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Hierarchical self-organisation of tectonic plates

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It is well known that the Earth's surface is divided into plates of different sizes. It has been recently pointed out that the plate sizes display a hierarchical organisation. Using recently released reconstructed plate boundary polygons for the past 140 Myrs, we analyse the behaviour of their hierarchical structure. We find that (i) the distribution of the largest and the smallest plates are always decoupled in the last 45Myrs, confirming a match of the critical exponent of the small plates with a fragmentation mechanism; (ii) the distribution of the largest plates during the last 140Myrs is also a power law, involving the 6-7 largest plates; (iii) the fluctuations of the power law exponent for the largest plate sizes varies in a timeframe of tens of millions of years, reaching a maximum of almost one at 60-50 Ma, and a minimum of almost zero at 110-100 Ma; (iv) in the period 100-80 Ma the growth is the fastest ever observed; (v) in the last 100 Ma the fractal exponent appears to behave as a fast excitation followed by a slow relaxation. The coincidence between the initiation of spreading at mid-ocean ridges and jumps in ridge position during excitation, and plate rejoining or accretion during relaxation suggests that the plate tectonic system is a global self-organising system. The coupling between plate forces and mantle convection is analysed in detail to find the dominant physical process.