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Large-scale Oxidation and hydration of continental crust during Neoarchean subduction in the North China Craton

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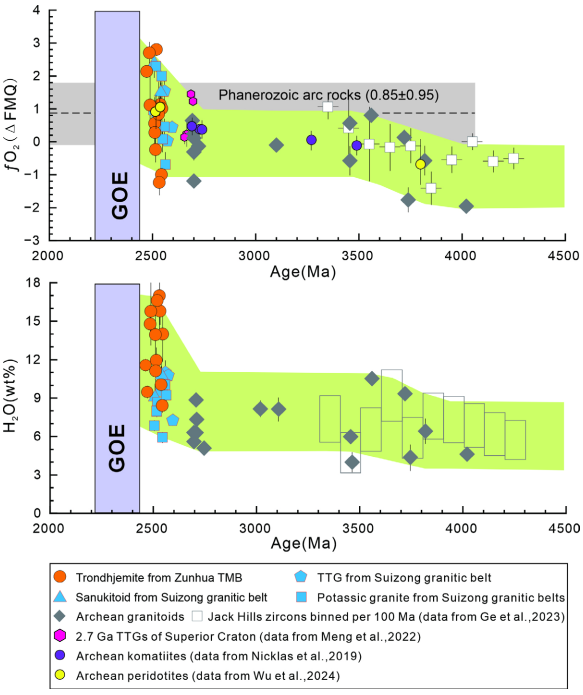
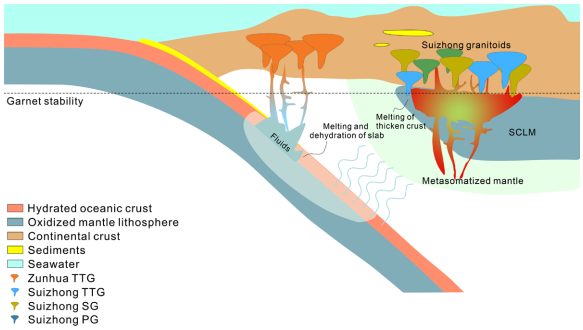
The Neoarchean represents a critical period of significant tectonic transition towards a habitable earth in the Earth's history. Global development of early plate tectonics during this era facilitated extensive crustal differentiation and maturation, reflected in the rock types and geochemical characteristics, i.e., significant increase of peraluminous and high-potassic magmas[1,2]. However, key physical properties of these Neoarchean magmas, such as oxygen fugacity (fO_2) and water content, remain poorly constrained in the continental crust. Our study investigates fO_2 and H_2O content in ~2.5-billion-year-old Suizhong granitic belt and Zunhua TTGs of Jidong high-pressure terrane in the North China Craton (NCC). Our results reveal that rocks from Suizhong granitic belt and Zunhua are more oxidized and hydrous, the former with average fO_2 and H_2O content of ΔFMQ +0.96 and 8.8 wt%, the later ΔFMQ +0.84 and 13.1 wt%, respectively. The significant elevation of crustal fO_2 and water content at 2.5 Ga, comparable to modern arc magmas, suggests that modern-style plate tectonics may have been operated at the end of the Neoarchean. Thermodynamic modeling indicates that water-fluxed partial melting of oxidized enriched Archean tholeiite can generate wet and oxidized melts similar to our Neoarchean granitic rocks. An additional source of hydrous fluids related to dehydration of hydrated slab can explain the varying high-water contents of Zunhua TTGs. The elevated fO_2 of the Neoarchean crust suggests a synchronous elevation of the redox state across the Neoarchean mantle, crust, and surface near GOE[3,4].





1. Moyen, J.-F. Archean granitoids: classification, petrology, geochemistry and origin. *SP* **489**, 15–49 (2020).
2. Laurent, O., Martin, H., Moyen, J. F. & Doucelance, R. The diversity and evolution of late-Archean granitoids: Evidence for the onset of "modern-style" plate tectonics between 3.0 and 2.5Ga. *Lithos* **205**, 208–235 (2014).
3. Wu, Z. *et al.* Rise of mantle oxidation by Neoarchean subduction in the North China Craton. *Earth and Planetary Science Letters* **646**, 119006 (2024).
4. Ostrander, C. M. *et al.* Onset of coupled atmosphere–ocean oxygenation 2.3 billion years ago. *Nature* **631**, 335–339 (2024).