Stratigraphy, petroleum sedimentology, geochemistry **2 / 2025**

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PALEOMAGNETIC STUDY OF ANDAMICH, AZA AND DIZA SECTIONS (NAKHCHIVAN, AZERBAIJAN)

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Summary. In the paper, the results of the study of Paleogene sediments in the territory of the Nakhchivan Autonomous Republic, the horizontal movements of the Earth's crust, and the solution to the problem are given. Paleomagnetic studies were carried out in two transects, Aza and Andamich, and Paleogene sediments were studied. Initially, the kinematic parameters and horizontal movements of the blocks are determined based on the paleomagnetic data. The discussion of the results of the paleomagnetic research conducted in the territory of the Nakhchivan Autonomous Republic was carried out on rocks of the Paleogene age.

Similar results were obtained while characterizing the components of I_n: clays, fine-grained sandstones are more stable, coarser-grained rocks are metastable, and coarse-grained sandstones, marls, siltstones, etc., are unstable. On average, they have the same direction as the magnetization direction, as determined by the cross-sectional method.

The sections show a regular alternation of rocks with direct and reverse magnetization. After temporary and temperature cleaning, as well as alternating magnetic cleaning, in the Aza and Andamich sections, both directly and reversely magnetized rocks have the same direction. All this indicates the synchronism of I_n^o and the absence of the secondary magnetization components in I_n after cleaning. The relevance and importance of the paleomagnetic studies conducted are also noted; only through this method is it possible to determine the paleotectonic positions and quantitatively assess the rotations of certain geological structures on others.

Keywords: *Magnetic susceptibility, stratigraphic division, geological-geophysical analysis of the Ordubad synclinorium, Andamich sections, Paleocene epoch*

Introduction

This paper reviews the stratigraphic and paleomagnetic studies in the Aza and Andamich sections of the Ordubad synclinorium in Azerbaijan. The stratigraphic sequence of the sediments filling the depression is considered. Particular attention is paid to the discussion of controversial issues and problems of stratigraphic division and determination of the age of stratigraphic units. The results of paleomagnetic studies of the Cenozoic sediments of the basin are summarized. The most promising objects of the detailed paleomagnetic studies are indicated. The studied Paleogene sequences at the Aza and Andamich sections are represented by volcanic-sedimentary and sedimentary rocks (Babayev və b., 2016).

The Andamich section represents the Danish Stage and the Paleocene from bottom to top. The thickness of this stage in this section is 361 m. When compiling general and regional paleomagnetic scales, it is necessary to obtain a better understanding of the nature of the change in the geomagnetic field over time and estimate the age of magnetic units. Paleomagnetic studies were therefore carried out using methods generally accepted in rock magnetism and paleomagnetism (Исаева и др., 2019).

The section of the Danian stage and Paleocene deposits along the northeastern Aza anticline (northwest of the village of Sabirkand at 943.4 m) are presented from bottom to top. The thickness of the Paleocene and Danian stages of the Aza section is 414 m. In most cases, the oriented samples were selected along the section; the sampling interval depended on the thickness of the section and the composition of the outcrop rocks (Fig. 1). This was necessary to obtain

the most objective data on the magnetic parameters of the considered massif. When selecting a sample, preference was given to the central part of the body, since they are less changed (Исмаил-заде и др., 2005).

Geology of the studied area

The geological structure of the Nakhchivan Autonomous Republic includes deposits of the Devonian, Carboniferous, Permian, Triassic, Jurassic, Cretaceous, Paleogene, Neogene, and Quaternary systems (Исаева и др., 2019).

Formations of the Paleocene section were detected in the river basins of Chahrichay and Nakhchivanchay as well as along the left riverbank of Araz between the towns of Julfa and Ordubad (Fig. 2). They mainly consist of the sedimentary formations of the Lower (Danian), Middle (Selandian), and Upper (Thanetian) Paleocene periods with an average thickness of 670 m and a generalized maximum thickness of 1.120 m.

The upper part of the Danish tier is located near the village of Aza. This formation is composed of a pack of gray carbonate thin-layered sandstones, with rare interlayers of sheet clay measuring 50-55 meters in thickness.

Foraminifera are found *Acarinina schakhdagica, A. tridadensis, A. spirialis, A. trifida, A. inconstans, Globigerina varianta, G. legitima, G. guadrata, G. triangularis* – nanoplankton – *Placozygus sigmoides, Chiasmolithus californicus, Ellipsolithus macellus, Cyclococcoolithus* sp.

In most cases, the oriented samples were selected along the section; the sampling interval depended on the thickness of the section and the composition of the outcrop rocks. This was necessary to obtain the most objective data on the magnetic parameters of the considered massif. When selecting a sample, preference was given to the central part of the body, since they are less changed (Халафов и др., 1996).

1. Alternation of gray thin and medium argillite (0.1-0.5) and sandstones (0.05-0.3 m). In the composition of argillites, *Globoconusa daubjergensis* (Bronniman), *Globigerina triloculinoides* Plummerand other foraminifera have been discovered.

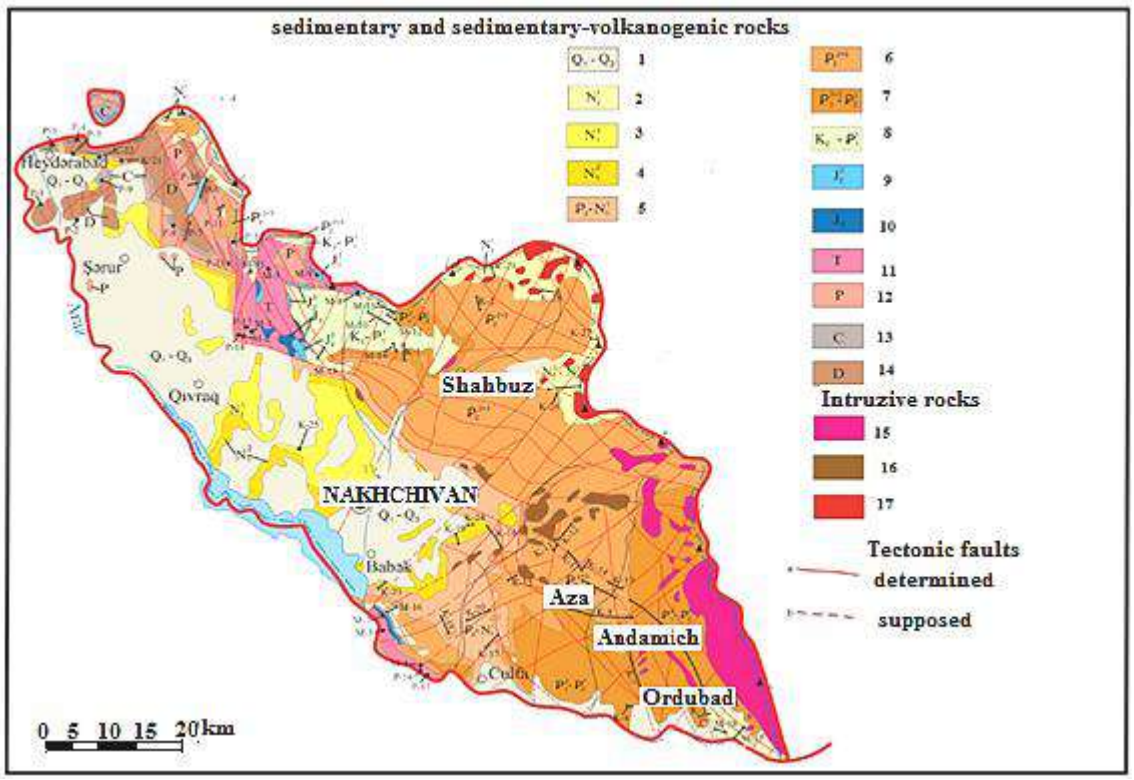

Fig. 1. Geological map of Nakhchivan Autonomous Republic (T.N.Kangarli)
1 – Pleistocene, **2** – Lower Pliocene, **3** – Upper Miocene, **4** – Middle Miocene, **5** – Oligocene and Lower Miocene, **6** – Middle and Upper Eocene, **7** – Middle Paleocene and Lower Eocene, **8** – Upper part of the Upper Cretaceous (Cenomanian) and Lower Paleocene, **9** – Middle Jurassic, **10** – Lower Jurassic, **11** – Triassic, **12** – Permian, **13** – Carbonian, **14** – Devonian, **15** – Eocene-Oligocene, **16** – Miocene, **17** – Lower Pliocene

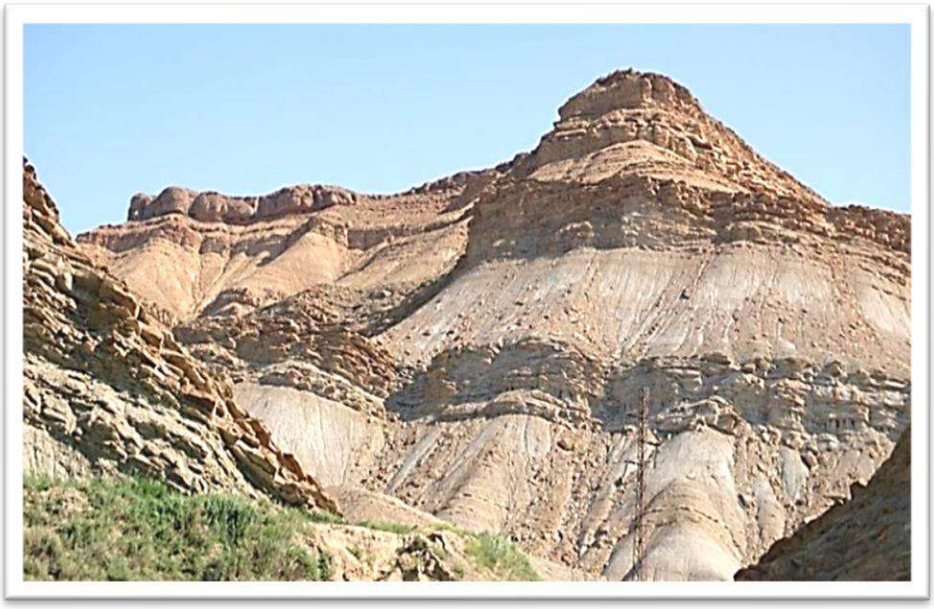

Fig. 2. Discovery of the Aza Deposit from the Lower Paleocene Period

2. Soft argillites of a gray, reddish hue (0.25-2.0 m), alternating with layers of fine-grained sandstone, foraminifera typical of the Danian age were found in argillites of the lower part of the layer *Acarinina trifida* Chal., *A. inconstans* (Subb.), *A. constans uncinata* (Bolli), *Globigerina trivialis* Subb., and *G. varianta* Subb.

3. Frequent alternation of gray-colored, thin- and medium-sized soft argillite, fine-grained calcareous sandstone, and calcareous sandstones. Argillites predominate. In the middle part of the layer the foraminifera of the Danian age were found in argillites: *Acarinina trifida* Chal., *A. inconstans* (Subb.), *A. constans uncinata* (Bolli), *Globigerina trivialis* Subb., and *G. varianta* Subb.

4. Alternation of thin and medium-layered argillite dense, sheet-shaped finegrained sandstones of gray color. *Acarinina inconstans inconstans* (Subb.), *Globigerina trivialis* Subb. The thickness of the Aza layer in the described cross section is 493 m. (Babayev və b., 2016).

Methodology

Samples were taken in the area from Aza to Diza, where paleomagnetic studies were conducted. Magnetic susceptibility k was measured in the field and in the laboratory using a KT-5 kappometer (Czechia) with a sensitivity of 10^{-5} CGS. Under laboratory conditions we determined initial residual magnetization by measuring demagnetization in samples with variable and constant magnetic field by measuring with modern Spinmagnetometer JR-6A, AGICO LDA-5 TD-48-SC Thermal Demagnetizers thermal cleaning furnace (temperature demagnetization) devices (Bagirova et al., 2023) Spinmagnetometer JR-6A, production of Agico, Czech Republic. It is used to measure the residual magnetization of rock samples, especially strong magnetic samples. The principle of operation of this device consists in measuring the phase and amplitude of the changing force of electric motion. The TD-48-SC thermal cleaning furnace (temperature demagnetization) unit is designed for temperature demagnetizing of rock samples, as well as for creating thermal uniformity in a small fixed area. Temperature range: 25-800ºC.

LDA-5 Demagnetizer. This device measures the demagnetization of a sample with a variable and constant magnetic field. The demagnetization process is controlled and automated by a microprocessor. It is enough to set the demagnetization parameters, mark the sample in the sample holder, and place the retainer on the demagnetization coil. The rest of the demagnetization process is performed automatically according to the preset parameters (Молотовский, 1985). The technique of selecting the oriented samples and their documentation was carried out according to standard methods for paleomagnetic studies. Rock samples were

selected from each unit. The samples were given a cubic shape of 24x24 mm. The main issue in all paleomagnetic studies is the question of the primacy of the natural residual magnetization of the studied rock. For the primary residual magnetization arising at the time of rock formation to retain its original value and direction until the time of study, it must be stable in the face of various destructive effects.

Natural residual magnetization of rocks consists of two main components: primary, synchronous with the process of rock formation, and secondary, which arises after formation of the primary signal (Исмаил-заде и др., 2005). To isolate the viscous residual magnetization I_{rv}, we attempted to determine its prevalence and correct the associated error in the samples left for measurement. In the laboratory, the samples were influenced by the Earth's magnetic field for two weeks in the position in which they were in situ in the field. In this case, their viscous magnetization is restored. After temporary cleaning, the half-differences of both values give the viscous component of the residual magnetization in the samples.

Results

The field and laboratory paleomagnetic studies of the Paleogene rocks of Nakhchivan made it possible to determine the directions of I_n, to prove the nature of the initial residual magnetization and the synchronicity of these rocks with the time of their formation. On the basis of these studies, paleomagnetic zones of flat and reverse polarity were identified. These zones can be considered reliable since they are represented by more than 60 samples taken from different stratigraphic levels and traced in cross-sections of the same age at a distance from each other. Paleocene rocks collected in the Aza and Andamich river basins do not differ much in magnetic properties. Paleomagnetic data obtained from the Paleogene sediments of the Nakhchivan Autonomous Republic provide data on the nature of the Earth's magnetic field in the studied areas and tectonic movements in the Paleocene and Eocene (Храмов, Шолпо, 1967).

The direction of primary residual magnetization in the studied rocks indicates a sharp difference between the direction of the Paleocene and Eocene magnetic field and the modern field. Comparing these data, the kinematic parameters of local and regional rotation of the entire region were determined (Bagirova, Rzayev, 2018).

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Discussions

In order to isolate the viscous residual magnetization I_{rv}, we tried, on the one hand, to determine how widespread it is and, on the other hand, to correct the associated error on samples left for measurements. In the laboratory, the samples were exposed to the Earth's magnetic field for two weeks while maintaining their in situ position. In this case, their viscous magnetization is restored (see Fig. 3) (Исаева и др., 2019).

It is possible to easily determine magnetic minerals in the composition of rocks by the Curie temperature by the magnetic method. Ts=585º due to its mineralogical composition, maghemite is distinguished from magnetite with great difficulty. The lattice constant of the maghemite is smaller than that of magnetite. Due to the fact that it is not resistant to heating, it oxidizes and passes to hematite; it is very convenient to apply the magnetic method for its determination. The transition of the main part of maghemite to hematite occurs at the limit of 250-450º. This phase transition is observed with a decrease in the saturation magnetization of I_{rs} and an increase in H (Fig. 2) (Баженов, 1983).

After temporary cleaning, the half-differences of both values give the viscous component of the residual magnetization in the samples (Халафлы, 2007). The Paleocene and Danian deposits are represented by greenish-gray calcareous clays and sandstones. In these samples, magnetic susceptibility k varies within 6-7•10-3 SI units, and the value of residual magnetization I_n fluctuates within 4-8•10-3 SI units. In the Andamich section, the Q factor varies within 15-33, and in the Aza section, it is 1.6-2.0.

Thermal cleaning gives similar results. The natural residual magnetization of most samples decreases at a temperature of 100-150ºC to an average of 0.8-0.7, and at temperatures of 250-300ºC to 0.4-0.2 of the initial value, while the directions remain the same, probably close to the direction of the primary magnetization (Bagirova et al., 2023).

For samples collected near the villages of Aza and Andamich, it is possible to find the direction of primary magnetization using the method of intersection of remagnetization planes. For the Aza village section, the normal polarity specimens have a Fisher mean direction of: D=328º, J=44º, K=12, α_{95}=10º. The reverse polarity samples has a Fisher mean of D=142º, J=-45º, K=11, α_{95}=12º. For Andamich village section the normal and reverse mean directions are D= 97º, J=32º, K=3, α_{95}= 11º; D=106º, J=54º, K=5, α_{95}=16º. In the sections, a regular alternation of rocks with normal and reverse polarity magnetization is observed: for the Aza section, the sample means of k=1.75x10^{-6} SI units; and I_n are 10.09 x10^{-9} A/m, and for the Andamich section are k=0.5x10^{-6}SI units; I_n=8.7 x10^{-9}A/m (Tables 1, 3).

The rocks in the Aza and Andamich sections include hematite as the remanence carrier (Table 2).

Table 1

Primary paleomagnetic directions and paleomagnetic poles of the Paleogene rocks of Nakhchivan.
P=Paleocene, E=Eocene, N=number of samples, D=declination, J=inclination, K=Fisher K,
α_{95}=virtual geomagnetic pole (VGP) 95% cone of confidence

Sections	**N**	**Age**	**Latitude/longitude**		**Field directions**				**VGP**	
			φ	λ	D	J	K	α_{95}	Φ	Λ
Aza	41	P	38.9	45.8	42	45	11	7	53	142
Andamich	19	P	38.9	46.01	36	54	5	14	61	133
Julfa	32	E	39.2	45.6	341	33.5	11	8	63	269
Shahbuz	51	E	39.4	45.57	33	47	10	6	60	147
Diza	27	P	38.9	45.87	29	35	5	13	58	165

Table 2

Mineral content (%), based on X-ray diffraction

Sample name	**SiO_2**	**$CaCO_3$**	**Fe_2O_3 hematite**	**Others**
Andamich-200	12	54	4	Dolomite 5
Andamich-211	20	30	6	Dolomite 5
Andamich -219	20	25	9	Dolomite 7

Table 3

Chemical composition of minerals of rocks of the Danian-Paleocene formations of Nakhchivan

Sample	**TiO_2**	**MnO**	**Fe_2O_3**	**BaO**	**SrO**	**Cr_2O_3**	**Cl-**	**YTİ**
Andamich-200	0.62	0.08	4.47	0.01	0.12	0.0101	0.02	30.28
Andamich-211	0.92	0.13	6.44	0.13	0.07	0.0201	0.06	18.31
Andamich-219	0.72	0.18	9.99	0.02	0.05	1.8901	0.08	14.77
Shahbuz-10	0.54	0.14	4.02	0.50	0.09	0.0087	0.01	12.73
Shahbuz-13	0.46	0.10	4.84	0.09	0.07	0.0003	0.03	4.79
Shahbuz-28	0.65	0.12	6.01	0.09	0.15	0.058	0.01	14.59
Shahbuz-31	1.28	0.11	7.96	0.02	0.08	0.01	0.01	12.66
Aza-302	0.15	0.10	0.99	0.03	0.15	0.003	0.01	40.12

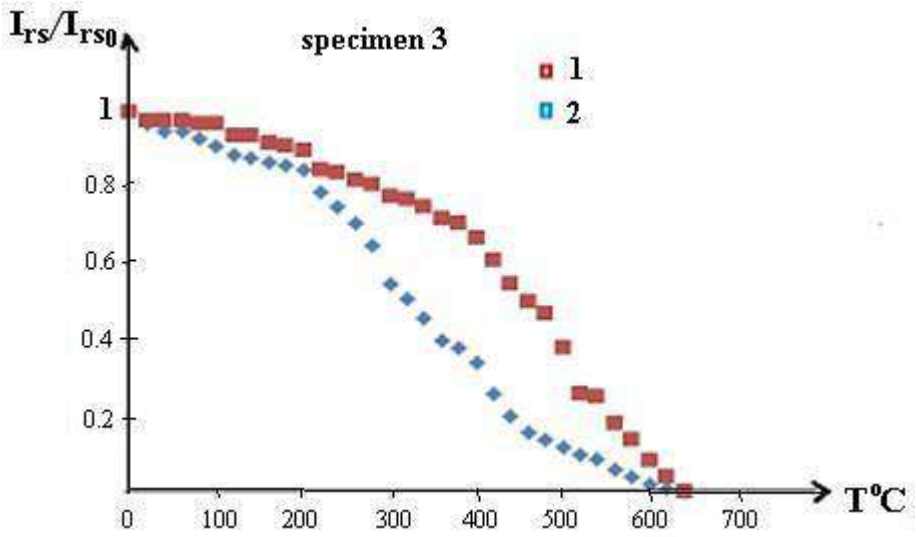

Fig. 2. Thermomagnetic analysis

The deposition dates and Paleocene in the Andamich (NAR) sections have close average values: k=0.5•10^{-6}SI units; I_n=1.75•10^{-6} SI units.

Thermal cleaning gives similar results. The natural residual magnetization of most samples decreases at a temperature of 100-150ºC to an average of 0.8-0.7, and at temperatures of 250-300ºC to 0.4-0.2 of the initial value, while the directions remain the same, probably close to the direction of the primary magnetization (Храмов, 1967).

Thermomagnetic analysis. When samples are heated to 600º, inflexions in the I_{rs}/I_{rs0} curves are detected (most often in the range 225-275º), which are not detected during reheating. After the first heating, there is no further noticeable increase (I_{rs2}/I_{rs1}=1.1-1.6 after the first and second heating), indicating the increase in I_{rs} after the first heating is associated with the decay of titanomagnetite and the release of pure magnetite (Bazhenov, 2002).

The inflection between 300 and 400ºC is not detected during further heating, which suggests this relates to a phase or phases that are not stable to heating. I_{rs} decreases after the first heating by 20-30%, indicating that the chemical transformations occurring during heating are oxidizing any newly generated or original iron hydroxides during the heating cycles (Heslop, Roberts, 2016). Some samples contain small amounts of hematite with Curie temperatures above 580ºC. These samples, which belong to the Upper Eocene deposits of Nakhchivan, are from red-colored tuffaceous sandstones. Thus, the stability to heating differs between the Eocene and Paleocene rocks (Fig. 3).

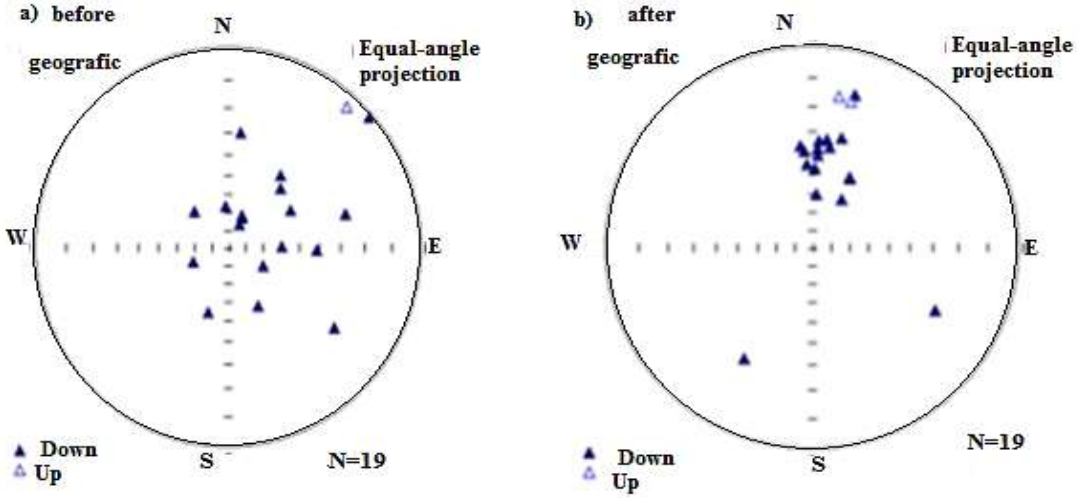

Fig. 3. Distribution of sediment rocks of the Paleocene Period

After cleaning of magnetizations, in the Aza and Andamich sections, both normally and reversely magnetized rocks have near antipodal directions (Fig. 3). This indicates the primary nature of the magnetization and the low impact of the secondary magnetization components after cleaning (Babayev və b., 2016).

The Julfa, the Diza section, the Julfa section, and Shahbuz areas were also explored, where there is a more secure link to the geologic timescale providing sections that are currently complete and well exposed. For the Paleocene–Lower Eocene located in the Nakhchivan Autonomous Republic, there are two magnetozones at Diza, with the youngest magnetozone of normal polarity corresponding to the Lower Eocene, and six magnetozones in the Paleocene: 3 zones of normal polarity and 3 zones of reverse polarity. In the Julfa River, this interval is represented by the Middle and Upper Eocene. According to paleomagnetic data, 4 magnetozones have been identified: 2 zones of normal polarity and 2 zones of reverse polarity, with the latter magnetozone of normal polarity corresponding to the Middle Eocene. The Aza section is represented by 3 magnetozones: 2 of normal and 1 of reverse polarity (Fig. 5).

The Aza and Andamich sections are represented by the Danian tier, while the N zones are distinguished by direct magnetization at the bottom of the tier on the border with the upper chalk (Heslop, Roberts, 2016). The power in section Aza is over 100 meters, and in section Andamich, it is 80 meters. In the context of Aza 2R, zone 2N, and Andamich 3R – zone 2N, there is a good convergence of poles of Azerbaijan with those of neighboring regions such as Georgia, Armenia, Turkmenistan, and Tajikistan (Fig. 4) (Fig. 4.1).

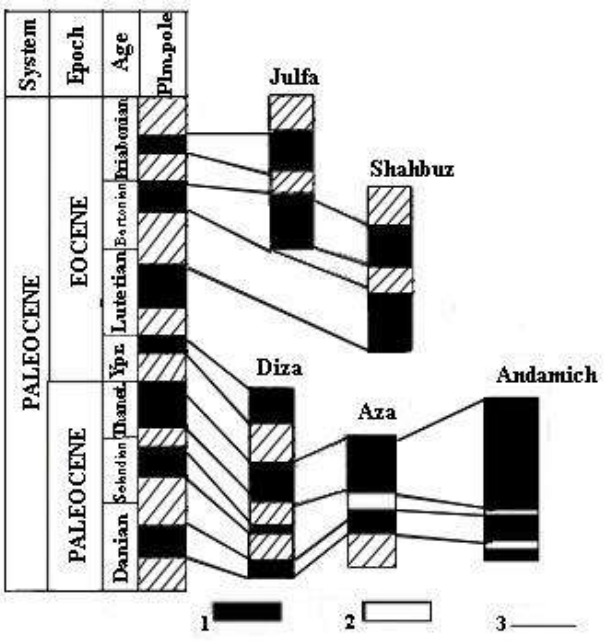

Fig. 4. Magnetostratigraphic sections of the Paleogene of the Nakhchivan Autonomous Republic
1 – zone of reverse magnetization; **2** – zone of direct magnetization; **3** – correlation lines

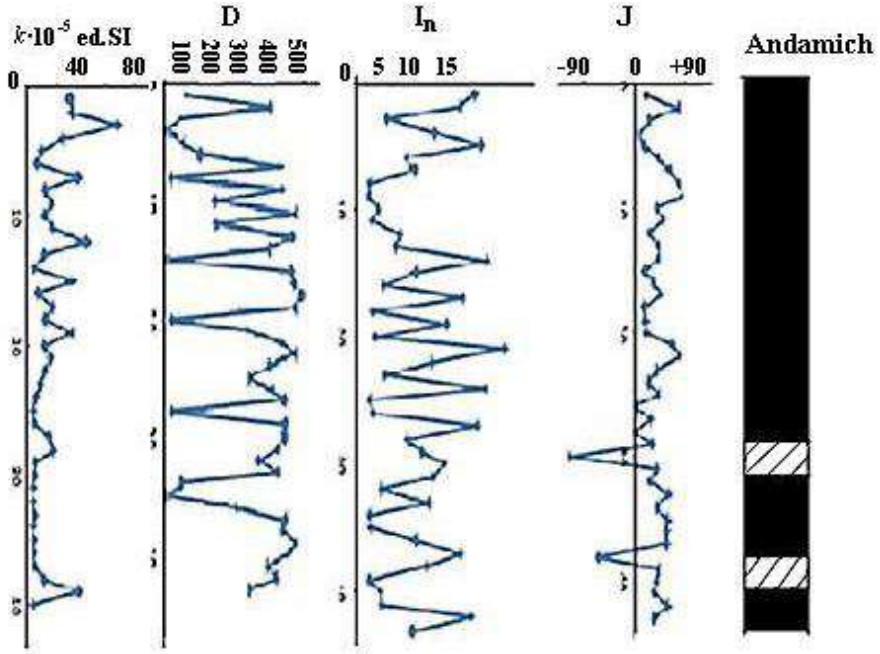

Fig. 4.1. Paleomagnetic section of continental Paleogene sediments of Andamich section

The direction of primary residual magnetization in the studied rocks indicates a sharp difference between the direction of the Paleocene and Eocene magnetic field and the modern field. Comparing these data, the kinematic parameters of the local and regional rotation of the entire region were determined. During the Paleocene epoch, the Diza section, located at the 34º paleolatitude, moved northwards at a velocity of 500±30 km/year, equivalent to 3.0-3.1 cm/year.

The Diza block rotated 29º degrees clockwise, respectively, and the Aza part, located at the 33º paleolatitude moved northwards at a velocity of 600±30 km/year, equivalent to 3.2-3.3 cm/year. The Aza block turned clockwise, respectively, 200º back.

During the Eocene epoch (23 Ma), the Diza section, located at a paleolatitude of 35º, shifted northward by 500±300 km with a translational motion rate of 2.3-2.5 cm/year.

The Diza section block rotated 34º counterclockwise, while the Julfa section, at a paleolatitude of 35º migrated northward by 500±300 km at a translational motion rate of 2.3-2.5 cm/year. The Julfa section block rotated 19º counterclockwise.

During the Eocene (41 Ma), the Shahbuz section located at a paleolatitude of 34º, moved northward by 500±30 km at a translational motion rate of 2.4-2.5 cm/year.

Conclusions

The paper presents the results of studying Paleogene deposits in the Nakhchivan Autonomous Republic, horizontal movements of the Earth's crust, and the solution to the problem. Paleomagnetic studies were carried out on two sections—Aza and Andamich—and Paleogene deposits were also studied. Initially, the kinematic parameters and horizontal movements of the blocks were determined based on paleomagnetic data. The results of paleomagnetic studies conducted on the territory of the Nakhchivan Autonomous Republic were discussed on rocks of the Paleogene age. Similar results were obtained in the characterization of the I_n-components: clays and fine-grained sandstones are more stable, coarse-grained rocks are metastable, coarse-grained sandstones, marls, siltstones, etc. are metastable. During magnetic purification, permanent magnetization components are isolated, which have on average the same directions as the pre-folded magnetization determined by the cross-sectional method. This indicates the predominance of the stable I_n-component in the studied rocks.

REFERENCES

Babayev Sh.A., Kengerli T.N., Mammadov A.B. Stratigraphy of Nakhchivan Autonomous Republic. Baku, 2016. (in Azerbaijani)

Bagirova A.A., Rzayev A.G. Kinematic parameters according to paleomagnetic data of blocks motion in Nakhchivan Autonomous Republic. Seismoprogn. Observ. Territ. Azerb. Vol. 15, № 1, 2018, pp. 14-18.

Bagirova A., Novruzov Z., Garayeva T. Determination of the kinematic parameters of the Sharur uplift from paleomagnetic data (Lesser Caucasus, Azerbaijan, Nakhchivan). Earth Sciences of Europe, Praha, Czech Republic, No. 112, 2023, pp. 23-25.

Bazhenov, M.L. Study of the dependence of paleomagnetic directions on lithology in Cretaceous and Paleocene deposits of the Western Kopetdag. Proceedings of the USSR Academy of Sciences, Earth Physics Series, No. 8, 1983, pp. 67-75. (in Russian)

Bazhenov M.L., Burtman V.S. Eocene paleomagnetism of the Caucasus (southwest Georgia): Oroclinal bending in the Arabian syntaxis. Tectonophysics, Vol. 344, Issues 3-4, 2002, pp. 247-259, https://doi.org/10.1016/S0040-1951(01)00189-5.

Heslop D., Roberts A.P. Analyzing paleomagnetic data: to anchor or not to anchor? Journal of Geophysical Research: Solid Earth, Vol. 121, Issue 11, 2016, pp. 7742-

ЛИТЕРАТУРА

Баженов М.Л. Изучение зависимости палеомагнитных направлений от литологии в меловых и палеоценовых отложениях Западного Копетдага. Известия АН СССР, Серия Физика Земли, № 8, 1983, с. 67-75.

Исаева М.И., Гараева Т.Ж., Новрузов З.А., Багирова А.А. Палеомагнетизм восточной части Малого Кавказа в палеогеновом периоде. Сборник Геофизические инновации в Азербайджане, № 4, 2019, с. 50-54.

Исмаил-заде А.Д., Рустамов М.И., Кенгерли Т.Н. Аразская мегазона. Геология Азербайджана, Тектоника, Издательство Nafta Press, Баку, Т. 4, 2005, с. 338-359.

Молостовский Э.А. Стратиграфические аспекты палеомагнетизма. Бюллетень Московского общества испытателей природы (МОИП). Отдел Геологии, Т. 60, вып. 5, 1985.

Рустамов М.И. Геология, геодинамика, магматизм и металлогения Нахчыванской АР. Том I. Геотектоническая и магматическая модель формирования вулкано-тектонических структур и кальдерообразования. Нафта Пресс, Баку, 2023, 336 с.

Халафлы А.А. Опорный палеомагнитный разрез средне-верхнеюрских отложений Малого Кавказа

7753, https://doi.org/10.1002/2016JB013387.
Isayeva M.I., Garayeva T.J., Novruzov Z.A., Bagirova A.A. Paleomagnetism of the eastern part of the Lesser Caucasus in the Paleogene period. Geophysical innovations in Azerbaijan, No. 4, 2019, pp. 50-54. (in Russian)
Ismail-Zadeh A.D., Rustamov M.I., Kangarli T.N. Araz megazone. Geology of Azerbaijan, Tectonics, Nafta-Press, Baku, Vol. IV, 2005, pp. 338-359. (in Russian)
Khalafov A.A., Mustafayev M.A., Gasanova K.D., Bagirov T.M. Paleomagnetism of Eocene volcanic rocks of the Shakhdag synclinorium, Lesser Caucasus (Azerbaijan). Izvestiya of the Russian Academy of Sciences, Physics of the Solid Earth, Vol. 32, No. 5, 1996, pp. 69-73. (in Russian)
Khalafly A.A. Supporting paleomagnetic section of the Middle-Upper Jurassic deposits of the Lesser Caucasus of Azerbaijan. Reports of the Academy of Sciences of Azerbaijan, Tahsil, Baku, 2007, 98 p. (in Russian)
Khramov A.N., Sholpo L.E. Paleomagnetism. Principles, methods, and geological applications of paleomagnetism. Proceedings of the All-Union Oil Research Geological Exploration Institute VNIGRI, Nedra, Leningrad Branch, Issue 256, 1967, 251 p. (in Russian)
Khramov A.N., Goncharov G.I., Komissarova R.A. et al. Paleomagnetology. Edited by A.N.Khramov. Nedra, Leningrad, 1982, 312 p. (in Russian)
Molostovsky E.A. Stratigraphic aspects of paleomagnetism. Bulletin of the Moscow Society of Naturalists. Geology Secion, 1985, Vol. 60, Issue 5. (in Russian)
Rustamov M.I. Geology, geodynamics, magmatism and metallogeny of the Nakhchivan Autonomous Republic. Vol. I. Geology, geodynamics, magmatism and metallogeny of Nakhchivan AR. Nafta Press, Baku, 2023, 336 p. (in Russian)
Азербайджана. Доклады АН Азербайджана, Тахсил, Баку, 2007, 98 с.
Халафов А.А., Мустафаев М.А., Гасанова К.Д., Багиров Т.М. Палеомагнетизм эоценовых вулканитов Шахдагского синклинория Малого Кавказа (Азербайджан). Известия Российской АН, Физика Земли, № 5, 1996, с. 69-73.
Храмов А.Н., Гончаров Г.И., Комиссарова Р.А. и др. Палеомагнетология. Под редакцией А.Н.Храмова. Недра, Ленинград, 1982, 312 с.
Храмов А.Н., Шолпо Л.Е. Палеомагнетизм. Принципы, методы и геологические приложения палеомагнитологии. Труды Всесоюзного нефтяного научно-исследовательского геолого-разведочного института ВНИГРИ, Недра, Ленинградское отделение, вып. 256, 1967, 251 с.
Babayev Ş.Ə., Kəngərli T.N., Məmmədov A.B. Naxçıvan Muxtar Respublikasının stratiqrafiyası. Baku, 2016.
Bagirova A.A., Rzayev A.G. Kinematic parameters according to paleomagnetic data of blocks motion in Nakhchivan Autonomous Republic. Seismoprogn. Observ. Territ. Azerb. Vol. 15, № 1, 2018, pp. 14-18.
Bagirova A., Novruzov Z., Garayeva T. Determination of the kinematic parameters of the Sharur uplift from paleomagnetic data (Lesser Caucasus, Azerbaijan, Nakhchivan). Earth Sciences of Europe, Praha, Czech Republic, No. 112, 2023, pp. 23-25.
Bazhenov M.L., Burtman V.S. Eocene paleomagnetism of the Caucasus (southwest Georgia): Oroclinal bending in the Arabian syntaxis. Tectonophysics, Vol. 344, Issues 3-4, 2002, pp. 247-259, https://doi.org/10.1016/S0040-1951(01)00189-5.
Heslop D., Roberts A.P. Analyzing paleomagnetic data: to anchor or not to anchor? Journal of Geophysical Research: Solid Earth, Vol. 121, Issue 11, 2016, pp. 7742-7753, https://doi.org/10.1002/2016JB013387.

ПАЛЕОМАГНИТНОЕ ИССЛЕДОВАНИЕ РАЗРЕЗОВ АНДАМИЧ, АЗА И ДИЗА (НАХЧЫВАН, АЗЕРБАЙДЖАН)

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Резюме. В статье приводятся результаты изучения палеогеновых отложений на территории Нахчыванской Автономной Республики, горизонтальных движений земной коры и пути решения проблемы. На двух разрезах, Аза и Андамич, были проведены палеомагнитные исследования и изучены палеогеновые отложения. Первоначально на основе палеомагнитных данных были определены кинематические параметры и горизонтальные перемещения блоков. Обсуждение результатов палеомагнитных исследований, проведенных на территории Нахчыванской Автономной Республики, проводилось на горных породах палеогенового возраста.

Аналогичные результаты были получены при характеристике компонентов I_n: глины, мелкозернистые песчаники более стабильны, более крупнозернистые породы метастабильны, а крупнозернистые песчаники, мергели, алевролиты и т.д. нестабильны.

Во время магнитной очистки фиксированные компоненты намагниченности изолируются. В среднем их направление совпадает с направлением намагниченности, определяемым методом поперечного сечения.

На разрезах наблюдается регулярное чередование пород с прямой и обратной намагниченностью. После временной и температурной очистки, а также попеременной магнитной очистки на разрезах Аза и Андамич как непосредственно, так и обратно намагниченные породы имеют одинаковое направление. Все это указывает на синхронность I_n^o и отсутствие компонентов вторичного намагничивания в I_n после очистки.

Актуальность и важность проводимых палеомагнитных исследований также подтверждается тем, что только с помощью этого метода можно определить палеотектоническое положение и количественно оценить вращение одних геологических структур относительно других.

Ключевые слова: *магнитная восприимчивость, стратиграфическое подразделение, геолого-геофизический анализ ордубадского синклинория, разрезы Андамич, палеоцен*

ƏNDƏMİÇ, AZA VƏ DİZƏ KƏSİLİŞLƏRİNİN PALEOMAQNİT TƏDQİQATI (NAXÇIVAN, AZƏRBAYCAN)

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Xülasə. Məqalədə Naxçıvan Muxtar Respublikası ərazisində Paleogen çöküntülərinin, yer qabığının üfüqi hərəkətlərinin və problemin həlli yollarının öyrənilməsinin nəticələri təqdim olunur. İki hissədə, Aza və Əndəmiç, paleomaqnit tədqiqatları aparıldı və paleogen çöküntüləri araşdırıldı. Əvvəlcə paleomaqnit məlumatlar əsasında kinematik parametrlər və blokların üfüqi hərəkətləri müəyyən edilmişdir. Naxçıvan Muxtar Respublikası ərazisində aparılan paleomaqnit tədqiqatlarının nəticələrinin müzakirəsi Paleogen dövrünə aid qayalarda aparılıb.

I_n komponentlərinin xarakteristikasında oxşar nəticələr əldə edilmişdir: gillər, incə dənəli qumdaşları daha sabitdir, qaba dənəli süxurlar metastabil, qaba dənəli qumdaşları, mərmərlər, lil daşları və s. qeyri-sabitdir.

Maqnit təmizlənməsi zamanı maqnitləşmənin sabit komponentləri təcrid olunur. Orta hesabla, onların istiqaməti kəsişmə metodu ilə təyin olunan maqnitləşmə istiqaməti ilə üst-üstə düşür.

Kəsilişlərdə birbaşa və tərs maqnitləşmə ilə süxurların müntəzəm dəyişməsi müşahidə olunur. Müvəqqəti və temperatur təmizlənməsindən, həmçinin Aza və Əndəmiç kəsilişlərindəki alternativ maqnit təmizlənməsindən sonra həm birbaşa, həm də geri maqnitlənmiş süxurlar eyni istiqamətə malikdir. Bütün bunlar I_n^o sinxronluğunu və təmizləndikdən sonra I_n-də ikincil maqnitləşmə komponentlərinin olmamasını göstərir.

Paleomaqnit tədqiqatlarının aktuallığı və əhəmiyyəti yalnız bu metodla paleotektonik mövqenin müəyyən edilə bilməsi və bəzi geoloji strukturların digərlərinə nisbətən fırlanmasının kəmiyyətcə qiymətləndirilməsi ilə təsdiqlənir.

Açar sözlər: *Maqnit həssaslığı, stratigrafik bölgü, Ordubad sinklinoriumunun geoloji-geofiziki təhlili, Əndəmiç kəsilişləri, Paleosen dövrü*