Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.27616

Chalcophile element contents of coeval volcanic rocks derived from heterogeneous mantle beneath the eastern North China Craton

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The metasomatized subcontinental lithospheric mantle (SCLM) is thought to play a key role in the formation of giant Au deposits. However, the metasomatized SCLM is generally heterogeneous and often yields magmas with diverse chemical compositions. Whether such source heterogeneity displays various metal contents in the mantle and derivative magmas remains poorly understood. The metasomatized SCLM beneath the eastern North China Craton (NCC) displays two different mantle domains (EM1-type and EM2-type) during the Early Cretaceous at the west and east sides of the trans-lithospheric Tanlu Fault system (TLF). Here, based on detailed petrological studies, we report platinum group element (PGE), Au, and Cu contents of coeval volcanic rocks along the TLF zone. These rocks display arc-like trace element patterns and distinctly enriched Sr-Nd isotopic compositions with EM1-type or EM2-type affinity [1]. Sulfide petrography and the lack of correlation between chalcophile element contents, Cu/Pd and MgO contents indicate negligible sulfide segregation during ascent for EM1-type rocks, whereas EM2-type rocks show sulfide separation and increasing Cu/Pd with progressive evolution. The EM1-type and EM2-type magmas display MORB-like PGE, Au and Cu contents. The broad correlations between Ba/Nb and the value of Au/Cu and Au/Pd suggest weak Au elevation during mantle metasomatism and the introduction of some metals related to subduction. Magmatic differentiation also led to a slight increase in Pd, Au and Cu contents for some EM1-type magmas. However, these relatively primitive EM1-type and EM2-type magmas display comparable Au and Cu contents. Therefore, mantle heterogeneity may not be the key cause leading to diverse metal contents in mantle sources and magmas. Instead, the crustal thickness and fault systems of EM1 and EM2 areas are distinct [2]. We thus propose that distinct evolution pathways of mantle-derived magmas induced by the regional tectonic settings [3] rather than mantle heterogeneity in metal fertility are key for spatial variations of metal distribution and final mineralization in the crust.

[1] Wang et al (2024) ES, 49, 669-684; [2] Deng et al (2018) ESR, 182, 251-272; [3] Chiaradia et al (2022) EPSL, 599, 117864.