*International Journal of Geology, Earth & Environmental Sciences ISSN: 2277-2081*
*An Open Access, Online International Journal Available at http://www.cibtech.org/jgee.htm*
*2019 Vol. 9 (3) September-December, pp. 84-89/Inatov and Sidorova*
***Research Article***

# DEEP GEOLOGICAL STRUCTURE OF SOUTHWESTERN GISSAR RANGE ALONG THE GUZAR-BABASURHAN PROFILE (SOUTHERN UZBEKISTAN)

**N.K. Inatov* and I.P. Sidorova**
*Institute of Geology and Geophysics named after Kh.M. Abdullaev*
*49 Olimlar st. 100041, Tashkent, Uzbekistan*
**Author for Correspondence: nurbek.inatov@gmail.com*

## ABSTRACT
Southwestern Gissar region in south Uzbekistan constitutes the western margin of the Afghan Tajik depression. Afghan Tajik depression is a sedimentary basin situated between the south-western Tian Shan and the Pamir mountains, west of the western Himalayan syntaxis (Figure 1). It stretches from Uzbekistan in the west to Tajikistan in the East and Afghanistan in the South. Its sedimentary fill is essentially constituted of post-triassic to Pleistocene-recent sediments that record a complex tectonic and climatic history. In terms of geology, Afghan-Tajik basin is a 400x200 km depression to the West of the Pamirs and South of the westernmost Tian Shan mountains. The depression is bounded to the West by the Kugitang (mega-)anticline, which exposes Paleozoic basement in its core. The Afghan-Tajik Mesozoic-Cenozoic sedimentary cover was deformed into a classical fold belt in the Pliocene-Quaternary. The focus site of the present study is determining deep geological structure of this region from Quaternary up to Jurassic formations of sedimentary section along the profile Guzar-Babasurhan. Following the breakup of Gondwana, Permian and Triassic sediments infilled grabens before being overlain by late Triassic to Jurassic detrital sediments associated with sagging processes, themselves contemporaneous with the Cimmerian orogeny that closed the Paleo-Tethys ocean (Sengör 1979, Şengör 1984). Subsequently, from late Jurassic to Paleocene-Eocene times, the area encompassed long-term subsidence and shallow-marine carbonate and continental sedimentation opened to the west onto the margin of the Paratethys Ocean. During India-Asia collision, these Mesozoic and Cenozoic series were deformed into a classical fold-and-thrust belt with fold axes perpendicular to the direction of relative motion between the Pamir and Tian Shan ranges (Leith& Alvarez 1985) (Figure 1). Late Cenozoic uplift of the surrounding mountain ranges and coeval topographic loading of the Tadjik depression induced deposition of thick syntectonic continental red beds series from late Eocene to present (Thomas *et al.* 1994, Nikolaev 2002).

***Keywords:*** *Gissar Range, Afghan-Tajik basin, Common Deep Point, Well, Seismic Method, Time Section, Geological Section*

## INTRODUCTION
Southwestern Gissar is not well studied despite of its importance to the oil and gas industry of Uzbekistan. Although subsurface data are abundant, little has been published about this region in the international literature. This is explained, firstly, by the strong structural landform, which does not allow full use of geophysical methods in some areas, as well as tectonic structure of the region, which was formed as a collision structure (*Tal-Virsky, 1982*).
Southwestern Gissar is mountain-folded area, composed mainly of Mesozoic-Cenozoic formations. They attitude consistently and almost continuously; the only serious angular disagreement separates the Neogene red layers from the Upper Pliocene-Quaternary, and this is not always manifested in synclinal structures. In this regard, the main task of the study was to study the structure of the Meso-Cenozoic sediments, by reinterpreting seismic materials, along profiles crossing these tectonic elements. The study area is a mountainous terrain with sharp elevations, steep slopes, deep and narrow gorges, the steepness of individual slopes reaches 450. Absolute elevations vary from 564 to 1230 m; relative elevations reach 90 m per km of profile.

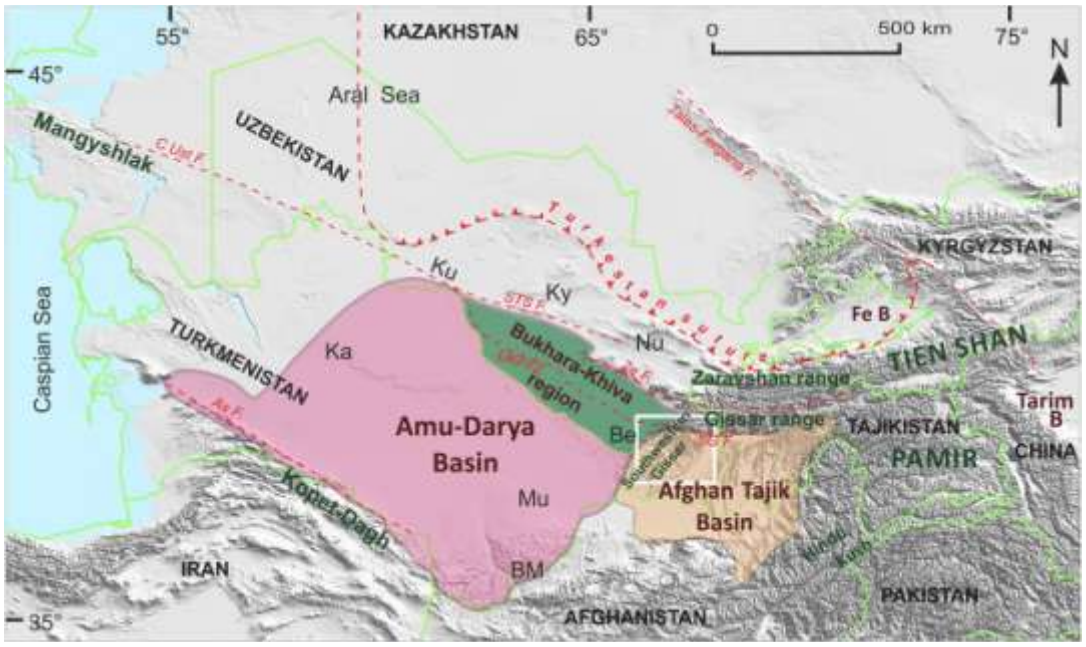


**Figure 1 Situation of the study area.**


**Figure 2: Location profile Guzar-Babasurkhan (Southern Uzbekistan)**

## MATERIALS AND METHODS

In order to compile deep geological section along the Guzar-Babasurhan profile, materials from VSP (vertical seismic prospecting) and CDP-2D (common deep point) research were used, as well as materials from the geological documentation of wells. The basis for constructing a geological section along the Guzar-Babasurhan profile was the geological documentation of wells located along the profile.

These are wells New Guzar No.1, Eastern Karail No.4, Gumbulak No.19, 1, Adamtash No.13, 4, 14, Babasurhan No.2. Wells revealed Jurassic, Cretaceous, Paleogene, Neogene, and Quaternary formations. In order to trace the behavior of stratigraphic horizons between wells, determine the position and nature

of faults, seismic materials were used along the CDP profiles - 31912491, 35912491, 26850984, 43850984 located in the immediate vicinity of the studied profile and across the faults.

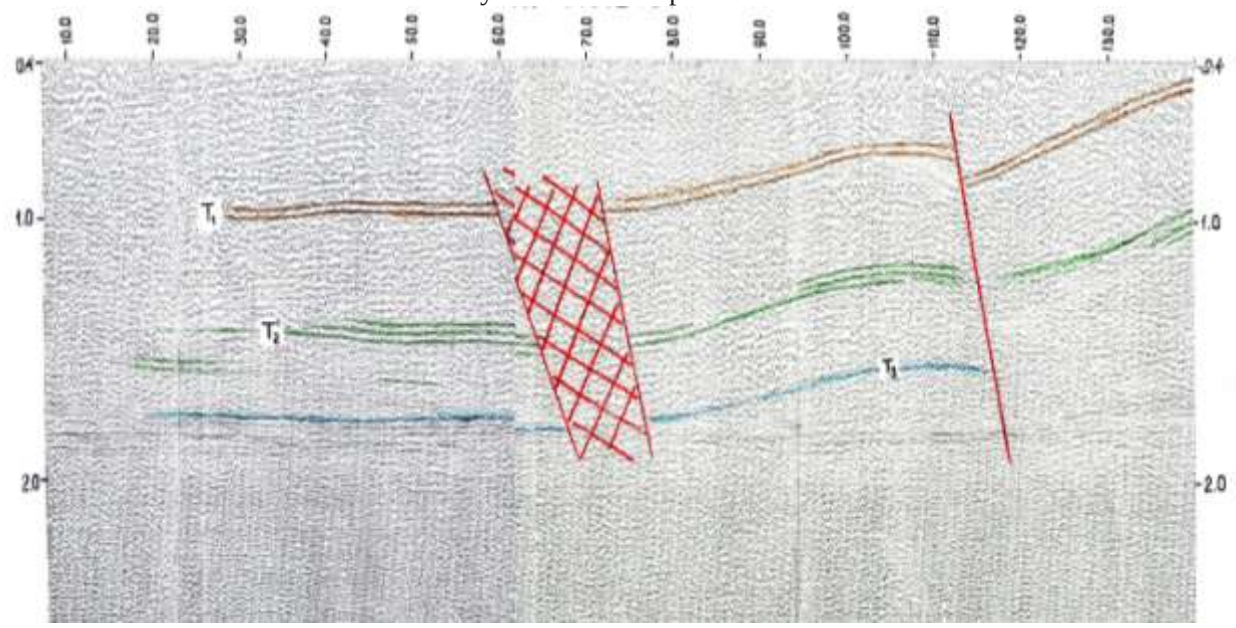


**Figure 3: Time section from 31912491 CDP profile. (Horizontal axis indicates number of pickets and vertical axis is wave travel time, respectively)**

The following reflective boundaries were identified by time sections along the profile: $T_5$ — associated with sediments of lower anhydrites and reefs of carbonates of the Upper Jurassic; $T_2^{/}$ - reflection from the IX-th Cenomanian horizon, $T_1$ - reflection from the Bukhara layers of Paleogene.

Unfortunately, none of the wells revealed Paleozoic depositions. The wells in the New Guzar, Gumbulak and Adamtash squares revealed terrigenous Jurassic deposits, and in the New Guzar, Eastern Karail, Gumbulak, Adamtash and Surkhan squares - depositions of the upper Jurassic. The maximum thickness of the evaporite formation is 550 m in the Gumbulak, Adamtash, Surkhan areas, the minimum 30 m in the areas of New Guzar and East Karail. The thickness of the remaining sediments in the section does not change much (Atabaev *2009*).

## RESULTS

In general, the geological section along the profile has a complex structure. The sedimentary cover is dissected by a series of faults on tectonic steps, the structure of the steps is mainly of the anticline-syncline type. In total, the structure traced the structure of the six tectonic steps of the Shurtan, Atar, Pachkamar, Gumbulak, Adamtash, Beshbulak formed by the Langar-Karail and Baysun-Kugitan faults.

The most complex structure has the central and southwestern part of the profile. This section of the profile intersects the structures of Gumbulak, Adamtash, Auzkent. The structure of the New Guzar is located at the beginning of the section, and in the direction of the profile it has a small amplitude of 120 m, only the southeastern wing of the fold is traced, the tectonic disturbance of a thrust nature, limited by a tectonic disturbance, is 200 m along the fault. According to seismic data directly at the fault, there is a decrease in the thickness of the Upper Jurassic evaporite formation.

The Atar step, from the northwest bounded by the above described fault, is located in the extreme northwest of the horst mega-anticline, its length along the profile is 5 km. Within the limits of the step, there is an anticlinal uplift, whose amplitude along the profile is 100 m. From the southeast, the step is limited to the flexural-discontinuous zone (Koshkuduk thrust). Pachkamar step is pulled over to Atar. The amplitude of the displacement along the fault plane is 260 m.

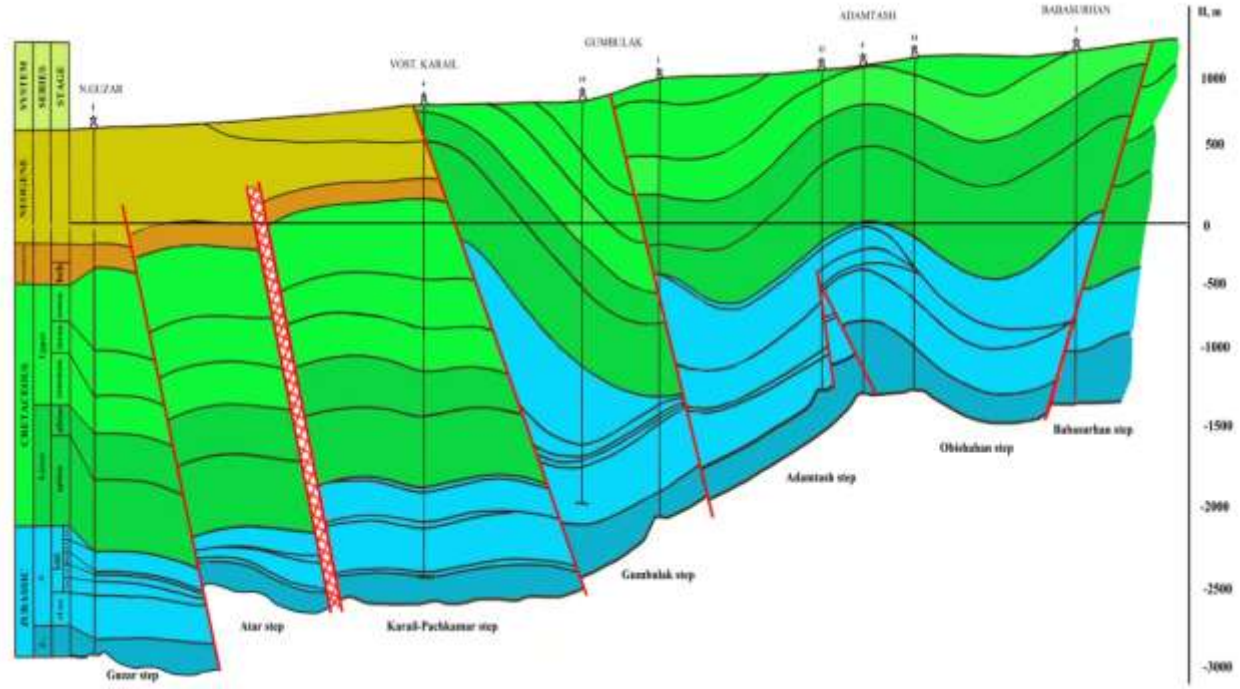


**Figure 4: Deep geological section along the profile Guzar-Babasurhan**

Pachkamar stage has a length of 6.5 km along the profile. In the evaporite formation between the well № 4 Vost. The Karail and Karail thrusts pinch out the middle anhydrites, the thickness of the formation decreases.

From the southeast, the rung is bounded by the Karail thrust, and the Gumbulak rung is pulled over it to Pachkamar. The Karail thrust is formed by a fault, the plane of displacement of which is southeast. The displacement amplitude is 1600 m. Within the limits of the step, the anticlinal uplift is distinguished, by oversalt deposits, with amplitude of 1.1 km, the northwestern wing is cut off by a rupture (Karail fault).

On subsalt deposits under the fold there is a syncline. This is due to the salt bag formed in the core of the fold. The structure is traced according to well drilling data. Vosk.Karail well No. 4 passes through the core of the fold, well Gumbulak No. 19 and Gumbulak No. 1 are located along the south-western steep wing of the fold, along which a sharp increase in the thickness of the salt-anhydrite formation is observed in the core of the fold.

The Gumbulak stage is separated from the Adamtash stage by the Belesyainak thrust, which cuts sediments from the Jurassic to the Paleogene inclusive. The fault falling plane has a south-east direction, the displacement along the fault is 850 m. The anticlinal fold adjoins the fracture from the southeast, the amplitude of the fold does not exceed 150 m according to Alba-Senon deposits. The amplitude of the fold in the evaporitic formation is 300 m; a fold is created by increasing the salt-anhydrite rocks in the near fault area (Abidov *et. al., 2013*).

This anticline is not traced by subsalt sediments. This area is a deflection. This may be due to the fact that this area is located hypsometrically significantly lower than the Adamtash fold, in connection with this there was an overflow of salts into more submerged areas. In the southeastern direction, the rocks that form a step rise to the depths: salt-anhydrite from 160 to 200 m, chalk - 300 m, forming the Adamtash anticlinal uplift.

Between the Kyzyl-Bayrak thrust and the Obishikhan thrust, recorded at the end of the profile, the Obishikhan step is located; within this step, the southeast fold of the fold is replaced by a synclinal deflection which passes into the anticline fold of the Obishikhan fault. The amplitude of displacement

along the fracture along subsalt deposits is 100 m, and oversalt increases up to 500 m due to an increase in thickness of upper anhydrite.

The Obishikhan Fault has the opposite direction of the displacement plane, along which the Obishikhan Stage is pulled over Babasurhan.

Based on the results of the work carried out, the following conclusions can be drawn: the structure of the South-Western Spurs of Gissar has a stepped structure along the profile, the Shurtan, Atarskaya, Pachkamarskaya, Gumbulakskaya, Adamtashskaya, Obishikhanskaya and Babasurkhanskaya stages are clearly distinguished. formed by faults that are thrust resulted by tectonic processes and determine the allochthonous character.

The constructed geological section made it possible to reveal the discrepancy between the structural plans of the suprasalt and subsalt deposits along the profile, clearly manifested within the steps of the Gumbulak and Adamtash. It is also necessary to note the peculiar deformation behavior of salts and anhydrites, which in the regions located in the immediate vicinity of the Turan plate, where the displacement amplitudes along the faults are insignificant compared to the central part of the studied region, flow into the syncline cores. In remote areas, with large displacement amplitudes, the formation of salt bags can be observed in the cores of anticlines. Thus, the observed anticline structures on the oversalt deposits may not have their continuation in subsalt structures and vice versa. This fact must be taken into account during explorations for hydrocarbon deposits in the Upper Jurassic carbonate sediments, which are productive for this region.

Conclusion according to geodynamic point of view is following:

The Afghan-Tajik and Amu Darya basins are situated on the southern part of the Turan Platform (*Fürsich et. all, 2017*). Their early extensional history during Late Permian – Early Triassic is not well known as these deposits, possibly filling grabens, are deeply buried. Permian and Triassic sediments occur on the southern margins of the Amu-Darya and Afghan-Tajik basins in south Turkmenistan and North Afghanistan where they unconformably overlie Palaeozoic beds. The narrow grabens were linked to intra-arc and back-arc extension behind subduction of the Palaeotethys towards the North, below the Turan Plate. Several Cimmerian blocks became detached from Gondwana during the Permian and collided with Eurasia leading to the formation of the Eo-Cimmerian unconformity and the Eo-Cimmerian belt. First the Iranian blocks collided in Late Triassic, followed by the Central Afghanistan and Central Pamir blocks at the end of the Triassic, accounting for a slightly younger unconformity, deformation and post-collisional magmatism towards the East. From the eastern part of Iran and the Amu Darya Basin towards the East, Palaeozoic and Triassic sediments are unconformably covered by Jurassic sediments. Eo-Cimmerian reliefs were uplifted and eroded, providing Jurassic siliciclastic sediments that filled the new basins (Amu Darya and Afghan-Tajik basins) created by extensional tectonics.

The northwestern Afghan-Tajik Basin of the study area in southern Uzbekistan was shaped by this framework of horst and grabens created in the Early Jurassic as result of the dismembering of a part of the Eo-Cimmerian orogenic belt. Here no Triassic sedimentary rocks have been encountered; sedimentation started in the Toarcian and was probably diachronous. Extensional tectonics induced active tectonic subsidence. This explains the observed variations in thickness, the progressive deepening, and the onset of marine conditions in the Late Bajocian. The area of the Kugitang Mountains occupied a deep part of the extensional margin which shallowed towards the North-East. The extension ceased during the Middle Jurassic to give way to a more continuous thermal subsidence. During Mesozoic and Early Palaeogene times, the Afghan-Tajik and Amu Darya basins formed a single basin (Ulmishek 2004). The Late Palaeogene-Neogene collision of the Indian Plate with the Eurasian Plate uplifted the southern margins of the basins, mainly shaped the southwestern Gissar range, which divided the northern portion into the two basins, and strongly deformed the Afghan-Tajik Basin, situated nearest to the Pamirs.

**REFERENCES**

**Abidov AA (2009).** Oil and gas potential of the lithospheric plates of the world Fan, Tashkent, 628.

**Abidov AA., Dolgopolov FG (2013).** Some aspects of geodynamic zoning of oil and gas regions of Uzbekistan *Uzbek Journal of Oil and Gas*. 1, 41-47.

**Atabaev DKh (2009).** Geoplastic model of the Earth's crust according to the Mubarek-Guzar-Baysun profile *Bulletin of National University of Uzbekistan; Tashkent*, 3/2, 38-41.

**Fürsich, FT., Brunet, MF., Auxiètre, JL, Munsch H (2017).** Lower–Middle Jurassic facies patterns in the NW Afghan–Tajik Basin of southern Uzbekistanand their geodynamic context. *Geology Society of London Spec. Publ.* 357–409. *https://doi.org/10.1144/SP427.9*.

**Tal-Virsky BB (1982).** Geophysical fields and tectonics of Central Asia Moscow, *Nedra*, 271.