

Macroseismic evaluation of Santa Maria island (Azores) 1937 and 1939 earthquakes

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The Azores archipelago is located at the triple junction between the Eurasian, Nubian and North American lithospheric plates. The Mid-Atlantic Ridge defines the boundary between North American, and Eurasian and Nubian plates, while the Azores-Gibraltar Fault Zone delimits the boundary between the Eurasian and Nubian plates. In the Azores domain, this plate boundary is defined by the East Azores Volcano-Tectonic System (EAVTS) that joins to the east to the Gloria Fault. The EAVTS is a complex and diffuse deformation shear zone with a dextral transtensive regime where the islands of central and eastern groups are located. As a result of its tectonic setting, the Azores archipelago is exposed to frequent seismic and volcanic activity. Since the settlement of the archipelago in the fifteenth century, 28 volcanic eruptions and 31 destructive earthquakes have taken place, causing thousands of deaths and severe damage.

Santa Maria island, located in the eastern group, is the oldest of the archipelago and is placed slightly southwards of the EAVTS domain. Based on kinematic data, some authors argue that the island belongs to Nubian plate, once it shows a similar displacement behaviour. Regarding seismic activity, the island has shown in historical period lower seismicity when compared with other islands. Nevertheless, some seismogenic zones associated to the plate boundary in this region such as the Grande Norte Seamount, the Povoação Basin, the Formigas islets zone and the Gloria Fault, may generate earthquakes that can strike this island, sometimes causing damages.

Since the twentieth century, at least 30 earthquakes were felt, being the majority with intensities lower than V (Mercalli Scale 1956, MM-56). The highest intensities were reached by the two earthquakes that occurred clustered in time, in November 21st, 1937 and May 8th, 1939, being both felt with a maximum intensity of VII (MM-56), causing damages in some parishes, mainly in Santo Espírito and São Pedro. No deaths were reported. For the 1937 earthquake the epicentral location is uncertain. For the 1939 earthquake several epicentral locations eastward of Santa Maria and magnitudes between 6,5 and 7,1 (Ms) were calculated. Probably both earthquakes are linked to the Gloria Fault seismic activity.

A new macroseismic analysis of these major events using the European Macroseismic Scale 1998 (EMS-98) was made based in newspapers and governmental documents for the reconstruction of the affected areas. For both earthquakes, there are quite detailed descriptions for the damages. The dwellings were of masonry type with class A vulnerability displaying damages reaching grade 4 (very heavy damage) in São Pedro and in Santo Espírito parishes. These data are consistent with a maximum intensity of VII (EMS-98). The isoseismal maps drawn for these events suggest a higher intensity zone that extends in the middle part of the island with a NW-SE direction, not very consistent with the epicentral locations east of the island or even at Gloria Fault.