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Plio-Quaternary coastal uplift along the western Iberian margin: insights from dated marine terraces (Peniche, central Portugal)

Margarida Gouveia¹, **Pedro Cunha**¹, António Martins², Christophe Falguères³, Pierre Voinchet³, Alberto Gomes⁴, Jean-Jacques Bahain³, Martin Stokes⁵, Telmo Pereira⁶, Silvério Figueiredo⁷, Qingfeng Shao⁸, Olivier Tombret³, and Pu Yang¹

¹Univ. Coimbra, MARE- Marine and Environmental Sciences Centre, Dep. Earth Sciences, Portugal (pcunha@dct.uc.pt, mariamporto@gmail.com, pu.yang991@gmail.com)

²ICT – Institute of Earth Sciences, Dep. Geosciences, Univ. Évora, Évora, Portugal (aam@uevora.pt)

³HNHP UMR 7194 - Histoire Naturelle de l'Homme Préhistorique, MNHN-CNRS-UPVD, Dép. Homme et Environnement, Muséum National d'Histoire Naturelle, Sorbonne Univ., France (christophe.falgueres@mnh.fr, pierre.voinchet@mnhn.fr, bahain@mnhn.fr)

⁴CEGOT, Dep. Geography, Univ. Porto, Portugal (albgomes@gmail.com)

⁵School of Geography, Earth and Environmental Sciences, Univ. Plymouth, UK (M.Stokes@plymouth.ac.uk)

⁶Polytechnic Institute of Tomar, Univ. Autónoma de Lisboa, Portugal (telmojrperreira@gmail.com)

⁷Polytechnic Institute of Tomar, Geosciences Center—U.C., Portuguese Center of Geo-History and Prehistory, Portugal (silverio.figueiredo@ipt.pt)

⁸Normal Nanjing University, Nanjing, Chine (qingfengshao@nju.edu.cn)

This study provides a detailed geomorphological study of the Peniche Peninsula, located in westernmost Iberia, a resistant rocky limestone headland subjected to high energy Atlantic Ocean coastal processes. We have used field mapping, surveying, sedimentary facies analysis, geochronology (electron spin resonance [ESR]; U-Series), but also identification of fossils and lithic artefacts, in order to: 1) reconstruct styles and timing of paleoenvironmental changes, 2) correlate to Marine Isotope Stages (MIS), and 3) quantify coastal uplift rates during the Quaternary. The marine terrace deposits, comprising calcite cemented conglomerates and siliciclastic sandstones, sometimes capped by travertines, were studied in detail along the SW sector of the peninsula, at the Furninha Cave site.

The mapping (1/10,000 scale) and dating results obtained allow to identify several marine levels and to correlate them to MIS's: 1) a culminant wave-cut platform at 29-33 m (above mean sea level) (Pm), with a probable age of 3.7 Ma; 2) a wave-cut platform at 24-28 m (Tm1), dated as 883±120 ka, probably correlated with high sea level conditions spanning ca.1000-790 ka (MIS25-19); 3) a wave-cut platform at 19-21 m (Tm2), with a beach conglomerate and sandstone, dated as 707±32 ka and correlated to 790-680 ka (MIS17); 4) a wave-cut platform at 14-16 m (Tm3), with a beach conglomerate and sandstone, and capping travertine, probably recording aggradation during 620-460 ka (MIS15-13) (ESR: 598±160, 563±63, 490±44 ka; U-series: >620 ka); 5) a wave-cut platform at 11-13 m (Tm4), with beach conglomerate and sandstone followed by travertine, dated as 315±48 ka, probably recording 430-275 ka (MIS11-9); 6) a wave-cut platform at 6-9 m (Tm5), with beach conglomerate, sandstone and travertine, dated as 288±53 ka, probably spanning 290-180 ka (MIS7); 7) a wave-cut platform at 4.0 m (Tm6), probably spanning 125-85 ka (MIS5); 8) aeolian sand units, respectively, of Late Pleistocene and Holocene age; 9) modern beach sediments, ranging from sands to boulders.

A long term Plio-Quaternary corrected uplift rate of 0.004-0.006 m/ka is obtained using the Pm level as a key geomorphic marker (eustatic level = +10-20 m). In contrast, for the last ~1 Ma the inset Pleistocene marine terrace levels (Tm1-Tm6) indicate apparent short-term uplift rates between 0.02 and 0.05 m/ka (means of 0.03 to 0.04 m/ka) and corrected short-term uplift rates between -0.05 and 0.05 m/ka (means of -0.02 to 0.05 m/ka).

This study demonstrates that the Quaternary compressive reactivation of the Western Iberian Margin has determined coastal low to moderate uplift rates; active tectonics play an important role in the geomorphic expression and distribution of Pleistocene marine terraces, recording vertical ground motions (uplift/subsidence) superimposed onto global sea-level oscillations.