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Analytic models of internal strain during slab bending in subduction zones

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Seismicity associated to the descending slab in subduction zones has been related to different origins: (1) the interface between both plates, generating the most devastating earthquakes on Earth, (2) internal slab deformation due to external forces, mainly slab pull, mantle drag forces and interface coupling, and (3) internal strain due to slab bending. We have developed simple analytic models of internal strain during continuous fold generation by slab bending in subduction zones. The difference of longitude between the inner and outer arcs during folding can be solved by two different mechanisms or a combination of both: pure-shear dominated folding, with extension of the outer arc and contraction of the inner arc; or simple-shear dominated folding (flexural slip). The amount of deformation obtained from the models is compared with seismicity of real subduction zones with different degrees of coupling. Thrust mechanism earthquake ruptures are observed on subduction zones at depths below the seismogenic coupled interface. These events are difficult to explain by the presence of external forces, and must be related to the internal deformation of the slab during flexure. While pure-shear strain is classically used to explain shallow outer-rise normal earthquakes, we propose that the deeper intraslab reverse faulting earthquakes can be related to bending by simple-shear deformation mechanism.