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KINEMATIC PARAMETERS ACCORDING TO PALEOMAGNETIC DATA OF BLOCKS MOTION IN NAKHCHIVAN AUTONOMOUS REPUBLIC

A.A.Bagirova[1], A.G.Rzayev[2]

ABSTRACT. The article presents the results of studies of the Jurassic and Cretaceous sediments of sections of the Nakhchivan Autonomous Republic, the aim of solving the problem of horizontal movements of the Earth's crust. The paleomagnetic studies were carried out in four sections. Jurassic and Cretaceous sediments have been studied in the sections of Negram, Chalkhan Gala, Jagrichay and Paiz. In the early years, based on paleomagnetic data, kinematic parameters of the movement of blocks and horizontal movements of the north are determined.

Keywords: *magnetization, susceptibility, horizontal displacement, kinematic parameter, tectonics, gorst rise, stratigraphy, lithology*

Introduction

The territory of Azerbaijan Republic covers the eastern part of the Caucasian segment of the Mediterranean Belt, a characteristic feature of the Earth's crust structure, which, like the Caucasus as a whole, is its tectonic heterogeneity, expressed in a complex ratio of structural and formation units constituting it with a different lithologic-stratigraphic section, the character of deformation and history of geological development.

The current state of research in the field of paleomagnetism of the Meso-Cenozoic rocks of the Lesser Caucasus allows us to consider in more detail the problem of horizontal movements of the Earth's crust.

The role of paleomagnetic data for solving a number of issues related to the restoration of the relative position of tectonic units, their paleogeographic position, kinematics, and drift is difficult to overestimate. The whole diversity of paleotectonic reconstruction schemes, both regional and global, is unthinkable without a paleomagnetic structure that provides the basis for models of the geological development of the region.

Paleomagnetic studies on the territory of the Nakhchivan Autonomous Republic were carried out on the Jurassic and Cretaceous sections.

Magneto-mineralogical studies were carried out according to the generally accepted technique in rock magnetism and paleomagnetism.

When studying the magnetic properties and diagnostics of ferromagnetic minerals, we were guided by the works of T.Nagaty, D.M.Pecherskiy, S.Y.Brodskaya, V.E.Pavlova and others. (1)

For confident paleomagnetic constructions, first of all it is necessary to establish the nature of the natural residual magnetization Jn^0 and determine the ferromagnetic minerals responsible for Jn.

Non-heating methods of magnetic mineralogy were used, including demagnetization of natural residual magnetization in alternating magnetic fields, methods of magnetic cleansing and methods of sedimentation of sedimentary rocks.

Thermo magnetic studies were carried out, including removal of the temperature demagnetization curves of the residual saturation magnetization, determination of the Curie points and the results of thermal heating.

Measurements of the magnitude and direction of the natural residual magnetization were carried out on a two-speed spin-magnetometer JR-6.

The magnitude of the magnetic susceptibility was measured by the Czech device KT-5 (1,2,3).

[1] *Institute of Geology and Geophysics of Azerbaijan National Academy of Sciences*
[2] *Republican Seismic Survey Center of Azerbaijan National Academy of Sciences*

The discussion of the results

Paleomagnetic studies on the territory of the Nakhchivan Autonomous Republic were carried out on the Jurassic and Cretaceous sections. For paleomagnetic studies, 110 oriented pieces were selected from which 330 cubes were cut out. (5)

We studied two sections of the Jurassic sediments: the Negram and Chalkhan Gala sections. In these sections, Callovian, Aalen, Bayos and Bat Jura were investigated. From the Negram section, 30 samples were selected, of which 80 cubes of Jurassic sediments were cut out. All samples of the above collections have been temporarily cleaned. The total thickness of the studied section is 295 m. The entire collection is processed in the paleomagnetic laboratory by the standard method.

Stereograms were constructed for the rocks of the Cretaceous and Jurassic deposits of the Nakhchivan Autonomous Republic, which gave positive results.

Figures 1 and 2 show stereograms of the In distribution before and after temporary cleansing in the presence of the Earth's magnetic field.

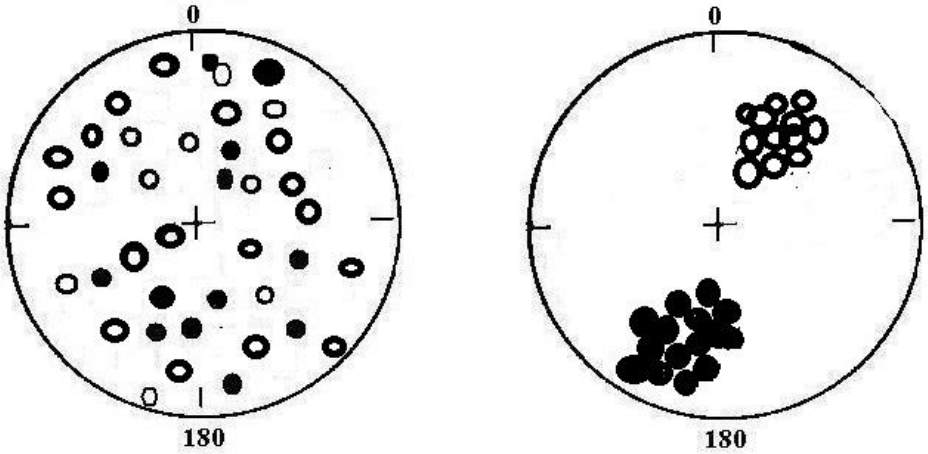

Figure 1. In distribution of Jurassic rocks of the Nakhchivan AR (a- before magnetic cleaning; b- after magnetic cleaning)

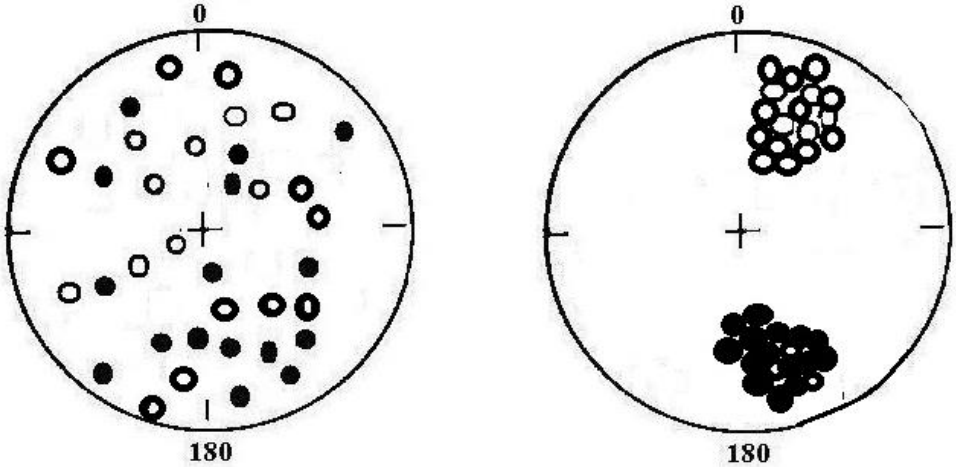

Figure 2. In distribution of Cretaceous rocks of the Nakhchivan AR (a- before magnetic cleaning; b- after magnetic cleaning)

According to paleomagnetic data, it was found that in the Jurassic time, the Negram section was located at a paleolatitude of 24^0 and moved to the north by 1,400 ± 300 km, the translational speed was 2.1–2.2 cm/year. The Negram block turned accordingly clockwise by 21^0, and the Chalkhan Gala section, being at a paleo-latitude of 25^0, moved to the north by 1,300 ± 300 km with a translational speed of 2.0–2.1 cm/year. Block Chalkhan Gala turned, respectively, clockwise at 32^0.

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As a result of studies conducted in the Negram section, 3 zones of direct polarity and one of reverse polarity were established. In the section of the Chalkhan Gala in the Aalen and Callovian sediments there is only one zone of direct polarity. There are two zones of direct polarity and one zone of reverse polarity in Bayos and Bat levels. The Aalen deposits studied in both sections Negram and Chalkhan Gala have a direct polarity.

As a result of the conducted studies, 7 zones - 4 of direct polarity and 3 zones of reverse polarity - were established in the Negram section, and only one zone of direct polarity in the Chalkhan Gala section in the Aalen and Callovian deposits. In bayos and in bat, one zone of direct polarity and one zone of reverse polarity were revealed (Fig.3).

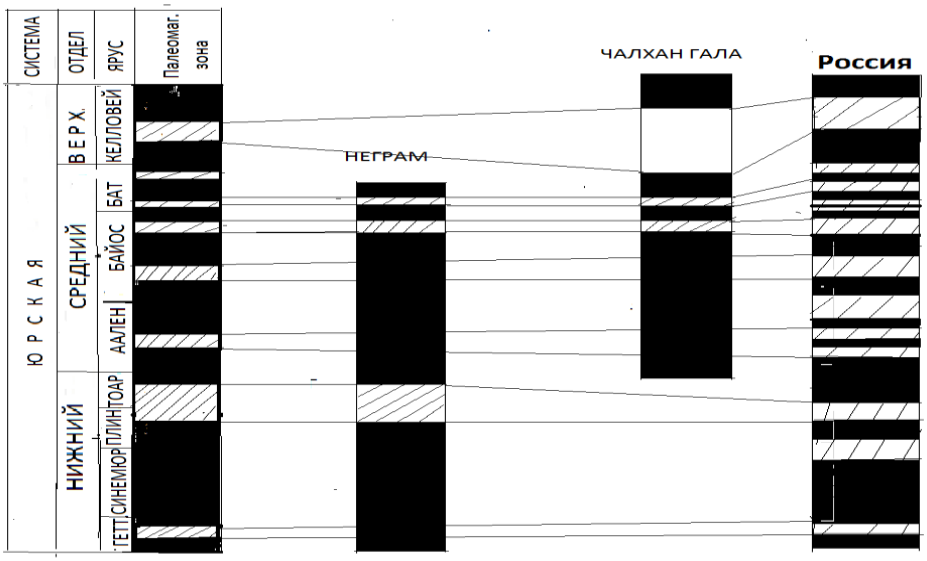

Figure 3. Regional diagram of magnetostratigraphic sections of the Nakhchivan Autonomous Republic: 1-zone of reverse magnetization; 2-zone of direct magnetization; 3- unexplored parts of the crust; 4-lines of correlation

Cretaceous sediments in the territory of the Nakhchivan Autonomous Republic are represented by lower and upper sections. Of the Lower Cretaceous sediments, only Albian formations were found.

Upper Cretaceous sediments in the basin of the Arpachay River are developed by separate small islands, in the basin of the Jagrichay River they are widespread, stretching along the strip between the settlements of Aznabyurt and Paiz. Alba deposits in this band are fixed in small areas in syncline troughs in the area of Aznabyurt and Gulistan. Deposits of Cenomanian and Turonian are exposed in the western and southern parts along the bed of the Jagrichay River. Cognac santona and kampana deposits occur in the central and eastern parts of this band, while younger deposits — Maastricht, Danish stage and Paleocene — are recorded only in the southern and eastern parts of this band (4.6).

We studied 2 sections of Cretaceous sediments - Paiz and Jagrichay. In these sections, rocks of the Upper Cretaceous sediments (cognac-santon, Maastrich) were investigated.

From the Paiz section, 35 rocks of Cretaceous sediments were selected. From each ore, 4 cubes with a 24 mm rib (105 cubes in total) were subsequently cut out. All samples of the above listed collections have been temporarily cleaned. The total thickness of the studied part of the section is 685 m., the length of the section is about 1,200 m. The values of the natural residual magnetization Jn of the selected samples vary within narrow limits from $2 \cdot 10^{-6}$ to $26 \cdot 10^{-6}$ SGS ($2 \cdot 10^{-6}$ to $26 \cdot 10^{-6}$A/M). As a result of laboratory studies, we concluded that the magnetization of the studied rocks is primary and corresponds to the direction of the geomagnetic field of the formation time of the studied rocks (Fig.4).

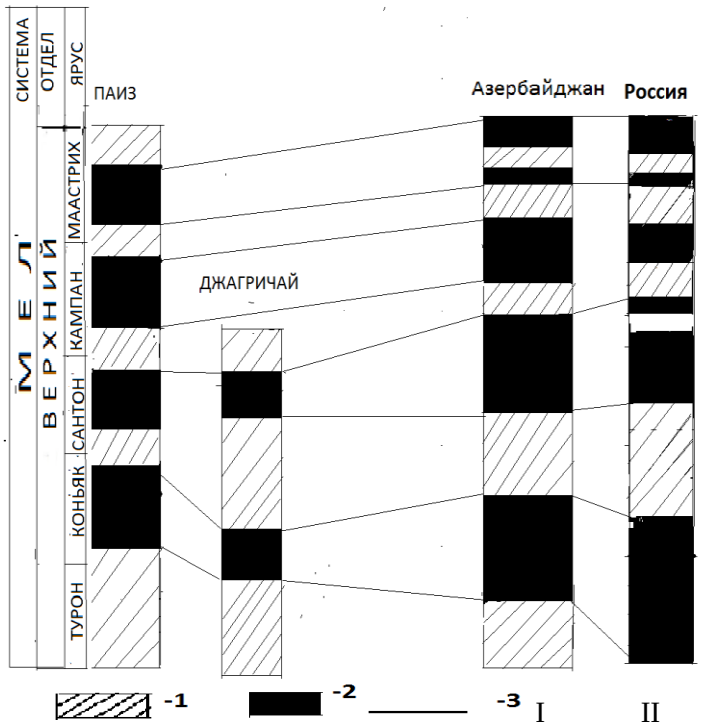

Figure 4. Regional scheme of magnetostratigraphic sections of the Upper Cretaceous of the Nakhchivan AR. 1- reverse magnetization zone; 2 - direct magnetization zone; 3- correlation lines; I - summary scale of the Mesozoic of Azerbaijan; II - the general scale of Russia

The average directions of magnetization and the coordinates of the paleomagnetic pole of the studied region were also determined: D = 44.3^0, J = 66.3^0. K = 9, α_{95} = 13, F = 53, λ = 88. The calculated paleomagnetic pole differs from the Middle Paleopole of the Lesser Caucasus. According to paleomagnetic studies, it was found that in the Cretaceous time, the Paiz section, being at a paleo-latitude of 29^0, moved to the north by 1,250 ± 250 km with a speed of 2.0-2.1 cm/year. The Paiz block turned clockwise by 36^0 (Table 1).

Table 1
Paleomagnetic directions and paleomagnetic poles of the studied sections of the Nakhchivan Autonomous Republic

Section name	Age	Coordinates of the research		Direction NRM		K	A_{95}	Polarity	Paleomagnetic poles		Θ	Θ	φ_m
		φ	λ	D	J				φ	Λ			
Chalkhan Gala	Middle Jura	39.3	45	32	48	14	6	N	6	64	8	6	29
Negram	Middle Jura	39.5	45	34	45.9	11	8	R	8	67	9	5	24
Paiz	Upper Cretaceous	39.1	45	44.3	66.3	9	13	N	53	88	16	10	30
Jagrichay	Upper Jura	39	45	36	70	11.4	15	R	61	91	11	9	28

The Jagrichay section cut 1.2 km south-west of the river Jagrichay. Here there is an anticlinal fold along the river ravine. From the Jagrichay section, 18 oriented pieces were selected (of which 2-4 samples of the cube were cut out with a 24 mm rib, a total of 72 samples). The total thickness of the

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studied part of the section is 186 m; the length of the section is about 500 m. The values of the natural residual magnetization Jn of the selected samples vary in a narrow range from $7 \cdot 10^{-6}$ to $86 \cdot 10^{-6}$ SGS ($7 \cdot 10^{-6}$ to $86 \cdot 10^{-6}$A/M). Magnetic susceptibility ranges from (17÷196) SI units. In most cases, the viscous magnetization did not exceed 40% Jn.

All samples were subjected to stepwise cleaning with an alternating magnetic field of up to $4 \cdot 10^4$ ^{6}A/M in increments of up to $2 \cdot 10^2$A/M.

The results of laboratory studies indicate the primacy of the nature of the natural residual magnetization and the compliance of its direction with the paleo-time of formation of the studied rocks.

The average directions of magnetization and the coordinates of the paleomagnetic pole of the studied region were also determined: $D = 36^0$, $J = 70^0$. K = 11,4, α_{95} = 15, F = 61, λ = 91. The Jagrichay section, being at a paleo-latitude of 28^0, moved to the north by 1350±300 km at a speed of translational motion of 2.1-2.2 cm/year. The Jagrichay block turned clockwise at 41^0 (table 1).

Conclusion

For the first time, on the basis of paleomagnetic data in the Nakhchivan Autonomous Republic, turns are studied and the kinematic parameters of the movement of the blocks of the Earth's crust are determined: clockwise turns and horizontal movements to the north.

Thus, carried out paleomagnetic studies have shown that the distinguished paleomagnetic directions are ancient, synchronous to the time of rock formation and can be used to analyze patterns associated with the ancient magnetic field, as well as for paleostratigraphic reconstructions of the region.

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