Ca. 650 Ma mafic-ultramafic dike swarms in South China

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Mafic and ultramafic dikes constitute a common expression of crustal extension and serve as major conduits for transferring magmas to the upper crust and are linked to asthenospheric upwelling or deep mantle plumes. They generally contain important information about dynamic processes accompanying the breakup of continents.

Numerous ca. 650 Ma mafic and ultramafic dikes were emplaced in the South Qinling Belt of the northern Yangtze Block. The dikes from the eastern South Qinling Belt are composed of gabbro and olivine gabbro that show arc-affinity trace-element compositions characterized by enrichment of LILE and LREE and depletion of HFSE. Both chemical and modeling results reveal that these dikes were derived from a lithospheric mantle that had been extensively modified by earlier subduction and underwent strong contamination by the ancient granulite rocks in the lower crust.

By contrast, the mafic dikes from the western South Qinling Belt show MORB-like elemental characters. Their elemental and isotopic evidence suggests that these mafic dikes originated from a heterogeneous asthenospheric mantle, which may have been enriched by OIB and seamount subduction. The mafic dikes underwent minor contamination in the lower crust but were modified by high temperature hydrothermally-altered supracrustal materials.

Generation of the voluminous mafic and ultramafic dikes in the South Qinling Belt occurred in a passive continental margin after a long period of subduction. Their diverse origins and complex geodynamics suggest that magmatism in rifting continental margins is not only controlled by the structure of the lithosphere and upwelling of the asthenospheric mantle, but also by interaction between melts and continental crust. The mafic-ultramafic dikes in this study further indicate that an active magma plumbing system may evolved beneath a “non-volcanic” passive continental margin.