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Earthquakes along the Azores-Iberia plate boundary revisited

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The plate boundary that separates the Eurasian and African plates between the Azores triple junction and Gibraltar has unleashed some of the highest magnitude earthquakes in Europe in the historical and instrumental periods, including the 1755 great Lisbon earthquake with an estimated magnitude of M8.5-8.7, a M8.3 earthquake in 1941 in a transform oceanic fault, a M8.1 fault in 1975 in an oceanic intraplate domain, and a M7.9 earthquake in 1969 offshore SW Portugal. The plate boundary evolves from a divergent boundary in the east – the Azores domain – through a strike-slip domain at the center – the Gloria fault domain – to an oblique convergence domain in the west – west Iberia and its oceanic margin. A proper mapping of the seismicity along this plate boundary is key to better understanding it.

Prior to the early eighties, many earthquakes with epicentre in the Atlantic and even in mainland Portugal were undetected or not located instrumentally. However knowledge of the occurrence and location of earthquakes prior to this period is critical to understanding the seismicity of the region and for the assessment of seismic hazard and risk. The relocation of events recorded instrumentally until 1960 is particularly difficult due to the poor sensitivity of the seismographs, few available stations, incompleteness of the reports and lack of accuracy of station chronometers. Thus, different catalogues often provide different locations for the same event, with no information about how they were obtained. On the other hand, there are also conspicuous gaps in the instrumental records of some Portuguese stations. For many earthquakes of the studied period records rely solely on felt effects. In general, a good control on the accuracy or quality of epicenters lacks.

Here we present a review of the locations of instrumental earthquakes of the Azores-west Iberia region in the period 1900-1960. In total, we reviewed around 350 earthquakes. More than 160 additional events have been consigned in the resulting catalogue. Earthquakes were re-located using both a 1D velocity structure and a linear inversion procedure (Hypocenter) and using a 3D structure developed for the region and a non-linear inversion algorithm (NonLinLoc). The results are interpreted in light of the most recent knowledge of geological structures, precise earthquake locations obtained for the most recent decades, which identify belts of preferential clustering of earthquakes, focal mechanisms and gravity anomalies.