Large subducted features, such as seamounts, play an important role in the locking mechanism, earthquake generation, crustal erosion and earthquake segmentation process at subduction zones. However, until now, it has only been possible to image subducted features towards the upper limit of seismogenic locked zone, that is, down to approximately 12 km depth, whereas great megathrust earthquake ruptures initiate at 20-40 km depth, that is, towards the lower limit of locked zone. The role of deep subducted seamounts in the earthquake process has therefore not been investigated till now. Using new technology, we present a deep seismic reflection image of a 3-4 km-high, approximately 40 km-wide seamount below the Sumatra forearc mantle at 30-40 km depth, showing for the first time that a seamount can subduct intact to such depths. The subducted seamount is collocated with the complete absence of seismicity above and below it, which combined with the persistence of the seamount after more than 160 km of subduction suggests that the coupling between the seamount and the overriding plate is weak. We also observe low bathymetric anomalies in the wake of the seamount. These results, taken together, suggest that the presence of subducted seamounts leads to segmentation of subduction zones and could reduce the maximum size of megathrust earthquakes.