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Control of slab width on backarc basin formation and cordilleran mountain building at subduction zones

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The style of overriding plate deformation at subduction zones varies considerably. At one end of the spectrum are subduction zone systems that experience backarc spreading, such as observed in the Scotia Sea, or overriding plate extension in the backarc and/or forearc, such as observed in the Aegean Sea. At the other end of the spectrum are subduction zone systems that experience overriding plate shortening that leads to cordilleran orogeny such as the Andes. It remains unknown why some subduction zones experience overriding plate extension/spreading, others experience shortening, and yet others show no deformation. In the current contribution, advanced numerical models of progressive subduction in 3D space will be presented that have been developed to investigate the role of subduction zone size (its trench-parallel extent expressed as slab width W) and time on the style and rate of deformation in the overriding plate, as well as, more generally, on the style, geometry, kinematics and dynamics of subduction. The models demonstrate the crucial role that subduction zone size and time play in determining overriding plate deformation style. The onset of cordilleran orogeny is only observed in a mature stage of subduction ($\sim$70 Ma) during subduction of a very wide slab ($\geq \sim$6000 km) into the lower mantle, while narrow slab subduction is characterized exclusively by overriding plate extension, even during subduction into the lower mantle. Ultimately, the geodynamic models can explain the diversity of overriding plate deformation observed on Earth as exemplified by two end member cases, namely Scotia backarc basin formation in the Southern Atlantic and Andean orogeny in South America.