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Geophysics

2-3D Structural Model of the Sakharetba Anticline Using Seismic Profiles, Kura Foreland Basin

Alexander Razmadze

M. Nodia Institute of Geophysics, Ivane Javakhishvili Tbilisi State University, Tbilisi, Georgia

(Presented by Academy Member Tamaz Chelidze)

In the paper 2-3D structural models of the Sakharetba anticline are introduced using seismic profiles interpretations. The Sakharetba anticline is located in the western Garekakheti which is the constituent part of the Kura foreland basin. Structural interpretation of the seismic profiles was conducted using the fault-related folding theory. The Move software was applied in the seismic profiles' interpretations and 3D structural model construction. The interpreted seismic profiles have revealed the geometry of the Sakharetba anticline. It is represented by the south-vergent fault-propagation fold. South-vergent duplexes constructed by Maikopian deposits are developed below the Sakharetba anticline. Two detachment surfaces that join on the termination of the duplexes developed under the Sakharetba anticline are well-observed on the interpreted seismic profiles. 3D models have been created for faults and single horizons using interpreted seismic profiles. According to obtained results the Sakharetba south-vergent fault-propagation fold and developed below it duplexes could be considered as potential hydrocarbon structural traps. *© 2021 Bull. Georg. Natl. Acad. Sci.*

Kura foreland basin, seismic reflection profile, fault-propagation fold, duplex

The Kura Foreland Fold-and-Thrust Belt (KFFTB) is located in the northernmost part of the Arabia-Eurasia collision zone. The KFFTB includes/covers the territories of Georgia and Azerbaijan and is situated in-between the Lesser and Great Caucasus. According to modern opinions the Kura foreland was a typical foreland basin during the Oligocene-Lower Miocene period. During Middle Miocene-Pliocene-Pleistocene it underwent compressional deformation and its modern geometry is introduced by south-vergent thrusts [1-5].

Up-to-date earthquake and GPS data indicate that the Kura Foreland is an active fold-and-thrust belt [6-8]. Our research area is represented by the western Garekakheti territory which is the constituent part of the KFFTB (Fig. 1). The deep-structure of the Sakharetba anticline (located in Garekakheti) interpreted using seismic profiles is introduced in the paper. The assumption is made that the Sakharetba anticline is a fault-propagation fold.

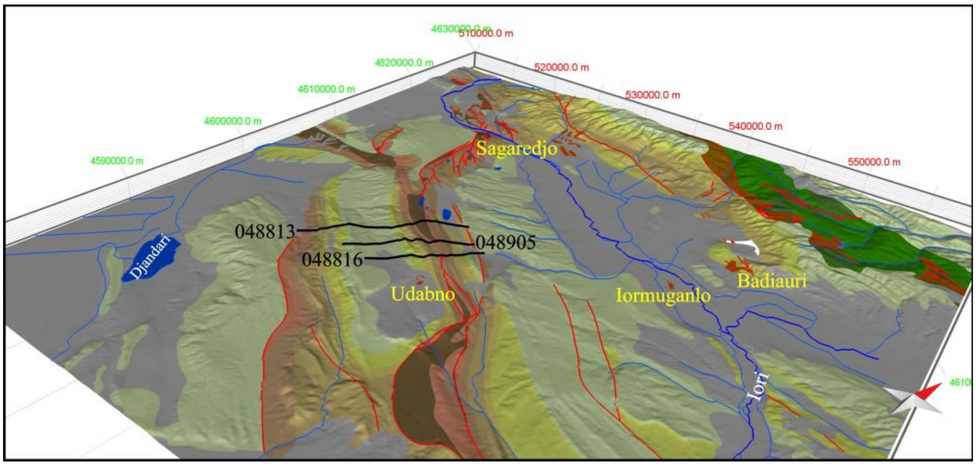

Fig. 1. Geological map of the study area, modified from O. Sepashvili [9].

The stratigraphy of the study and adjacent areas mainly reflects the evolution of the Kura foreland basin [10]. The Oligocene-Lower Miocene, Middle-Late Miocene and Pliocene-Pleistocene deposits are represented by shallow-marine and thick continental strata [9, 11, 12]. Morphologically well-defined linear folds complicated by reverse faults are developed within the Kura Foreland. Folds are characterized by narrow anticlines and wide synclines [9]. Synclines are mainly filled with unconformity by Akchagilian-Apsheronian sediments [9, 12]. Within the western Garekakheti the compressional deformation began in the Late Miocene-Pliocene time followed by development of the series of thrust-related basins within the area [5, 13]. In the KFFTB the Late Miocene (Sarmatian and the Shiraki Suite) deposits are oil bearing complexes and all main oil deposits/fields and the majority of oil shows of the Kura Foreland are related to these complexes at the surface as well as in wells. The Mtsarekhevi oil deposit was defined within the western Garekakheti in the Akchagilian-Apsheronian strata [9].

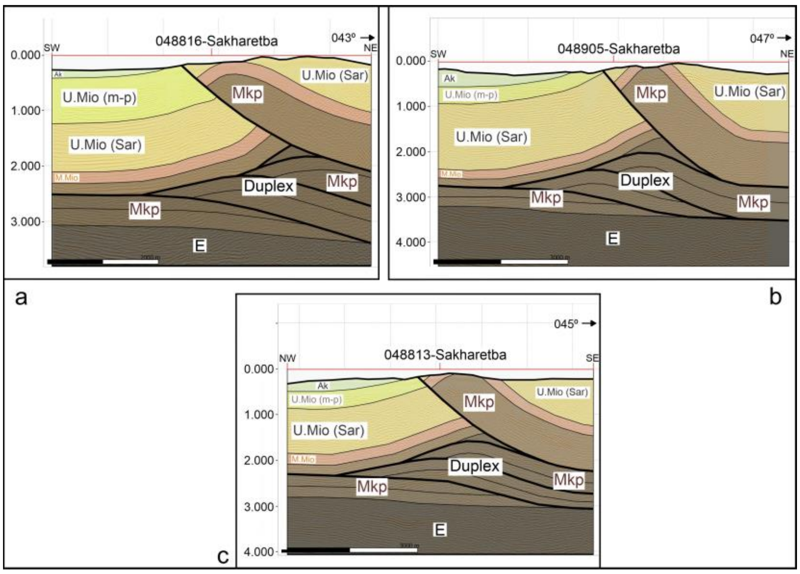

Fig. 2. Interpreted seismic reflection profiles (048816, 048905 and 048816). Location is shown in Fig. 1.

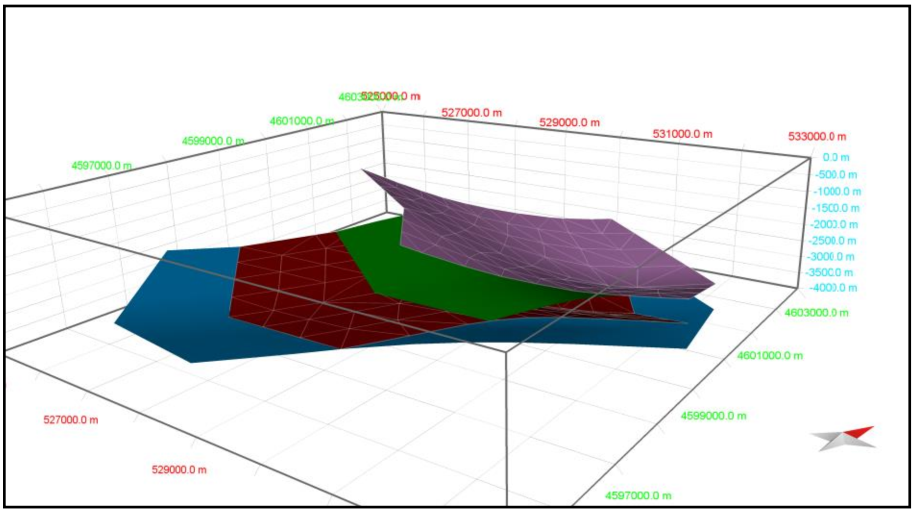

Fig. 3. 3D structural model of the thrusts. Perspective view, looking from the SE.

The interpretation of the seismic profiles was carried out applying structural geology modeling software Move. Our analysis uses subsurface structural geologic techniques to interpret the combination of seismic reflection profiles under the theory of fault-related folding [14]. For understanding the deformation structural style and geometry of the Sakharetba anticline, we selected three seismic profiles (048816, 048905, 048813) across the anticline that are based on a time-migration, which offers clear images of faults and related folds (Fig. 2). The location of the seismic reflection profiles is shown in Fig. 1. The surface geological information is obtained from 1:50000 geological map (Fig. 1). Identification of stratigraphic units at depth for seismic profiles was based on outcrop data correlations.

The interpreted seismic profiles introduce the geometry of the Sakharetba anticline. The anticline is represented by the south-vergent fault-propagation fold. Under the Sakharetba anticline south-vergent duplexes are developed made up by Maikopian strata (Fig. 2).

Two detachment surfaces are well-observed on the interpreted seismic profiles: the upper detachment surface is developed on the Maikopian-Middle Miocene boundary, whilst the lower (main) detachment surface is developed on the Maikopian shales level. The detachment surfaces join at the termination of the developed under the Sakharetba anticline duplexes (Fig. 2). The 3D model of the faults was created applying interpreted seismic profiles. Planes of single faults and thrusts were selected and combined. The 3D model of the faults is introduced in Fig. 3 below. According to obtained results the Sakharetba south-vergent fault-propagation fold and developed below it duplexes could be considered as potential hydrocarbon structural traps.

The results obtained as a result of the seismic profiles interpretation and by 3D models allow us to answer the set by project study goals and objectives:

- The Sakharetba south-vergent anticline is a typical fault-propagation fold;
- Built up by Maikopian sediments south-vergent duplexes are developed under the Sakharetba anticline;
- Two detachment surfaces are well-observed in seismic profiles and 3D models: the upper detachment surface is developed at the Maikopian-Middle Miocene boundary, whilst the lower (main) detachment surface is developed on the Maikopian shales level;
- Potential hydrocarbon structural traps are represented by fault-propagation fold and duplex.

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გეოფიზიკა

საჯარეტბის ანტიკლინის ორ და სამგანზომილებიანი სტრუქტურული მოდელი სეისმური პროფილების გამოყენებით, მტკვრის ფორლანდური აუზი

ა. რაზმაძე

ივანე ჯავახიშვილის სახ. თბილისის სახელმწიფო უნივერსიტეტი, მ. ნოდიას გეოფიზიკის ინსტიტუტი, თბილისი, საქართველო

(წარმოდგენილია აკადემიის წევრის თ. ჭელიძის მიერ)

სტატიაში წარმოდგენილია საჯარეტბის ანტიკლინის ორ და სამგანზომილებიანი სტრუქტურული მოდელი სეისმური პროფილების გამოყენებით. საჯარეტბის ანტიკლინი განლაგებულია დასავლეთ გარეკახეთში, რომელიც მტკვრის ფორლანდის აუზის შემადგენელი ნაწილია. რღვევებთან დაკავშირებული ნაოჭების თეორიაზე დაყრდნობით მოვახდინეთ სეისმური პროფილების სტრუქტურული ინტერპრეტაცია. სეისმური პროფილების ინტერპრეტაციის და სამგანზომილებიანი სტრუქტურული მოდელის აგებისთვის გამოყენებულია კომპიუტერული პროგრამა Move. ინტერპრეტირებული სეისმური პროფილები გვიჩვენებს საჯარეტბის ანტიკლინის გეომეტრიას. ანტიკლინი წარმოდგენილია სამხრეთ-ვერგენტული რღვევა-გავრცელებადი ნაოჭით. საჯარეტბის ანტიკლინის ქვევით განვითარებულია სამხრეთ-ვერგენტული დუპლექსები, რომლებიც აგებულია მაიკოპური ნალექებით. ინტერპრეტირებულ სეისმურ პროფილებზე კარგად დაიკვირვება ორი მოწყვეტის ზედაპირი, რომლებიც ერთიანდება საჯარეტბის ანტიკლინის ქვეშ განვითარებული დუპლექსების დაბოლოებაზე. ინტერპრეტირებული სეისმური პროფილების გამოყენებით, აგებულია რღვევების და ცალკეული ჰორიზონტებისთვის სამგანზომილებიანი მოდელები. მიღებული შედეგების მიხედვით ნახშირწყალბადებისთვის პერსპექტიულ სტრუქტურულ დამჭერად შეიძლება განხილულ იქნეს, საჯარეტბის სამხრეთ-ვერგენტული რღვევა-გავრცელებადი ნაოჭი და მის ქვევით განვითარებული დუპლექსები.

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