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Reworking a long-lived Hadean Oceanic Plateau to produce an Archean continent: evidence from the Eoarchean Muzidian Gneiss Complex

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Our understanding of the nature of the Hadean crust on Earth is still poor due to the minimal preservation of Hadean magmatic record. Compared to the age of our planet, the oldest known igneous rock records are ~500-700 Ma younger, dated at 4.0 – 3.8 Ga. One geochemical approach to overcome this limitation is to combine the short-lived 146Sm-142Nd isotopic systematics and the projection of zircon Hf isotopic evolution of Eoarchean igneous rocks, which provides important hints on the Hadean magmatic history.

Here we focus on the recently discovered Eoarchean Muzidian Gneiss Complex in central China. We report a suite of early Archean rocks (TTGs) with near continuous ages from ~3.9 to 3.4 Ga. Our new zircon Hf and O isotope data, combined with existing 142Nd data, suggest that these TTGs were derived from melting of a common mafic precursor, likely > 4.3 Ga mafic proto-crust. This hints a likely oceanic-plateau-like setting for crust production in the first billion years of Earth history, which would require a significant volume of mafic crust to be formed prior to ~4.3 Ga. This mafic proto-crust was long-lived and remelted episodically in order to produce felsic TTGs. This indicates that the oceanic plateau was relatively stationary, so that horizontal tectonics or subduction was not required to explain the formation of these TTGs in the early Archean, prior to ~3.4 Ga. Furthermore, our new oxygen isotope data suggest the likely operation of vertical tectonics at ~3.5 Ga.