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A thickening event of the continental lithosphere ca. 2.2 billion years ago

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Continental lithosphere thickness significantly influences Earth’s tectonic style, the stabilization of cratons, the compositions of intraplate volcanic rocks, and specific types of metallogenesis. Although the Archean cratons currently boast the thickest lithosphere among Earth's continents, the evolution of its thickness throughout geological history remains inadequately comprehended. Intraplate small-volume volcanoes, typical products of magmatic activities within continents with thick lithosphere on the modern Earth, were rarely observed until the early Paleoproterozoic, possibly due to the high mantle temperature and insufficient thickness of the continental lithosphere. Here we show that the modern intraplate continental basalts exhibit distinctive signatures of both elevated Nb/Ta and Dy/Yb ratios, setting them apart from basalts found in arc, rift, and plume settings. Our statistical analysis of a geochemical database of basalts worldwide spanning the past 3.5 billion years indicates that modern-like intraplate continental basalts have become extensive since ca. 2.2 Ga. We attribute the emergence of intracontinental basalts to a lithospheric thickening event within the Archean craton continents, resulting from horizontal compression of the lithosphere during the assembly of the Nuna supercontinent.