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Lechaion Gulf: the last descendant of the Proto-Gulf-of-Corinth basin

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Introduction

The Lechaion Gulf is a relatively shallow small gulf developed behind (south of) the southern marginal fault of the central Gulf of Corinth basin. North of the Lechaion Gulf, the Perachora peninsula constitutes an uplifted horst composed mainly of alpine lithologies. The fault bounded Perachora horst separates Lechaion Gulf to the south from the Alkyonides basin to the north (Fig. 1). The latter is an asymmetrically developed basin developed in Pleistocene in the hanging wall of the north-dipping fault-zone (Sakellariou et al, 1998).

Loutraki fault borders Perachora horst to the south, towards the Plio-Pleistocene deposits of Corinth Isthmus. South of Lechaion Gulf, widely exposed, thick Pliocene to Pleistocene marls, sandstones and conglomerates of the Proto-Gulf-of-Corinth basin (Ori, 1989) are being uplifted, forming a hilly landscape. The Plio-Pleistocene deposits cover the entire region between the Gulf of Corinth and the Gulf of Lechaion to the north and the mountainous area of Sofiko, Nemea, Killini Mt. and Chelmos Mt. to the south. Well developed marine terraces distributed parallel to the present-day coastline indicate continuous uplift of the region during the last 350 ka (Keraudren & Sorel, 1987; Armijo et al, 1996).

Single channel seismic profiling and gravity coring was performed in the Gulf of Lechaion. Targeted fieldwork, mainly structural mapping and microtectonic investigation has been carried out on focused areas and faults within the emerged Corinth-Nemea basin and at its borders to the alpine basement.

Structure of Lechaion Gulf

The gulf deepens rapidly from the area of the uplifted Corinth Isthmus towards west and reaches its maximum depth, approximately 350 m., off Iraion cape, at the footwall of the southern bounding fault of the central Gulf of Corinth basin. The prolongation of Iraion cape below the sea level towards west forms a tectonic horst, which separates the deepest part of Lechaion Gulf to the south from the 900m. deep basin of the Gulf of Corinth.

Both, north and south, slopes of the submarine Iraion horst are faulted. The south-dipping fault runs along the foot of the southern slope and can be observed all along the southern coast of Perachora peninsula up to the coastal city of Loutraki, where it meets the trace of the south-dipping Loutraki fault. Thus, Loutraki fault is the main tectonic feature, which controls the evolution of the Lechaion Gulf basin.

The basin itself displays asymmetric character (Fig. 2), with the maximum subsidence being concentrated close to the south-dipping Loutraki fault. Successive packages of strong parallel reflectors alternate with relatively transparent, reflection free packages. This configuration is very similar to the seismic structure of the Central Gulf of Corinth basin (Lykousis et al, in

press) and indicates deposition of mud to sand turbidites during the successive low- and high-sea-level stages occurred in Pleistocene.

A total sediment thickness of at least 400m. was measured below the depocenter of the basin. Nevertheless, since the penetration of the system used was limited and no basement has been recorded below the sedimentary infill of the basin, we believe that the true thickness may well exceeds the observed 400 m.. Preliminary results of multi-channel seismic survey, performed recently in the Gulf of Corinth, indicate total post-alpine sediment thickness of about 2km below the Lechaion Gulf (Weiss et al. 2003).

Opposite to the northern steep faulted slope of the gulf, the southern slope, off the Corinth region coastline is gentle. Secondary, slope-parallel minor faulting occurs in the western part of the southern slope, adjacently to the deepest part of the gulf. This minor faulting accommodates flexure of the southern margin close to the fast subsiding Lechaion gulf depocenter.

Structural observations in Corinth-Nemea basin

The Plio-Pleistocene deposits of the Corinth-Nemea basin are to be found at altitudes up to 1800-2000m. Pliocene-Pleistocene marls as well as sandstones and conglomerates form the bulk sedimentary infill of the uplifted basin. Ori (1989) distinguished two sedimentary cycles within the Proto-Gulf-of-Corinth basin. The older one represents deposition in a lacustrine environment, which is being interrupted by the formation of alluvial plains. Papanikolaou et al (1989) were able to distinguish and map the most prominent lithological subsequences within the basin.

The character of the southern margin of the basin, towards the alpine basement of Northern Peloponese is rather unclear. Fault outcrops are rare, while usually Pliocene conglomerates or sandstones cover unconformably the alpine basement.

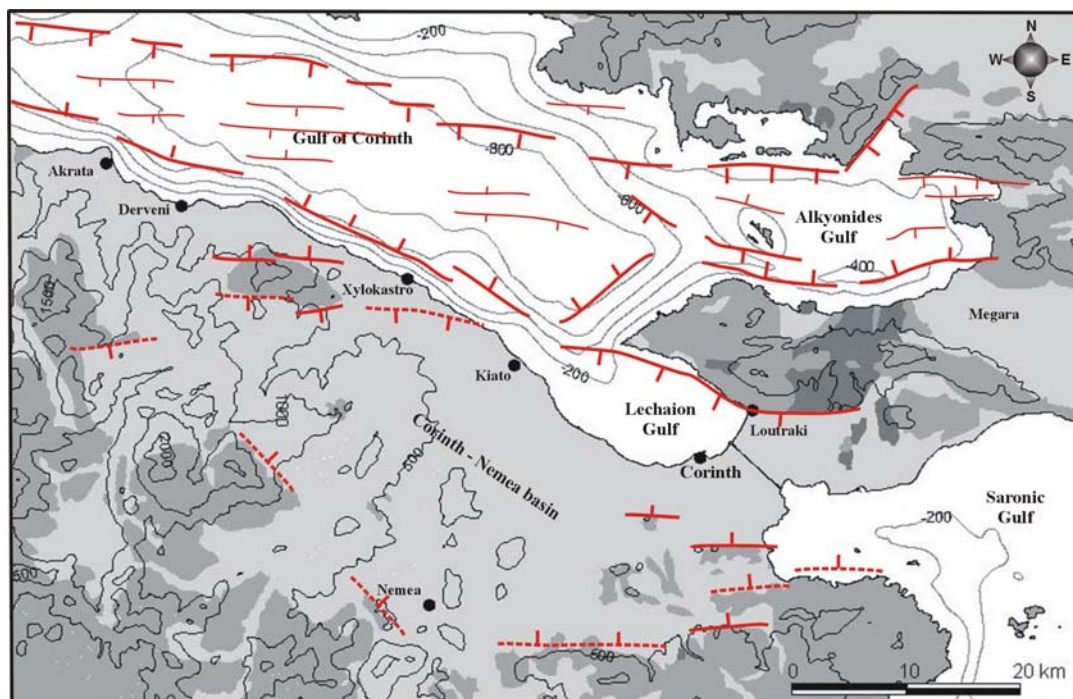


Fig. 1: Structural map of Eastern Gulf of Corinth and Corinth-Nemea basin with the major faults drawn in red. Light gray color shows Plio-Pleistocene deposits. Dark gray color indicate alpine sedimentary and ophiolite rocks. Dashed red lines indicate possible or possibly buried faults. Offshore faults after Sakellariou et al (2001).

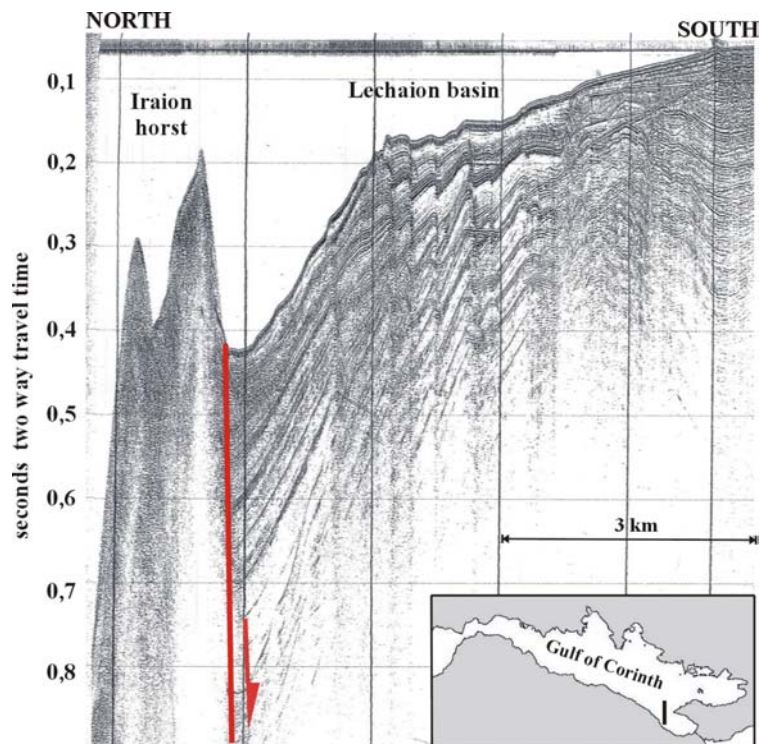


Fig. 2: Single channel Air Gun 10in³ profile across Lechaion Gulf and Iraion horst. Note the northward asymmetry of the Lechaion basin towards the S-dipping Loutraki fault.

Numerous E-W to NW-SE trending faults crosscut the Pliocene deposits forming secondary horsts and grabens within the basin. Papanikolaou et al (1989) proposed a major, NE-SW trending fault, which separates the Western Corinth basin from the Eastern Corinth one.

Strike slip movements may have taken place along this fault. Strike slip faults may have played a role during the evolution of the basin. South of Ano Trikala, close to the Ag. Vlassis Monastery, an almost vertical, N-S trending fault runs parallel to the eastern slope of Sithas valley (Fig. 3). The fault separates alpine limestones from Pliocene marls and sandstones. Horizontal striations on the fault surface clearly indicate strike slip movement. Next to this, oblique movements have been observed on several N-S to NE-SW trending faults.

Towards north, the Corinth-Nemea basin Plio-Quaternary deposits continue below the Lechaion Gulf seafloor and terminate at the Loutraki fault. Further to the west, the alpine rocks, which occur on the footwall of the N-dipping Xylokaastro fault are located on the westward prolongation of the Iraion cape. In-between them Pliocene marls cover the hilly region.

Conclusions - Discussion

The Plio-Pleistocene deposits, which form the sedimentary infill of the uplifted Corinth-Nemea basin, continue northwards below the seafloor of the Lechaion Gulf. The latter is an asymmetric basin, the evolution of which is being controlled by the S-dipping Loutraki fault. Consequently, The tectonic horst of Perachora peninsula is an uplifted structural high, which separates two opposite asymmetric basins: the Lechaion one to the south from the Alkyonides one to the north.

Strike slip or oblique faulting is common within the Corinth-Nemea basin. Nevertheless, it is quite probable that tectonic activity along the strike slip or oblique faults has ceased prior to or possibly during the initiation of the present-day Gulf of Corinth basin. The results of repeated seismic surveys within the Gulf of Corinth basin do not indicate any strike slip movements perpendicular to its long axis.



Fig. 3: Picture of the nearly vertical fault south of Ano Trikala village. See text for details.

We assume that basin evolution and subsidence in the Corinth-Nemea basin may have slowed down or terminated, when tectonic activity migrated towards north and concentrated along new, N-dipping faults, north of the Xylokastro – Iraion line. The onset of this new fault generation contributed to the uplift of the older basin and the formation of the Pleistocene terraces. Basin evolution in the Corinth-Nemea basin is still active below the Lechaion Gulf, where tectonic subsidence continues at the hangingwall of Loutraki fault.

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