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How Was Thick Archean Lithosphere Constructed?

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The construction of Archean (>2.5 Ga) continental lithosphere is a poorly understood process. While Neoarchean crust is well preserved in many locations, pre-2.8 Ga crustal packages (often called 'cratonic basement gneiss' or 'grey gneiss' terrains) are often deformed and have been metamorphosed on multiple occasions. Several competing models exist that attempt to explain, at times independently, the production of continental crust and the stabilization of lithospheric mantle roots. These range from modern-style subduction-like tectonic regimes, to mantle plume heating at the base of thickened crust, to Himalayan-style orogenesis. Though the processes of Mesoarchean crustal production are hotly contested, there is increasing evidence for deep, cool lithospheric roots during this time period. Additionally, final stabilization of crustal blocks represented by emplacement of large volumes of Neoarchean granites did not occur until after lithosphere formation in some cases. We present new data from Mesoarchean crustal packages in an attempt to link the lithospheric signatures recorded in mantle minerals with those preserved in deformed Mesoarchean crustal basement assemblages. In particular, we highlight data from Mesoarchean TTG suite rocks, including whole rock geochemical data and zircon U-Pb-Hf data. These data come from igneous zircons extracted from metaigneous rocks and provide a reliable measure of the age and Hf isotope composition of emplaced TTG suite rocks. We compare the results of this data to existing zircon geochemical datasets, including oxygen isotope and trace element suites, in an attempt to refine the acceptable petrogenetic models. Finally, we will summarize the construction of cratonic regions at large, and use this data to evaluate ancient tectonic and petrogenetic evolution models for the Earth.