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Late Quaternary extension in eastern Mirabello bay, Ierapetra Fault Zone, Crete, Greece

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Extended Abstract

The island of Crete is located at the southern part of the Hellenic Arc, where active extension occurs at the overriding plate of the Africa – Eurasia retreating subduction. Onshore and offshore faults in Crete display significant morphological features formed by the Pleistocene to present extensional activity, while their strike is both arc-parallel and arc-normal (Angelier, 1979; Armijo et al., 1992).

The study area is located in the eastern Mirabello bay, Lasithi District, where Late Quaternary normal faults NNE-SSW to NE-SW trending are exposed around Mirabello bay. The most significant fault structure is the Ierapetra Fault Zone (IFZ), a NNE-SSW normal fault zone that extends from the northern to the southern coast of Crete (Fortuin, 1978; Fytrolakis & Dermitzakis 1996, Caputo et al., 2010). IFZ consists of multiple normal fault segments, parallel and overlapping. The main IFZ is divided (from north to south) into Kavousi segment, Ha Gorge and Vainia segments, while Lastros and Sfaka faults are encountered to the east, along IFZ footwall (Caputo et al., 2006, Gaki-Papanastassiou et al., 2009, Mason et al., 2016, Veliz et al., 2018). A second, less well defined, fault zone is developed along the coast of eastern Mirabello bay; Pachia Ammos coastal fault and Psira offshore fault to the north. These faults are parallel to the IFZ and follow the eastern coast and bathymetric relief.

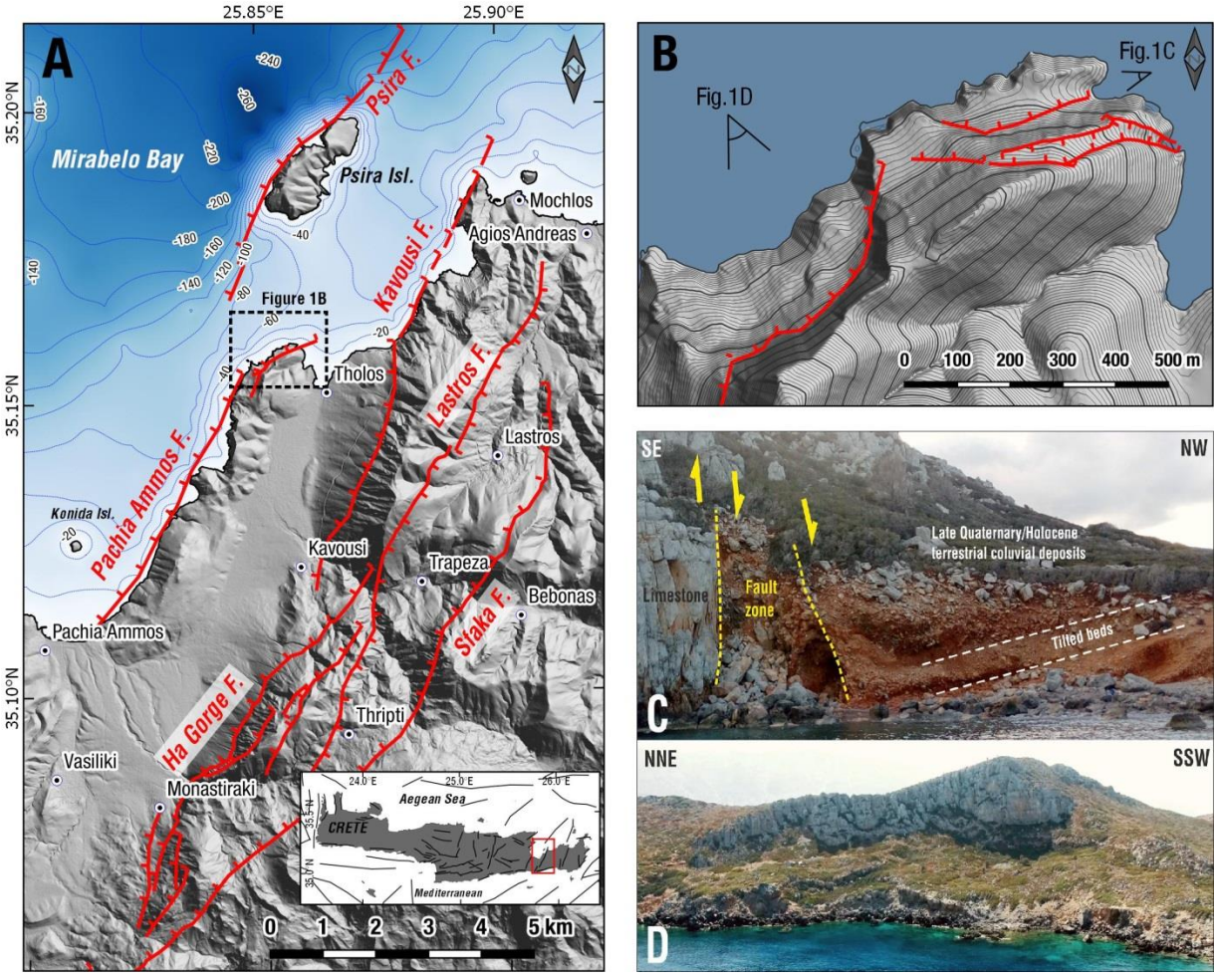

Figure 1. A) Late Quaternary faults in the area of study (eastern Mirabello bay, Ierapetra, Crete). B) Detailed fault traces mapped in the Tholos site. C) Profile of the main normal fault in Tholos site, with Late Quaternary colluvial sediments deformed and rotated on the hangingwall. D) View of the fault scarp in the southern Tholos site, with part of the footwall removed from a paleo-landslide.

In this study, we examine in detail a section of the Pachia Ammos fault zone. The site is located at the northernmost tip of the steep coast of east Mirabello bay, near Tholos site (Figure 1). Footwall lithology is comprised by carbonate Alpine rocks, mainly dolomites and dolomitic limestones of Triassic age (Papastamatiou et al. 1959). Different generations of Quaternary debris and colluvial terrestrial sediment scree can be found along the fault scarps and on the western slopes of the site. The morphology is dominated by the steep bedrock scarps formed by normal faulting or landslide erosion. Coastal erosion and a large paleo-landslide at the southern part of the site have removed part of the colluvial sediments and the fault scarp (Figure 1C-D).

Fault traces were mapped in a 1:2000 scale (Figure 1B) and reveal a composite fault structure with parallel fault scarps, and fault setbacks showing a variation in fault strike from west to east. The change in the fault strike from NNE-SSW to NE-SW occurs at the northern edge of the Pachia Ammos footwall and we examine two different scenarios to interpret this change of geometry:

- related to the development of a brecciated relay ramp between the Pachia Ammos fault and the Kavousi fault.
- different geometry and probable left-stepping overlap between Pachia Ammos and Psira faults.

Adjacent to the faults, deformed outcrops of the fault zones reveal deformed and tilted late Quaternary terrestrial deposits, a clear indication of recent fault activity. Although there is a lack of detailed offshore surveys in the area, we interpret the Pachia Ammos and Psira footwalls as part of a series of backtilted fault blocks towards the IFZ.

Although the coastal/offshore faults of Pachia Ammos and Psira preserve a lower morphological imprint due to coastal erosion and submergence of the hanging-wall than the IFZ, their structural features, geometry and segmentation contributes to the better understanding of the active extension in the eastern Mirabello bay. We conclude that paleoseismological and displacement features and observations is crucial for the further improvement our current understanding on the seismic hazard assessment of a rapidly developing area and a popular tourist destination.

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