), *Geophysical Research Letters* 50, e2023GL104951.
- [3] Dai, Oliveira, Zheng, Griffin, Afonso, Xiong & O'Reilly (2021), *Journal of Geophysical Research: Solid Earth* 126, e2021JB021663.
- [4] Dai, Zheng, O'Reilly, Griffin, Xiong, Xu, Su, Ping & Chen (2019), *Chemical Geology* 524, 88-103.