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Interplay between active and past tectonics in the Hellenic Arc (Greece): Geological and geomorphic evidences from Kythira Island

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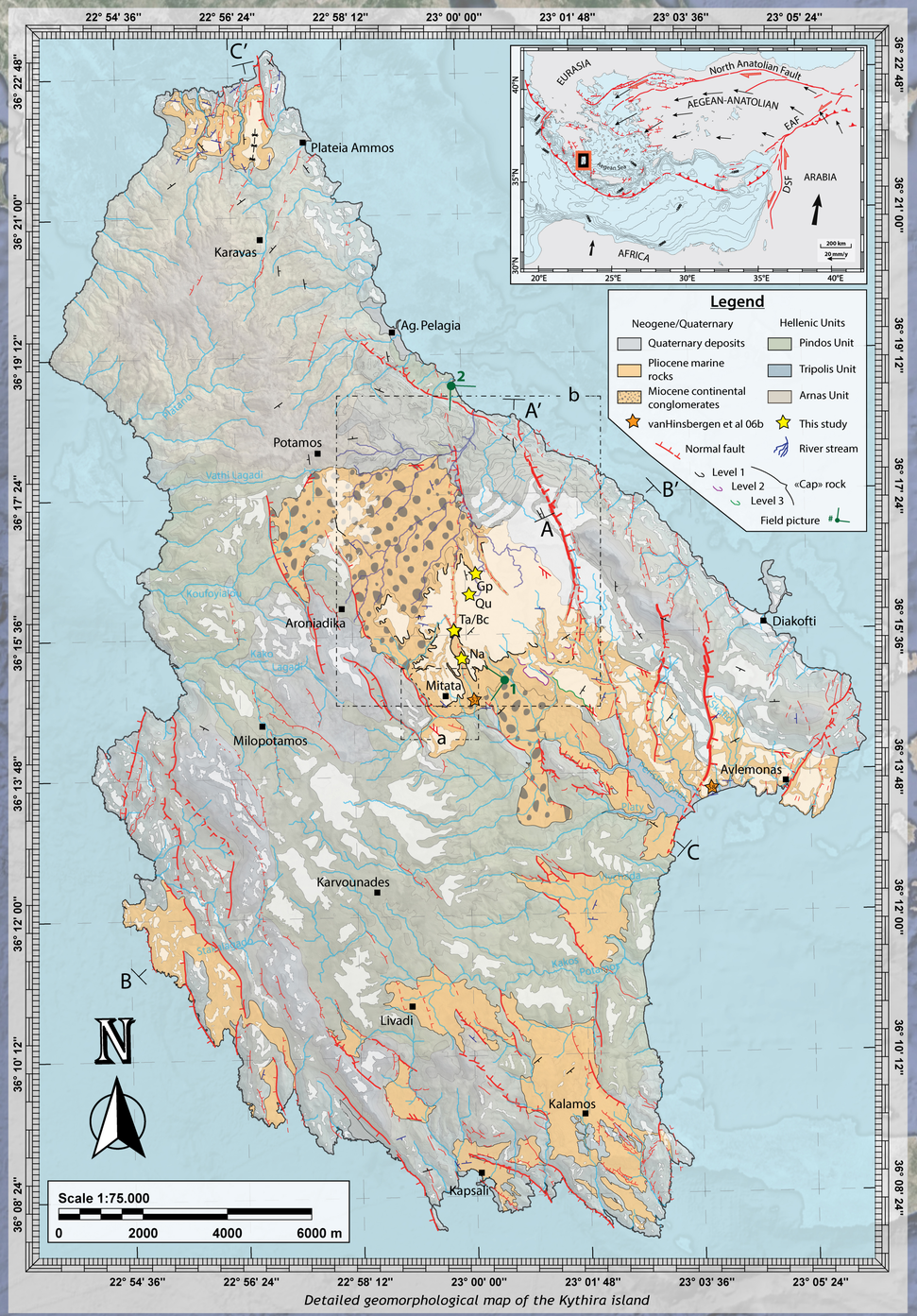
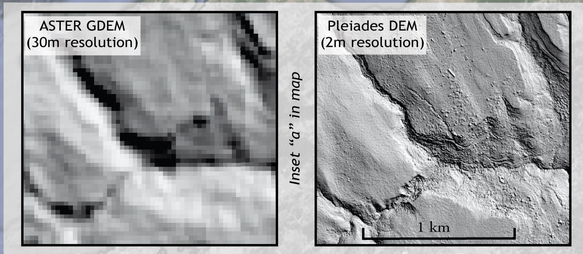


Detailed geomorphological map of the Kythira island

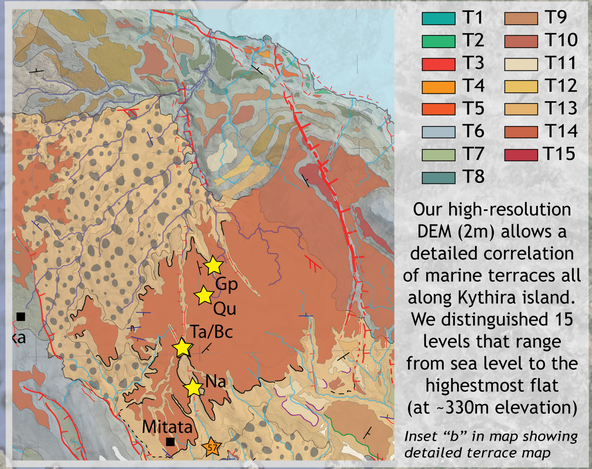


Comparison between the community-standard Aster GDEM (30m) and the DEM (2m) we produce with images of the Pleiades satellite

Introduction

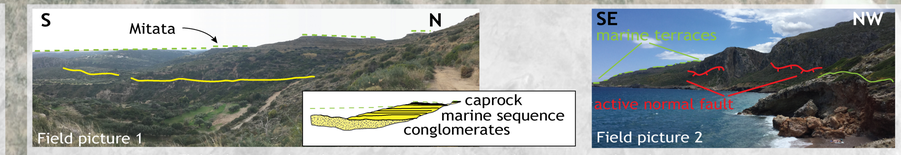
The Hellenic Arc undergoes the largest convergence velocity and highest seismic activity among Mediterranean subduction systems, so its outer-arc high islands are key to understand crustal deformation in subduction zones. The recent uplift of Kythira Island is marked in its landscape as paleosurfaces, marine terraces, and steep gorges, which taken together with its sedimentary record, allows attempts to reconstruct its tectonic evolution since the latest Miocene, and therefore a better understanding of the interaction between past and active tectonics in the Hellenic Arc.

Here, we present an exceptionally detailed geological and geomorphological map of the Kythira Island based on fieldwork, Pleiades satellite imagery and 2-m resolution DEM as well as the analysis of microfossils, marine terraces and river network morphometrics.



Our high-resolution DEM (2m) allows a detailed correlation of marine terraces all along Kythira island. We distinguished 15 levels that range from sea level to the highestmost flat (at ~330m elevation)

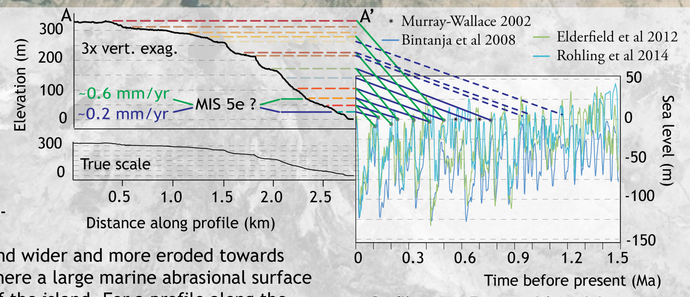
Inset "b" in map showing detailed terrace map



Field photographs taken near Mitata and along the east coast (locations in map)

Marine Terraces

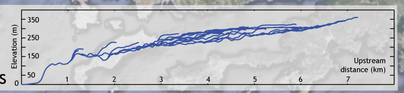
Pleistocene uplift of Kythira is marked by flights of marine terraces around the island. These are typically more distinct close to the coast, and wider and more eroded towards higher elevations, where a large marine abrasional surface covers a large part of the island. For a profile along the E-coast containing most of the 15 mapped terrace levels (see figure), we suggest a minimum and maximum uplift rate based on possible locations of the last major interglacial highstand (MIS 5e, ~125 ka)



Profile across E-coast with a minimum and maximum estimated ulift rate

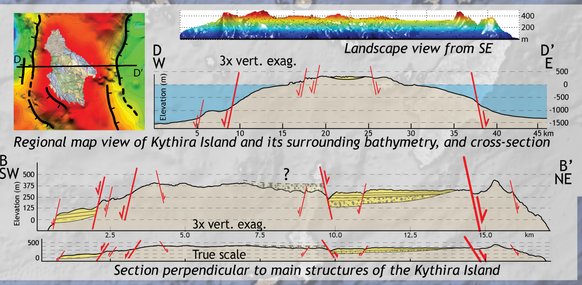
Rivers

Uplift is marked as non-steady state rivers



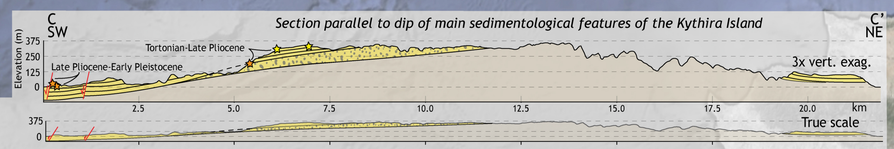
Active Faults

The infill sequence onlaps basement, except in the western margin where normal faults partly controlled deposition of the lower sectors of the infill sequence. These faults reactivated older Hellenic structures, parallel to the subduction trench, and were not active during the maximum marine transgression that led to the deposition of the subhorizontal part of the sequence. Younger, roughly N-S normal faults transecting Helleic-trending structures and the infill are responsible for subsequent surface uplift, and to a large extent, for the present day shape of the island and its seismicity.



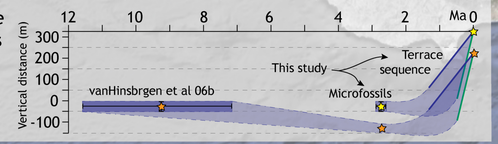
Regional map view of Kythira Island and its surrounding bathymetry, and cross-section

Section perpendicular to main structures of the Kythira Island



Post-Messinian vertical motions

Pliocene or younger infill sequences rest atop of Palaeocene or older rocks in several marine basins in the island. In the largest basin, we found a stratigraphic sequence with a (tilted) continental conglomerate at the base, passing upwards to a disconformal subhorizontal conglomerate, calcarenites and fine sands, and terminating with a marine conglomerate. This marine "cap rock" marks the topography and shapes the highermost, and most extensive, low-relief surface. Datation in microfossils found few meters below this surface suggest depostion at 10-50m depths during 2.87-2.59 Ma. Coupling this information with that in marine terraces, we reconstruct the vertical motions in the island (right plot)



Acknowledgements

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Conclusions

Our geomorphological map and geomorphometric analysis of the Kythira Island reports a history of Late Miocene protracted subsidence followed by latest Pliocene uplift (0,2-0,6 mm/yr), with an in-between relatively quiescent period of maximum marine transgression (which we relate with the Pliocene maximum warmth)