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Numerical simulation of faulting in Mentawai of the Sunda Trench shows that seamounts may generate megathrust earthquakes

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The role of seamounts in generating earthquakes has been debated, with some studies suggesting that seamounts could be truncated to generate megathrust events, while other studies indicate that the maximum size of megathrust earthquakes could be reduced as subducting seamounts could lead to segmentation. The debate is highly relevant for the seamounts discovered along the Mentawai patch of the Sunda Trench, where previous studies have suggested that a megathrust earthquake will likely occur within decades. In order to model the dynamic behavior of the Mentawai patch, we simulated forearc faulting caused by seamount subducting using the Discrete Element Method. Our models show that rupture behavior in the subduction system is dominated by stiffness of the overriding plate. When stiffness is low, a seamount can be a barrier to rupture propagation, resulting in several smaller ($M \leq 8.0$) events. If, however, stiffness is high, a seamount can cause a megathrust earthquake (M8 class). In addition, we show that a splay fault in the subduction environment could only develop when a seamount is present, and a larger offset along a splay fault is expected when stiffness of the overriding plate is higher. Our dynamic models are not only consistent with previous findings from seismic profiles and earthquake activities, but the models also better constrain the rupture behavior of the Mentawai patch, thus contributing to subsequent seismic hazard assessment.