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Review article

New ideas on the tectonic of the Kurveleshi anticlinal belt in Albania, and the perspective for exploration in its subthrust

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ABSTRACT

The external thrustbelt of Albania consists of some tectonic zones (Ionian, Kruja and Krasta-Cukali zones), that are westward overthrust, with a large amplitude (50–100 km), above the Apulian platform and South Adriatic Basin. The relative movement of the Adriatico-Apulian sub-plate between, the Euro Asiatic and African plates during from the Mesozoic to the Tertiary period, mainly controlled the tectonic evolution of the Albanides. The Ionian zone consists of anticline belts (Berati, Kurveleshi and Cika), that are overthrust toward the west with an amplitude about 20–30 km Their overthrustings was realized through regional sliding evaporitic horizons, which caused the masking of folded structures in the subthrust, with the perspective plays.

The Kurveleshi anticlinal belt represents a mega-anticlinal with a length of 210 km and a width of about 20 km, and it is characterized by anticline structures with heterogeneous dimensions, predominantly those of great dimensions and linear type. The overthrusting of the anticline units has a local character, and it is more developed in the Kurveleshi anticlinal belt. Its magnitude is about 8–10 km. As a result of these overthrusts, imbrication and duplex styles are formed, leadind to the masking of the subthrust complex with structures of large interest (e.g. Delvina, Karbunara, etc.) where two oil fields have been dioscovered beneath the Mali Gjere anticline (Delvina oil field) and the Kremenara anticline (Karbunara oil field). Backthrust faults phenomena are secondary and they taken place in the post-collision stage. Generally they are easterward thrust faults of structural units with an amplitude of 5–10 km. The Kurveleshi anticlinal belt, based on tectonic features, is divided into two parts: The southern part, from Qafa Sevaster in the north down to Greece to the south. and northern part, from Qafa Sevaster in the south up to the end of the Patos-Verbas structure.

In the southern part these features predominate: The anticline structures are large in size, and overthrust with a large amplitude (8–10 km) westward. The evaporitic diapirs have erupted through local faults of the anticline structures of the Kurveleshi anticlinal belt (Mali Gjere, Kurveleshi and Fterra anticlines). These eruptions (Delvina, Picar-Kapariel-Bashaj, etc.) have helped in the overthrusting of these structural units. It must be mentioned that the backthrusting is also affected by the diapir action. Moreover, vertical diapir occur, in the center of the structures like Navarica. In the northern part, the anticline structures are generally small to medium in size. Only the Patos-Verbas anticline is larger in size. In the Kurveleshi anticlinal belt the Ballsh and Visoka oilfields have developed. The eastern flank of the Shushica synclinal belt apears folded, and the carbonate anticline structures have developed. Existing oil fields include the Gorisht-Kocul, Cakran-Moallaj-Kreshpan and Amonica. These oil fields shoud continue towards the north (under the

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overthrust of the Patos-Verbas antcline) and in the south (under the regional ovethrust of the Kuervelesh anticlinal belt).

1. Introduction

Albania constitutes a key area for the petroleum system study in the foothills domain, where deformation is still currently active [1]. Situated on the external border of the Adriatic Sea, between the Dinarides in the north (Montenegro, etc.) and the Hellenides in the south (Greece), the Albanides constitute a segment of the wider Circum-Mediterranean peri-Thethyian thrust belt (Fig. 1).

In fact, the Albanian foothills correspond to a typical foreland fold-and-thrust belt, characterized by a west-verging thrust over the Apulia-Adriatic foreland. Geotectonically, Albania is part of the peri-Adriatic chain of the Alpine orogenic system. This system involves the Albanides-Dinarides-Hellenides and the Apennines, which are the product of their subduction and collision history and are presently separated by the Apulian-Adriatic foreland (Fig. 2) [2–5].

The Albanides-Dinarides-Hellenides are in the east of the Apulia-Adriatic foreland and characterized by double-vergent structural architecture caused by the west-verging thrust faults in the external Albanides.

The Apennines are overthrust in the east above the Apulia-Adriatic foreland. This eastward migration occurred in the middle-late Eocene to Pliocene periods [6].

Folds, thrusts and nappes are typical structures recording contractive in the orogenic belts encircling the Apulia-Adriatic foreland. Due to the continuous and unpredictable overthrusting from the east to the west, there are some tectonic nappes whose amplitudes are reduced and they move westward [7,8].

2. General information on the Albanides

2.1. Regional geology

Geologically, three main geological units (Fig. 3) can be distinguished in the Albanides: (i) the autochthonous.

Apulia-Adriatic foreland, (ii) the Albanides orogen that is divided into the external Albanides, developed in western Albania on the one hand and the internal Albanides of eastern Albania on the other hand, and (iii) the peri -Adriatic depression [7–9].

The authochthonous Apulia-Adriatic foreland (Sazani zone in Albania) is extended in the Adriatic and Ionian Sea and partly on shore (Italy, Albania and Greece), mainly under the peri-Adriatic depression and South Adriatic Basin. It is an autochthonous unit and it is partly folded and underthrust eastward under the orogen. The Sazani zone is characterized by slope-to-platform carbonate facies, with thick sequences of well-bedded rudisto-bearing Cretaceous biocalcarenites. Wells have locally reached Jurassic and Triassic dolomites. Unconformable Burdigalian clastic deposits attest to a relatively late flexural subsidence for the Sazani zone [1].

The Albanides orogen is divided into two parts.

First, there are the internal Albanides with two tectonic zones: the Korabi (Pelagonia in Greece) and Mirdita (Sub-pelagonia in Greece), which are characterized by the presence of magmatism (Upper Jurassic), many folding phases (Upper Jurassic, Eocene etc.) and total alloctony (Fig. 2). They are composed of metamorphic sequences on which post-orogenic tertiary Basins were formed (Korca and Burreli Basins), following the main phase of Alpine orogeny (Fig. 3) [10].

Second, there are the external Albanides, which include the following tectonic zones: the Ionian zone (Ionian in Greece), the Kruja zone (Dalmatian in Montenegro and Gavrovo in Greece) and the Krassta-Cukali zone (Pindi in Greece and Budva in Montenegro) (Fig. 1). There is an overthrusting of all tectonic zones westward, partly masking each-other. The external Albanides of western Albania form part of the peri-Adriatic chain. They are derived from the compression of the sedimentary sequence deposited on the eastern margin of the Apulian plate and its westward displacement during the Alpine orogeny phase (Fig. 2). Exploration interest has been mainly focused on the external Albanides (the Ionian and partially Kruja zones) [8,11].

Third, the peri Adriatic depression represents the basin between the external Albanides thrustbelt (Ionian and Kruja zones) and the Apennines thrust system (Italy) (Fig. 2). The entire post-carbonate deposition is represented by a terrigenous sedimentation, which in itself is included in the South Adriatic Basin. This basin overlies the Ionian zone to the southeast and the Kruja zone to the far west. Thi is a foredeep filled with thick terrigenous syn-flexural (Oligocene flysch) and syn-kinematic (Neogene molasses) units, that are covered by Quaternary deposits. The Serravallian (N_1^{2s}) and Tortonian (N_1^{2t}) sandstone-clay deposits are extended trangressively over the older units (Fig. 2). The peri Adriatic depression molasses consists of a considerable number of sandy-clay mega-sequences [12,13].

The tectonic style in Albanides represented by the subduction of the thinned continental thrust at the margins of the Apulina-Adriatic plate resulted in a large amount of horizontal shortening by the formation of the thrust belts [7,14,15]. The Upper Triassic evaporites formed the main gliding planes for overthrusting. The mountain front and fold belts in the external Albanides comprise the main features of a thrust system, including westward thrusting and a triangle zone. The thrusting of tectonic zones (and structural anticlinal belts or individual structures) on one another, represents one of the main features in the Kurveleshi anticlinal belt, and it has been proven as a common geological model of the oil fields discovered (Fig. 4) [8].

2.2. Stratigraphy of the Ionian zone and the Kurveleshi anticlinal belt

The stratigraphy column of the Kurveleshi anticlinal belt (Fig. 5) is composed of the Upper Triassic evaporites, the Upper Triassic to Eocene carbonates, flysch and flyschoide of the Oligocene, and Lower Miocene to Serravallian pre-molasses [8,16].