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A geodynamic model of flat slab subduction

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Flat slab subduction is characterized by a subducting slab that lies (sub)horizontally for several hundred kilometres below the base of the overriding plate. It has been documented at several subduction zones on Earth and has been ascribed to subduction of buoyant ridges/plateaus or to forced trench retreat. There are a number of settings in nature, however, with subduction of a buoyant ridge/plateau that lack a flat slab. Additionally, geodynamic subduction models with forced trench retreat require rates to reproduce flat slab subduction that are generally higher than observed in nature. In this contribution I will present the first buoyancy-driven geodynamic model of flat slab subduction, demonstrating that it can occur in the absence plateau/ridge subduction, in the absence of forced subduction, and during negligible trench migration. The transient flat slab subduction starts after a prolonged period (>100 Myr) of progressive decrease in slab dip, which enhances suction in the mantle wedge, and disappears due to overriding plate thickening, which forces the mantle wedge to open up. The model demonstrates that slab tearing or cessation of ridge/plateau subduction are not required to explain termination of flat slab subduction, but that termination occurs due to the overriding plate shortening it produces. This provides a potential explanation for Cenozoic flat slab termination in the Central Andes and flat slab termination at the end of the Laramide orogeny in western North America.