BACK THRUST OF MOLASSE DEPOSITS IN WESTERN ALBANIA

MEÇAJ Majlinda, DURMISHI Çerçis, PRIFTI Irakli

Abstract. The back thrust of molasse deposits in western Albania has been studied based on geological and geophysical methods as well as by borehole data. These studies pointed out that the External Albanides are mainly composed of westward thrusting structures. We shall try to explain back thrust of the molasse deposits in the Peri-Adriatic Depression. Based on the age of the deformed deposits, it results that the final shapes of the back thrusts were formed in and post-Pliocene. The main control factors of back thrusts are the buried overthrust (involved during pre-Serravalian tectogenic phase) and their westward movements. Here, the initial point of back thrust formation and development is related with the early stage of tip line of the orogene movements. A typical example to be analysed and for which we provide a lotof clear data is the Preza back thrust. The most advanced part of the back thrust occurred on that area where the duration of thrusting was longer. In our case because of westward thrusting, which produce westward curving features (westward curving of the thrust front), the back thrust response is eastward curving. That is why we do see only eastward curving of the back thrusts. Several back thrusts in a certain area, which appear like stair-case geometry, are having an overall single fault plane on a deeper cut (Back thrust at North of Shkumbini Area). The major back thrust is expected to be the most advanced one. In the western flank sometimes secondary faults are observed, due to compression and folding of deposits. These faults are observed near to the most uplifted part (crests area) of the back thrusts, giving the wrong impression of a flower structure.

Keywords: back thrust, westward thrusting, fault, Albania.

Rezumat. Forţa din spate a depozitelor de molasă din vestul Albaniei. Forţa din spate a depozitelor de molasă din vestul Albaniei a fost studiată pe baza metodelor geologice şi geofizice, precum şi a informaţiilor din forajele. Aceste studii au subliniat că Albanidele externe sunt compuse în principal din structuri de împingere spre vest. Vom încerca să explicăm împingerea depozitelor de molasă din Depresiunea Peri-Adriatică. Pe baza vârstei depozitelor deformate, rezultă că forma finală a tracţiunilor spate a fost definitivată în - şi post-Pliocen. Principalii factori de control al împingerilor înapoi sunt încălecarea îngropată (implicată în faza tectogenică pre-serravaliană) şi mişcările spre vest. Aici, punctul iniţial al formării şi dezvoltării împingerii în spate este legat de stadiul incipient al liniei de vârf a mişcărilor orogene. Un exemplu tipic care trebuie analizat şi pentru care aducem o mulţime de date clare este forţa de întoarcere Preza. Cea mai avansată parte a tracţiunii în spate a avut loc în zona în care durata de împingere a fost mai lungă. În cazul nostru, din cauza împingerii spre vest, care produce caracteristici înclinate către vest (curbarea spre vest a frontului de împingere), răspunsul de împingere a spatelui este curbarea spre est. Acesta este motivul pentru care vedem doar curbarea spre est a spatelui. Câteva împingeri din spate într-o anumită zonă, care par a fi scari geometrice, au un singur plan general de faliere atunci când se taie mai adânc (Împingerea de la nord de Shkumbini Area). Se aşteaptă ca forţa majoră împingere să fie cea mai avansată. În flancul de vest se observă uneori falii secundare, datorită comprimării şi plierii depunerilor. Aceste falii sunt observate în apropierea celei mai ridicate părţi (zona fisurilor) a tracţiunilor din spate, dând impresia greşită a unei structuri de floare.

Cuvinte cheie: împingere înapoi, împingere spre vest, falie, Albania.

INTRODUCTION

The western areas of the External Albanides are mainly composed of westward thrusting structures. The faulting planes are dipping eastward, generally not exceeding 35°- 40°. In almost all cases, these faults stop below the pre-Serravalian erosion surface. Only in a few case the activation in later deposits has been recognized. The erosion surface of the Upper Oligocene deposits is noticeable in some cases, along with the transgressing surface of Burdigalian deposits in many uplifted structures, the pre-Serravalian deep erosion with its transgressive surface, all over the western pre-mountainous part of Albanides. This phenomenon show that the main folding and uplifting phase took place prior to Serravalian (Oligocene-Miocene tectonic phase).

Triassic salt alongside the major faults or as massive diapers acted as sliding surfaces during the westward horizontal movements phase. This period of time is characterized not only by structural compression and folding, but also by their westward slipping on considerable distances. This slipping continued even during younger geological times (post-Pliocene) and in our opinion, it was responsible in the Neogene structuring and faulting, starting from Serravalian (BEGA et al., 1995).

We shall try to explain the back thrust phenomenon of the molasse deposits of the Peri-Adriatic Depression. Theoretically, the main cause of back thrusts concerns the buried overthrusts (MCCLAY, 1992; FISCHER & WOODWARD, 1992). The buried overthrusts are, in our opinion, the initiating control factors of back thrusts.

The configuration of the back thrusts is controlled by their horizontal slipping and transfer faults (Shkoder-Peje and Vlora-Diber transverse faults). Hence, back thrusts took place as a result of the pre-Serravalian basement.

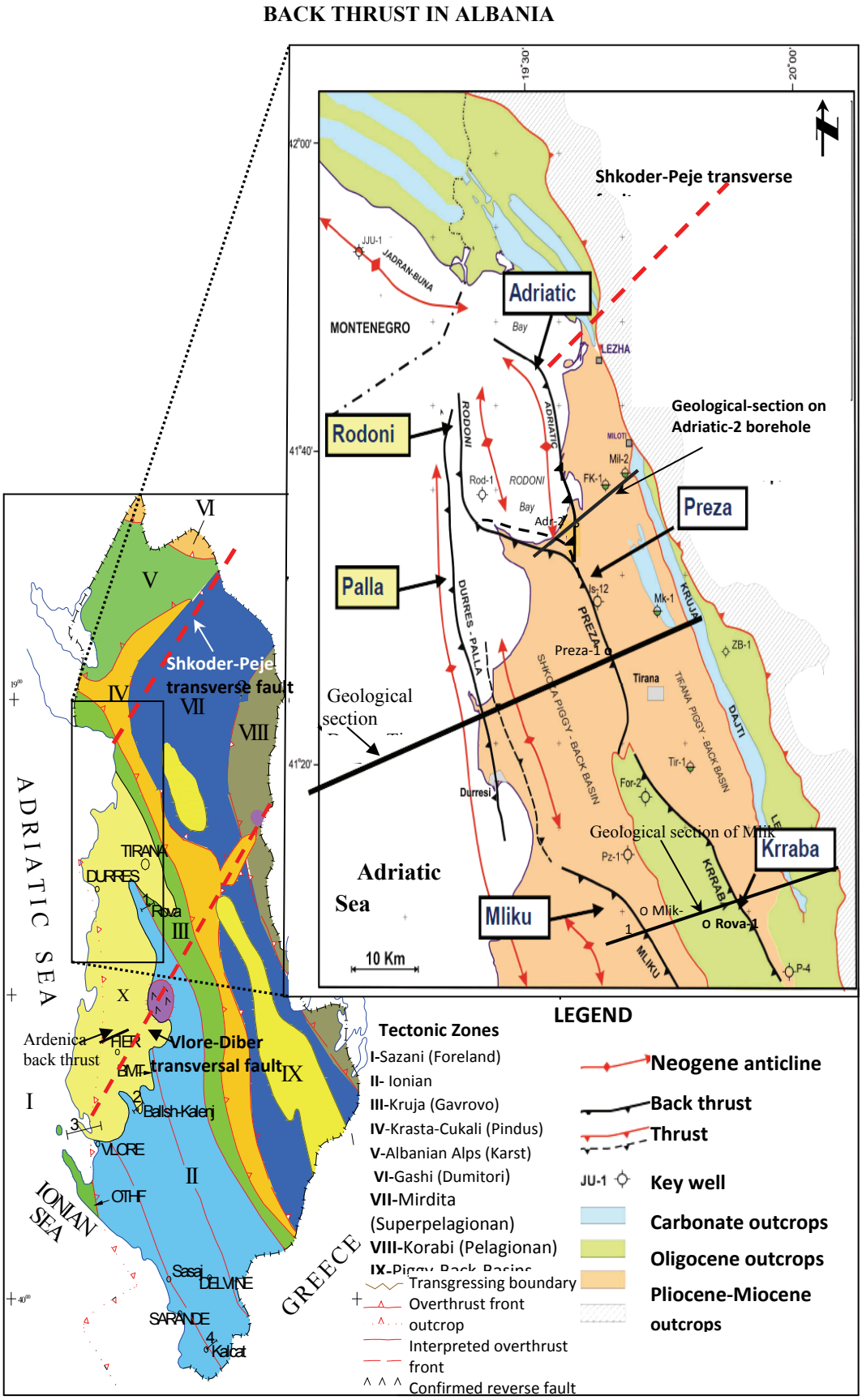

Figure 1. Back thrust sections on the tectonic map of Albania (XHOMO et al., 2002).

Back thrusts are recognized in many areas such as in Preza, Durres, Mlik, Ardenica etc. (Fig.1). Seismic data, sometimes nice outcrops and deep wells data contributed to better explain and define their behavior. Satellite spot images added a contribution in recognizing them in the External Albanides, as well. Preza, Durresi and Ardenica back thrusts are documented by deep wells, while Mlik back thrust relies on the outcrops dipping westward, as well as on seismic sections. Based on the age of the deformed deposits, it results that the final shapes of the back thrusts formed in and post-Pliocene.

Preza back thrust

The main causes of back thrusts are buried overthrusts (involved during pre-Serravalian tectogenesis) and their westward movements. Here, the initial point of back thrust formation and development is related with the early stage of the tip line of the orogene. A typical example to be analyzed and for which we possess lots and clear data is Preza back thrust (BEGA & JANOPULLI, 1995).

The geological phenomenon of Preza is known by the Albanian geologists as the "Preza monocline". Seismic and drilling data at the Preza-1 well (geological formations crossed by Preza-1well: 0–950 m Tortonian; 950–1250 m Messinian–Tortonian; 1250–2150 m Tortonian; 2150–2400 m Serravalian) evidence the back thrust fault plane dipping westward. The Preza-1 well crossed Serravalian turbiditic deposits (dominant clayish, with few interbedded sandstone), into the deltaic deposits (Fig. 2).

Seismic sections show different dipping events. In the West of the Preza-1 well, the Miocene dips are westward, whereas obviously in the East the Miocene is almost flat. Molasse deposits of the Tirana-Ishmi Depression have a wide spread distribution on the East of Preza back thrust. They lay transgressively on top of the carbonate and flysch deposits of the Kruja Zone (BEGA, 2013).

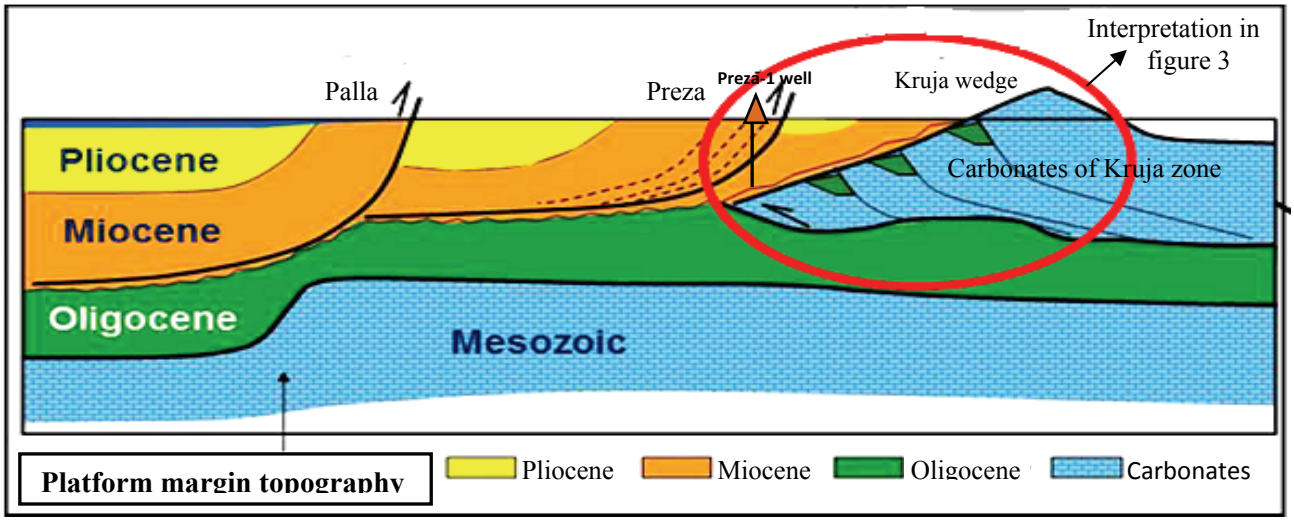

Figure 2. Back thrusts of Miocene section from Durres to Tirana (Palla to Preza).

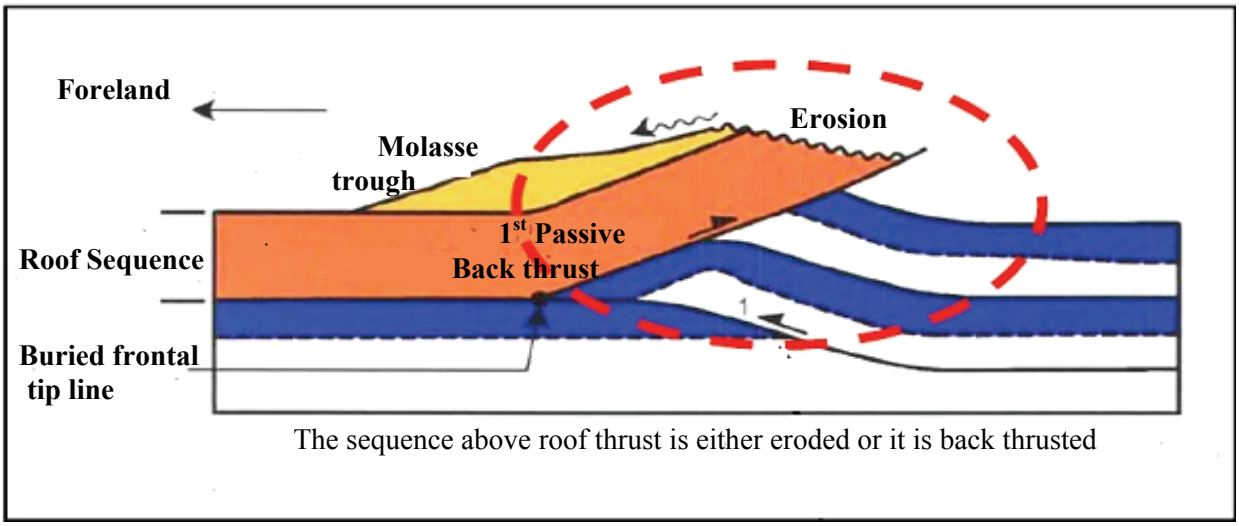

Figure 3. Interpretation of the Preza back thrust (based on FISCHER & WOODWARD, 1992).

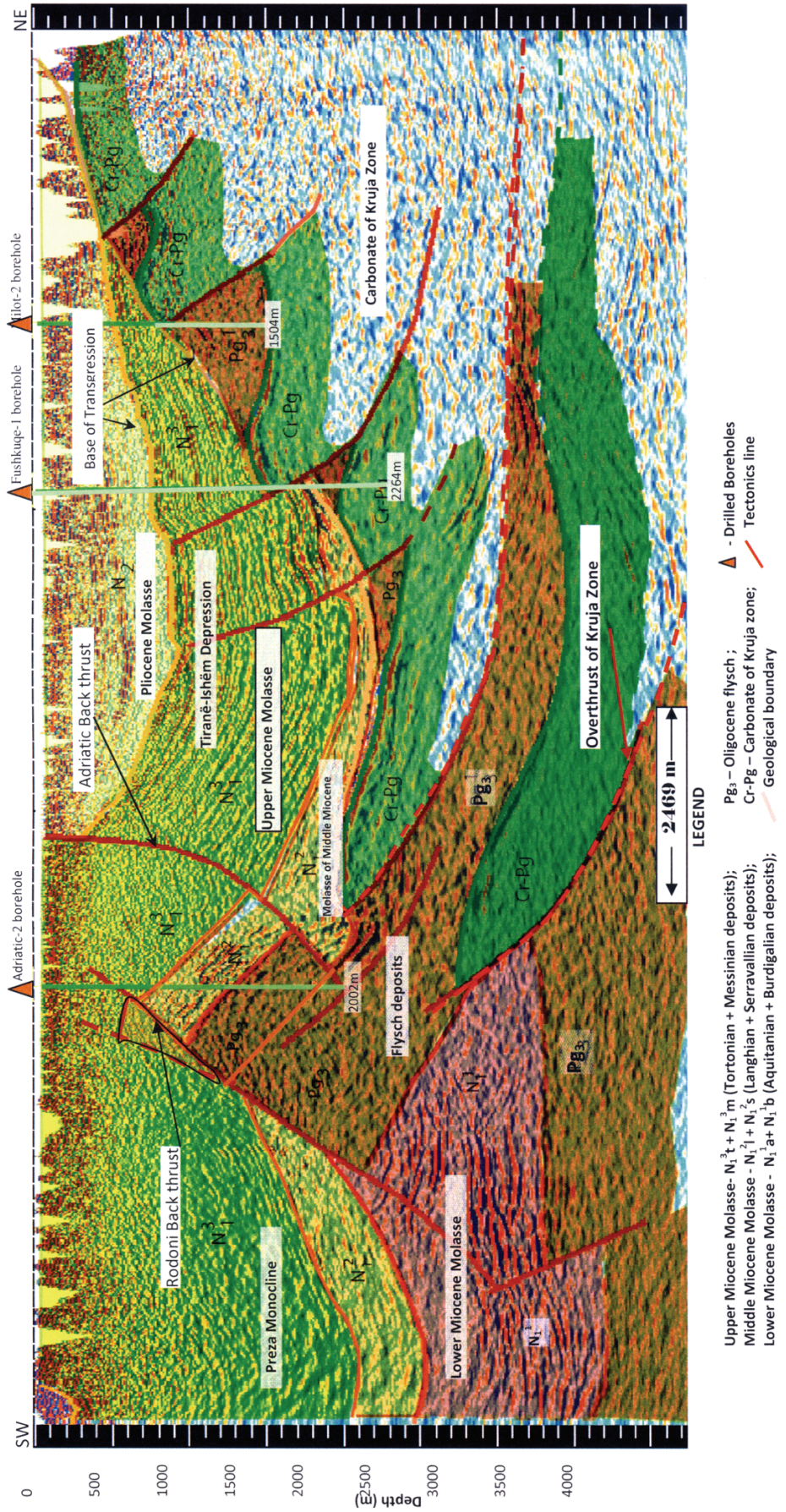

Figure 4. Geophysical section in the Rodon area (SILO et al., 2009)

Transgression is recorded in many borehole logs and it is obviously seen also on the seismic sections. Underneath transgression, the pre-Serravalian structure of Kruja Zone is distinguished, as well as the deep erosion of the carbonate structures of Kruja Zone (Figs. 2, 3). Faults formed exactly during this time, the structures were above the sea level (before Serravalian).

After erosion and subsidence took place, the molasse deposition started, where the littoral-lagoon and deltaic sedimentation played a major part.

The delta has advanced gradually towards West until the end of Miocene. This delta facies remains part of the actually western flank of Preza back thrust. During that time, the Preza back thrust and the Tirana- Ishmi Depression was a single, undivided basin. The same situation lasted even later, during Pliocene, despite the fact that a large part of Tirana-Ishmi Depression area remained emerged.

In the pre-Pliocene phase, after studying the cross section, it results that we have to deal with a non-folding uplift movement and horizontal movement. However, the biggest horizontal shift that caused the Preza back thrust with the above-mentioned characteristics happened in Pliocene and post-Pliocene (Fig. 2). It might have happened that at this period of time Preza was uplifted and, later on the erosion has brought about separation of depositions, especially the deltaic ones, which are continuous and uninterrupted depositions (GURI et al., 2002)

The back thrust of Preza in the position of the Adriatic-2 well is divided into two back thrusts; Rodoni and Adriatic back thrusts (Figs. 2, 4). This division is conditioned by several factors:

- the impact of Shkoder-Peja transverse tectonic line,
- the influence of the overthrust of the Kruja zone,
- high sedimentation rates,
- influence of the Apulia plate eastward.

Other back thrusts

The Durres back thrust. It is verified in deep wells, and it is clearly observed in the seismic sections. It has the same trend (S-N) as the Preza back thrust. To the East of the back thrust, Pliocene deposits are common with the Tortonian ones. Part of the Tortonian deposits is eroded alongside the ridge. According to the available seismic data even this back thrust is due to horizontal movements of the pre-Serravalian structuring, which are predicted as buried and to the East of the back thrust track.

The Mliku back thrust. It is difficult to be detected, though being outcropped well with westward dipping deposition. The seismic sections are very helpful for showing these westward dipping events, which support the back thrust. There are some of these events which are observed from one place to another. On the West a normal fault takes place also due to the compression of deposits, during the same time the back thrust was developed (Fig. 5).

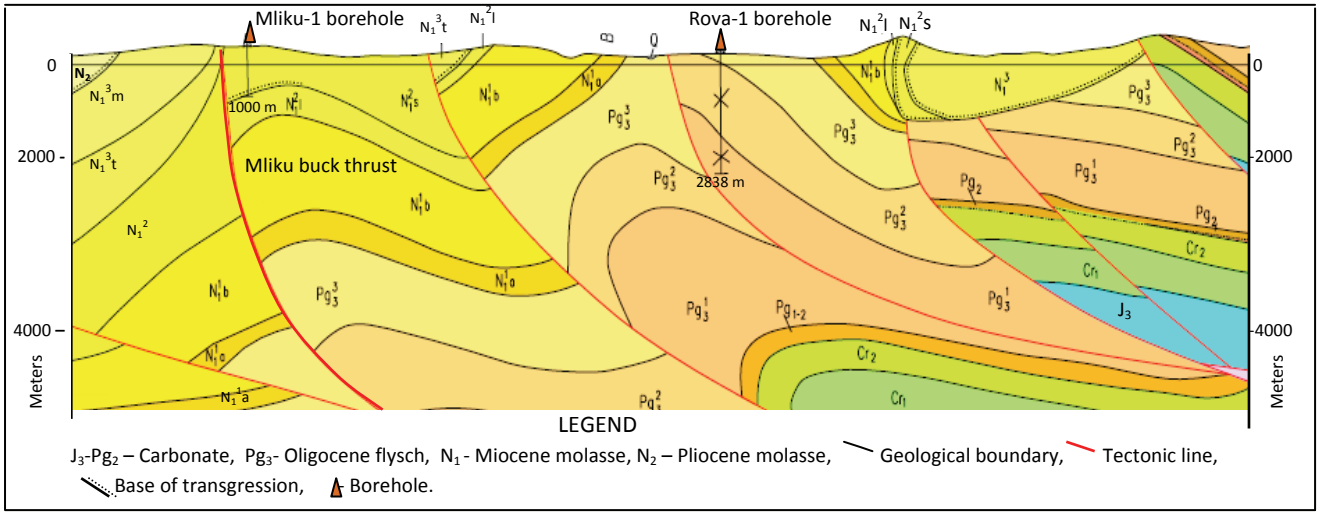

Figure 5. Mlik back thrust of Miocene deposits.

The Ardenica back thrust. It is proved by deep wells (Ard-18 well etc.) and as well as by many seismic sections. The origin of this back thrust is easy to be understood, because to the east of there is the buried big Patos-Verbas anticline of pre-Serravalian age. Westward, the folding and thrusting of other units are detectable (Fig. 6).

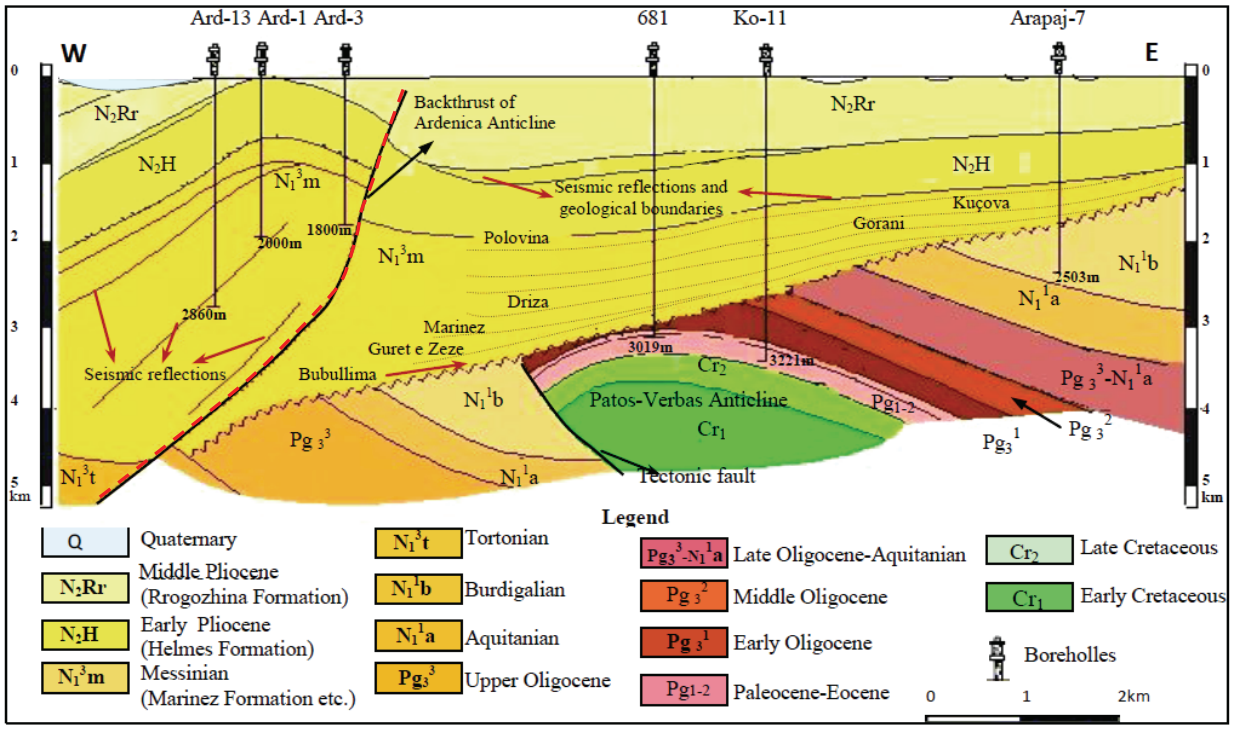

Figure 6. Back thrust of Ardenica anticline (based on PRIFTI & DORRE, 2015).

The most advanced part of the back thrust occurred on that area where the duration of thrusting has been longer. In our case, because of westward thrusting, which produces westward curving features (westward curving of the thrust front), the back thrust response is eastward curving. Several back thrusts in a certain area, which appear like stair-case geometry, are having an overall single fault plane when cutting deeper. The main backt hrust should be the most advanced.

In the western flank sometimes secondary faults (normal faulting) are noticed, due to compression and folding of deposits. These faults are observed near to the most uplifted part of the back thrusts, which giving the wrong impression of a flower structure.

CONCLUSIONS

The main cause of the back thrusts are the buried thrust fronts of the Kruja and Ionian structures. The origin (first tracks) of the back thrusts seems happened during pre-Serravalian thrusting and folding, while their final shape is post-Pliocene, because of horizontal movements.

In most of the cases, back thrusts are considered as stair-case geometry, but the major one is the most-eastern-advanced one. The outcrop dips are very steep, some time overturned. They gradually smooth down, when going deeper. The upper parts of the back thrusts are very important for gas exploration.

Back thrusts are considered to be indirect indicators of orogenic structures, beneath and nearby them (more to the east), in which the most advanced and uplifted area should be related with the duration of early orogeny.

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