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Geochronological Framework and Geodynamic Implications of Mafic Dykes in the Liaodong Peninsula, North China Craton

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The North China Craton, one of the oldest continental nuclei on Earth, is bounded to the north by the Central Asian Orogenic Belt and to the south by the Qinling–Dabie ultrahigh-pressure metamorphic belt. The Liaodong Peninsula is located on the northeastern margin of the North China Craton. The late Archean–Paleoproterozoic basement of the Liaodong Peninsula is overlain by unmetamorphosed Mesoproterozoic–Cenozoic cover rocks. Mafic dykes are widespread on the Liaodong Peninsula (Fig. 1). The majority of these dykes were originally thought to have occurred during the Pre-Sinian,

although the precise geochronological framework of this magmatism was unclear. More than 50 U–Pb analyses of dyke samples were performed over the past decade, with the aim of determining the spatial and temporal distribution of mafic dykes in this area. These data indicate that Paleoproterozoic–Mesoproterozoic mafic rocks are not as widely distributed as previously thought. The combined geochronological data enabled the subdivision of the mafic dykes into six episodes that occurred during the middle Paleoproterozoic, the late Paleoproterozoic, the Mesoproterozoic, the Late Triassic,

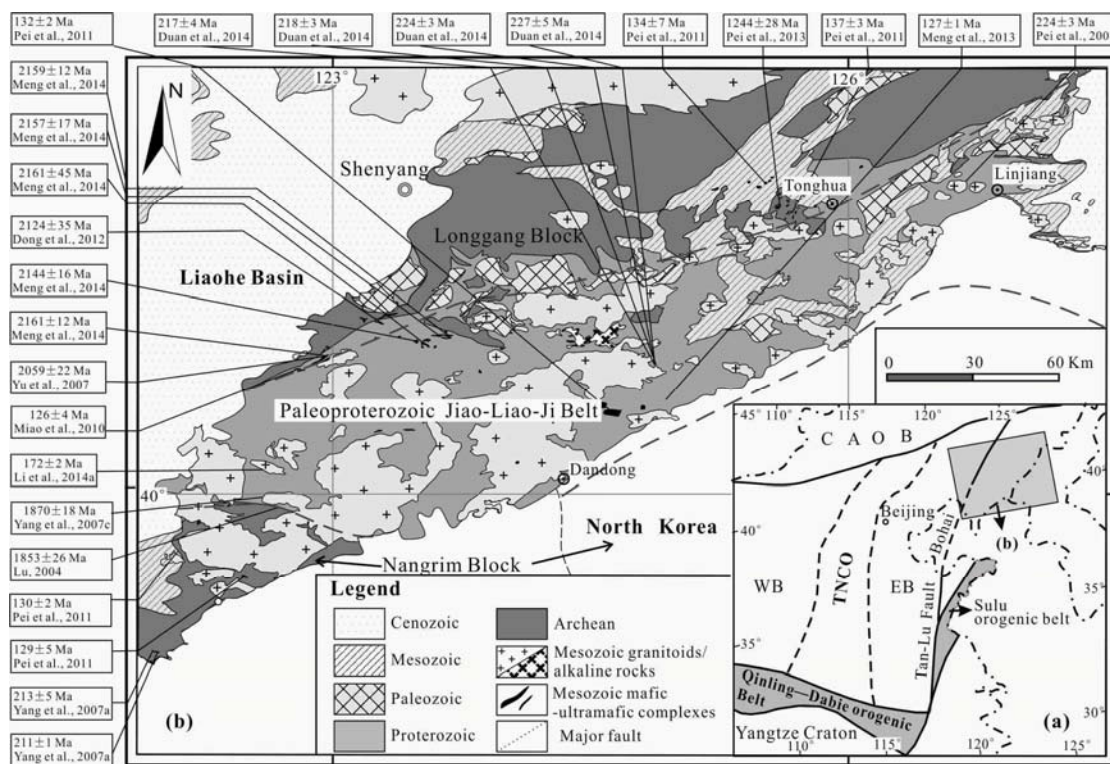


Fig. 1. Geological sketch map of the Liaodong Peninsula and adjacent regions. (a) Subdivision of the NCC and surrounding area; (b) Geological map of the Liaodong Peninsula and adjacent regions emphasizing the distribution of mafic rocks and their ages.

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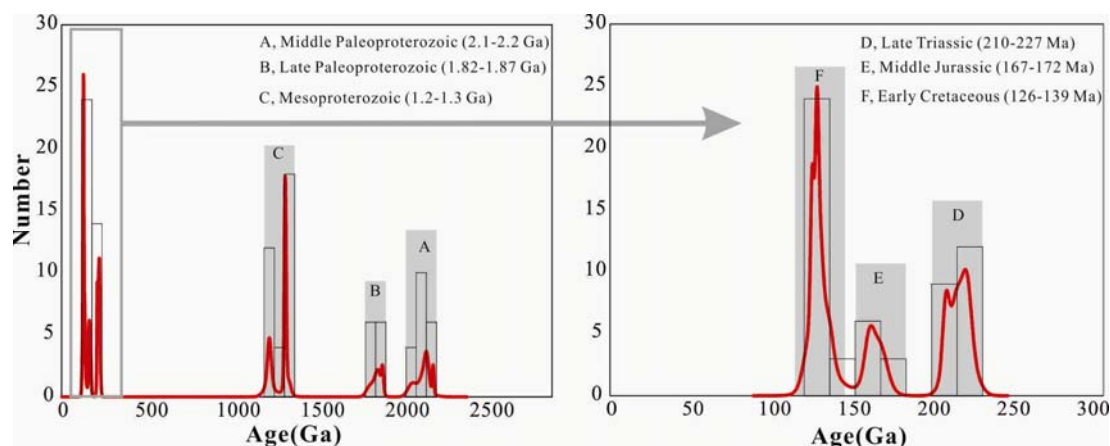


Fig. 2. Probability plot of the zircon U–Pb ages of the mafic rocks in the Liaodong Peninsula and adjacent regions. Note the six major episodes of the mafic magmatism: Middle Paleoproterozoic, Late Paleoproterozoic, Mesoproterozoic, Late Triassic, Middle Jurassic and Early Cretaceous.

the Middle Jurassic, and the Early Cretaceous (Fig. 2).

(1) The middle Paleoproterozoic (2.1–2.2 Ga) mafic rocks formed in a subduction-related setting and were subsequently metamorphosed during a ca. 1.9 Ga arc-continent collision event. The distribution of the Paleoproterozoic mafic rocks in the study area, with tholeiitic to calc-alkaline rocks in the north and calc-alkaline rocks in the south, provides evidence of south-directed subduction.

(2) The 1.82–1.87 Ga mafic dykes and the undeformed pegmatite–granite–syenite intrusions in this area were emplaced during post-collision extension in the late Paleoproterozoic, and they crosscut the 2.1–2.2 Ga mafic dikes, gneissic granites, and middle Paleoproterozoic metamorphosed volcano-sedimentary rocks, marking the end of the Paleoproterozoic tectono-thermal event.

(3) Mesoproterozoic mafic dike swarms provide evidence of global Mesoproterozoic rifting events associated with the final breakup of the Columbia supercontinent. The majority of the 1.2–1.3 Ga mafic dike swarms in the present study area are geochemically classified as continental flood basalts, with some being either continental flood basalts or alkali basalts that formed within continental rift settings or have E-MORB

compositions.

(4) The Late Triassic mafic magmatism is part of a Late Triassic magmatic belt that was generated by post-collisional extension. Late Triassic magmatism has been identified in the form of mafic dikes, diorites, syenites, lamprophyres, and monzogranites with mafic enclaves on the Liaodong Peninsula.

(5) The Middle Jurassic mafic dikes formed in a compressive tectonic setting.

(6) the Early Cretaceous bimodal igneous rocks formed in an extensional setting similar to a back-arc basin. These latter two periods of magmatism were possibly related to subduction of the Paleo-Pacific plate. The volume of mafic magmatism increased from the Middle Jurassic to the Early Cretaceous, leading to the development of Early Cretaceous alkaline basalts that have geochemical affinities to continental-rift-related basalts.

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