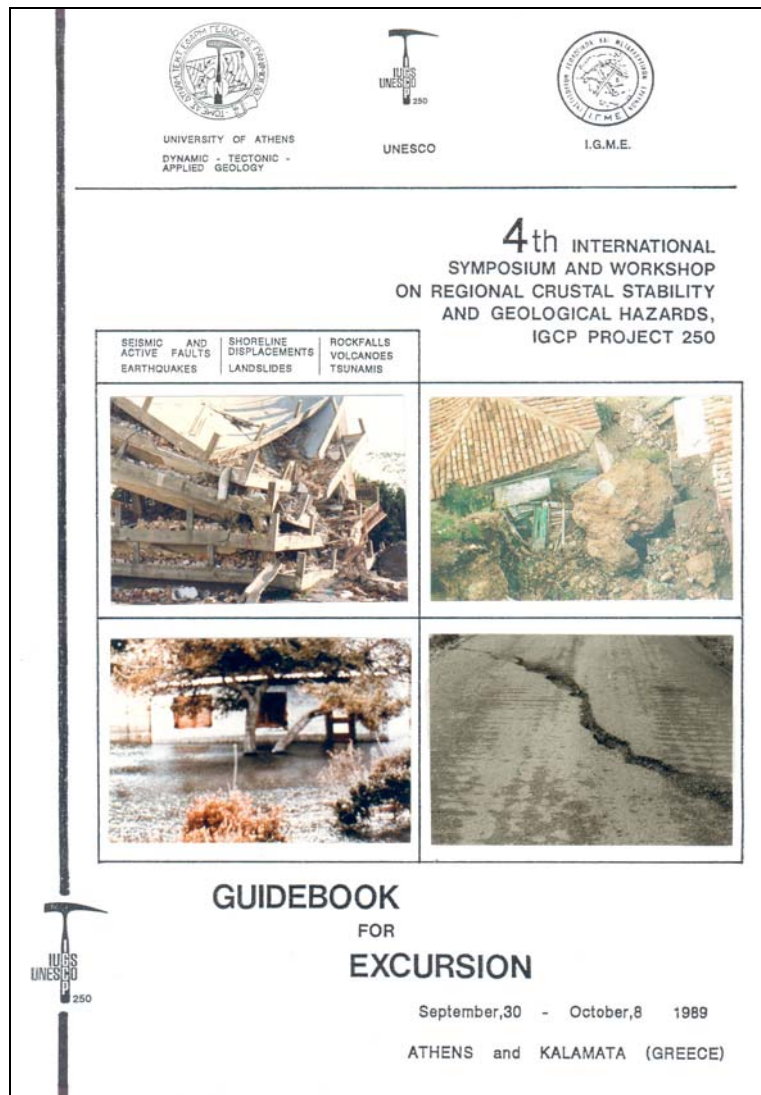


ΔΗΜΟΣΙΕΥΣΗ Νο 10α



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DESCRIPTION OF THE ITINERARY

by

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INTRODUCTION

The seven days symposium and workshop includes five days excursion and field work and two days for sessions. The five days excursion will cross the geological formations and the neotectonic structures of Peloponnesus from East to West and from North to South.

The localities to be visited belong to NW Attica - NE Peloponnesus (stops 3.1-4.3), NW Peloponnesus (stops 4.4-4.5), SW Peloponnesus (stops 5.1-7.6) and to central Peloponnesus (stops 7.7-7.8).

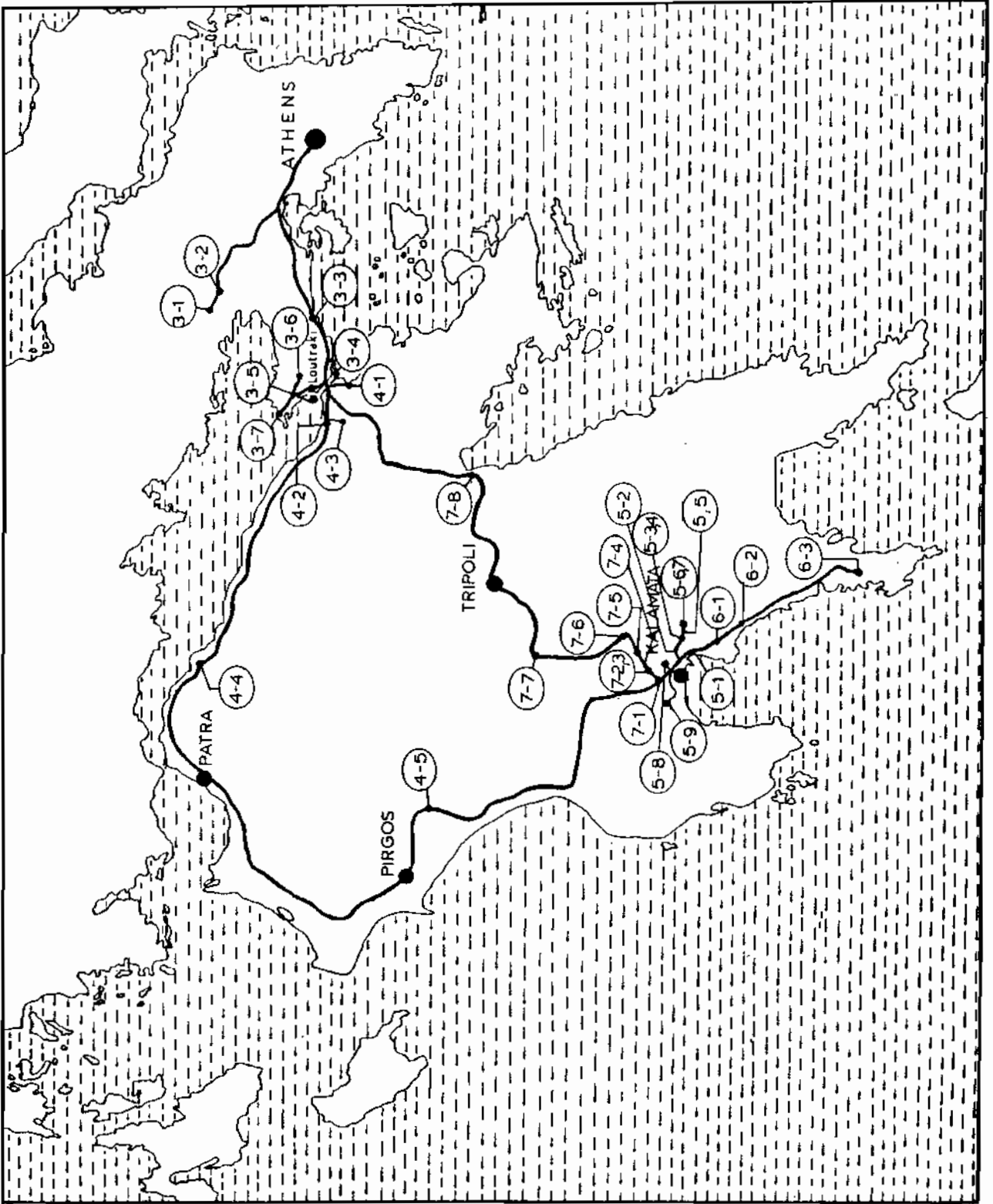
In NW Attica - NE Peloponnesus the main topics are the neotectonic macrostructures and the active and seismic faults of this area. In NE Peloponnesus the main topics are the kinematic interpretation of the Korinthian gulf, the active faults and the sea level changes during the neotectonic period. In SW Peloponnesus the main topics are the neotectonic macrostructures of SW Peloponnesus, the kinematic and dynamic interpretation of the seismic structures during the September 86 Kalamata earthquakes and the caused distructions and rockfalls, and the active faults and sea level changes at the Mani area. Finally, in central Peloponnesus, the neotectonic evolution of Megalopolis basin and the lignites are the main topics.

3rd day. THE AREA AFFECTED BY THE EARTHQUAKES OF FEBR. 1981

Stop 3.1

Caparelli: A case of two neotectonic intersected faults partly reactivated by the earthquakes of February-March 1981. The maximum observed net slip is about 1.20 m but in average is 0.60-0.70 m. The movement is composite. The dip slip component dominates but a strike slip component with a dextral sense of

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movement is also present. The ratio between the horizontal and the normal slip is 30/70. - Small grabens and horsts created by the earthquakes - Compressional and extensional domains at the side and along the fault surface.

Stop 3.2

Platees. The village destroyed by the earthquakes of 1981.

Stop 3.3

Kakia Skala: The active fault zone of Kakia Skala forms the NW margin of the Saronic Gulf. It has an E-W average trend and dips to the S. Large fault surfaces of a fault system of normal character, tectonic breccias with some rounded fragments. The observed slickensides are indicative for a dip slip movement.

Several generations of talus (partly seismic talus?) are indicative of the high activity of this fault zone.

Stop 3.4

Isthmus of Corinthos - Canal: Unconformity between Pleistocene and neogene deposits, Pleistocene and recent faulting. A neotectonic graben transformed partly to an apparent horst. A case of a neotectonic antitilted multiblock macrostructure caused by a stress field of torsional character. Crossing of the canal.

Stop 3.5

Pissia: One of the main marginal neotectonic faults of the eastern Corinthian Gulf reactivated by the earthquakes of 1981. The fault has an average E-W trend and dips towards North. The slickensides on the fault surface are indicative of a dip slip movement.

Stop 3.6

Cape Heraeon: Several shore lines on different levels.

4th day. NORTHERN PELOPONNESUS AREA

Stop 4.1

Kenchrees: Shorelines displacement (subsidence) in historical times. The shorelines has been subsided by 2.2 meters since 200 BC.

The study of the area showed that during the period from 200 BC until 400 AC the shorelines have been subsided by 1.4 meters, whereas during the period from 400 AC up to the present there has been a subsidence of 0.80 m.

Stop 4.2

Lechaeon: An ancient harbor entrance older than 2000 years (Roman) has been uplifted by 1,2 m above the present sea level, as it is proved by the presence of Lithodomus shells in the building material of the harbor.

Stop 4.3

A few km north of the Korinthos new city, the ancient town is situated. It is built along the active fault zone (striking E-W) of the northern margin of Akrokorinthos horst. The building material of the ancient constructions consists mainly of calcareous oolithic sandstones from the surrounding area (Upper Pleistocene sediments), called "Poros" by the Ancient Greeks. The ancient town of Korinth was totally destroyed by the 77 A.D. earthquakes. The ruins now visible are those of the Agora (Forum) of the Greek city, as it was in Roman times, which developed mainly during the 1st century AD. A stately avenue led up to the Forum from Lechaion, the city's port on the Gulf of Corinth. The spacious enclosure contained arcades, shops, places of workshop, small temples, administrative buildings as well as the city's three ancient fountains, Iera Krini, the Kato Pirini springs and Glafki. On the mound, to the North of the forum, seven of the thirty-eight columns of the archaic temple of Apollo have remained standing (it was built about the middle of the 6th century B.C.). To the NW of the forum the remains of the theatre and the Roman Odeon.

The Acrocorinth is an ancient fortified citadel at the foot of which, on the northern side, the city of Corinth was built. The fortress now standing was built in Byzantine times, over the ruins of an ancient structure. Various additions were made by Frankish, Venetian and Turkish conquerors. On the summit there are ruins of Byzantine, Venetian and Turkish buildings as well as the ancient Ano Pirini spring.

Stop 4.4

Aeghion Area - Elikí: Active and seismic faults. The ancient city of Elikí vanished by an earthquake of the 5th century BC.

Stop 4.5

The archaeological site of Olympia is situated on an active neotectonic graben at the northwestern Peloponnesus. At the foot of the Kronion Hill stretches the space formed by the wedge of land between the converging rivers of the Alfios and the Kladeos. This was the site called the Sacred Grove of the Altis, regarded as belonging to Zeus in which, in historically recorded times, the most famous of Greek sanctuaries was established.

Formerly it had been a place of worship of pre-Hellenic deities. Every four years, athletic contests were organized here in honour of Zeus, lasting seven days. According to legend, the Olympic Games began after a victory by Pelops against Oenomaos, King of Pissa. Historically, the Olympic Games began in 776 B.C. Up to the 5th century B.C., the sacred enclosure contained the Heraion (Temple of Hera), the Prytaneion, the Pelopeion and the Hippodameion while, at the foot of the Kronion hill the twelve Greek city treasures stood. Outside the enclosure to the West was the Stadium with a 45.000 seating capacity (men only were allowed in). Access to the stadium was along a Vaulted passage and, to

the South, was the Bouletririon where the Olympic Senate met. From the 5th century onwards, the sanctuary assumed its final form with the impressive Temple of Zeus (peripteral in the Doric style), the Metroon, the Arcades (Stoa of Echo and the southern Stoa), the Gymnasium and the Palaestra the living quarters of the priests, the large Leonidaion Hostel and the Filippeion. To the south of the dwellings of the priests, excavations revealed the studio of the sculptor Phidias in which he carved the gold and ivory statue of Zeus, one of the seven Wonders of the world. Finally, in Roman times, the villa of the Roman emperor Nero was added, also the "Exedra" of Herod Atticus and Roman baths. The Olympic Games ceased in 393 A.D. after the edict issued by Theodosius the Great, which forbade all the pagan festivals. They were revived for the first time after 15 centuries, in 1896 in the marble stadium in Athens. Today, an international Olympic Academy functions at Olympia.

5th day. MAJOR AREA OF KALAMATA

Under the opportunity of two days staying at Kalamata city, some observations concerning the September 1986 earthquakes and the caused damages, can be done.

The city of Kalamata is located at Southwestern Peloponnesus, at the northern margin of Messinian gulf. It is traversed by the Nedon river (Striking NNE-SSW) and it is built at the Southeastern margin of Kalamata-Kyparissia big graben, mainly consisting of Pliocene (marls, conglomerates and sandstones), Pleistocene (sandstones and non cemented conglomerates) and Holocene formations (alluvial, scree, ferraces and loose material).

The extent of the city is about 3 km and the population is about 42.000 people. The constructions are represented by old buildings (1-3 floors from masonry), as well as by new ones (reinforced concrete buildings with 4-7 floors). The damages caused by the September 1986 earthquakes are the following:

- i) 20 people have been killed and 180 people have been wounded.
- ii) 33% from the city constructions was totally destroyed and in 76% of them more or less destructions have been caused.
- iii) Destructions in the water supply and sewage system and fires in the electric light wires, also have been caused after the shock.
- iv) Tsunamis or other damages along the coasts have not been observed, except the western part of Kalamata harbor, where a horizontal movement of the top of the quay-wall occurred.
- v) Changes to the quality of the drinkable water have not

been caused by the earthquake shock.

From the detailed geotechnical studies that had been taken place under the supervision of (Research center of public works ministry), the narrow area of Kalamata city can be separated in 3 (three) distinct zones, according to fundamental periods of elastic soil profile, which are the following: (BOUKOUVALAS and SABATAKAKIS 1987)

By all mentioned above, the following observations, concerning the damages and destructions of Kalamata city, can be done.

- i) The main feature is that the damages caused by the September 86 earthquakes was not evenly distributed over the city or over the epicenter (MARIOLAKOS et al 1987, 1989, GAZETAS 1987, BOUKOUVALAS and SABATAKAKIS 1987).
- ii) Along the coastal zone of Kalamata city the damages and the destructions were very small, although the geomechanical conditions were very bad (loose and unconsolidated material, water table level 1,5m) (MARIOLAKOS et al 1987,1989, BOUKOUVALAS and SABATAKAKIS 1987).
- iii) There is not a very close relation between the ground and soil mechanical properties and the damages which are very well combined and correlated (like the rockfalls) with the presence of seismic fractures or reactivated microfaults (MARIOLAKOS et al 1987,1989).
- iv) Independently from the ground foundation and the number of floors the most damages was observed in the buildings from masonry. In contrast to this only a relative small number of reinforced concrete buildings was damaged. (BOUKOUVALAS and SABATAKAKIS 1987).
- v) Independently from the type of buildings, in zones II and III the most damages were observed in the high buildings (4-7 floors) (BOUKOUVALAS and SABATAKAKIS 1987).
- vi) The seismic fatiguing in zone I at the northern part of the city was normally distributed independently from the number of floors (BOUKOUVALAS and SABATAKAKIS 1987).

Stop 5.1

About 5 km from the town of Kalamata, the Kato Verga village is situated with a panoramic view to the Messinian gulf and the Kalamata graben. From this place, an introduction to the alpine geotectonic units and structures and their relation to the neotectonic deformation, will be presented. Some other subjects

for discussion are the neotectonic macrostructures of 1st, 2nd... order, such as the Messinian gulf, the Kalamata - Kyparissia graben and the Kalathion horst, the marginal fault zones (active or non active), the successive generations of talus and screes along the western margin of Kalathion horst and finally the damages in the Verga village during September 1986 earthquakes and their relation to the block movements.

Stop 5.2

About 2 km after Kalamata city, to the roadcut towards Eleochori, the Xerilas torrent and the Xerilas fault zone exist. This fault belongs to the transition fault zone between the Dimiova-Perivolakia graben and the Kalathion horst. Linear erosion, due to the block movements, and conglomerates, paleosoild and cones of different age indicators for the palaeogeographycal conditions and the morphotectonic evolution, are observed and discussed.

Stop 5.3

About 1 km before Eleochori village, there is a reactivated fault by the earthquakes of September 1986. The fault plane strikes NNE-SSW and the total displacement, due to the earthquakes, was about 15 cm to WNW. Along the fault zone rockfalls also have been observed.

Stop 5.4

The Eleochori village, built on the Tripolis unit neritic limestones, was totally destroyed by the earthquakes of September 1986. It represents one of the most typical places where a very close relation, between the seismic fractures or reactivated microfaults and the destructions, is revealed. Some other subjects that can be also discussed are the following: i) the relationship between the age and the type of the constructions and the damages (i.e. the remains of the ancient construction of the mycenian wall wasn't destroyed by the September earthquakes, in contrast to the other younger buildings in the surrounding area, ii) the behaviour of the foundation basement, iii) the neotectonic deformation of the Pindos nape surface and iv) the rate of the erosion and the relation between the morphotectonic evolution and the tectonoisostatic movements.

Stop 5.5

About 1 km after Eleochori village, towards Dimiova Monastery there is an outcrop of the contact between the limestones and the flysch of the Tripolis unit. This contact is a typical normal fault, known as Zimbeli fault surface. The fault plane strikes NE-SW and dipping 65 to the NW. A recent landslide at the slope of the road revealed a big part (20x6m), of the fault surface. On this part, not yet eroded, a great number of small brittle structures can be seen. These structures give information about the evolution of the concrete fault (reactivations...etc), as well as about the deformation type of

this surface. The shape of the fault surface is not plane, but curve, convexe and concave. The main minor structures on this surface are the following: a) Many generation (at least 6) of slickensides, plunging in different directions whereas the slickensides of the 3rd set they are almost horizontal, b) Four (4) different categories of tectonic breccias can be distinguished taking into consideration the material they consist of and their relative age, c) Small scale fractures and microfaults in an echellon arrangement cut the fault surface and they seem to be connected with the slight curvature of this surface. The younger sets of these microfaults which are the bigger ones (0,5-7m), show the maximum displacement (3-4cm). Also a "gap" (opening) of about 10 cm in the central part of the fractures is observed. The block displacement on both sides of the fractures hasn't always the same direction. So, in some microfaults the NW block (footwall) uplifted and the SE block (hangingwall) subsided, whereas, in a few cases the opposite is observed.

Taking into account the above mentioned minor structures and the curved shape of this surface, we discuss the type of the stress field and the kind of structures that can be created, always taking into account the lithology, the conditions and the type of deformation.

Stop 5.6

About 500 m before Dimiova's Monastery there is an outcrop of the transitional beds to the flysch of the Tripolis unit. The main lithologies are sandstones, marls, pelites with intercalations of tourbiditic microbrecciated limestones (calcarenites). The Alpine structure is represented by closed or isoclinal folds with an axis striking mainly in the NW-SE direction. In contrast to this the younger structures (neotectonic) represented by normal type faults striking in the NW-SE and NE-SW direction and building conjugate sets of faults. In the mesoscopic scale, the kinematic of these faults, as it is expressed by the en echellon arrangement and the rotational movements of the microblocks, coincides with the kinematic type of the neotectonic macrostructures in this region (i.e. Dimiova-Perivolakia graben, Kalathion horst).

Stop 5.7

At the Dimiova-Perivolakia Monastery there is an outcrop of the tectonic contact (overthrust) between the Pindos nape (consisting mainly of limestones) and the flysch of the Tripolis unit. Along the tectonic contact a lot of springs are existing because of the favourable hydrogeological conditions. As it is obvious, the location of the springs, along the tectonic contact, depends on the "morphology" and structure of the overthrust surface, which is the result of the alpine and post alpine (neotectonic) tectonism. From this place also, a discussion can be done concerning the Dimiova-Perivolakia graben which is a 2nd order neotectonic macrostructure at the eastern margin of

Kalamata-Kyparissia graben. The study of the tectonic and geomorphological elements shows that the endogenetic processes - responsible for its creation - are complex, both from the kinematic and the dynamic point of view and they are expressed on the relief through concrete landforms, such as the formation of intense ravines and the planation surfaces. The marginal faults, the structural map of the Pindos nape, the formation of intense ravines, the planation surfaces and the recent geodetic data, prove that the graben is the result of rotational movements, with one N-S principal rotation axis and another secondary in the E-W direction, so that the western and more especially the southwestern part of the graben is the most subsiding area.

Stop 5.8

About 2 km after Kalamata city, on the roadcut towards Koutalas village, there is an outcrop of a reactivated fault during the September 1986 earthquakes. The fault cuts the Neogene formations (marls, conglomerationes and sandstones), striking NNW-SSE. From this place, there is a panoramic view of the Kalamata Kyparissia graben and some observations, concerning the relationship between the morphology and the block movements, can be done. In the major area we can see also the remains of the Plio-Pleistocene sediments on the alpine basement and the origin and creation of the Pleistocene clastic red-cilicious formation. A discussion about, the paleocoast and paleoshore lines displacement, the estimation of the rate of subsidence and uplifting, and the type and rate of the in situ erosion of the Neogene formations will follow.

Stop 5.9

Messini is a small town to the west of Kalamata city. It is built to the Kato-Messinia basin which consists mainly of Plio-Pleistocene deposits (sandstones, marls, pelites and conglomerates). In the major area, a lot of sandquarries exist, giving very good geological sections for the study of the post alpine structure and tectonism. Sedimentary structures seem to be correlated with the neotectonic deformation. Some faults and unconformities also, are very well documented. The kinematic interpretation of this multifaulted area is corresponding to this one of the seismic fractures and reactivated faults that was created during the September 1986 earthquakes. The study of the neotectonic evolution of the major area shows that the central part of Kato (Lower) - Messinia basin (Messini area), represents the neotectonic accumulation center. A discussion on the rate of deposition in the subbasins of the Kalamata-Kyparissia big graben and correlation to the mobility of the subbasins, also can be done

6th day. THE AREA OF MANI

Stop 6.1

Stavropigi: The tectonic graben of Kampos - Stavropigi

(S.Messinia). The neotectonic interpretation of the desimentary sequences. Correlation between the cinematic of three adjacent sub-basins. The Kampos - Stavropigi graben has a general N-S trend. This graben is bounded by two major fault zones striking in the N-S direction.

Stop 6.2

Kardamilli: The palaeocoasts. The structures of the alpine basement. The rate of the erosion. Discussion on the beachrocks and the relief energy. Discussion on the tectonoisostatic movements of the area.

Stop 6.3

Dyros (Lakonia) - Mani area: Two caves of Diros village i. the "Alepotrypa" and ii. the "Glyphada" cave. The caves have been formed in upper cretaceous marbles of the Mani Unit along joints striking NNE-SSW, E-W and occasionally NE-SW.

A. C a v e "A l e p o t r y p a"

Cave Alepotrypa is located in "Portarakia" at an elevation of 20 m just above Dyros bay. The cave was discovered by Anna Petrochilou in 1958.

In the cave the following rooms are successively encountered 1. the "Olive tree chamber" 2. the "Crystal rain" chamber 3. the "Curred staircase" chamber 4. the "balcony" 5. the "Chamber of the Rocks" 6. the "Second filled" chamber 7. the "Worship heality" 8. the chamber "Joints" 9. the "Royal Balcony" 10. the "Large Hall" in which the "Great Lake" is situated 11. the "Upper floor".

The following objects have been found from time to time in the cave a. Human ... and Sculpts. b. Many pieces broken vessel. c. Marble statuettes tools made of stone (Palaeolithic stone age) e. Miscellaneous tools made of Obsidian, clay, copper and iron h. Bracelets and ear ings made of silver.

B. C a v e C l y p h a d a

Cave Clyphada is located at an elevation of 0,10 m. Just above Dyros bay. This cave was known even before 1900. An underground river circulates through the cave and flows into the sea.

The natural entrance to the cave is almost at the sea level so that when the sea is rough, the access to the cave is not possible. For this reason a new entrance has been constructed at a higher level.

The following rooms are encountered when visiting the cave. 1. the "First staircase" 2. the "first lake" where visitors get on boats 3. the "Dead City" 4. the "Crossroad" 4 galleries begin at this point. Two of these are directed to the NW and two to the NE.

The NW gallery goes through the part of the cave which is dry. Here the waters of the river go through a siphon and flow

into the sea. Visiting the dry part of the cave one can find the "Posidon Palace". The NE gallery takes us to a "Picturesque lake" and then to the "Corridor of the large plate" and from this point to the large Ocean where a recently excavated corridor takes us to the chamber of the "Tower of Piza". We find then the "chamber of the Dragon", the "Red Staircase", the "Chocolate staircase", the chamber of the "golden Rain" and the "Sea of the Shipwrecks" beginning from the "White isle" and via "The white Corridor" goes to the "artificial Tunnel" which join the NE and NW galleries.

In the NW gallery one finds the chamber "Shappel" the "White Rooms", the "Tower of Dyros" rooms, the "Cathedral", the "Corridor of miracles" and the "Oceanide lake". Bones attributed to Prohippopotamus and Provous have been found in the cave.

S h o r e l i n e d i s p l a c e m e n t s

Older shorelines can be observed in the area. The first is found at an elevation of 14.5 metres above sea level. It is identified by traces of Lithodomus lithophagus as having a Tyrenian age (J. Petrochilos). The second is found at an elevation of 8m above sea level and is identified by many small caves which exist there. The third is found 5-15m, below sea level and is identified by the existence of ancient buildings.

7th day. DEPARTURE (THOURIA-AMFIA-MEGALOPOLIS-ARGOS)

Stop 7.1

Thouria: Plio-Pleistocene (Hyalinea baltica) and faulting. We are at the eastern margin of the Kato Messinia graben. The Pleistocene deposits have a visible thickness of about 400 meters.

The section is located 500m after the village Thouria on the way to village Ano Amphia.

Marls with intercalations of sands and sandstones can be found there.

Stop 7.2

MOMA workfield on the way to Ano Amphia: 2,5 km after the village Thouria the palaeorelief developed on alpine formation is revealed by erosion. Over this palaeorelief, marine sediments of Pleistocene age have been unconformably deposited.

At this locality two generations of relief have been identified.

a. The older one was formed before the deposition of Lower Pleistocene sediments b. The younger relief began after the deposition of the Pleistocene sediments and the uplift of the region.

Stop 7.3

Ano Amphia (Potis Tavern): Remnants of the Pleistocene deposits on the alpine basement can be clearly observed at this locality. The transgression is indicated by the presence of coral

fossils identified as Cladocora. Remnants of Pleistocene sediments can be found on hillsides up to a present altitude of 400m.

Stop 7.4

The entrance of Girorema gorge: Systematic study of the neotectonic structures - reactivation of the faults - erosion to the depth relative to the Quaternary kinematic - correlation between rockfalls and the reactivation of faults - Seismic erosion. Changes of the rocks properties because of the intensive fracturing. Active and nonactive faults. Fracturing and carstification.

Stop 7.5

The polje of Poliani: The polje Poliani is the largest carstic basin on the mountainous area at the eastern margin of Kato Messinia basin (graben). The polje Poliani developed on neritic carbonates of the Tripolis unit - which are generally intensively carstified - with an area of almost 2.25 km², is structurally controlled, although the faults are not expressed on the landscape.

The polje is filled with coarse clastic river sediments (max. thickness 50-70m) of different lithology. Interesting is the presence of pebbles of metamorphic rocks, which today outcrop actually outside the catchment area of the basin.

The polje could be considered - from tectonic point of view - as a relatively "inactive" area, located between two large tectonic grabens, namely this of Kato Messinia and that of Megalopolis.

The polje behaved - for some time - as a closed geomorphological and hydrological system, whereas from hydrological point of view as an open system because of the carstification. Later on it has been transformed into an open system. Discussion of the kinematic of the tectonic macroblock.

Stop 7.6

Dyrrachi: The watershed between Alfios and Pamissos river. Interesting and remarkable the presence of conglomerates (Pleistocene) consisting exclusively of metamorphic rocks although the adjacent area consist of carbonates.

The Pindos overthrust. The strike contour map of the overthrust surface indicates rotational phenomena.

The large fault zone Dyrrachi - Leontari, the western margin of the Taygetos horst.

Stop 7.7

Megalopolis: (see page 58)

Stop 7.8

Lerni-Spring: The hydrogeological conditions of the carstic spring of Lerni and the myth of Hercules and the Hydra. The hydrogeological interpretation.

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