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A Global Full-plate Model for the Past 2 Billion Years

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Global plate reconstructions with continuously closed topological boundaries, also known as full-plate models, provide a key framework for understanding Earth's history. These models serve as essential boundary conditions for exploring mantle thermochemical evolution, surface dynamic process, and global climatic changes. Here we present the first global full-plate model for the past 2 billion years (Li et al. 2023; Wu et al. 2024). Our model is constructed using a set of newly developed apparent polar wander paths (APWPs) based on novel weighted-mean statistics and a critically assessed list of paleomagnetic poles. The model is then optimized with geodynamic considerations and tested against geological constrains. Key differences between our model and the existing ones include: (i) Our model is built on a paleomagnetic reference frame ensuring that all plates with paleomagnetic constraints are positioned at their "correct" paleolatitudes; (ii) Our model constrains the paleolongitude using the orthoversion hypothesis, which posits that supercontinents form about 90 degrees longitudinally away from their predecessors; (iii) We provide two alternative models with different paleolongitudinal options (Fig. 1). While our model inevitably contains significant uncertainties due to the limitations of available data and should be used with caution, it lays the groundwork for further testing and refinement by the scientific community as new critical data and enhanced databases become available.

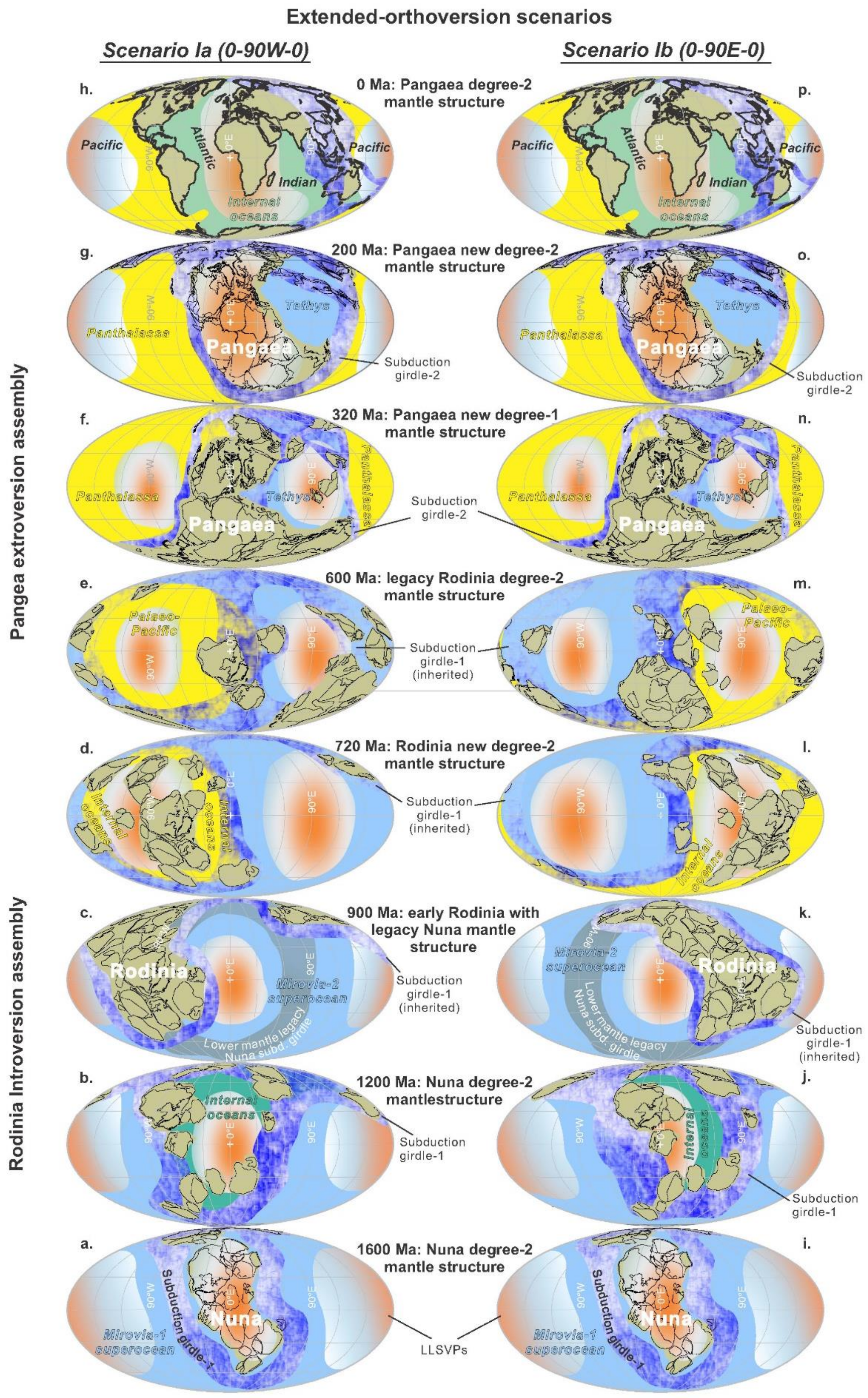

Fig. 1. Cartoons illustrating the implications of two alternative scenarios based on the extended-orthoversion geodynamic assumption where a 90° longitudinal change occurs between supercontinents and associated mantle structures (e.g., LLSVPs, and the I_{mins} as defined by the two antipodal LLSVPs). (a–h) Scenario Ia where Nuna is centered at 0°E, Rodinia at 90°W, and Pangaea at 0°E (0–90 W-0). (i–p) Scenario Ib where Nuna is centered at 180°E, Rodinia at 90°E, and Pangaea at 0°E (0–90 E-0).

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