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Tectonic evolution of the proto-Korean Peninsula in the Boring Billion: Implication for the disruption of the Columbia Supercontinent

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The Middle Proterozoic period (1800–800 Ma), often called the "Boring Billion", was characterized by a stable environment with low atmospheric oxygen levels and globally anoxic oceans. In East Asia, this period has been frequently linked to the breakup of the Columbia supercontinent at ca. 1400 Ma, as evidenced by widespread litho-stratigraphic evidence (e.g., Bayan Obo, Yanliao, Xionger rift systems) of rifting in the North China Craton. Similar Mesoproterozoic rift-related lithologies have been identified in the Hwanghae Rift Zone (HRZ) on the northern Korean Peninsula (Jon et al., 2011; Han et al., 2013), suggesting that the Korean Peninsula may have been a part of the global-scale rift system associated with the disruption of the Columbia Supercontinent.

From this point of view, this study examines the tectonic evolution of banded-iron formation (BIF)-bearing metamorphosed sedimentary and volcanic successions in the Western Gyeonggi Massif of the Korean Peninsula. The meta-sedimentary sequences consist of quartzite, biotite-muscovite schist, BIF, and marble, while the volcanic suite comprises amphibolite and meta-gabbro, occurring as clasts, boudins, and blocks within the marble beds. All the rock types exhibit amphibolite facies metamorphic alterations and deformations. Intercalation of quartzite with Algoma-type BIF suggests siliciclastic sedimentation concurrent hydrothermal Fe input from deep-seated faults in a matured continental shelf environment. The carbonate deposition indicates biological activities on the volcanic atoll in the calm marine environment, following active volcanism. The dismembered amphibolite blocks or lenses show massive, igneous textures, and sub-alkaline basaltic composition, with trace and rare earth element patterns resembling ocean island basalt (OIB) and enriched mid-ocean ridge basalt (E-MORB), indicative of rifting of continental landmass similar to modern-day Iceland driven by plume-ridge interactions. U-Pb zircon dating of dismembered amphibolite blocks or lenses reveals ca. 1419 Ma protolith age followed by ca. 251 Ma metamorphism. These findings represent the earliest Mesoproterozoic volcanism and sedimentation recorded in the central-western margin of the Korean Peninsula, which has been considered part of the Permo-Triassic collisional belt. We propose that the central-

western margin of the Korean Peninsula witnessed rifting concurrently with its northwestern margin, coinciding with rifting in the North China Craton (e.g., Bayan Obo, Yanliao, Xionger rift systems) as part of the global rift system associated with the disruption of Columbia supercontinent during the "Boring Billion".