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Nature vs. Nurture: Understanding the survival of Archean cratons

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In a geodynamic, geological and geophysical review of global Archean cratons, we find that the survival of Archean cratons depends on the initial conditions of their formation, as well as the tectonic processes to which they were exposed. In a sense, we must consider both their nature and how they were nurtured. In a review of existing literature and models, we use stability regime diagrams to understand the factors that contribute to the intrinsic strength of a craton: buoyancy, viscosity, and relative integrated yield strength. We find that cratons formed in the Archean when thermal conditions enhanced extraction of large melt fractions and early cratonization promoted the formation of stable Archean cratonic lithosphere. In terms of the cratons' nurturing, processes that may have modified and weaken cratonic lithosphere include subduction and slab rollback, rifting, and mantle plumes, as these processes introduced materials and conditions that warmed and metasomatized the lithosphere. Examining four Archean cratons that are more stable, and four that are categorized as modified or destroyed, we note that continental lithosphere that was cratonized prior to the end of the Archean has more potential to survive deformation during the last 500 My. Although, the survivability of these cratons is highly dependent on their unique positions relative to larger scale tectonic processes, such as subduction. We also observe that once an Archean craton begins to undergo even a small amount of modification, it is more likely to continue to be modified, as it loses the preservation advantage that it had upon birth.