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Research Article

Magnetic stratigraphy of Paleogene rocks of West Gobustan (Azerbaijan).

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Abstract:

To solve the issues of stratigraphic, paleogeographic, litofacies and paleoecological directions, a detailed stratigraphic base is required.This article presents the results of joint biomagnetostratigraphic studies of the Paleogene deposits of the Greater Caucasus (Azerbaijan) in order to clarify the boundaries of the Paleocene, Eocene, Oligocene and Mioceneв. Paleomagnetic studies of Paleogene deposits of Azerbaijan have shown frequent changes in the geomagnetic field during this period. The results of scientific research on the southern slope of the Greater Caucasus have confirmed this fact. We have identified two paleomagnetic hyperzones: 1) Khorezm (it is dominated by reverse polarity zones, but the upper part of the Paleocene has a direct polarity) and 2) Sogdiana (characterized by alternating paleomagnetic fields of direct and reverse polarity). In the Lower Paleocene, 2 subzones of direct polarity were distinguished: the Danian and the Monian.The identification of a paleomagnetic zone of reverse polarity contributed to the determination of the boundary between the Mons and Tenes stages. This result was confirmed by identifying changes in the micro-faunistic composition of deposits and observing the nature of variations in micro-floristic complexes.

1. Introduction

As a research area, we chose the area of the southern slope of the Greater Caucasus, where Paleogene deposits are widespread (Figure 1).
It is possible to carry out accurate age distribution of rocks by the paleomagnetic method. Both paleomagnetic and paleontological studies were carried out in Paleogene-aged sediments of the studied area, and accurate age distribution was given between basement and half-floors.
The Paleogene-Paleocene, Eocene and the lower Oligocene layers were studied in the article and each layer was considered separately.
The Perekishkul section (total thickness 616.5 m) is located near the Perekishkul village of the same name on the southeastern flank of the East Dzhanginskaya syncline. The studied Oligocene deposits are underlain by Eocene deposits, but the line of contact cannot be traced. This contact is hidden under the scree (8 m). According to the section, the Maikop series of rocks is subdivided into 2 sections (from bottom to top). The lower section (553 m thickness) is represented by clays (from gray to brown), sandstones, and dolomitic limestone at the base. The upper section (63 m thick) is represented by lilac and brown clays with layers of platy sandstone and concretions. The contact of the Maikop deposits with the underlying Eocene deposits is smoothly marked by the disappearance of such forms of foraminifers as

Subbotina eocenica irregularis and Globorotalia praebulloides and a sharp decrease in the number of individuals of Globigerina ofisinalis Subb(Figure.2)[1-8].

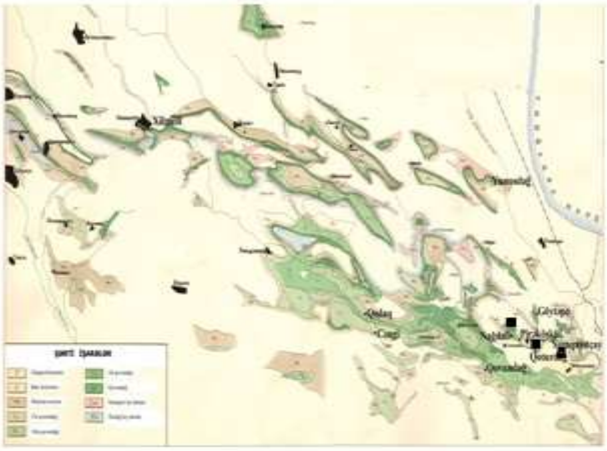


Figure.1 *Place of sampling*

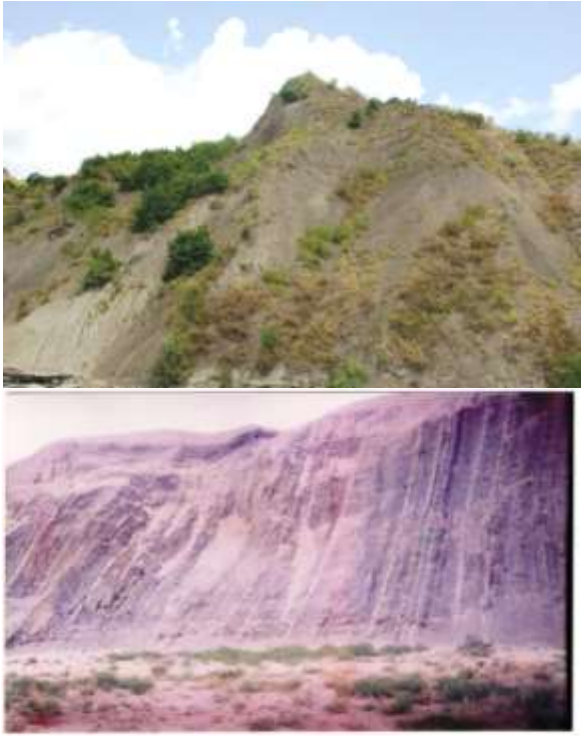
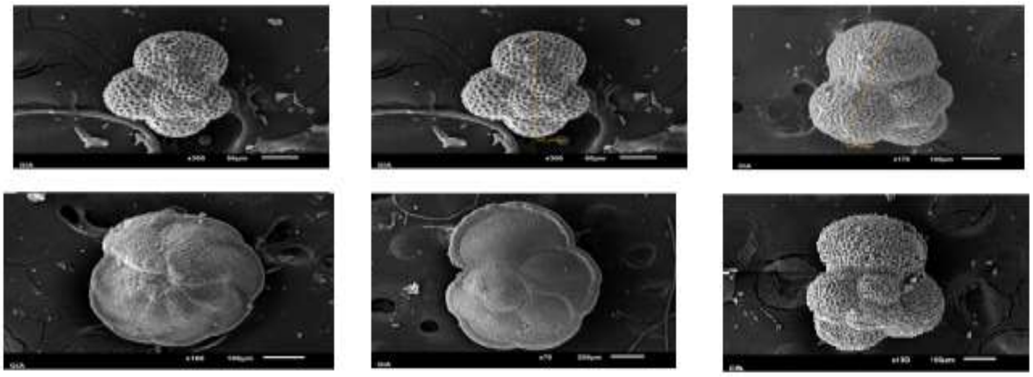


Figure. 2. *Outcrop of Paleocene sediments in the Perekishkul and Khilmili section*



Fauna

1 and 2 - Globigerina officinalis, Subbotina; 3 – Globigerina eocaenica, Terquem; 4- Globoratalia araqonensis, Nutall; 5- Globoratalia mardinodentata, Subbotina; 6- Globoratalia bulloides, Orbigny

Figure 3. *Faunanın*

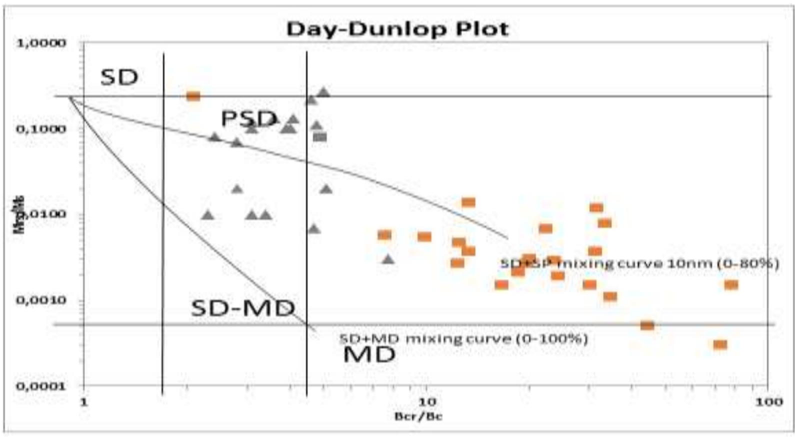


Figure 4 *Curves of magnetic-mineralogical research.*

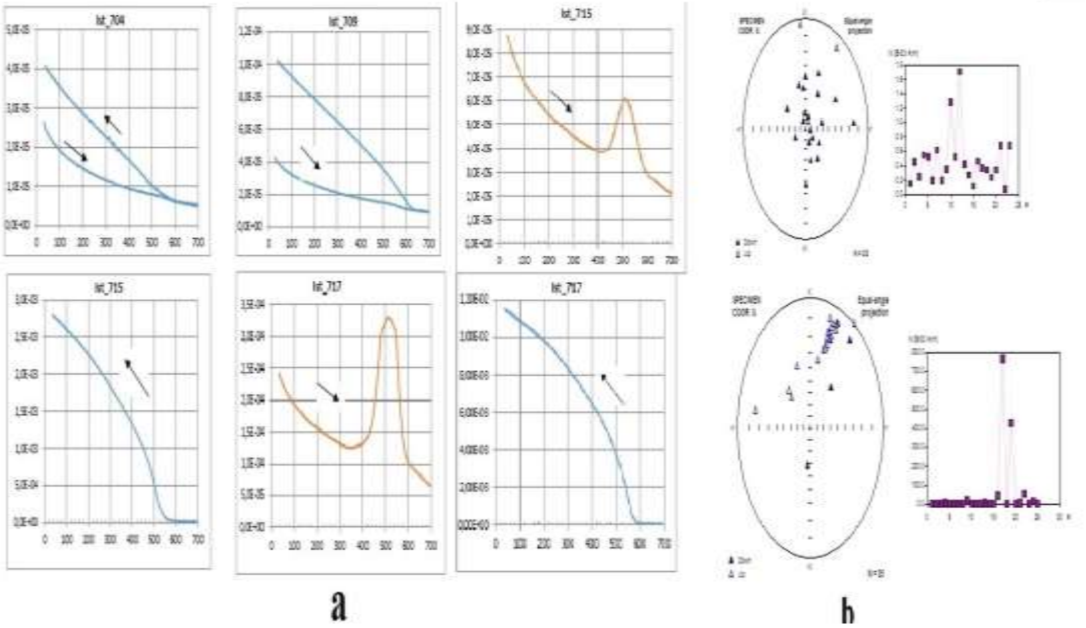


Figure 5. *The paleomagnit characteristics of the West Gobustan. a) graphs of thermomagnetic analyses; b) variable magnetic field cleaning; c) temperature cleaning.*

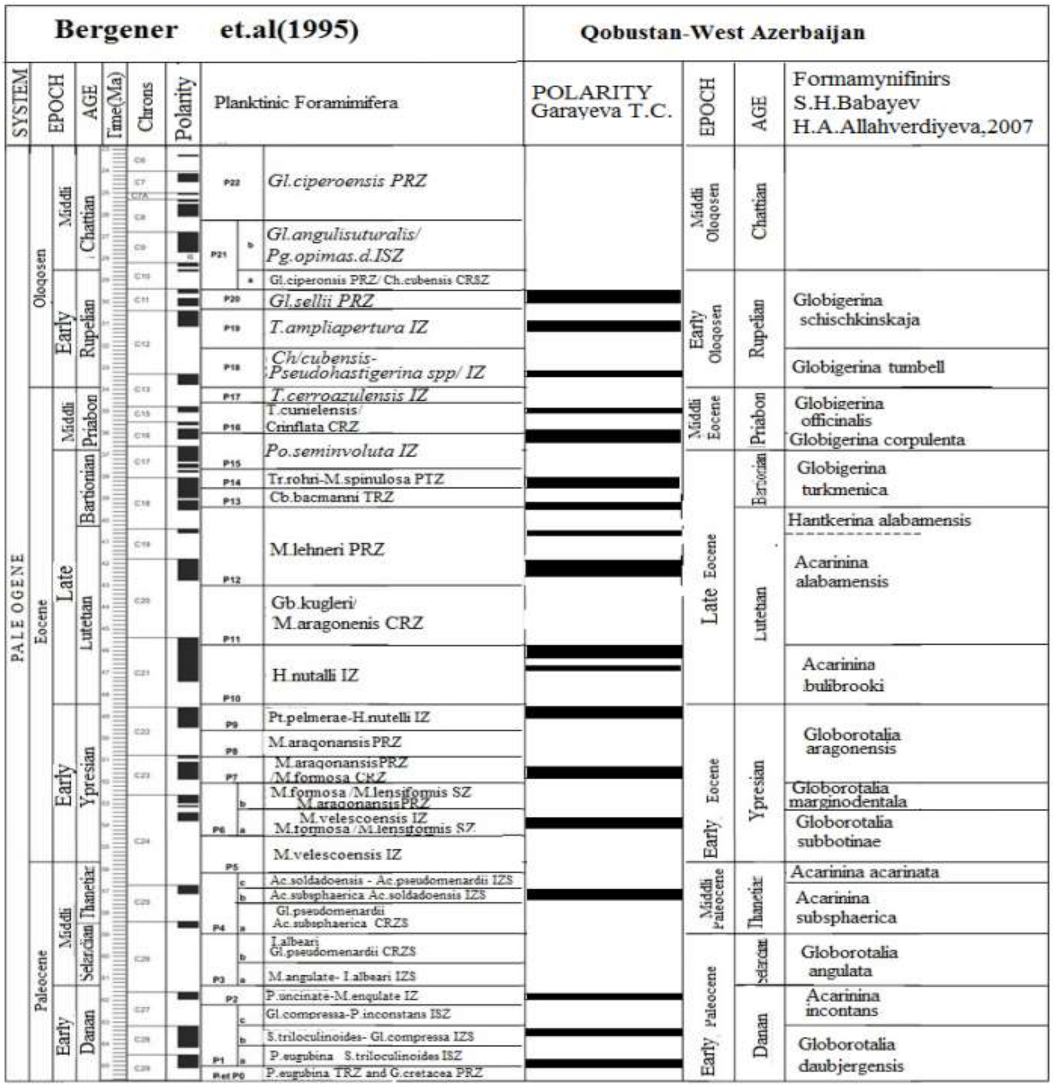


Figure. 6 *Scheme of paleomagnetic-stratigraphic correlation of the Paleogene*

In the Zeland and Thanet floors, sandstones with intermediate layers of brick-red, reddish-brown, and greenish-gray clays. The sediments of the Ipr floor are represented by gray, dark gray clays.

The lutet floor is represented by gray, dark gray clays. In these clays, *Acarinina acarinata, Globorotalia marginodentata, G. subbotinae, Globigerina triloculinoides, G. eocaenica, G. compressaformis, Acarinina acarinata, Cibicides felix, Anomalina ex. Gr. affinis etc.* is recorded.

Globigerapsis index, Gglobigerina turkmenica, G. eocaena, G. tetracamarata, Cibicides eocaenicus, Nonion pseudomartkobi are widely distributed in the dark gray clays with interlayers of sandstones in the Priabon floor.

In the Perekishkul section, the sediments of the rupel floor are green-gray. The total thickness of lower Maykop sediments reaches 215 m in this section.

With a total thickness The Khilmili the sectionof 185 m, are lithologically represented by dark clays from gray to black with layers of mica and the remains of tree trunks.

In Pliocene and the Eocene sediments, gray, greenish-gray, reddish-brown marly clays with rare limestone, gravelite and conglomerate in interlayers are *Globoconusa daubyerensis, Acarinina inconstans, Nutalloides trumpyi, Heterohelix irregularis, Globorotalia compressa, Acarinina subsphaerica, Globigerina variant* determined.

In the Khilmili section, the Upper Paleocene lies transgressively on the Denmark floor.

The Ypresian sediments lie conformably on the upper Paleocene sediments and are represented by the alternation of rare thin-plate gray clays in the interlayers.

In the Eocene floor, it is represented by greenish gray, dark gray, gray clays, marly clays. In the Khilmili section, the Upper Paleocene lies transgressively on the Denmark floor.

The Ypresian sediments lie conformably on the upper Paleocene sediments and are represented by the alternation of rare thin-plate gray clays in the interlayers.

In the Khilmili transect, the sediments of the upper Oligocene Priabon floor were *Globigerina corpulenta, G.eocaena, G. officinalis, Globigerapsis index, Bolivina antegressa, Nonion pseudomartkobi, Nonionella chilmiliensis, Cibicides lobatulus etc., Nonionellata chilmiliensis, Glomospira corona, Hastigerina micra* determined.

The Rupel floor of the Oligocene department lies suitably on the priabon and is expressed by Gray, greenish-gray, dark gray low-Galin thin layers of clay. Layers of yarosite and manganese oxide are noted on these clays. Clays are characterized by *Globigerina eocaena, G. postcretasea, Hastigerina micra, Ammosphaeroidina caucasica, Nonion pseudomartkobi, Bolivina dentalata, B.antigressa, Nodosaria inexculta, N. capitata.*

The Jangi settlement is located near the village of the same name. The section consists of Eocene, Oligocene and Miocene sections, and its thickness is 289 m. Lithologically, it consists of dark gray sheet clays and sandy clays.

Over the Lower Eocene, relatively thin (5-10 cm) brownish-brown, greenish-gray oily clays alternate with the least thick (4-8 cm) fine-grained sandstones. In these sediments *Globigerina ex. gr.bacuana, Heterohelix pumilla, Ammodiscus incertus, Acarinina pentacamerata* are widespread.

The Oligocene sediments lying conformably on top of the Eocene are represented by dark-gray, gray, yellowish-brown, brown, thin-layered clays with a thin layer of sandstone(Figure.3)[8].

2. Methods and Magnetic mineralogy:

For reliable paleomagnetic constructions, first of all, it is necessary to establish the nature of natural remanent magnetization, the primacy of the identified NRM component, the correspondence of the primary component to the time of formation of the studied rocks, and to determine the NRM carrier minerals[3,9,10].

For paleomagnetic studies, the samples were taken in those places where the occurrence elements of the layers were confidently measured. Field and laboratory studies were carried out according to the method generally accepted in paleomagnetism [3,10]. The relative error in determining NRM and χ averaged 5-9%. Natural remanence (NRM) and magnetic susceptibility (χ) of the studied rocks vary within $(3\text{-}18{,}0)\times10^{-3}$ A/m and $(0{,}25\text{-}2{,}90)\times10^{-3}$ SI units, respectively (figure 4).

To identify magnetic minerals-carriers of magnetization, thermomagnetic studies were carried out. The results of thermomagnetic analysis revealed maghemite with T=325-425^{o}C and magnetite with T=580-600^{o}C [3].

Thus, field and laboratory paleomagnetic studies of the Paleogene and Miocene rocks of the southern slope of the Greater Caucasus made it possible to determine the directions of NRM and the nature of primary remanent magnetization, as well as to prove the synchronism of NRM during the formation of these rocks. Based on these studies, paleomagnetic zones of direct and reverse polarity were identified (figure.5.). The first group of samples loses 50% of the initial magnetization at 120-175ºC. The stable part of I_n is observed at 300-350^{0}C. The second group of rocks loses 60-70% of its former temperature before heating to 150º C. The stable part of I_n is observed in the range of 250º-300ºC. Based on the magnetomineralogical studies conducted on the samples, the following can be said: their mean directions in the geographic coordinate system D= 24^o; J= 32^o; k = 9; alfa95 = 11^o, the mean direction in the stratigraphic coordinate system D= 51^o; J= 41^o; k = 11; alfa95 = 8^o. The accuracy of the characteristic component is clearly improved by the 60% correction of the sedimentation layer (D= 28^o J= 42^o; k = 9; alfa95 = 10^o). Most of the studied samples have a component with an accuracy of 200 to 600 and higher, this component has a direction (in the Geographic coordinate system) close to the direction of the modern geomagnetic field; sometimes the calculated direction of this component cannot be compared with any possible direction either in the modern or in the ancient coordinate system. Paleomagnetic data made it possible to clarify the age of a number of geological formations. Thus, the lower part of the Khadum Formation, which according to geological data is attributed to the Early Oligocene, according to paleomagnetic data, is a Late Eocene formation. In all studied sections of the Paleogene, at the boundary of the Upper Eocene - Lower Oligocene, an R-paleomagnetic zone was distinguished, along which the boundary between the stages was drawn. The coordinates of the paleomagnetic pole calculated for this sequence are characteristic of the Upper Eocene paleopoles. The beginning of the Oligocene in Azerbaijan is fixed due to a new cycle of sedimentation, in which the sediments are more terrigenous than the underlying Upper Eocene deposits. At the beginning of the Oligocene, in many regions of Azerbaijan, a transgressive overlap of the layers of the Eocene and older deposits is recorded. In some places, basal conglomerates developed, while in others, clayey sediments developed, apparently, on a denuded, almost flat land surface (figure 6). Thus, starting from the end of the Middle Eocene, especially in the Upper Eocene and Oligocene, extensive synclinal troughs gradually turned into their opposite - uplifts, forming complex folded structures [4,7,9,11] and also other related works [12-14].

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
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