The origin of the Andes unravelled

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Why do the Andes exist? Why is it not a place of lowlands or narrow seas? Wouter Schellart, a geophysicist at the Vrije Universiteit Amsterdam, has been pondering these questions for more than a decade. Now, he has found the answers using an advanced computer model. "It's a matter of enormous size, longevity and great depth", he said. "These aspects made the Andes the longest and second-highest mountain belt in the world."

All the other major mountain belts on Earth, such as the Himalaya and the Alps, were formed due to colliding continents. But there are no colliding continents in the Andes; rather, the Andes are located at a so-called subduction zone, a place where an oceanic tectonic plate sinks below another plate (in this case the Nazca plate sinking below the South American plate) into the Earth's interior, the mantle. There are numerous other subduction zones on Earth, such as in Greece and Indonesia, but these locations are characterized by small seas (such as the Aegean Sea) and tropical lowlands, not massive mountain chains. So the big question is: Why did a massive mountain chain form in South America?

Andean evolution

Schellart's model, which took more than two years to complete on Australia's supercomputer Raijin, has reproduced the evolution of the South American subduction zone, from start to present (initiating some 200 million years ago and thereby the oldest subduction zone in the world), to investigate the origin of the Andes. What came out? The size of the subduction zone, some 7000 km and thereby the largest in the

world, is crucial for mountain building. What else came out? The first signs of crustal shortening and mountain formation started already in the mid Cretaceous, some 120-80 million years ago. Before this time there were elongated narrow seas at the western edge of South America rather than mountains. Form the mid Cretaceous onwards the subduction zone was deep enough to induce large-scale flow in the deep mantle, down to 2900 km, the boundary between the Earth's mantle and core.

These flows dragged South America westward, causing the continent to collide with the subduction zone and thereby forming the Andes. Because the South American subduction zone is so wide, it provides much resistance to migrate laterally, in particular in the centre. This is why the collisional forces between the South American continent and the subduction zone are largest in the centre, resulting in the highest mountains in the Central Andes and formation of the Altiplano, a high plateau at 4 km above sea level, but much lower mountains in the north and south.

Read more about this research in *Nature Communications*

More information: W. P. Schellart, Andean mountain building and magmatic arc migration driven by subduction-induced whole mantle flow, *Nature Communications* (2017). DOI: 10.1038/s41467-017-01847-z

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