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Hierarchical self-organization of tectonic plates

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It is well known that the earth surface is divided in plates of different size and it has been already proposed by (Bird, 2003) and (Sornette and Pisarenko, 2003) that their distribution follows a fractal law. It is however controversial the origin of the size of the largest ones, whether their dimension is caused by coupling with mantle convection or due to a fragmentation process as well. We investigate the time evolution of the distribution of plate size in the last 140Ma employing the most up-to-date available reconstructions of plate boundary. We find that (1) the distribution of the largest plates and of the smallest plates are always decoupled in the last 45Myrs and therefore they respond to different physical mechanisms; (2) the distribution of the smallest plates is relatively constant in the last 45Myrs and corresponds to a fragmentation law, confirming what envisaged by Bird; (3) a power law type distribution of the largest plates in the last 140Myrs has been detected for the first time, involving no more then 7-8 plates but being always a robust verifiable feature; (4) the fluctuations of the power law exponent for the largest plates oscillate in a timeframe of tens of millions of years, reaching a maximum of almost one about 60-50Ma, and a minimum of almost zero 110-100Ma: this last tessellation corresponds to a perfect Benard convection; (5) the growth, mostly in the period 100-80Ma, is much faster then the following relaxation and seems to indicate a pulsation, probably due to a radical change in the dynamics of the Earth deep interiors.