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THE POLJE OF NERAIDA* AREA, PHARSALA (SOUTHERN - THESSALY)

by

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Summary: *In this study the origin, morphology hydrology and evolution of the Neraida polje is investigated. The Neraida polje is situated at the northern side of «Othrys» mountain in the southern part of Thessaly.*

The said polje have been formed into upper-Cretaceous limestones which have been deposited upon the Othrys'Ophiolites and «Sehiefer Hornstein». The initial formation of the polje is due to tectonic depression within the limestones while its latest morphology was influenced by karstic erosion.

Due to the seasonal floods the said polje is classified to the seasonally inundated poljes; its drainage is attained by swallowholes (ponore) either «Schlürflocher» or«Thorkatavothren».

INTRODUCTION

Poljes are characterized the well established closed depressions in limestone KARST areas, having elliptical shape in most cases. They are usually large in area varying from several km² to several hundreds km² (Livanjsko polje 370 Km² in area, Nivno polje 50 km in lenght and 10 km in width). Their altitude is ranging from the sea level to more than 1 km. Poljes in low altitudes usually have lakes or they are swampy during most part of the year. Generally their bottom consist of a fertile alluvian plain which is usually habitable.

At the lower part of the poljes several torrents are usually formed while the surface water moving through this network is concentrated on the margins of the poljes where it is flown into swallow-holes (see page 3) and disappeared to the underground water network within karstified limestones. In the case the underground network is connected with a higher basin in the area the process is reversed and the water enters the

*The local name of the polje is «Gotza Lakka»

poljes through these swallow-holes which now turned into a Vauclusian type springs.

Two main factors appear to influence significantly the formation of the poljes; originally a tectonic depression and subsequently the karstic erosion represented chiefly by solytion processes (corrosion). Therefore the poljes are also called corrosional plains (M. HERAK, 1970).

In Greece the wide spreading of calcareous rocks and the climatic conditions during the past and present time have favoured the formation of similar geomorphological units. In Greece several karstic phenomena have been investigated by PHILIPPSON (1894), SIDERIDIS (1911), PSARIANOS (1958, 1961), THEODOROPOYLOS - ZAMANI (1972), MONOPOLIS (1971), DOUNAS (1971), SWEETING (1961) et. al.

THE POLJE OF NERAIDA

The Neraida polje is situated at the northern side of the Othrys mountain about 20 km eastwards of the town Pharsala, between the villages Philaki, Neraida, Palaeomylos, Agios Haralampos, at an altitude of approximately 270 meters.

The Neraida polje is surrounded by the following hills which are also covered by bushy vegetation: Neraiditis hill (614 m) to the west, Makria rahi (406 m) and Paliomandria (405 m) hills to the north, Megalo sphyri (559 m) and Ntara Su (523 m) hills to the south, while low hills joined together on the east side and the polje becomes a closed basin. The polje has an asymmetrical elongated form; its largest axis of about 2.5 km is trending east to west while its shortest axis of about 1.5 km follow a perpendicular trend.

It is interesting that the trend of its largest axis follows the general trend of the mountains range and the south fault in the area supports the tectonic origin of the Neraida polje (A. GRUND 1903). The shape characteristics of the Neraida polje follow the general characteristics of the Greek poljes as studied by several workers such as PSARIANOS (1961), THEODOROPOULOS-ZAMANI (1972), DOUNAS (1971).

The bedrocks around the margins of the polje have been smoothed, while the margins are interrupted by the formation of several «pocket valleys» to the hillsides of the polje. The sediments, however, which have been deposited in the polje appear not to be affected yet by erosion processes. The slopes of the polje are somehow steep, except the eastern part of it. The low part of the polje, which covered by weather-

ed material, occupies an area of about 3 km² and forms a rather flat area which inclined slightly westwards.

As a result of this slight inclination, the surface water which enters the polje from the surroundings is directed to the west part of the polje. It must be pointed out that the surface water is not able to form a stream network within the polje. The only way, the water can move in the polje, is through an artificial furrow about 0.30 m deep. which directed westwards. The water in the polje moving through this furrow, is concentrated in the west part of the polje where it is flown into the natural passage of the swallow-hole Nº 1 (figure 1).

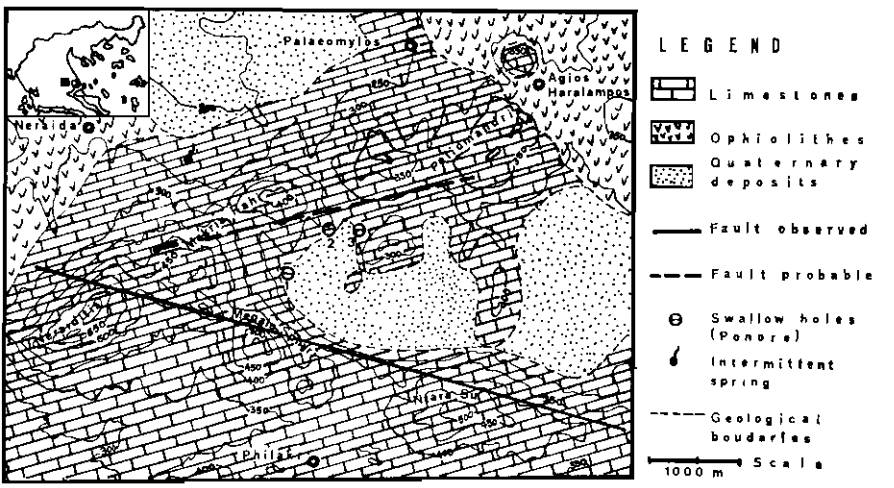

Figure I. Geological sketch map of the Neraida polje.

The capacity of the swallow-holes to absorb water is very limited so that during the rainny period, when the rainfall in the area is increased, the water is concentrated in the lower part of the polje and cover an area of about 1 km². The area then becomes swampy and uncultivated. Later in the year when the rainfall decreases the water passes through the swallow-holes to the underground network and the area is completely dried. The seasonal formation of a small lake in the lower part of the polje which is dried during the summer period, may be used to characterize the Neraida polje as a seasonally inundated polje.

The lack of lake deposits, as the borehole made within the polje shows, supports the idea that the polje was never turned into a lake; instead, the polje appears to have kept its present form and processes since its original formation.

Swallow-holes or «ponore» are characterized the deep vertical shafts or holes in limestone country, leading from the surface into an underground cave system, a torrent or stream may fall into it, permanently or intermittently. They are usually found in the botton or on the margins of small or large depressions (hollows). Some of then correspond to the local concentrations of fissures and fractures without special morphological distinctions. The most important are those on the margins of the poljes (F. J. MONKHOUSE 1970, M. HERAK 1972).

The neo-Hellenic term of «katavothre» was used by PHILIPPSON (1930) to describe these swallow-holes while the term of «ponore» was used by other writers. PHILIPPSON distinguished the shallowholes in two main categories: first the «Schlurflocher» or «Bodenponore» which are formed at the bottom of the polje and second the «Thorkatavothren» or «Wandponore» which are formed on the margins of the polje.

Three swallow-holes have been found (figure 1) in the said polje: The swallow-hole No 1 is situated in the western part of the polje within alluvian plain. It can be characterized as «Schlurflocher». It has an elliptical inverse conic shape (largest axis of 35 m, shortest axis of about 18 m) while the estimated altitude of its surface is 265 m. The lower part of the swallow-hole No 1 is about 7 m. bellow the surface of the polje and within the alluvian deposits. The area around this swallow-hole is covered by a rich bushy vegetation in contrast to the rest of the polje which is cultivated. As was mentioned above, a small artificial furrow ends in this swallow-hole that drains the polje slowly. Due to the formation of the swallow-hole No 1 on the western margins of the polje, the water of several small seasonal torrents from the hilly area around the polje, is flown into this swallow-hole.

The swallow-hole No 2 is situated 800 m to the northeast of the swallow-hole No 1 at an altitude of about 270 meters on the northern margins of the polje. The swallow-hole No 2 have been formed within the limestones and can be classified to the «Thorkatavothren» type. A levee which have been created between the shallowhole No 1 and the lower part of the polje prevents the concentrated water to flow towards this hole, unless the water overflows the levee, as it happens during the rainny periods. The swallowhole No 2 has a rather irregular triangle shape with steep sides; its lower part have heen narrowed and blocked by huge stones. This swallow-hole drains only a part of the polje especially during the rainny period when the level of the concentrated water is exceptionally high.

The swallow-hole No 3 is situated about 400 m to the east of the

swallow-hole No 2 whithin the limestones, and is characterized as «Thorkatavothren» type. Its present position is higher than the lower part of the polje, so that the concentated water cannot be absorbed by this swallow-hole.

The Neraida polje was originally formed within a tectonic depression while its latest morphology was mainly influenced by intensive erosion of the limestones due to the dissolving action of the water.

The area of the polje belongs to the sub-Pelagonian zone of the Greek geotectonic structure which consist of two main types of rocks: the lower formation of Ophiolithe - radiolarite series or «Schiefer Hornstein» (AUBOUIN, 1965) and the overlying formation of the upper-Cretaceous limestones. The upper Cretaceous limestones appear as compact unstratified units having a grey or dark colour and turned into microbreccias in some places; within these limestones only few small fragments of Rudistes were found. The unconformity between the limestones on the top and the Ophiolithe-radiolarite formation of the basement as well as the occurence of the above mentioned fragments of Rudistes within limestones, indicate that these limestones were deposited during the Cretaceous transgression (KALLERGIS, 1970). The Neraida polje have been formed into the upper-Cretaceous limestones, while the whole lower area have been covered by Quaternary deposits.

According to AUBOUIN, J. (1959) the Cretaceous transgression which represented by the limestones of Kasidiaris mountain, to the southwest of the polje, may be considered as upper-Santonian - lower - Kampanian. From a borehole made by the Land Reclamation Service (Y.E.B.) of Larissa (fig. 2) in the area became clear that the Quaternary deposits on the top are followed by the upper-Cretaceous limestones up to a depth of 105 m. The top 10 m of the limestones have been carstified recently, while within the last 5 m in the bottom, red-clay is occured probably due to carstic erosion under similar geologic and climatic conditions as the recent ones.

The sub-Pelagonian zone is known to have emerged during the lower-Cretaceous (Austrian folding) with the subsequent formation of a high relief (KALLERGIS, 1970). The upper Cretaceous limestones were deposited over the Jurassic Ophiolithe-radiolarite series, during the following transgession which lasted until Eocene; the sub-Pelagonian zone was emerged again and became a continent with no significant changes since then. The ophiolithes appear on the northeast part of the area (figure 1) and are characterized as Jurassic according to BRUNN, J. (1956) and MARINOS G. (1956). Within the polje both clastic sediments

and recent loose materials have been deposited. The clastic sediments in the lower horizonts consist of conglomerates and breccias within a matrix of red-clay and appear in a consolidated form as a result of diagenetic processes. The clastic sediments appear at several places along the eroded margins of the polje and may be considered as Pleistocene formation.

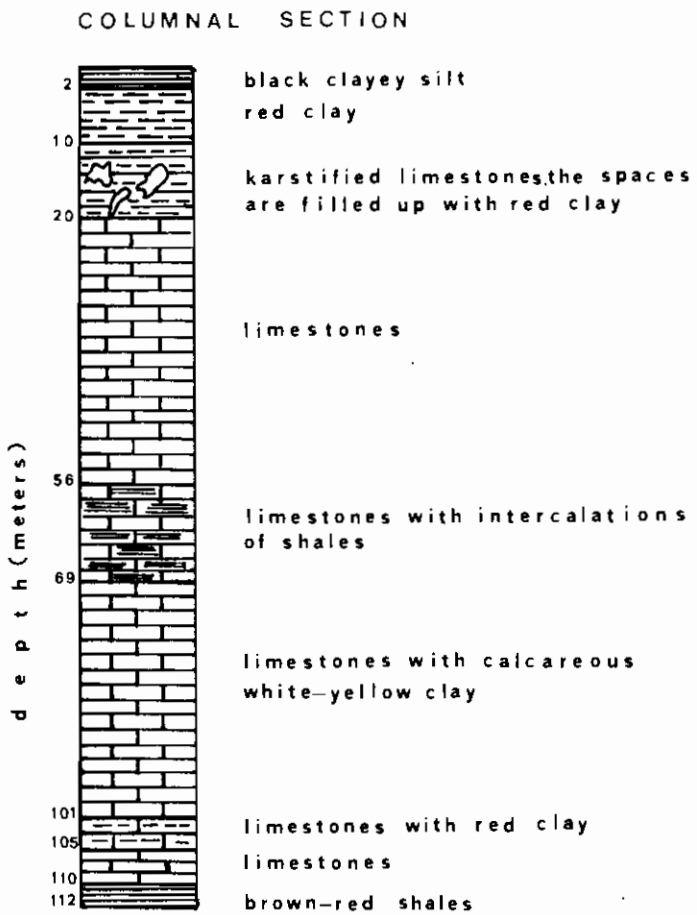

Figure II. Borehole made by the Land Reelamation Service.

From the borehole which was made near the swallow-hole No 2 on the margins of the polje, became clear that the thickness of the Quartenary deposits there was about 10 m; the thickness of these deposits appears to be increased towards the centre of the polje. The top 2 m of these deposits consist mainly of black clayey silt as a result of the desin-

tegration of organic material during the denutation of the area by water and the creation of swampy conditions. The remaining 8 m of deposits underneath, consist mainly of red clay as a result of the erosion processes under sub-aerial conditions. A possible explanation to the difference between the red clay of the bottom and the black clayey silt of the surface may be based on the role of the swallow-holes within the polje. During the first stages of their formation, where ouly a limited amount of sediments were deposited into the polje, the capacity of the swallow-holes to absorb water was enough to drain the polje entirely. The sediments which deposited recently changed the relief and blocked the swallow-hole creating the above mentioned swampy conditions.

The basement of the polje was found in a depth of 110 under the limestones and consist of brown-red shales. The relatively small thickness of the Quartenary deposits which are followed by limestones up to a depth of 100 m at the bottom of the basin indicates that the polje has been recently formed; the main factors of its formation appear to be tectonic faults within the limestones and the subsequent karstic erosion which may have started during the Eocene, the period of emergence of the Pelagonian and sub-Pelagonian zones (KALLERGIS 1970).

The combination of erosion processes and tectonic movements which was in operation in the area for a relatively long period, as the sucessive erosional cycles indicate, resulted in the formation of advanced stages karstic phenomena. Parts of the margins inside the polje as well as the limestones which are not covered by Quartenary deposits display karstified forms of advanced stages.

The main features which can easily be distinguished on the limestones are the following:

A lot of «clints» (regenrillen) on the surface that give the impression of neuroses of leaves and several well established «lapiaz» (lapies, karren) that follow the general direction of the joints trending from west to east. A number of grooves and small caves have also been formed within the limestones due to the dissolving action of the raining water; within these features red-clay have been deposited, as a residue of the solution of the limestones.

The underground water which follows the complicated network within the limestones, may issuing from intermittent springs outside the polje or it may flown to the sea. In the area studied, however, an intermittent spring was found on the northern side of Makria rahi hill at an altitude of 230 m. The water of this spring appear to come from the swallow-hole No 1 at the nortwest part of the polje from an altitude of

265 m. The distance between the swallow-hole No 1 and the spring is estimated at about 2.5 km. The water from the polje passing through the swallow-holes is moving northwards taking advantage from the hypsometric difference between the polje and the area around it.

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Plate I. Western part of the polje: Swallow-hole No 1.

Plate II. View of northwest part of the Neraida polje.

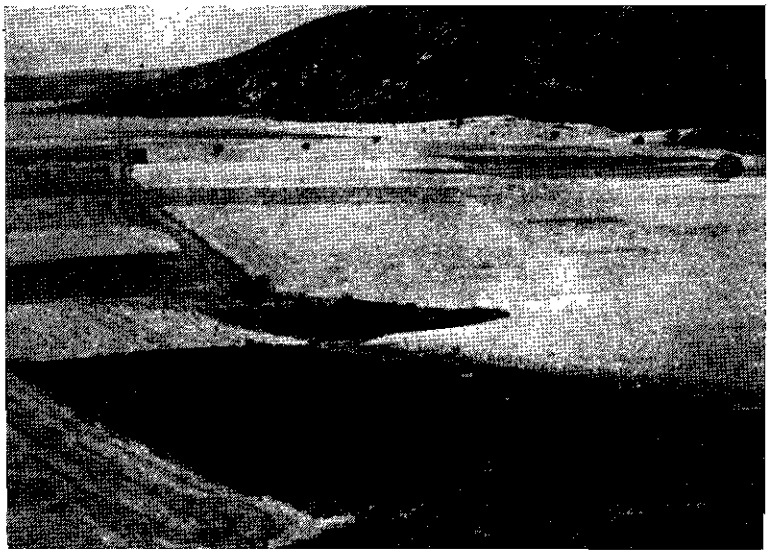

Plate III. The entrance of the swallow-hole No 2.

ΠΕΡΙΛΗΨΙΣ

Η ΠΟΛΓΗ ΤΗΣ ΝΕΡΑ·Ι·ΔΑΣ* ΦΑΡΣΑΛΩΝ (ΝΟΤΙΟΣ ΘΕΣΣΑΛΙΑ)

Ὑπὸ

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(Ἐργαστήριον Φυσικῆς Γεωγραφίας Πανεπιστημίου Θεσ/νίκης)

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Ἡ Πόλγη ἐσχηματίσθη ἐντὸς τῶν ἄνω - Κρητιδικῶν ἀσβεστολίθων οἱ ὁποῖοι ἀπετέθησαν ἐπὶ τῶν Ὀφειολίθων καὶ τῆς σχιστοκερατολιθικῆς διαπλάσεως τῆς Ὄθρυος. Ὁ ἀρχικὸς σχηματισμὸς τῆς Πόλγης ὀφείλεται εἰς τεκτονικὸν βύθισμα, μεταγενεστέρως ὅμως ἡ μορφολογία της μετεβλήθη, λόγῳ τῆς μακροχρονίου καρστικῆς διαβρώσεως. Κατατάσσεται εἰς τὰς περιοδικῶς πλημμυριζούσας Πόλγας λόγῳ ἐποχιακῶν πλημμυρῶν, ἡ ἐν μέρει δὲ ἀποστράγγισις τῶν ὑδάτων ἐπιτυγχάνεται διὰ καταβοθρῶν καταρροφητικοῦ καὶ πυλοειδοῦς τύπου.

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* Ὑπὸ τὴν τοπικὴν ὀνομασίαν «Γκότζα Λάκκα».