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Holocene turbidites reveal earthquake supercycles at a slow convergence plate boundary (Northern Algeria)

Gueorgui Ratzov (1,2), Antonio Cattaneo (2), Nathalie Babonneau (1), Karim Yelles (3), Rabah Bracene (4), Tassadite Lateb (1,3), and Jacques Déverchere (1)

(1) Université de Bretagne Occidentale, IUEM, Domaines Océaniques, Plouzané, France, (2) IFREMER, Laboratoire Environnements Sédimentaires, Plouzané, France, (3) Centre de Recherche en Astronomie, Astrophysique, et Géophysique, Algiers, Algeria, (4) SONATRACH Exploration, Boumerdès, Algeria

Ongoing evidence for earthquake clustering calls upon records over numerous earthquake cycles to improve seismic hazard assessments, especially at places where recurrence times overstep historical records.
Here, we show that meaningful information of large earthquakes recurrence intervals over several seismic cycles may be obtained using turbidite record offshore the Algerian margin. The Africa-Eurasia plate boundary is slowly convergent (∼3mm/yr), with deformation in the investigated margin segment accommodated mainly onland, along thrusts and strike-slip faults. Historically, two relatively large earthquakes stroke the area in 1954 (Orléansville M6.7) and 1980 (El Asnam M7.3).
Holocene turbidites emplaced offshore are triggered by thirteen earthquakes. Most of them tune to paleoseismic record of the El Asnam fault onland, whereas two are slightly diachronous (<100 yrs), and likely result from bursts of activity on nearby faults. Turbidites depict a bimodal distribution over ∼8 kyrs that support the concepts of earthquake supercycles and rupture synchronization between nearby faults. Thirteen coastal paleoquakes underpin clusters of 3 to 6 events with mean recurrence intervals of ∼300-600 years, separated by two periods of quiescence of ∼1.7 ka without major events on any fault. They imply alternation of broad phases of strain loading and shorter phases of strain release along the fault network.
More generally, our results demonstrate that fault slip rates are time-dependent and that earthquake occurrence might be strain-predictable rather than time- or slip-predictable.
Turbidite paleoseismology investigation is ongoing on an adjacent margin segment where the Boumerdes M6.9 earthquake occurred in 2003. Preliminary results retrieved the traces of historical earthquakes, and established Holocene time-series. They support a similar bimodal seismic distribution, suggesting that earthquake supercycling should be a major strain release process along the Africa-Eurasia plate boundary.