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Seismic activity along a Cretaceous magmatic intrusion in Monchique, SW Iberia

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Iberia and its offshore areas, in the southwestern tip of Europe, display a complex pattern of seismic activity, with most known active faults slipping at low rates (< 1 mm/yr), but nevertheless generating remarkable seismic activity, with numerous destructive earthquakes in the historical record. The most active seismic cluster in mainland Portugal is very localized (small spatial extent), extends vertically from 5 to 20 km depth and lays on the Monchique late Cretaceous magmatic intrusion. This magmatic intrusion, in addition to creating a strong rheological contrast between the intruded magmatic rocks and surrounding Paleozoic rocks, is further the locus of abundant natural water springs. Several pertinent questions remain to be answered concerning earthquakes in Monchique, namely: Are earthquakes in Monchique simply a response to tectonic stresses (given the proximity of Monchique to the EU-AF plate boundary), with the localization of brittle failure in the region facilitated by the rheological contrast between the Cretaceous intrusion and surrounding Paleozoic rocks? In addition to the above, do fluids play a role in facilitating slip in existing fractures? Or, conversely, is the circulation of fluids facilitated by the faulting that results from the rheological contrasts? And finally, but importantly, are there hazardous faults in Monchique? In this presentation, we re-analyze in detail the seismic data recorded by the regional permanent seismic network, in order to better understand the relationship between seismic activity and igneous intrusion. In particular, we re-locate earthquakes using NonLinLoc and PRISM3D, a 3D velocity model for the region, when possible re-locate earthquakes using HypoDD, perform a clustering analysis based on waveform similarity, compute focal mechanisms for the region and analyze the spatio-temporal evolution of seismicity. The results show that earthquakes align along two main directions, E-W and NNE-SSW, coinciding with surface features of the magmatic intrusion. Focal mechanisms indicate dominantly strike-slip faulting, with the possible fault planes coinciding with the favored directions of earthquake lineations.

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