Generation of continental crust in oceanic arcs

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Earth's crust is the life-sustaining interface between our planet's deep interior and surface. Most "terrestrial" planets in the solar system have basaltic crusts similar to Earth's oceanic crust, but the continental masses, areas of buoyant, thick silicic crust, are a unique characteristic of Earth. Therefore, understanding the processes responsible for the formation of continents is fundamental to reconstructing the evolution of our planet. We use geochemical and geophysical data to reconstruct the evolution of the Central American Land Bridge (Costa Rica and Panama), which evolved from an oceanic subduction system (where two oceanic plates collide) over the past 70 million years. We found that the geochemical of erupted lavas evolved to continental-like signatures about 10 million years ago - coinciding with the onset of subduction of more enriched oceanic crust that originally formed above the Galápagos mantle plume. We also found that seismic P-waves (body waves) travel through the crust at velocities closer to values observed in continental crust world-wide. Finally, we developed a continental index based on global statistical analyses of all magmas produced in modern oceanic arcs compared to the global average composition of continental crust to quantitatively correlate geochemical composition with the average P-wave velocity of arc crust globally, resulting in a strong correlation (r2=0.85). We conclude that although the formation and evolution of the continents may involve many processes, melting enriched oceanic crust within a subduction zone - a process probably more common in the Archaean (~2.5-3.5 Ba) when most continental landmasses formed - can produce juvenile continental crust.