Δελτίο της Ελληνικής Γεωλογικής Εταιρίας, Τομ. XXXIV/4, 1493-1501, 2001 Bulletin of the Geological Society of Greece, Vol. XXXIV/4, 1493-1501, 2001
Πρακτικά 9ου Διεθνούς Συνεδρίου, Αθήνα, Σεπτέμβριος 2001 Proceedings of the 9th International Congress, Athens, September 2001

THE INTERPRETATION OF SEISMIC FACIES IN THE MOLASSIC DEPOSITION OF PREADRIATIC FOREDEEP

A. GJIKA[1], S. GURI[1], M. GURI[2], M. GJIKA[1], E. TRIFONI[1]

ABSTRACT

The purpose of this article is to illustrate the principles of seismic facie analysis used in the interpretation of sedimentary rocks, in siliciclastic deposits, especially in molassic one.

The recognition and definition of a seismic facies and the analysis of its vertical evolution (facies associations) lead to an environmental interpretation, which can give useful information on both sedimentary facies and reservoir characteristics.

With this aim, the major depositional systems, from continental to deep marine, and the depositional elements in which they can be subdivided, will be briefly overviewed in terms of extension, geometry, continuity and lateral variations.

For each of these systems, it is pointed out, the major physical active processes during the deposition, the resulting sedimentary structures and their vertical and lateral evolution.

The comparison between the environmental interpretation derived from bottom cores, well - logs and that derived from the current depositional models, is used to predict the nature and distribution of reservoir and sealing rocks.

KEY WORDS: depositional sequence, seismic facies, reflection terminations, sequence boundary, system tracts, reflection configuration ratio, sea level changes, molassic, PreAdriatic foredeep.

INTRODUCTION

The aim of this paper is to present an analysis of seismic facie of siliciclastic deposits, especially the molasses ones, in PreAdriatic foredeep.

The seismic facies analyses is a new approach and many of phenomena are already better explained. Many paleogeographycal and structural studies, in this region have been performed,(Guri S., Gjika A., 1989), but using applied seismic facies analyses method the facies and paleoenvironments geometry have been performed and very often gives, especially on molassic deposits, possible predictions on reservoirs quality. All indicators data of multidiscipline (seismic, paleontology, sedimentology, etc.) are integrated.

Based on deep processing seismic lines, by interpreting the reflection terminations (downlap, onlap, toplap, erosional truncation, apparent truncation ect.), (AAPG, Memoir - 26), it is attained to identify:

- The sequence boundary of basal surface type (Sb_1 or Sb_2)
- The boundary surfaces such as downlap, transgression and flooding ones
- System tracts and seismic facie within siliciclastic sequences

In each sequence, it is analysed:

a. The eustasy (sea level changes)
b. The reflection configuration, such as sheet, hummocky, oblic, sigmoid, parallel to sub parallel, divergent ect.
c. Main facies and paleoenvironments

Due to baselap + toplap / reflection configuration ratio, a certain numbers of seismic facie maps are compiled.

THE GEOLOGICAL SETTING

The periAdriatic foredeep is a well studied region from the geological point of view, where the contribution of seismic facies analyses is of great importance. In stratigraphic aspect, it originates since Serravalian, and it is represented by a premolassic and a molassic facie. (Arapi M., et al, 1994)

South Adriatic basin and Ionian one take part in the geological constitution of the study area, where the

1. Oil and Gas Institute, Lagja 1 Maj, Fier, ALBANIA
2. Albanian Geological Survey, Tirana, ALBANIA

PreAdriatic foredeep is in concordance with these basins, but in discordance and transgressive in their borders. (Fig. 1). It is formed in a compressional regime.

SEQUENTIAL STRATIGRAPHY

CRITERIA OF CORRELATION

The correlation of depositional units is based on the combination of seismic data with biostratigraphical one. In local correlation, the well - logs are used, too.

In a regional context, the microfacies and biozones, seismic facies and reflection termination have been used as a criterion in the evaluation of sequence boundaries, downlap surfaces, transgression surfaces and maximum flooding.

By means of seismic facies parameters it is attained to be individualized the genetic units, such as depositional sequences and system tracts.

In molassic formation, ten sequences of third and forth order are individualized, which correspond to the base of stages or respectively to the biozone's bases. It happens to be more than two or three sequences in one stage, as in Tortonian, lower Pliocene and Quaternary. (Fig. 2)

Based on numerous seismic data and many well - logs, these sequences compound the most recognizable ones. (Dhimulla I., et al, 1989)

SERRAVALIAN SEQUENCE

In the eastern part of the PAF, near the front of the orogen, the chaotic and the reflections free one are the most characteristic internal reflection patterns, whereas the high continuity and low amplitude reflection is observed westward.

The model c – c / p (c – c the concordance in the upper and lower parts of the sequence, p – the parallel internal reflection configuration) is the main seismic facie of this sequence, but it is also present another seismic facie according to the model onlap – toplap / sigmoid – progradational internal reflection configuration.

It is also observed:

- The presence of primary sedimentary structures, such as flute cast, groove cast, ball and pillow structure, clay balls, immature minerals.
- A sedimentation bathymetry, from ecological point of view of 700 – 800 m
- A poor well sorted and graded bedding sandstones with a low matrix – grains ratio
- A marine offlap and marine onlap
- A shale prone facie intercalated with channel or thin capricious sandstones

By integrating the above-mentioned data, we draw the conclusion that the sedimentation is controlled by turbidite currents. The basin and slope fans of lowstand system tracts predominate in this sequence.(Fig. 3)

TORTONIAN SEQUENCES

Two sequences of third order are identified in this stage. A parallel to sub parallel internal reflection configuration is the main feature of the seismic facie in Tortonian basin borders, on the over thrusted zones.

In this part, in whole the seismic lines, onlap and toplap reflection termination is encountered on the base and below the top of sequence boundary. The most common characteristic of reflection is the high continuity and high amplitude. In the cases of deltaic sedimentation, a low continuity and moderate amplitude is present.

A divergent to oblique – sigmoid complex reflection configuration, or slope front fill are distinguished westward, where a moderate to high continuity and high amplitude characterize the morphology beyond the shelf edge.

Toward the depocenter, there are generally separated the mounded external reflection forms with variable continuity and amplitude, somewhere else with drape external reflection form accompanied by high continuity and low to moderate amplitude.

Together with the multidisciplinary data, such as:

- The presence of considerable sandstones just in the base of sequence
- The sedimentary package onlaping toward the slope in the east

Is done possible to be individualized the slope and basin floor fans.

The second sequence of Tortonian has the same features, but the facies itself migrate toward the depocenter. Besides this, the geometry of fan system (outer, middle and inner parts), as well as the deltaic sedimentation are identified and shaped based on the well data and seismic facies. (Guri S., Gjika A. 1992)

As a result, in the Tortonian sequences, the lowstand and highstand system tracts for the northern part of PAF onshore and the lowstand and transgressive system tracts for the southern part are distinguished.

MESSINIANE SEQUENCE

It corresponds with Messinian stage or G. Conomiozea biozones. The lower boundary of this sequence is of Sb_1 type, as it is evidenced by:

- The reflection termination, as marine and coastal onlap
- Erosional truncation under it
- The exposure of the majority part of the shelf

A basin flore fan with external reflection configuration as a mound, and compounded of many sandstones bodies is observed and contoured.

A diversity seismic facie is laterally developing from east to west, or from basin margins to the depocenter of the basin. (Fig. 4)

THE ONLAP AND TOPLAP REFLECTIONS TERMINATION ARE ENCOUNTERED ON THE BASE AND UNDER THE TOP OF SEQUENCE BOUNDARY. THE MOST COMMON CHARACTERISTIC OF REFLECTION IS THE HIGH CONTINUITY AND HIGH AMPLITUDE, WHICH ARE PRESENTED AS PARALLEL TO DIVERGENT. THE SEISMIC FACIE PARAMETERS RATIO, COMBINED WITH THE PALEOGEOGRAPHICAL MAPS, IN THIS CASE INDICATES SHELF CONDITION SEDIMENTATION.

Another type of seismic facie, such as oblique – sigmoid complex reflection configuration, or slope front fill is distinguished westward, from a moderate to high continuity and amplitude, which characterizes the morphology beyond the shelf edge. (seismic line 17/89 fig.3)

Toward the depocenter, there are generally separated the mounded external reflection forms with variable continuity and amplitude, somewhere else with drape external reflection form accompanied by high continuity and low to moderate amplitude.

Hereon, all the system tracts of a depositional sequence, including the late highstand are preserved and encountered.

This is depicted by the seismic facies interpretation, as well.

PLIOCENE SEQUENCES

This sequence occurs immediately after a rapid falling of the sea level at the end of upper Miocene.

It is proved by encountering a sequence boundary of Sb1 type, on the over thrusting zones, where this boundary surface is onlapped and toplapped by seismic reflection groups.

In the onshore of the PAF, the transgressive and highstand system tracts are represented. The lowstand is thought to be developed in the Albania offshore.

Parallel to sub parallel reflection going to divergent one have been distinguished more westward than the former sequence.

A retrogradational facie is distinguished in the Albania onshore over the orogen and a progradational one (oblique and sigmoid one) is encountered near the seacoast.

We come across the same seismic facie parameters ratio, with the exception that they represent a sedimentary facie always in a more restricted basin, westwards.

QUATERNARY SEQUENCES

THE FIRST SEQUENCE

This sequence took place soon after the sea level fall at the end of upper Pliocene, as it is presented in the global sea level changes Charts, too.

In our basin, it is confirmed by evidencing a sequence boundary of Sb1 type, near Karavasta lagoon, where this boundary surface is onlapped and toplapped by seismic reflections groups.

This boundary belongs to a new sequence. The Quaternary base is correlated through regional seismic lines of Albanian offshore with the accepted Quaternary base of Italian offshore. (Fig. 5)

A progradational facie (oblique and sigmoid one) is encountered in the middle of Adriatic Sea, in concordance with the slope morphology.

Together with some other data, it is resulted that the first Quaternary sedimentation belongs to lowstand system tracts.

Then, we come across in the Albanian onshore (seismic line 192/89) the transgressive and highstand system tracts "expressed" by a distinctive unconformity near the sea coast (in the western side of the neogenic anticline structures).

An aggradational facie accompanied by strong and continuous seismic reflections must indicate shelf condition sedimentation of highstand system tracts.

THE SECOND SEQUENCE

The second depositional sequence took place 800 thousand years ago. Its boundary surface is encountered in both sides of Quaternary basin (offshore seismic lines), where onlapped reflection terminations are observed.

The nature of reflections and their geometry indicates an inner shelf sedimentation (Albania onshore) and an outer shelf to basin sedimentation (Albania-Italian offshore).

Parts of transgressive and highstand system tracts, with predominant fluvial processes, can be interpreted in the study area. The sedimentary environments (alluvial plain, deltaic plain, lagoon, marshes, delta fronts) migrate westward to younger stratigraphic levels.

THE THIRD SEQUENCE

The third sequence belongs to Holocene and has just taken place with its sediments not farther than 0.05 million years ago. It's no evidence of the lowstand system tract away in offshore, but we can deal with that of highstand in our study area. The presence of fluvial processes is typical, and better preserved than in the older sequences.

CONCLUSION

1. The depositional sequences belong generally to type – 1, with Sb_1 basal boundary and rarely of Sb_2 type.
2. The lowstand system tracts is more preserved, but the highstand took place almost in the whole depositional sequences and it is dominant in the younger ones (since Tortonian onwards).
3. A reliable and a resistible correlation of genetically related units according to chronostratigraphic significance is obtained.
4. Through seismic facie parameters, sedimentary environments with their respective facie are evaluated.
5. The unconformities of each sequence are encountered in the sedimentary basin extremities, which migrate on younger time toward the depocenter.
6. The geometry of fan system (outer, middle and inner parts), as well as the deltaic sedimentation are identified and shaped due to the drilled well and seismic facie.

REFERENCES:

ARAPI M. (1994) The geological framework and the oil - gas bearing in the South Adriatic basin. Oil and Gas Institute, Fund.

BALLY A. (1989) Plate tectonics, structural styles and the evolution of sedimentary basins. Oil and Gas Institute, Library.

DHIMULLA I., TUSHE D., MEHILLKA LL. (1989) The structural model of external Albanides. Oil and Gas Institute, Fund.

AAPG Memoir 26, 36, 39, and 42. Oil and Gas Institute, Library.

GURI S., GJIKA A. (1989) The molassic basin analyses of PAF. Oil and Gas Institute, Fund.

GURI S., GJIKA A. (1992) The interpretation of sequence stratigraphy in molassic deposits of PAF. Oil and Gas Institute, Fund.

GURI S., DHIMA S. (1995) The geodynamic of Albanides. Black sea Conference, Sofia, Bulgaria. Oil and Gas Institute, Fund.

A SCHEME OF MOLASSIC BASIN IN PAF

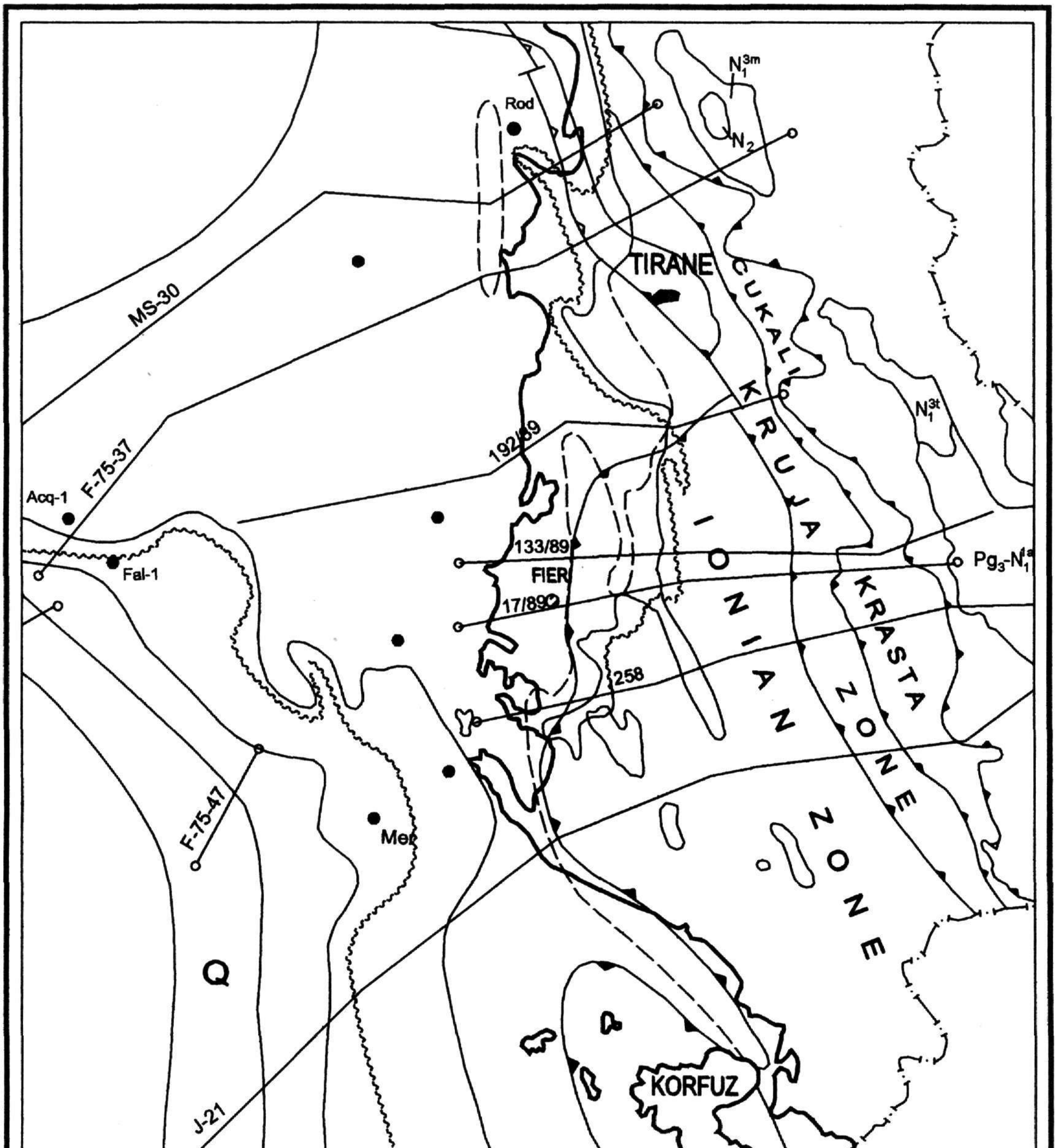

Fig. 1.

GENERALIZED STRATIGRAPHICAL COLUMN OF NEOGEN IN SOUTH ADRIATIC BASIN

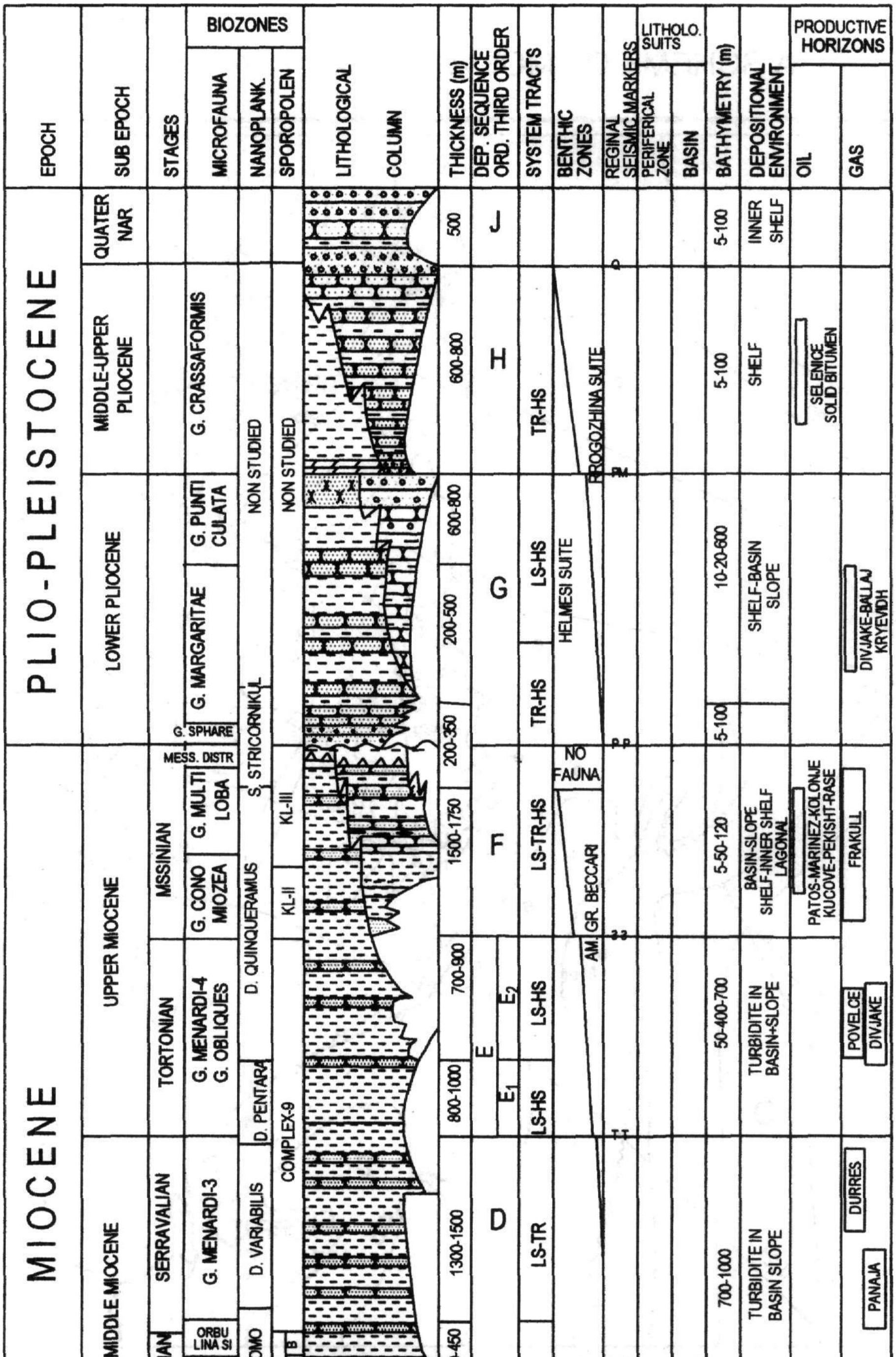

Fig. 2.

INTERPRETATION OF SEISMIC FACIE 17/89

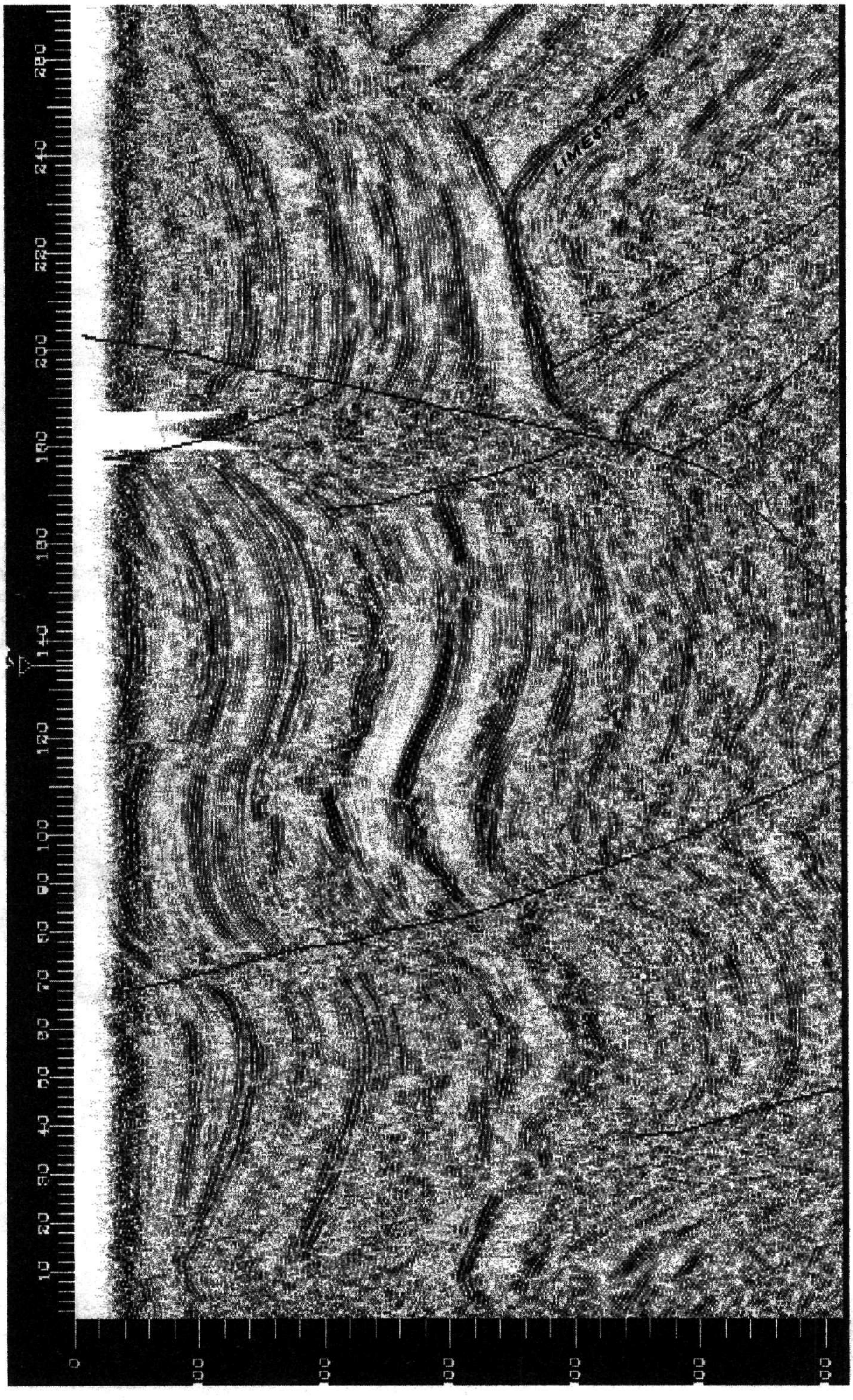

Fig. 3.

Seismic facie Map of upper Miocene in PreAdriatic Foredeep

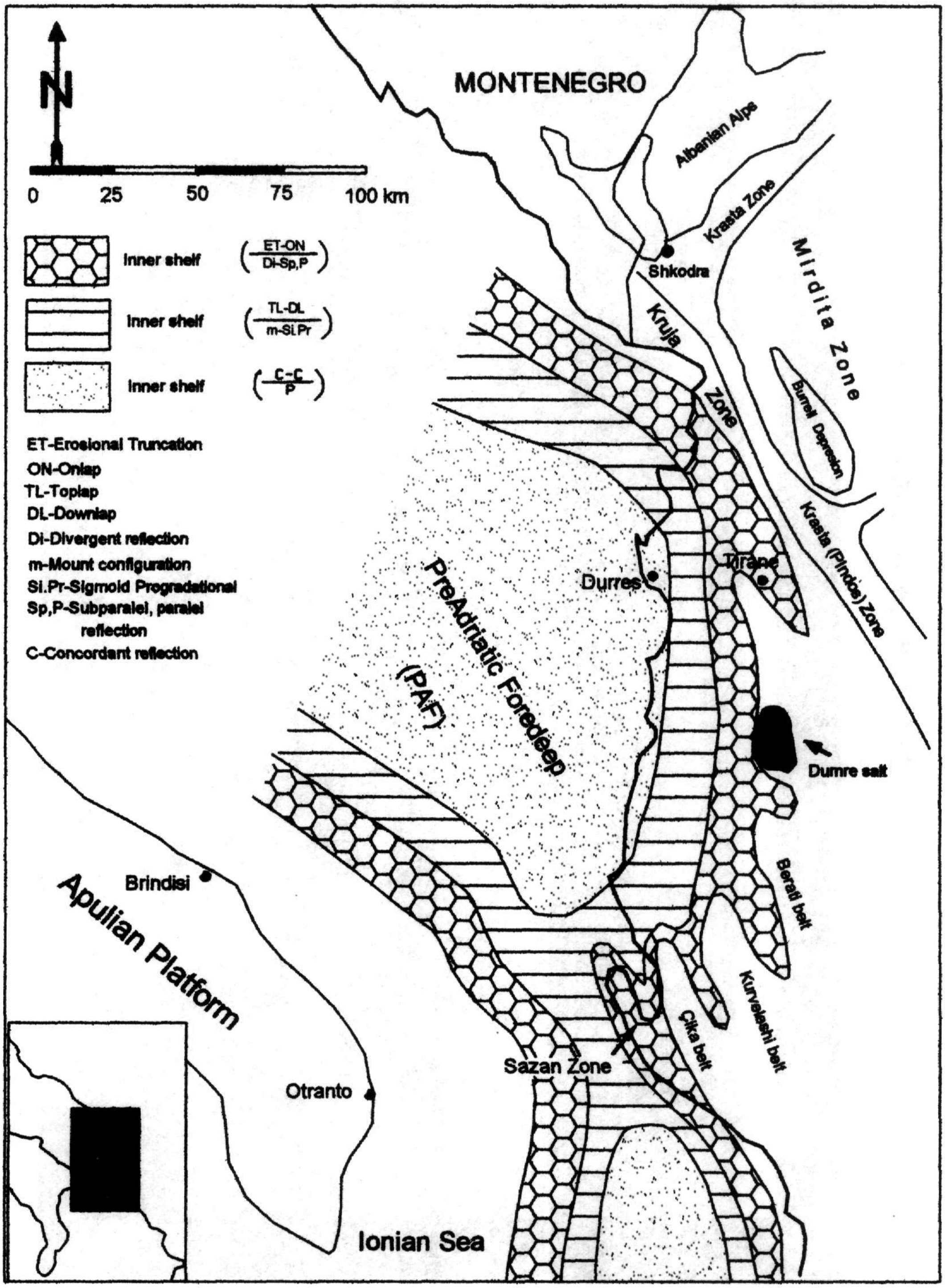

Fig. 4.

Seismic facie Map of Quaternary Deposits in PreAdriatic Depression

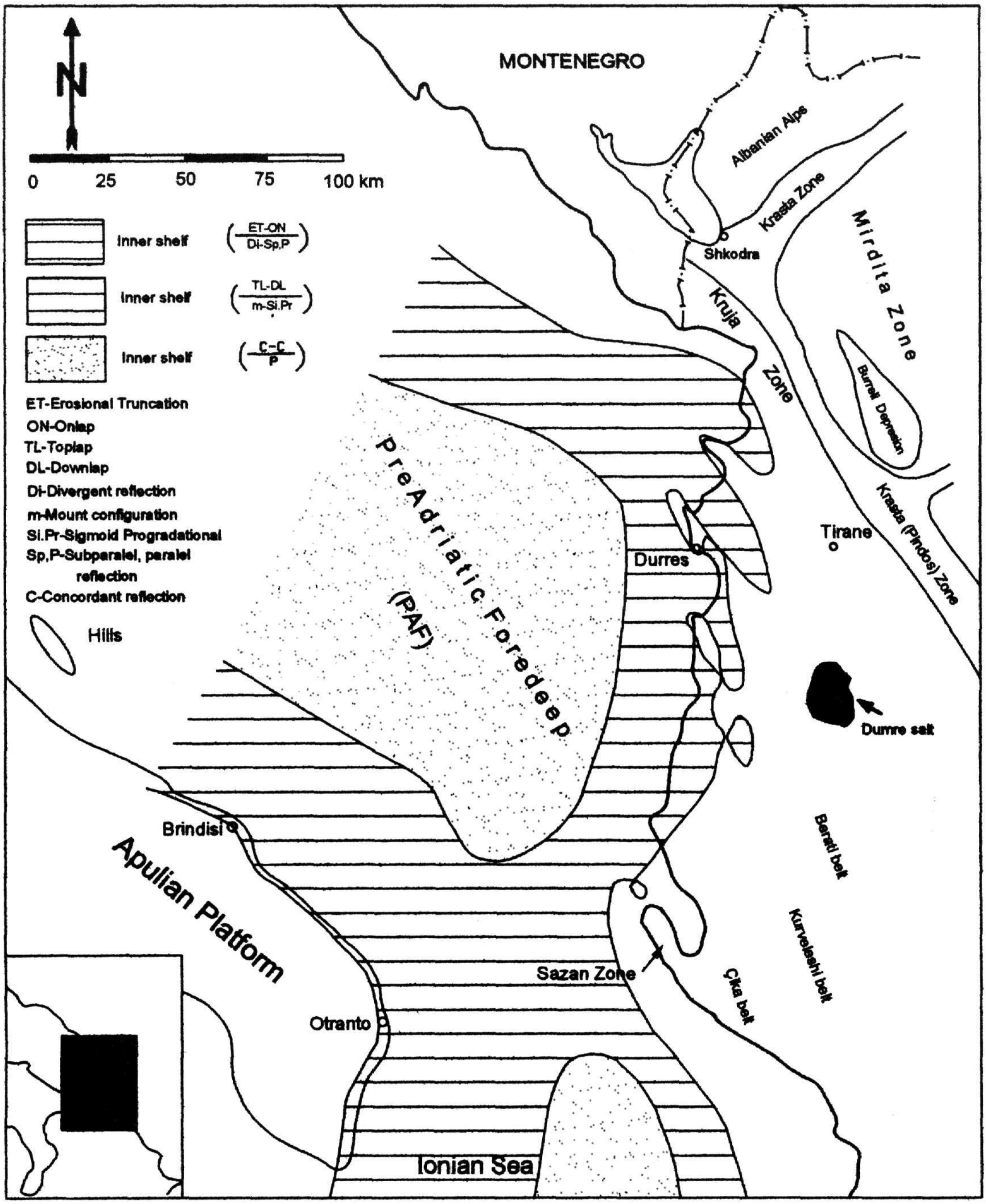

Fig. 5.