

STRUCTURAL AND TECTONIC CRITERIA FOR PREDICTING THE OIL AND GAS POTENTIAL OF JURASSIC DEPOSITS IN THE MUYNAK UPLIFT (UZBEKISTAN)

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ABSTRACT

To increase the efficiency of geological exploration for oil and gas, it is necessary to conduct further exploration activities in the Ustyurt region of Uzbekistan, adjacent to the highly prospective Berdakh gas accumulation zone. The Muynak Uplift is in the eastern part of the region; in the southwestern slope part, indications of oil-bearing potential have been identified in the Eastern Muynak and Saule areas of Lower Jurassic deposits. The main method for searching for oil and gas deposits is deep drilling, which requires the presence of reliable traps capable of containing hydrocarbon accumulations. Such traps consist of reservoir rocks capable of storing them and sealing rocks capable of holding them. Through the interpretation, reinterpretation, and comprehensive analysis of geological and geophysical data from previously drilled wells and seismic data within the study area, several structures have been identified as targets of interest for deep exploration drilling.

Keywords: *Muynak Uplift, Jurassic system, fault, trap, amplitude, reflecting horizon, sandstones, argillites, oil, gas*

INTRODUCTION

Until the late 1970s and 1980s, the territory of the Muynak Uplift was located within the Aral Sea's water area. As the sea retreated, this territory became part of the geological exploration process, which included seismic work and deep drilling. As a result, indications of oil-bearing potential were identified in the Eastern Muynak and Saule areas (Yuldasheva and Karomatov, 2020). The study of the territory by seismic exploration works was conducted in various modifications of the OGT during the late last century, when the intensive shallowing of the Aral Sea began and the territories where seismic works were conducted were exposed, according to which two main complexes were identified – a sedimentary cover characterized by a gentle occurrence, only weakly dislocated in individual areas with the formation of low-amplitude folds, and pre-Jurassic formations, the internal structure of which is quite difficult to determine, as reflective horizons are very weakly traceable and are represented by intermittent reflections that do not form any long-term boundaries or in the form of a continuous medium. However, in its upper part, objects are distinguished, represented by tectonic protrusions and anticlinal structures, which are tectonically bounded by faults. Analysis of deep drilling and geophysical research data showed that the characteristics of the geological structure of the territory, as well as the history of geological development, predetermined the presence of sandstone horizons with high filtration parameters (potential collectors) in Jurassic terrigenous deposits, which is characteristic of intensive denudation zones where diverse terrigenous deposits accumulate, alternating with layers of dense argillites formed during the existence of continental lake and alluvial conditions (Ajgaliev *et al.*, 2022; Yuldasheva, 2022).

MATERIALS AND METHODS

Comprehensive analysis of geological and geophysical data and exploratory drilling results, interpretation and reinterpretation of well-logging data and geophysical materials, methods for facial analysis of sedimentary formations, and correlation of sections.

RESULTS AND DISCUSSION

Based on the interpretation of 3D seismic survey data for the area east of the highly prospective Berdakh anticline, which is a scarp-like uplift with a gradual transition in the east to the Muynak Uplift, located in the eastern part of the Ustyurt region. In this transitional zone, the development of anticlinal and non-anticlinal traps is expected, including productive reservoirs in the western periclines of structures along the flank of the downwarp (Ju Hwan Woo *et al.*, 2015).

Analysis of previously conducted seismic exploration work in various modifications shows very weak deformation of the sedimentary envelope rocks in the southern part, which was one of the reasons for the absence of UV deposits.

Meanwhile, in the northwestern direction, where this tectonic element extends, seismic data indicate the presence of anticlinal folds, mainly in the lower part of the Jurassic section (Fig. 1).

One such structure is the Sayat structure, which is traceable across the lower Middle Jurassic and Lower Jurassic deposits, where seismic anomalies in the form of bright reflections are recorded, possibly related to the presence of dense rocks serving as cover (Fig. 1). To the southwest, the development of the depression zone separating the Muynak Uplift from the Berdakh Ridge is observed, which plays a favorable role in the formation of a potential hydrocarbon generation zone and source for elevated areas.

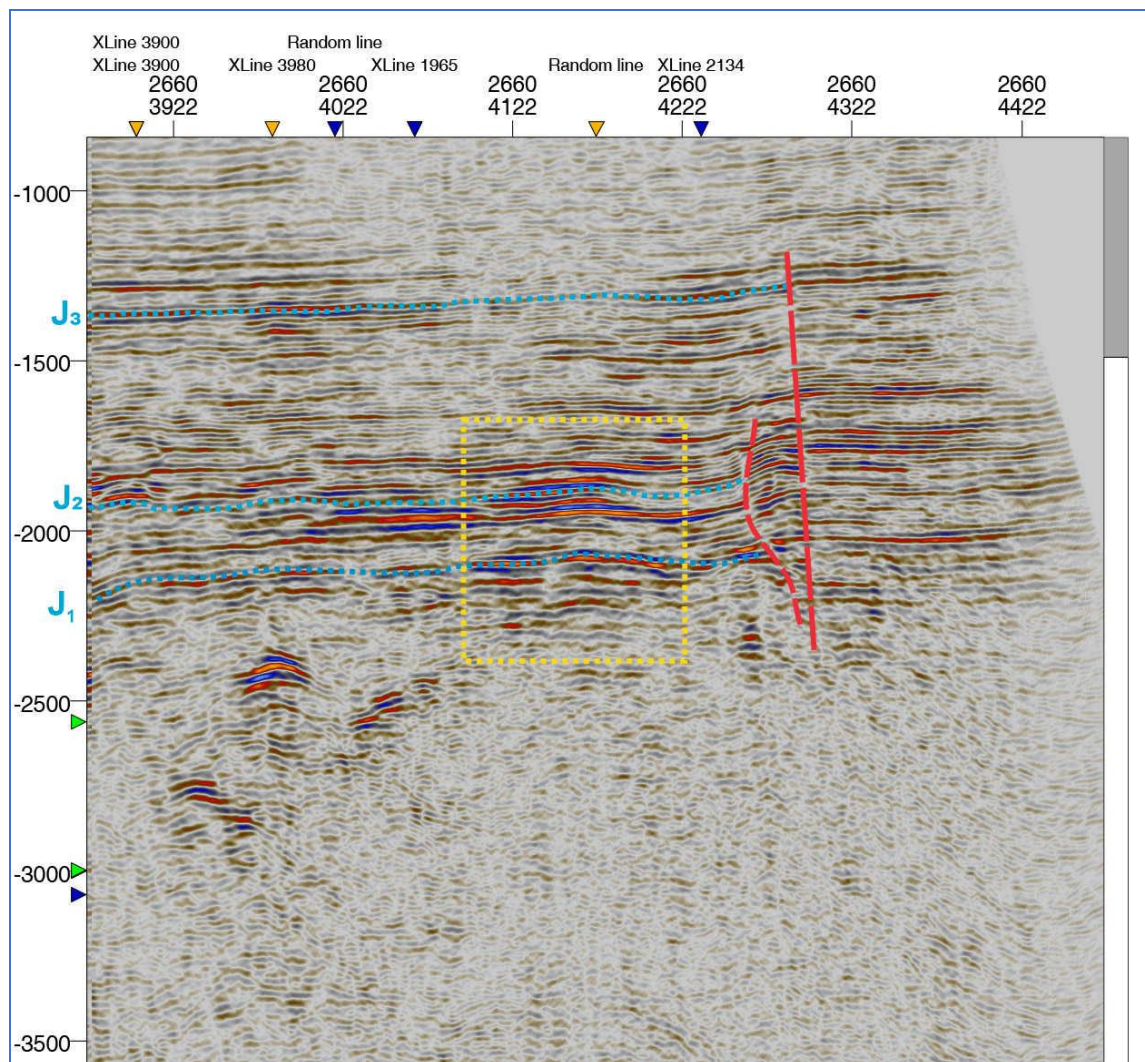


Figure 1. Fragment of a MOGT-3D temporal section highlighting the low-amplitude object Cayat

Another structure is the Kipchak structure (Fig. 2), which is delineated to the south of the Urdabay-1 exploration well, located in its periclinal part and drilled to a depth of 3,023 m, reaching Lower Jurassic deposits at the bottom.

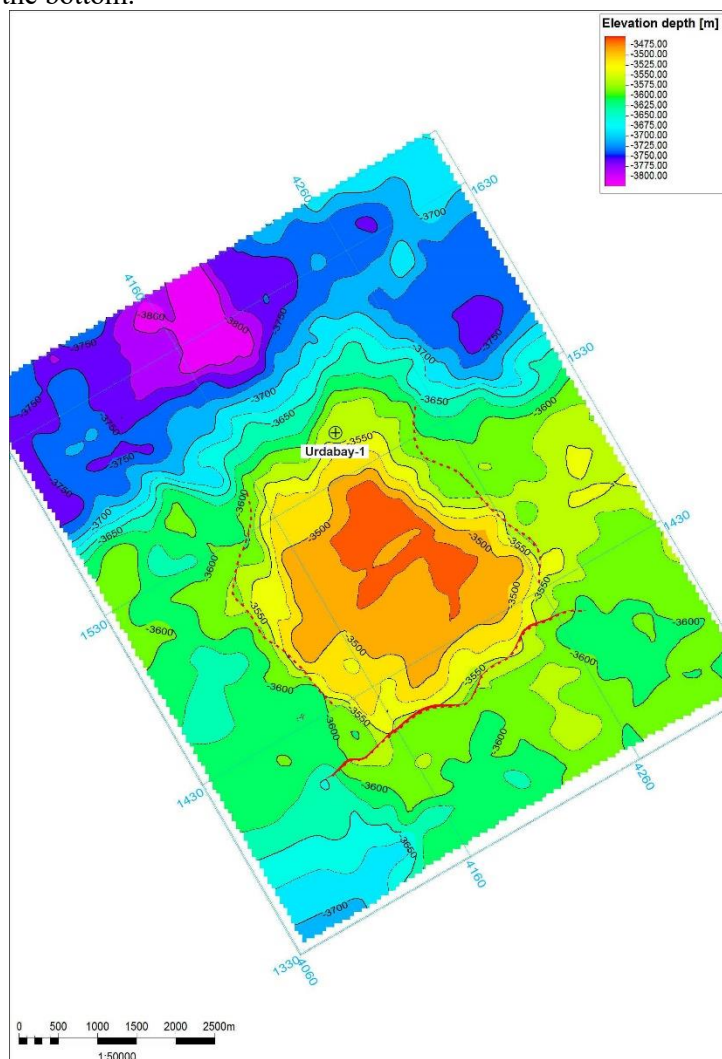


Fig. 2. Structural map of the reflective horizon associated with the inferred base of the Jurassic complex, highlighting the Kipchak structure

In the section of the drilled well, according to well logging data, no reservoir intervals are identified, meaning the sediments are represented by dense rocks. However, as a result of the test, formation water was obtained from Middle Jurassic deposits, which is a strong, highly metamorphosed, low-sulfate, sedimentogenic brine, with an increased content of iodine, bromine, naphthenic acids, and benzene, indicating a stagnant regime favorable for the preservation of hydrocarbon deposits (Bartashevich *et al.*, 1980; Nikitenko *et al.*, 2021).

From the temporal sections, it is clearly visible that the upper sedimentary complex is characterized by a gentle sedimentation, unlike the Paleozoic complex, which, like the rest of Ustyurt, forms a fragmented relief, forming remains covered by terrigenous sediments.

The wave pattern confirms the factual data, where Lower Jurassic deposits are represented as a clearly defined seismic reflective horizon, usually associated with dense rocks, below which reflections are absent, possibly indicating the presence of a loosened zone here in the form of an erosion crust or the presence of permeable rocks. In temporal sections (Fig. 3), the anticlinal structure is clearly distinguished, covered in the upper part by dense rocks, below which reflections are weakly visible and represented by a chaotic pattern. Furthermore, from the east, the presence of a depression zone is

observed, possibly filled with terrigenous deposits with increased thickness, the prospects of which have been proven by the discovery of the Sharkiy Arslan and Aralbay deposits, where industrial gas inflows were obtained from Lower Jurassic deposits.

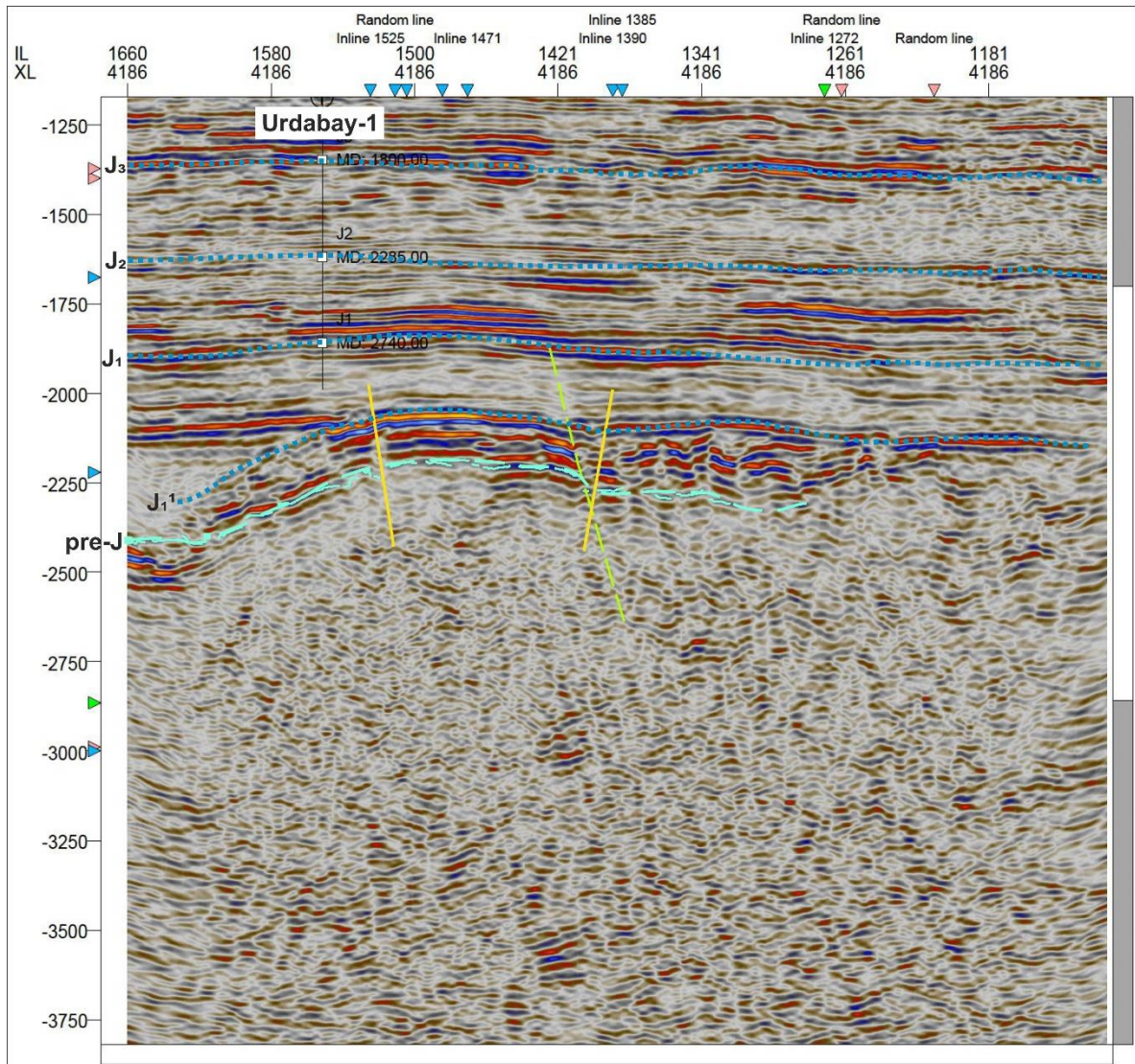


Figure 3. Fragment of the MOGT-3D temporal section highlighting the Kipchak object

In the presented model of the Kipchak structure along the reflective horizon within Lower Jurassic deposits, it is represented by an isometric anticlinal structure lying at an approximate depth of 3,500 m. In Urdabay-1, this horizon has not been explored through deep drilling.

According to conducted drilling data within the southern part of the Muynak Uplift, the thickness of Lower Jurassic deposits ranges from 400 to 600 m, in which approximately six sandy layers were identified, from which signs of oil content were obtained. Lower Jurassic deposits are primarily represented by sandstones with interlayers of gravelites, dark gray to black aleurolites, and argillites. According to well logging data, sandy layers possess an effective porosity of up to 15-16% (Mukhutdinov *et al.*, 2022).

The Middle Jurassic deposits are composed of stratification by argillites, aleurolites, and thick (50 m) sandstones ranging in thickness from 500 to 870 m. According to GIS well logging data, sandy layers possess an effective porosity of up to 9-16%. Upper Jurassic deposits are primarily represented by

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predominantly argillaceous rocks with frequent and thin interbeds of aleurolites and sandstones, formed in coastal-marine zones with a thickness of 230-440 m. The open porosity of the reservoirs is 16-27%.

Thus, within the Muynak Uplift, three main factors are present in Lower Jurassic sediments: the reservoir, the cover, and the trap, all of which are essential for hydrocarbon accumulation. Middle and Upper Jurassic deposits possess only two criteria (collector and cover), but the structural factor is very weakly expressed, with rocks occurring in an almost horizontal position.

Thus, identifying Lower Jurassic deposits as the primary target horizon, increasing depth of exploration, the industrial gas-bearing potential of Lower Jurassic deposits in adjacent territories, and the obtained indications of oil-bearing potential within the territory of the Muynak Uplift will serve as the primary basis for developing effective geological exploration directions to assess hydrocarbon raw material reserves and evaluate the potential of Jurassic deposits.

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