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Not My Fault: A vacation in Argentina and a glimpse of Gondwanaland

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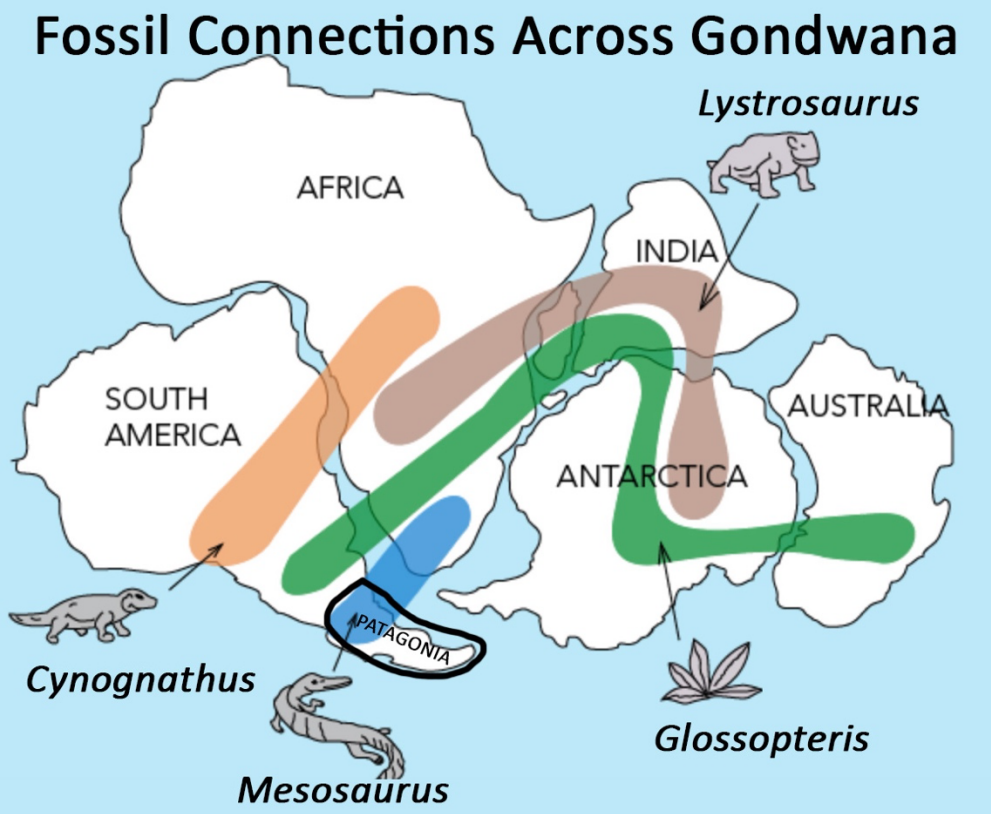

A sketch of fossil connections across Gondwanaland, the supercontinent composed of modern-day Africa, Australia, Antarctica, and South America. Color bands show locations where fossils of reptiles and a plant have been found. My travels took me to Patagonia, where Mesosaurus fossils have been found.

My husband and I recently returned from a vacation in Argentina. The trip was a fishing junket for Tom and several of his fly-fishing buddies and I joined for ten days beforehand. Travel brings many pleasures but for those of us with earth science background, it is a special treat to visit different tectonic regimes and to work out some of the geologic underpinnings.

A disclaimer: I have no background in Argentinian geology, my pre-trip reading was cursory, and we only visited two small areas – Buenos Aires and a bit of Patagonia. There are plenty of technical articles in print, but I couldn't find any good general geology overviews in English (I don't speak or read Spanish) so take my conjectures with a grain of salt.

For big chunk of geologic time, South America was part of a supercontinent that we call Gondwana or Gondwanaland joined to what is now Africa, Antarctica, Australia, India, New

Zealand, Madagascar, and New Guinea. Gondwana is a Sanskrit word first used to describe a region in central India where the Gond people lived and applied in the late 19th century to southern continent sites where similar fossils had been found.

I was introduced to Gondwana in 1965 in my first geology course – a general ed class for non-majors at Berkeley. That was early days for plate tectonics, and roughly half of the Berkeley earth science faculty still found the notion of continents colliding and breaking up unlikely. My professor Howel Williams was a famed volcanologist about to retire and had no qualms about exploring new ideas. He talked about Antonio Snider-Pellegrini's identification of similar fossil zones in Europe and America that pre-dated Alfred Wegener continental drift hypothesis by half a century and showed us Wegener's maps of geologic units, glaciations, and connecting coastlines.

I clearly remember being learning about Cynognathus and Lystrosaurus (land reptiles) and Mesosaurus (freshwater reptile) critters incapable of the traveling across an ocean that are now spaced widely apart. Glossopteris was a leafy plant that dominated the swamps of middle and high latitude areas in Permian times nearly 300 million years ago. Imprints of its long distinctive leaves are found in all of the former Gondwana continents. When the Cal Poly Humboldt Natural History Museum was founded in 1989, I was excited to see several Glossopteris fossils and a cast of Mesosaurus where they are still on display today.

The notion of drifting continents was highly controversial for the first half of the twentieth century. It became an established geologic tenet by the 1970s when the magnetic seafloor evidence and a better understanding of how temperature and pressure affected the mechanical properties of earth materials coalesced into the plate tectonic theory of today. California elementary school students are introduced to the supercontinents of Pangaea and Gondwanaland in fifth grade.

I've traveled to five bits of Gondwana, with Antarctica, India and Madagascar still on my list. But it wasn't until our Patagonia adventures that drove me to dig a little deeper into its history. Supercontinents are a pretty common part of earth's history. Fifth graders learn about Pangaea (all earth) when all of the continental land masses were clumped together for about 150 million years during the Paleozoic and Mesozoic ears, but they are unlikely to hear about all the predecessors.

Reconstructing past continents and plate movements is difficult, especially going back further in time. Plate movement and surface processes continually rework the surface making ancient rock hard to find. But geologists are persistent and have uncovered at least four supercontinents have formed over earth's 4.5-billion-year history. The Columbia supercontinent persisted for over 450 million years, breaking up over 1.3 billion years ago. Fragments reassembled into Rodinia, 250 million years later. Gondwana reassembled the southern continents about 600 million years and collided with the other continental masses to form Pangaea 335 million years ago.

Pangaea was a relatively short-lived super continent, beginning to break up around 200 million years ago when North America (still connected to Europe), northern Africa, and South America rifted apart creating the central Atlantic ocean. Gondwana would remain intact for another ~30 million years when South America and Africa broke away from the rest of the southern

continents. The South America broke free of Africa 20 million years later as the southern Atlantic ocean opened.

Much of Argentina and Brazil retain their Gondwana origins with large areas Paleozoic and Mesozoic rock dating back to times of union with Africa. But not all has been passive since the time of separation. Rifting and the formation of the Atlantic has gathered most of the popular press but something equally important was occurring along the west coast of the America's at the same time.

I hadn't thought much about the evolution of the planet's greatest ocean before our Argentina trip. The Pacific has been around for a very long time but not in its present form. Called the Panthalassic Ocean, it goes back to the times of the Rodinian supercontinent and comprised 70% of earth's surface when it surrounded Pangaea. The sea floor of that ancient ocean is now long gone, consumed by more modern subduction zones.

Part of the Panthalassic sea floor was made up by the Farallon plate that extended over much of the central and eastern Pacific from what is now the southern part of Chile to Alaska. A subduction zone began to form along the west coast of what would become the America's not long after the Atlantic began to form, slowly building the Andes mountains in the south, and later the Sierras and Rockies in the north Pacific.

The Andes are a marvel to behold, the longest continental mountain chain in the world and along with the Tibetan Plateau, a major driver of weather patterns and global climate. The Andes are still growing today at roughly a half inch a year. No surprise that the Andes and much of the adjacent plateau were covered in ice during peak glacial periods, scouring the landscape and leaving much of the region scraped of soil and littered with glacial debris.

We spent most of our time in Patagonia, that includes areas of Chile and Argentina south of 40° latitude. Before the arrival of Europeans, this was the land of the Tehuelche and Mapuche peoples, nomads who followed the wild guanaco and rhea herds for food. We stumbled upon the small Museo de Leleque which featured the history of the indigenous peoples. The Tehuelche were large people and given the name patagones (big feet) by Magellan's crew who were impressed by the size of their footprints. I was most moved by a recording made in the late 1800s of an elder speaking a beautiful rhythmic language, a ghost language now as no one speaks it today.

The nomadic people of Patagonia existed at the same time as the Inca and their large cities. Inca expansion led them north as far as Quito, Ecuador and into northwestern Argentina but there is no evidence they ventured south of Santiago, still hundreds of miles north of Patagonia. My guess is that geology is the reason – the glacial scraping of the land and the arid environment in the Andes rain shadow made the region unsuitable for agriculture and urbanization.

I am left with more questions than answers and hope to go back.

Note: tectonic animation of the formation and breakup of Gondwana at https://www.reddit.com/r/educationalgifs/comments/u5jo0e/animated_map_globe_showing_tectonic_plate/

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