

Defining the worst case scenario for the Makran Subduction Zone: the 1008 AD tsunami

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The Makran Subduction Zone is located within the Arabian Sea (Northern Indian Ocean) and marks the boundary between the Arabian and the Eurasian plate. The sinistral strike-slip Sonne fault separates the subduction zone in an eastern and western segment. The convergence rate is about 40 mm/yr and slightly faster in the east than in the west. The seismicity is low in general and the few documented seismic events are concentrated in the eastern segment. No seismic activity is known from the western segment in historic times. The hazard potential is enigmatic as the only documented and recorded tsunamigenic earthquake (MW 8.1) within the subduction zone occurred in Nov 1945. However, thermal modelling suggests a wide potential seismogenic zone, apparently capable of generating very significant (>MW 8.5) tsunamigenic earthquakes. Furthermore, submarine slumping is another tsunami trigger which has to be taken into account.

We used the modelling results as a hypothesis and mapped extreme wave event deposits along the coastline of Oman, bordering the Arabian Sea. We were able to document extensive boulder fields along rocky parts of the coastline. These boulders are decorated with marine sessile organism such as e.g oysters or barnacles testifying for an intertidal setting of the boulder prior to dislocation. The organism remains were used for radiocarbon dating assuming that the death of the organism was related to the relocation of the boulder. Storm-induced boulder movement is possible as the coastline is subject to infrequent tropical cyclone impact. However, boulder movement was not observed during the strongest storm on record in 2007. The dating exercise revealed a cluster of dates around 1000 AD, coinciding with a potential earthquake event known from a historic Persian text dating to the year 1008 AD.

Archaeological evidence, mainly pottery artefacts found along the sea shore near the capital area Muscat/Oman also indicate a catastrophic event which may be correlated to the 1008 AD earthquake and tsunami inundation.

The boulder deposits as well as the archaeological remains testify for a maximum tsunami runup of 15m, exceeding by far the inundation as observed in 1945. We define this as the worst case scenario for the Makran Subduction Zone. However, the return period is rather large (>500 years).