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What drives tectonic plates?

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Does the Earth's mantle drive tectonic plates, do plates drive the mantle? Today, this long-standing question proves to be ill-posed: the lithosphere and the mantle belong to a single, self-organizing coupled system. The question can be rephrased as: does the mantle below the lithosphere resist surface motion or does it propel it? A hurdle to answering this question is to design dynamic models of mantle convection with plate-like behavior evolving over more than 500 My. Using such models, we find that the key factor that promotes active mantle drag is the presence of multiple continents. Regardless of the strength of their keels, it is instead due to continental collisions, followed by slab break off and, in turn, transient episodes of vigorous mantle flow and plate fragmentation. On a model that produces Earth-like surface observables, the areal fraction of the lithosphere exposed to mantle drag remains below 40%, and is not constant below a given plate. Only continents can be mostly dragged by the mantle, when they do not belong to a subducting plate, hence moving slowly ($<$2 cm y^{-1}). When continents breakup, the surface drags the interior, and slabs tearing scatters continental pieces apart at $>$10 cm y^{-1}, for less than 30 My following breakup. Synchronously, peaks of toroidal velocities indicate redistribution of mass anomalies in the upper mantle. Plumes contribute to breakup by thermally weakening the boundary layer and localizing ongoing fragmentation.