



The Vidigueira and Alqueva faults (SE Portugal, W Iberia): an example of coupled reverse and normal active faulting in a compressive stress regime.

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The Vidigueira fault is a 65 km long, E-W trending left-lateral Variscan structure located in SE Portugal (W Iberia) that has been reactivated during the Cenozoic with oblique reverse right-lateral slip. It is intersected by, and interferes with the NE-SW trending Messejana-Avila fault. E of this intersection, for a length of 40 km it borders an intracratonic basin on its northern side, thrusting Palaeozoic slates, at the north, over Cenozoic continental sediments preserved in the tectonic basin, at the south. W of the faults intersection evidence of Cenozoic reactivation is scarce. In the eastern sector, Plio-Quaternary fault reactivation is evidenced by geomorphological, stratigraphical, and structural data, showing predominantly reverse movement with some right-lateral strike-slip component, in response to a NW-SE trending compressive stress. An average vertical displacement rate of 0.056 mm/yr to 0.095 mm/yr since late Pliocene (roughly the last 2 Ma) has been estimated. A segmentation model based upon morphotectonic and structural data indicates that this active fault has the capacity of generating M_W 6.5 earthquakes, or close to 7, if rupture of the entire 40 km is admitted, with an average recurrence period of 5 to 6 ka, assuming a characteristic earthquake model.

The Alqueva fault is a WNW-ESE trending, northward dipping, 7.5 km long anastomosed fault zone that affects Palaeozoic basement rocks, located 2.5 km north and on the hanging block of the Vidigueira active reverse fault. It also is a Variscan structure, which was reactivated with distinct behaviours in various phases during Cenozoic times, showing kinematic and geomorphic evidence of Plio-Quaternary normal movement, with an average vertical displacement rate of 0.025 mm/yr in the last 2 Ma.

It is proposed that the normal displacements on the Alqueva fault result from tangen-

tial longitudinal strain on the upthrown block of the Vidigueira fault due to climb on a convex ramp on this main reverse structure. According to this model, the former structure works as a bending-moment fault which soles at a “neutral surface” corresponding to the Vidigueira fault ramp located at an estimated depth of 7-10 km. This depth is inferred from ramp geometry assumptions, and agrees with the recognized surface length of the Alqueva fault and with regional geophysical data. It is expected that the displacements on this fault increase towards the topographic surface with the increase in the amplitude of the imposed extension, declining downwards until they vanish at the “neutral surface”.

Accordingly, the Alqueva fault may behave aseismically, although co-seismically with events generated at the nearby Vidigueira fault. Triggered seismogenic rupture on the Alqueva fault is not discarded, attending to the estimated depth where it soles, although the small fault length restricts the magnitude of the maximum earthquake that it is capable of generating. The Alqueva fault thus represents mainly a significant surface rupture hazard, the risk being higher because a large dam (the 96 m tall Alqueva dam) has been built in 2004 astride the fault zone. Besides the surface rupture threat to the dam, the normal fault may work as a leakage passage for the reservoir water to the underlying Vidigueira fault, thus inducing seismic slip on this major regional structure.