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A review of the geodynamic evolution of flat slab subduction in Mexico, Peru, and Chile

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Subducting plates around the globe display a large variability in terms of slab geometry, including regions where smooth and little variation in subduction parameters is observed. While the vast majority of subduction slabs plunge into the mantle at different, but positive dip angles, the end-member case of flat-slab subduction seems to strongly defy this rule and move horizontally several hundreds of kilometers before diving into the surrounding hotter mantle. By employing a comparative assessment for the Mexican, Peruvian and Chilean flat-slab subduction zones we find a series of parameters that apparently facilitate slab flattening. Among them, trench roll-back, as well as strong variations and discontinuities in the structure of oceanic and overriding plates seem to be the most important. However, we were not able to find the necessary and sufficient conditions that provide an explanation for the formation of flat slabs in all three subduction zones. In order to unravel the origin of flat-slab subduction, it is probably necessary a numerical approach that considers also the influence of surrounding plates, and their corresponding geometries, on 3D subduction dynamics.