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Unstable structure and dynamics in Earth's deepest mantle

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In Earth's deepest mantle, there are two huge structures with anomalously lower seismic velocities, and perhaps different compositions, than their surroundings. One such structure is found beneath Africa and the other is beneath the Pacific Ocean. They are often called "Large Low Velocity Provinces". These structures are footprints of Earth's long-term evolution. By examining their morphology and physical-chemical properties, we can greatly improve our understanding of how the planet evolved in the past 4.5 billion years. Through an exhaustive analysis of previous seismic images of Earth's mantle, we discovered that the African anomaly is about 1,000 km taller than the Pacific anomaly. By performing mantle convection simulations with high-performance computers, we find that the most significant control on the maximum height that a compositionally distinct structure can reach is its density. These results further suggests that the Africa anomaly is unstable because it is not dense enough, in which case it may have been rising up in recent geological time.

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