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THE PREOROGENIC HISTORY OF THE LAGONEGRO BASIN (SOUTHERN APENNINES)

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THE PREOROGENIC HISTORY OF THE LAGONEGRO BASIN (SOUTHERN APENNINES)

by

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INTRODUCTION

The stratigraphic sequence of the Lagonegro basin is of a type that is widespread in the Mediterranean area along the southern margin of the Tethys (Imerese zone in Sicily, Lagonegro zone in the southern Apennines, Budva-Kotor zone in Yugoslavia, Cukali zone in Albania and the Pindos-Olonos zone in Greece). This type of sequence has become classic in Greece as a result of the studies of Auboin (1959, 1965) who described in an outstanding manner the stratigraphic succession in the Pindos Mountains, selecting it as a model for the "eugeosyncline", *i.e.* an "internal" domain of oceanic type. An analogous interpretation of these successions, albeit purely in "actualistic" terms, was recently given in Sicily (Wezel, 1970; Wezel and Ryan, 1971), where the Imerese basin is located in the southernmost part of the Tethys sea, between the mid-oceanic high (Panormide zone) in the north and the African continental margin (Iblea zone) in the south. Other studies (Bernouilli and Laubscher, 1972; Scandone and Radoicic in preparation), on the other hand, place the areas of the Pindos type outside the Tethys and consider them to have a continental substratum.

In the southern Apennines, the main outcrops of the Lagonegro sequence form an asymmetric anticlinorium that is convex to the east and which is some hundred kilometers long and about twenty km. wide. These structures range from the border of the Calabro-Lucano region to the Vulture Mountain (Figure 1). North of the Vulture, the Lagonegro strata (belonging to the highest part of the sequence) appear again in a few outcrops in Campania, Molise and the Abruzzo. In addition, tectonic windows in the carbonates of the "Apennino Calcareo" in the Picentino Mountains show interesting successions of the Lagonegro strata, here fairly distant from the main outcrops which occur on the fringes of the "Apennino Calcareo". South of the Calabro-Lucano border the Lagonegro strata disappear under higher tectonic units.

All along the outcropping area the Lagonegro deposits are recognized to form two sheets in which the same succession is repeated although in a slightly different facies.

In Table I are summarized the formations making up the two sheets, along with their ages.

Facies analyses, together with field measurements, show that the Lagonegro Unit II represents parts of the western flank of the original basin. In the Lower Miocene (Langhian) beds of this unit have been thrusted over beds deposited in the axial part of the basin itself (Lagonegro Unit I).

The Lagonegro basin, which belongs to an "external" area of the Apennine "geosyncline", was limited by the Campano-Lucana platform to the southwest and the Abruzzo-Campano platform to the northeast.

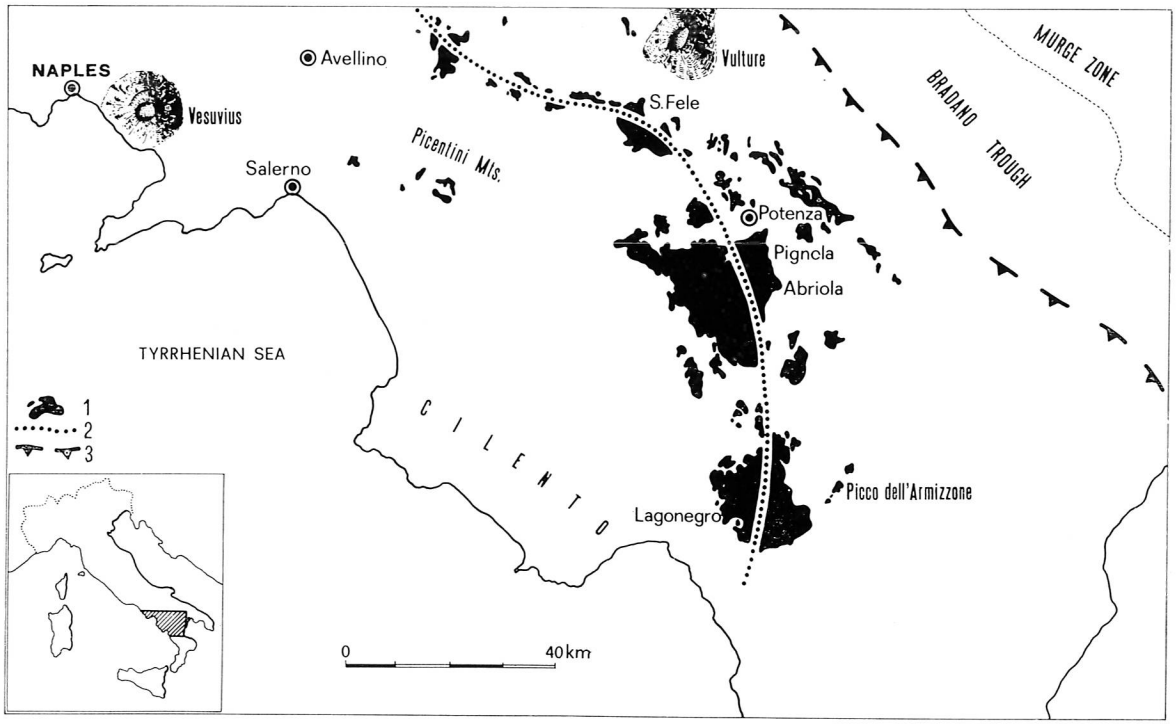

Fig. 1. Distribution of the principal outcrops of the Lagonegro strata in the Campano-Lucano Appennines.
1. outcrops of the Lagonegro strata.
2. average course(?) of the axes of the anticlines in the curve of the fold.
3. front of the Apennine "coltri" (packets or sheets).

Current use of "southwest" and "northeast" do obviously not refer to the original position that was probably modified by great rotations of the total complex.

The Lagonegro units are, at present, thrusted over the Abruzzo-Campano platform and are in turn overthrusted by strata of the Campano-Lucano platform the Cilento Flysch and the Varicolored Shales (See Ippolito, D'Argenio, Pescatore and Scandone in this volume).

LAGONEGRO UNIT I

The strata of the Lagonegro Unit I form the major mountainous terrains in the Lagonegro area (Monte Sirino, M. Castagnereto, M. Costa dell'Alto, Gianni Griecu) and in the upper Agri valley (M. Vulturino, Serra di Calvello, M. Lama). Besides, they crop out in the tectonic window of Campagna in the Picentini Mountains. The facies is generally homogenous and indicates deposition in quiet areas away from clastie sources (distal). This type facies has been named Lagonegro-Sasso di Castalda facies. A small change is only found in the siliceous shales which are entirely pelagic (radiolarites and siliceous argillites) in the southern outcrops, whilst they have some intercalations of graded breccias in the outcrops to the north (upper Agri valley, Sasso di Castalda).

The sequence will be described from bottom to top with the names of the formations as they are now used in the local geological literature, even where there is no formal definition of the formation.

LIMESTONES WITH CHERT

The formation in over 500 m. thick; the lower boundary does not crop out. The age is Upper Triassic (Carnian-Rhaetian).

From the bottom upwards appear:

a) grey calcilutites with bands and nodules of chert (50 meters). In the middle part is present the pelecypod *Halobia styrica*;

TABLE 1

AGE	LAGONEGRO UNIT I (LOWER)	LAGONEGRO UNIT II (UPPER)
Lower Miocene		*"Numidico Flysch"* Yellowish graded quartz sandstones, argillites and grey siltites with intercalations of quartz sandstones.
Lower Miocene to Upper Cretaceous	*"Red Shales of Pecorone"* Calcarenites and graded calcisiltites with intercalations of red and grey clays; Polycrome siliceous argillites and cherts.	*"Red Flysch"* Graded calcirudites and calcarenites with large foramenite shrdlu A2mi with large foraminifera, with intercalations of argillites, polychrome cherts and graded calcarenites.
Middle and Lower Cretaceous	*"Galestri" (Marls)* Dark grey and black argillites and strongly siliceous calcilutites.	*"Galestri" (Marls)* Grey marls and argillites, more or less siliceous, breccias of graded limestones, calcilutites.
Jurassic	*"Siliceous Shales"* Polychrome radiolarites and siliceous argillites, with very rare graded calcarenites and calcisiltites.	*"Siliceous Shales"* Polychrome radiolarites and siliceous argillites with intercalations of calcirudites and graded calcarenites; graded and partially dolomitized colcirudites.
Upper Triassic	*"Limestones with Cherts"* Calcirudites with bands and nodules of chert, with *Halobia* and posidonids.	*"Limestones with Cherts"* Calcilutites with *Halobia* and posidonids, intraformational conglomerates and dolomites with banks and nodules of chert.
Middle Triassic		*"Monte Facito Formation"* Grey, red and green clays and marls, siltites and sandstones with lenticular intercalations of massive limestones with algae.

b) alternation of marls, yellowish and grey laminated argillites with intercalations of grey calcilutites (80 meters). Present are *Halobia superba, H. styrica, H.* cf. *cassiana* and numerous Posidonids;

c) grey calcilutites with beds and nodules of chert with intercalations of marls and yellowish, red and greenish argillites and cherts (350 meters) in the upper part. In the lower part is found *Halobia charlyana*

and in the upper part *H. halorica, H. norica, H. Lineata* and various species of Posidonia.

Through a gradual increase of the argillite and chert intercalations and the progressive decrease of limestones, the formation grades to the overlying "siliceous shales".

SILICEOUS SHALES

The thickness of the formation, which is Jurassic in age, is not more than 70 meters.

From the bottom upwards the sequence is formed by:

a) polychrome radiolarites and red and greenish tinged siliceous argillites, with few rare beds of silicified "allodapico" limestones (30 - 35 meters). In the upper Agri valley as well as in northernmost outcrops occur also granded calcareous microbreccias which contain a microfauna indicative of the Liassic.

b) greenish tinged radiolarites in very regular thin beds of 5 - 10 cms. (30 - 35 meters).

The formation grades through alternating radiolaritic cherts, siliceous argillites and very strongly silicified limestones with abundant iron and manganese carbonate, to the overlying "galestri" formation.

"GALESTRI" (MARLS)

The thickness of this formation, which is of Middle and Lower Cretaceous age is around 400 meters. The sequence consists of a monotonous alternation of lead-grey argillites, radiolarian cherts, and siliceous limestones rich in iron and manganese carbonates. These limestones represent distal turbidites.

These are turbudites of the mixed type with both neritic and pelagic material.

The passage to the overlying "Red Shales of Pecorone" takes place rapidly whilst the differences in competence of the materials generally result in a "mechanical" contact.

RED SHALES OF PECORONE

The formation, whose upper part in missing measures some sixty meters in thickness. The middle part is Upper Cretaceous in age and its upper part may be as young as Paleogene.

From bottom to top the sequence is:

a) radiolarites, cherts and polychrome argillites (10 - 15 meters);

b) alternation of marls, grey siliceous argillites, red to dark greenish, graded calcarenites and calcisiltites (45 - 50 meters). In the graded calcarenites are present *Globotruncana* sp. and *Moncharmontia apenninica.* The "Red Shales of Pecorone" are invariably truncated upwards either by the Lagonegro Unit II or by the Cilento Flysch.

LAGONEGRO UNIT II

Strata of this unit crop out extensively between the Lagonegro area and the upper Agri valley, where they form the main topographie features between the source of the Agri river and the zone of Pignola-Abriola (Monte Arioso, M. Pierfaone, etc.). They also crop out in the windows of Campagna and of Giffoni Vallepiana in the Picentini Mountains.

The facies of the Lagonegro II unit vary considerably. In the limestones with cherts and in the siliceous shales we may recognized three successions or type facies: the Armizzone facies, the Pignola-Abriola facies and the S. Fele facies. These. facies grade laterally into each other. This transition from south to north between the Armizzone facies and the S. Fele facies indicates a passage from a strongly distal part of the basin to parts of the basin progressively nearer the source.

The succession will be described here from bottom to top and, just as it was done in the Lagonegro Unit I, each formation will be named as it is used in the local geological literature even when a formal definition of the formation is lacking.

MONTE FACITO FORMATION

This formation attains, without its missing lower limit, a thickness of around 200 meters. Its age is Middle Triassic (Anisian - Ladinian). Two members are distinguishable: a terrigenous one consisting of clays, siltites

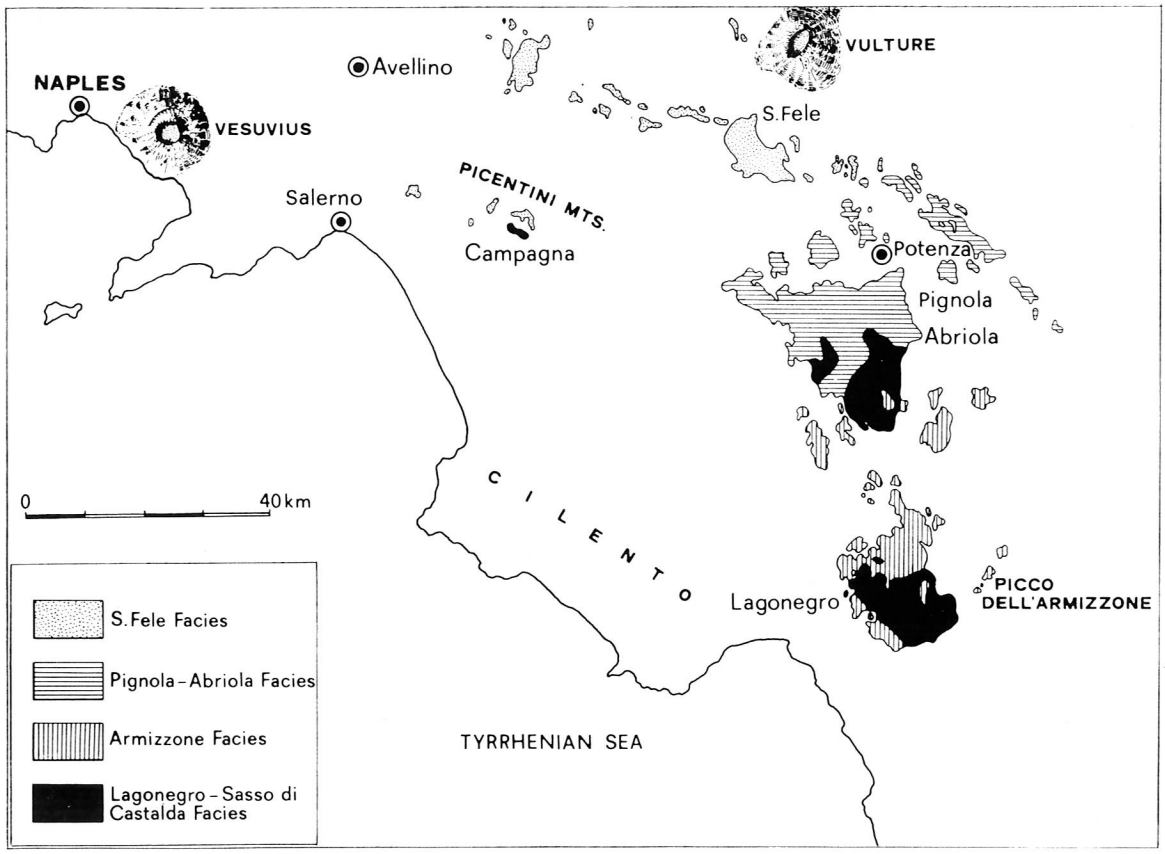

Fig. 2. Facies distribution in the Lagonegro region of the Campano-Lucano Apennines.

sandstones and conglomerates, and a reefoidal member consisting of algal reefs. These reefs appear as lenticular bodies of large dimensions, about eighty meters in thickness and one kilometer in length, and are intercalated within the clastic member. It appears that the lower algal reefs are in stratigraphic continuity with the surrounding strata, whereas the higher ones appear to have moved down from nearby topographically higher areas. There is no difference in age between these limestones reefs (brachiopods, lamellibranchs, gastropods, rare ammonites and daonellian pelecypods, crinoids, corals, algae, etc.) and the surrounding clastics (daonellian pelecypods).

In the clastic member the sequence is as follows from bottom to top:

a) clays, grey and yellow marls, alternating with fine-grained sandstones with ripple marks (50 meters). Brachiopods, among which *Spiriferina fragilis* are present.

b) alternating fine-grained sandstones with quartz and muscovite, siltites, marls and red and green argillites with intraformational conglomerates (130 meters). Locally are found small lenses of basalt in the form of pillow lavas and pillow breccias. *Daonella taramelli, D. udvariensis, D. boeki, D.* cf. *badiotica* and *D.* cf. *tyrolensis* are present in the middle part of the interval;

c) clays and red clayey marls with *Daonella lommeli* and *Posidonia* type pelecypods (4 meters);

d) alternating siliceous calcilutites, marls and red and greenish tinged argillites (around 10 meters).

Through a gradual reduction of the argillites and increase of limestones the formation grades to the "limestone with chert".

LIMESTONES WITH CHERTS

It was mentioned above that facies changes take place from south to north, from the Armizzone facies to the Pignola-Abriola facies and S. Fele facies. The sequence will be described in facies types here below. The age of the three facies types is the same, *i.e.* Upper Triassic (Carnian-Rhaetian).

Armizzone Facies. The Limestones with Cherts attain a thickness of around 160 meters. From the bottom upward are present:

a) well-stratified grey calcilutites with bands and nodules of cherts (20 meters). In the lower part occur *Halobia styrica* and *H. cassiana,* whilst *H. austriaca* is present in the upper part;

b) green argillites with *Halobia superba* (1.50 meters);

c) grey calcilutites with bands and nodules of chert with levels of intraformational conglomerates. In the upper part are intercalated argillites and greenish tinged and yellowish chert (140 meters).

Pignola-Abriola Facies. Thickness approximately 230 meters. From the base upward follow:

a) grey calcilutites with bands and nodules of chert with intercalations of greenish tinged argillites (80 meters). *Halobia cassiana* is present in the lower part and *H. austriaca* and numerous posidonids.

b) green argillites with *Halobia superba* with thin tuff intercalations (5 meters).

c) grey calcilutites and saccharoidal dolomites with bands and nodules of chert (40 meters). Dolomite and calcilutites grade into each other vertically and laterally in the same bed. *Halobia* cf. *mojsisovicsi* and abundant posidonids are present in the basal part.

d) dolomites with bands and nodules of chert and dolomitic breccias with chert in angular fragments (60 meters).

e) alternation of dolomites, argillites, polychrome marls with chert with thin beds of siliceous limestones in the upper part (40 meters).

S. Fele Facies. The lower boundary is missing; the thickness is around 200 meters and is built up by a monotonous succession of dolomites with bands and nodules of chert and dolomite breccias with cherts in angular fragments.

SILICEOUS SHALES

Here also it is possible to distinguish three facies. The age is Jurassic throughout.

Armizzone Facies. The "Siliceous Shales" have a thickness of approximately 165 meters. From the bottom upward the succession is:

a) alternating radiolarites, red, yellow and greenish tinged siliceous argillites, graded calcarenites and siliceous limestone which represent very distal turbidites.

b) red, yellow and green radiolarites with thin intercalations of breccias of graded limestones, for the greater part silicified, with *Nautiloculina oolitica* and *Protopeneroplis striata* (70 meters).

Pignola-Abriola Facies: Thickness is around 240 meters. The sequence is from the bottom upward:

a) alternating marls, siliceous argillites and yellowish, greenish tinged, red and brown cherts with radiolaria with intercalations of calcirudites and graded calcarenites (150 meters).

b) red and emerald green radiolarites which are brown in the upper part, with intercalations of beds and, subordinately, layers (maximum 2 meters) of graded limestone breccia with *Protopeneroplis striata, Nautiloculina oolitica* and *Trocholina* species (90 meters). Slumping took place in the upper part.

S. Fele Facies. Thickness is around 240 meters. From the bottom are distinguished:

a) graded calcareous breccias and microconglomerates, partially dolomitized and silicified, with thin beds of varying thickness (maximum 4 meters) with intercalations of argillites and grey and greenish tinged cherts which are more frequent in the lower part. In the redeposited strata occur coral fragments, molluscs, echinoderms, brachiopods and algae. In the upper part of the interval are present *Dictyoconus* (?) *cayeuxi,* indicating the Aalenian-Bajocian boundary and *Nautiloculina oolitica;*

b) alternating intervals of graded calcareous breccias (maximum 30 meters) siliceous argillites, cherts and radiolarites (maximum 10 meters) with *Protopeneroplis striata, Nautiloculina oolitica* and *Trocholina* spp. in the calcareous breccias (60 meters);

c) greenish tinged and reddish radiolarites with intercalations of beds and banks of graded limestone breccias which contain the same microfossils as the underlying interval does (140 meters). Slumping has been observed in the upper part.

"GALESTRI" (MARLS)

The sub division of three facies types as given with the "Limestones with chert" and the "Siliceous Shales" is not practical with the "Galestri" because the various sequences do not possess such strongly differentiated characteristics. Nevertheless, it is possible to recognize a gradual facies change to more proximal, or near source, environments from south to north. The sequence consists of a monotonous alternation of grey and black argillites, marls, graded breccias calcareous and fine-grained limestones which are more or less siliceous. The fine-grained limestones represent distal turbiditic deposition and consist of both neritic and pelagic material. In the breccias appear algal fragments and numerous foraminifera, such as *Protopeneroplis, Nautiloculina* and *Trocholina.* Rare calpionelids also occur. The finest material consists of unidentified calcareous grains and nanno-plankton. Maximum thickness of the entire sequence is around 300 meters. Age is Lower and Middle Cretaceous.

RED FLYSCH

Also here, as in the case of the "Galestri", it is not practical to subdivide the formation in the three type facies, partly because sufficiently differentiated characteristics do not exist and partly because the Red Flysch has not been studied in such detail as the other formations have. Also here, however, facies become increasingly proximal going from south to north. The thickness ranges from a little over a hundred meters to around 350 meters. Age is Upper Cretaceous to Lower Miocene (Langhian) From the bottom upwards occur:

a) Siliceous argillites, red, greenish tinged and brown cherts and radiolarites with more or less manganese carbonates and with rare intercalations of calcareous breccias and of graded, often silicified, calcarenites (from 10 to 20 meters). In the breccias occur orbitolinids and rudist fragments;

b) alternating calcarenites and graded calcisiltites, red and greenish tinged marls and clays, conglomerates and graded calcareous breccias. Greatest diameters of the clastics vary from a few millimeters in the southern outcrops (upper Agri valley) to more than a decimeter in the northern outcrops (from S. Fele northward). The thickness of this interval varies from a hundred meters to more than three hundred. In the lower part occur *Globotruncana* spp., *Siderolites calcitrapoides* and *Orbitoides* media; in the middle part *Nummulites* and *Alveolinas* and in the upper part lepidocyclinids and lastly *Miogypsina gunteri.*

NUMIDICO FLYSCH

From the "Red Flysch" through alternating fine-grained, graded calcarenites, marls and argillites and siltites one reaches a clastic sequence which consists of graded yellowish quartz sandstones of Aquitanian to Langhian age. This sequence, widespread in the central - western Mediterranean represents the well known Numidico Flysch.

During deposition of the Numidico Flysch a series of movements, with a predominant horizontal component, were initiated at the western margin of the Lagonegro basin. This tectonic phase caused a fairly considerable narrowing of the Lagonegro basin in the Langhian. Over the remaining part, in the Langhian, the Irpino Basin developed (see Ippolito, D'Argenio, Pescatore and Scandone in this volume).

THE STRATA OF THE EASTERN FLANK OF THE LAGONEGRO BASIN

In the foregoing, it has been made clear that the strata of Lagonegro Units II and I

represent deposits of the western flank and the axial part of the basin, whilst there is no trace of deposits of the eastern flank of the basin. In effect, the tectonic phase of the Langhian by truncation and horizontal movements interrupted deposition along the western flank and in parts of the axial portion of the basin. On the eastern flank however deposition continued to the Tortonian as it was not interrupted by tectonic movements. Consequently, while the strata of the Lagonegro Unit II (which covered tectonically the strata of the axial part of the basin represented by Lagonegro Unit I) were covered by allochthonous sheets or discordantly overlain by the deposits of the Irpino basin (belonging to a more recent tectonic cycle), the sediments of the eastern flank of the basin show a regular stratigraphic continuity in contrast to those of the Irpino units and especially to the so-called "Daunia Flysch" (named after the Daunia in the Sangro Valley in the Abruzzi). In fact, at the base of this unit occur strata that show strong analogies with the "Red Flysch". Whereas, however, the "red flysch" was formed by material derived from the Campano-Lucano platform, these other sediments must have been formed by material derived from the opposite side, *i.e.* from the Abruzzi-Campano platform.

DIMENSIONS, FORM AND DEPTH OF THE LAGONEGRO BASIN

As mentioned above, the Lagonegro basin was bounded on the west by the Campano-Lucana platform and on the east by the Abruzzo-Campano platform. As a consequence, the original direction of the basin must have been nearly parallel to the elongation of these platforms. Today, the direction of the elongation is northwest - southeast; there are insufficient data to reconstruct the rotation of these geological bodies in the course of their tectonic-sedimentary evolution, and successively in the course of their orogenic movements.

It can be seen that the thrusting of the Lagonegro Unit II over the Lagonegro Unit I is not less than 40 kilometers. If therefore a figure of 40 km. can be accepted for the western flank and 40 km. each for the axis and eastern flank, then the width of the entire basin is not less than 120 km. The original width of the basin was possibly more than that, if it is taken into account that the strata of the S. Fele facies (proximal) are superimposed on those of the Lagonegro-Sasso di Castalda facies (distal) without intermediate facies, which have thus to be added to arrive at a total.

Data regarding the longitudinal dimensions are yet more uncertain: Lagonegro strata extend up to the Abruzzi region in the north; in the south they disappear at the latitude of Lauria. The outcrops therefore extend for over 300 kilometers. Taking as true the hypothesis that the Pindos type strata in the central-eastern Mediterranean belong to a single basin would bring to longitudinal dimensions of some thousands of kilometers. At present no data are available for the necessary connections between Sicily, the southern Apennines and Yugoslavia.

As regards the depth, the Lagonegro deposits range from a neritic environment in the Middle Triassic (Monte Facito Formation), to a bathyal environment in the Upper Triassic (Limestone with Cherts) and an abyssal environment in the Jurassic, below the compensation depth of the calcium carbonate. In the Cretaceous the depth is considered to be above those limits (or the limit is placed at a greater depth) but the environment remains bathyal to the Lower Miocene when the horizontal movements began.

The hypothesis of the origin of radiolarites in deep waters seems here the most logical in view of what is verified to date of the origin of radiolarian oozes. It is to be noted that below a certain depth (compensation depth of aragonite first, followed by the compensation depth of calcite) the carbon dioxide concentration causes all the calcium carbonate in seawater to remain in solution.

On the other hand, calcareous bodies - organic or inorganic - which sink through the water by gravity are unavoidably subject to solution when they go deeper than the compensation depths. The problem, in recon-

structing the past, is whether the compensation depth has remained constant or has been raised in the course of time.

The most recent authors on these data seem to accept oscillations from 3000 - 4000 to 7000 meters (see discussion of this subject in Garrison and Fischer, 1969).

Some authors, even in recent times, have questioned the deep water origin of radiolarites because of the presence of "neritic limestones" intercalated with the radiolarites. It has always been possible, however, to verify the inconsistency of these postulations, because the "neritic limestones" in question are in reality turbidites intercalated in normal pelagic basin deposits.

TECTONIC-SEDIMENTARY EVOLUTION OF THE LAGONEGRO BASIN

Although not sharing Aubouin's interpretation (1959, 1965) of the Pindos as a "eugeosynclinal" trench, and not sharing his theory of certain simplifications of the dynamics of the evolution of the basin itself, it seems that the subdivision used by that author to distinguish three pre-orogenic phases of the basin is valid. These phases are: a definition phase, a phase of non-deposition, and a phase of filling. In the analysis of the tectonic-sedimentary evolution of the Lagonegro basin this nomenclature will therefore be used at times with a significance or definition that is somewhat removed from that of Auboin.

DEFINITION PHASE

The definition phase is recognizable in the Monte Facito formation. The strata of the terrigenous member of that unit often have sedimentary characteristics which leads one to regard them as a flysch, to such an extent that the early geologists confused the formation with the paleogenic flysch. Instead, we are confronted with something that is exactly opposed to the significance of a flysch. Whereas flysch is, in fact, a syntectonic facies of the building up of an orogeny, the Monte Facito formation consists of a syntectonic facies that is connected with the levelling of an orogeny, namely the Hercynian. In this sense, the Monte Facito formation is an "anti-flysch". In the southern Apennines, as in many other areas of the southern margin of the Tethys, these clastic deposits of the Triassic represent the results of deep-seated phenomena such as arrested or unfinished rifting that is connected with a general tectonic instability over vast areas which in the Jurassic became clearly delineated as the northern margin of the African continent. These phenomena of incompleted rifting are not restricted to the basin areas, but are also documented at the base of such areas which will later develop into carbonate platforms. In any case, it is from these Triassic rifting phenomena that the first Alpine alignments originated along with early deep basins, probably in connection with zones of crustal thinning. Basic vulcanism has taken place in the Monte Facito formation and equivalent formations in other parts of the Mediterranean. The rate of sedimentation during the Anisian and Ladinian is from 20 - 25 Bubnoff units. (1 B (Bubnoff) unit equals 1 meter of sediments per 1-million years). This rate of sedimentation is less than the subsidence; the facies changes gradually from neritic to bathyal. The progressive reduction in terrigenous material defines (in the Upper Triassic) the change from clastic to chemical and biochemical ("limestones with cherts") sedimentation.

PHASE OF NON-DEPOSITION

In the Upper Triassic where the rate of sedimentation increased with values from 20 to 50 B, and the bottom subsided faster with indications of a very high rate. The compensation depth of calcite was reached during the Upper Triassic-Lower Liassic in the axial zone of the basin and in the Upper Liassic-Lower Dogger as regards the western flank. Once the calcite compensation depth has been passed authigenic carbonates could not be formed anymore and the deposits consisted exclusively of abyssal clays and radiolarian ooze, to which were occasionally added calcareous turbidites derived from the platforms. The rate of sedimentation

underwent an abrupt decrease and was reduced to values between 1 and 5 B in the axial zone of the basin where turbidites are not intercalated to the holopelagic deposits. Under these conditions the basin represented all the characteristics that led Auboin to define this phase of the evolution of the basin as the "phase of non-deposition". During the Tithonian-Neocomian transition the character and type of sedimentation changed, whereby the predominantly organic deposits of the Jurassic (radiolarites) were replaced by pelitic clastics (argillites) with periods of turbiditic activity (calcareous breccias granded and so-called "allodapici" limestones). The rate of sedimentation underwent a sudden increase with values of 7 to 10 B.

During the Lower and Upper Cretaceous, the bottom of the basin remained within the range of the compensation depth of calcite. From the Upper Senonian onward the bottom was without doubt above this level although it remained at a noteworthy depth. From the Senonian to the Aquitanian the rate of sedimentation in the western flank of the basin is around 5 B. Reliable data for the axial zone are not available but an estimate around 1.5 to 2 B can be made.

PHASE OF FILLING

A fast change in the type of sedimentation took place in the Aquitanian and this resulted in the replacing of the clastic calcareous deposits by terrigenous clastics with flysch characteristics (Numidico Flysch). In this stage the pre-orogenic period was finished and the basin became part of the areas involved in tectogenic processes.

In the course of the sedimentation of the "flysch Numidico" the western flank of the basin was over thrusted by the deposits of the Campano-Lucana platform and was, in turn, thrusted over the axial part of the basin. Contemporaneously, by gravity, packets of sediments deriving from more inland terrains were put in place. (Cilento Flysch and Varicolored Shales). In such newly formed basins, sedimentation went on with deposition of the unconformable "Irpini flysches". Only on the eastern flank did sedimentation continue without interruption until the Tortonian ("Dauna flysch") when finally even this area became involved in the general orogenic processes and became part of the Chain of the Apennines.

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