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Unstable Sundaland triggered dry-shod migration of hominids to Java

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H. erectus reached the island of Java during Pleistocene times across what is now the Sea of Java, likely taking advantage of now disappeared land bridges. The scheme of hominids dispersal across SE Asia is commonly analzed upon the premise that Sundaland is tectonically -and vertically- stable. This mostly implies that only eustatic sea level oscillations can make the necessary land bridges arise, for H. erectus to reach Java. Here we show that Sundaland is not a stable area, and that it currently subsides. We contend that the overall physiography of Sundaland, covered by flood plains and mangroves or locally festooned by constricted coral reef tracts, can only be explained by subsidence. Based on numerical models of coral reef growth that account for the intrisic properties of reef development as well as sea level oscillations, we find that the Sunda shelf currently subsides at a rate of 0.3 to 0.4 mm/yr. This result implies that Sundaland was permanently emerged prior to 500 kyrs. Dispersal of H. erectus could thus have occured regardless of the glacial cycles.

The origin of the vertical ground motion of the tectonically quiescent Sunda shelf is to be searched for in the underlying, convecting mantle. We relate the subsidence of the Sunda shelf to the deflection of the overriding plate topography by the subducting Indo-Australian plate that stirs the mantle. We model the associated transient dynamic topography, following the collision of the Australian continent to the East. Our model not only predicts a phase of subsidence over the last few 100s kyrs and until present-day, but importantly also indicates that current subsidence followed an earlier phase of uplift of similar duration during the Lower and early Middle Pleistocene. This episode of dynamic uplift could have emerged Sundaland and provided ephemeral land bridges at the very period of hominin dispersal across Sundaland. Indeed, the Sangiran dome, where most hominids are found, is associated to a series of marine to terrestrial environments. This regressive episode can be explained by the underlying subduction dynamics.