Coastal and submarine instabilities distribution in the tectonically active SW margin of the Corinth Rift (Psathopyrgos, Achaia, Greece)

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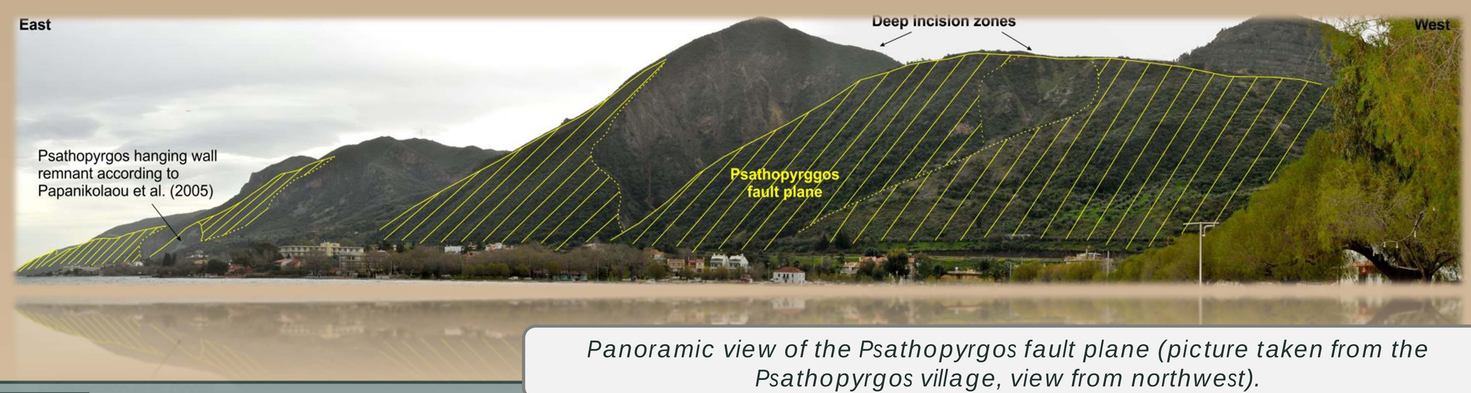
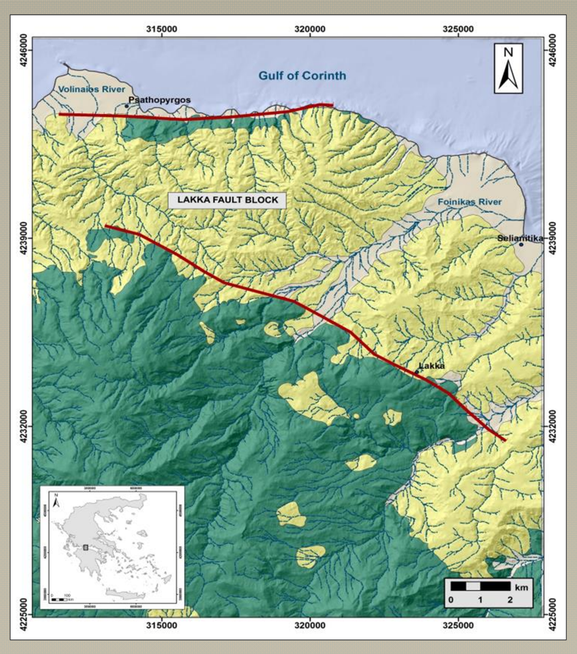
The **Gulf of Corinth**, the northern and most active part of the present-day Corinth Rift, constitutes a natural Laboratory for morphotectonic studies as it has been long identified as a site of major importance due to the continuous tectonic deformation.
The extremely high rates of concentrated seismicity, the enduring neotectonic activity deforming the coastal region of the NW Peloponnese, the exposal of the well preserved sedimentary sequences and the evidence of the intense geomorphological processes indicate the consequences of active deformation in the Gulf of Corinth. This active deformation, resulting from the high extensional rates (reaching approx. 14±2mm/yr) renders the western part of the Gulf as the most active of the Corinth Rift, arising special interest for understanding the physical model related to fault activity and surface processes.

The **Psathopyrgos fault**, considered as the presently active structure bordering the westernmost part of the Gulf of Corinth to the south (Doutsos et al., 1988; Doutsos & Poulimenos, 1992; Palyvos et al. 2007), is characterized by a steep coastal escarpment related to the high topographic relief and the outcrops of the alpine re-rift basement, indicating the high rates of the tectonic activity, which is demonstrated by rapid uplift (in the order of ~0.7-0.8 mm/year) of the footwall (Houghton et al., 2003).



Panoramic view of the Psathopyrgos fault plane (picture taken from the Psathopyrgos village, view from northwest).

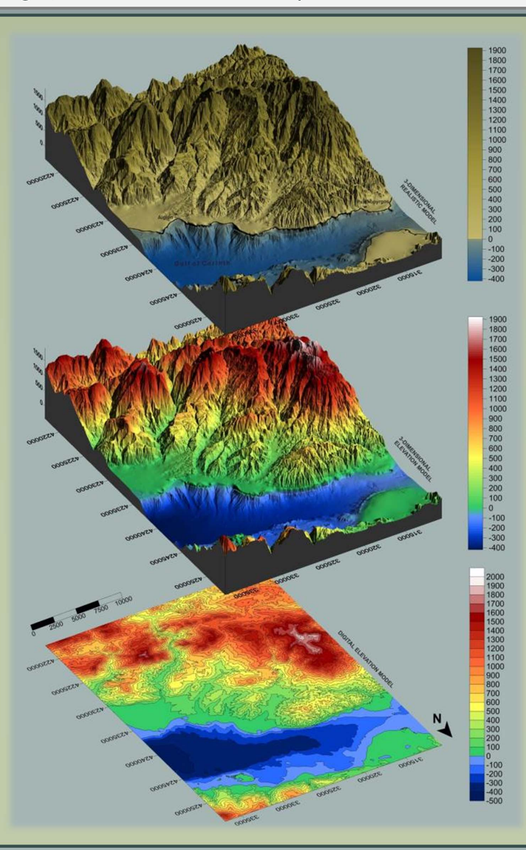


The NW Peloponnese is mainly characterized by extensive occurrence of post-alpine deposits of Plio-Quaternary (Ori, 1989) and alpine formations of Pindos nappe. The first formations correspond to Gilbert-type fan delta deposits (older or currently evolving) and indicate the high uplift rates of the south flanks of the Gulf of Corinth while alpine formations compose the pre-rift basement.

*Simplified Geological Map of the study area, presenting the development of the Holocene river deposits (beige colour), the Plio-Pleistocene formations (yellow colour) and the alpine basement of Pindos Geotectonic Unit (green colour).
The red lines represent the Psathopyrgos and Lakka fault traces, bounding the onshore study area (Lakka fault block).*

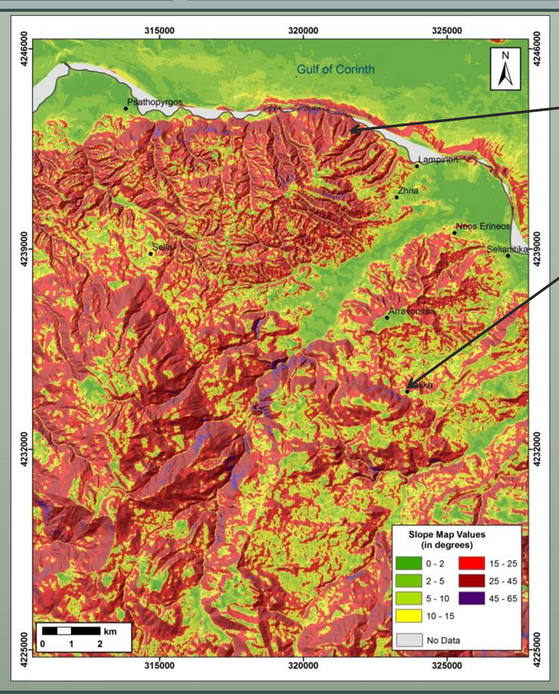
The construction of a Digital Elevation Model (DEM) has been the basis of the current analysis as it provides a representation of the terrain's surface from which various qualitative and quantitative values may be extracted. These values may allow the evaluation of specific morphostructural elements and characterise various processes that affect the landscape.

High-resolution multibeam bathymetry combined with the available land surface data have been primarily used for the construction of a combined DEM, which is subject to further detection of all those geomorphic features and anomalies that indicate the on-going active tectonic deformation and the effects of the erosional processes.

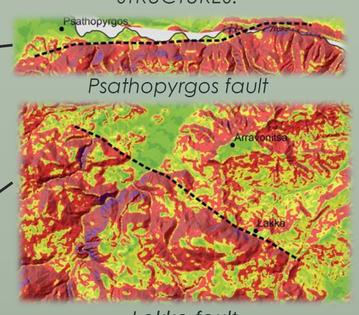


Digital Elevation Model (DEM), 3D Elevation Model and 3D Realistic Model of the combined marine & land surface data, presenting the morphology of the study area.

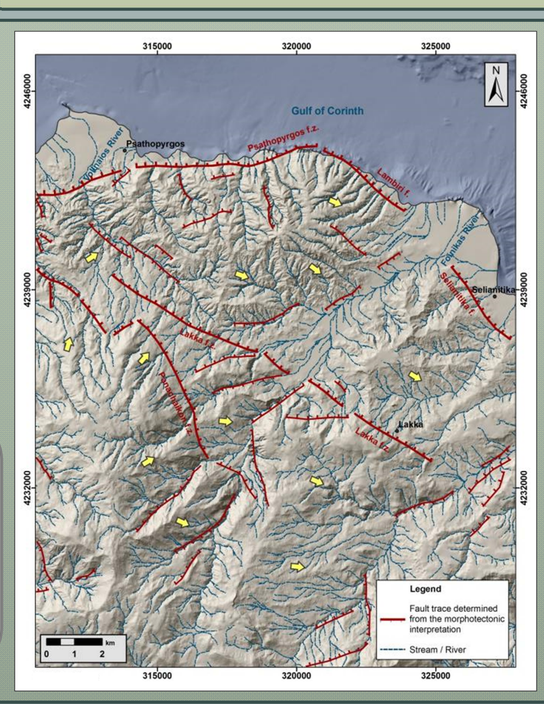
The morphological analysis was processed from the perspective of slope value distribution and the results are presented on the Slope Distribution map, which was composed from the combined onshore and offshore datasets. The resulting slope values (ranging between 0° - 65°) have been classified into seven classes aiming to indicate all those areas, both in the marine and the terrestrial environment, which are characterized by abrupt change of slope values, reflecting the position of active tectonic structures.
The combined datasets interpretation shows that the south-western margin of the Gulf of Corinth is characterized by intense coastal relief which passes abruptly to steep submarine slopes. These steep slope values reflect the effects of the most recent brittle deformation, which has occurred towards the currently active Psathopyrgos fault zone.



DISTINCT MORPHOTECTONIC STRUCTURES:

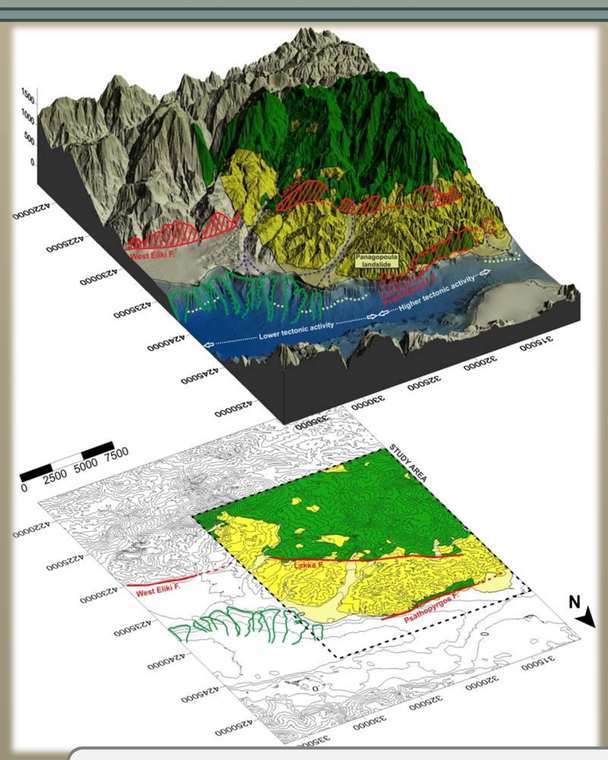


Morphotectonic Sketch Map (right figure) presenting the major and minor tectonic structures in the wider study area defined by their morphological signatures on the slope values (left figure), the geological setting and the drainage pattern. The yellow arrows correspond to probable local tilting of fault blocks entirely obtained by drainage asymmetries.



CONCLUSIONS

The erosional processes are expressed not only by slow rates of grain-by-grain weathering and transportation through the fluvial systems but by instant mass failures as well. Local lithology combined with the steep slope values, the intense seismic activity and the high rates of sedimentation in the coastal region contribute to a high-energy geodynamic environment, enchasing the possibility of instabilities triggering at the coastal zone. The steep slope values towards the Psathopyrgos fault zone denote the effects of the most recent brittle deformation which are related to limited but sizeable coastal instabilities (e.g. Panagopoula landslide). Conversely, the easternmost less active West Heliki fault is related to less steep slopes at the margins of the basin. Canyons and gullies are extensive and sediment mass failures are identified near the headwalls as retrogressive landslide scars. The mass movements evolving near the coastal and shallow marine areas may lead to natural hazards including coastal retreat or slump-induced tsunamis depending on the volumes of the mobilized materials. As human needs and activities are growing, a special interest has been arisen concerning risk assessment and management. The results of the current study are proposed following the 3D model of the SW Gulf of Corinth and could be further evaluated, not only from a geological, but from a geohazard perspective as well.



3D model of the wider study area illustrating the major fault planes (red stripping) and the distribution of instabilities (green lines with ticks) in response to active faulting. The geological setting is applied to the narrow study area, corresponding to the Holocene and Plio-Pleistocene sediments (beige and yellow colours respectively) and the Pindos alpine basement (green colour).

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