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# CURRENT STATUS OF PALEONTOLOGICAL-STRATIGRAPHIC STUDIES IN AZERBAIJAN*

**Alizadeh Ak.A.**

*Ministry of Science and Education of the Republic of Azerbaijan,*
*Institute of Geology and Geophysics,*
*119, H.Javid ave., Baku, AZ1143*

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***Summary.*** The history of the study of fossil paleontological remains in Azerbaijan is divided into several stages depending on the degree of research intensity, the scale of stratigraphic coverage, and the participation of national personnel. In the 50-80s of the twentieth century, the priority was to unite specialists according to age groups of fossil remains (e.g., Jurassic ammonites, Cretaceous inoceramas, ammonites and belemnites, Paleogene nummulites, Miocene pelecypods, etc.). Later, by the end of the nineties of the last century, the priorities of fundamental research shifted somewhat to the study of ecosystem evolution, paleobiology, event biostratigraphy, etc.

Such coryphees as academicians: M.M.Aliyev, G.A.Alizadeh, professors A.G.Khalilov, D.M.Khalilov, D.A.Agalarova stood at the origins of development of paleontological and stratigraphic researches in Azerbaijan. Activity of these scientists was accompanied by rapid development of paleontological and stratigraphic ideas, study of invertebrate fossil fauna, phytofossils (including nanofossils). Thus, by the end of the twentieth century, almost all archistratigraphic groups of fauna, their evolution, as well as paleoecological, paleobiological, paleobiogeochemical and other aspects of their habitat conditions had already been studied in detail.

As they say today, it really was the "golden age" of science, including paleontological and stratigraphic one. The main actor of this progress in science and its practical affairs, of course, was a researcher – an expert in his field, and only highly qualified personnel of Azerbaijani paleontological and stratigraphic science dynamically raised the bar of its achievements higher and higher. Among them are prominent paleontologists: T.A.Gasanov, K.M.Sultanov, H.Aliulla, B.G.Vekilov, A.B.Abbasov, R.G.Babaev, Sh.A.Babaev, M.R.A. Abdulkasumzadeh, G.A.Aliev, R.A.Aliev, R.O.Koshkarly, R.N.Mamedzadeh, O.B.Aliev, E.Z.Ataeva, H.Sh.Aliyev and others.

Thus, the wide scope of fundamental paleontological and stratigraphic research allowed Azerbaijani scientists to create a serious paleontological and stratigraphic base of geological research in Azerbaijan. The continuation of the systematic and systematic development of the regional geological study of the territory of Azerbaijan ultimately led to the creation of a fundamental formation-stratigraphic and geochronological basis, based on a set of modern methods and achievements in the field of paleontology, stratigraphy, isotope geochronology, facies-paleogeographic analysis and historical and geological synthesis.

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For over thirty years of the independence, Azerbaijani scientists have travelled a difficult and complex path in the field of paleontological and stratigraphic research. 1990s were marked by a stagnation experienced by all activity spheres of the country, including politics, culture, education, and science. The scientific sector of Azerbaijan, including academic studies, had unexpectedly become challenged by a number of difficulties, such as the shortage of funding, the outflow of talented young researchers, the transition of adventurous people to the business sector, and the breakage of ties with research organizations and scientists in Russia and the CIS countries. In general, the Azerbaijani science lived a deep crisis in the last decade of the 20th century. In their efforts to overcome the emerging problems, the local scientists, of course, including geologists-paleontologists, tried to maintain cooperation with their colleagues from the post-Soviet states, and to gain new partners overseas. Both efforts aimed at the integration with global scientific community – fundamental purpose of the national science of that period.

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Historians will probably more accurately determine the formation period, development stages and the "Golden Age" of the geological and paleontological science of Azerbaijan. In our opinion, the paleontological-stratigraphic research in Azerbaijan reached its' peak in the second half of the 20th century, when, through the efforts of several generations of specialists, the main features of the dynamics of paleontological and stratigraphic studies had been formulated. Based on these fundamental achievements, the local paleontologists and stratigraphers established a standard stratigraphic basis for large-scale geological surveys, deep and ultra-deep (Saatli well) formation drilling in the region (Alizade et al., 1999).

Moreover, rapid development of the national oil industry at that period also occurred thanks to the efforts of the Azerbaijani geologists, with essential contribution of paleontologists and stratigraphers. Starting from the hard times of 1990s, local researchers have managed to intensify the integration process of the Azerbaijani paleontological-stratigraphic science into the world scientific network. With signing of the "Contract of the Century" in 1994, new opportunities were created for a joint work with the world's largest oil corporations, such as British Petroleum, Unocal, Exxon, Shell, Amoco, Mobil, Statoil, Total, Agip, etc.

For the Azerbaijani geologists, stratigraphers and paleontologists this was a breakthrough into the international research auditorium. During this period, a relatively small team of scientists, mostly young specialists, completed over 50 research projects in geology, oil and gas problems, geochemistry and, of course, paleontology and stratigraphy. Joint desktop and field studies, followed by the analysis and interpretation of the produced data at the different foreign scientific centres and universities, have made it possible to quickly learn new research methods, software and standards used in the Western countries on the one hand, and to intensify training of local scientists on the other.

Historically, increased attention paid since the 1930-40s to the paleontological and stratigraphic research in Azerbaijan was primarily associated with the growing demands of oil-gas search and exploration. This had determined stricter requirements set against stratigraphic-paleontological studies implemented using various complex methodologies. You are all well aware that the territory of Azerbaijan has diverse geological and tectonic evolution record, resulting in the emergence of the Absheron Peninsula, Caspian shelf, Middle Kur Depression (Fig. 1) and the other world-famous oil and gas provinces.

The list of the pioneers of the Azerbaijani paleontology and stratigraphy contains the names of such famous scientists as academicians Musa Aliyev, Aliashraf Alizadeh, Gambay Alizadeh, Professors Dunya Agalarova, Jalil Khalilov, Damir Gadjiyev and others (Fig. 2).

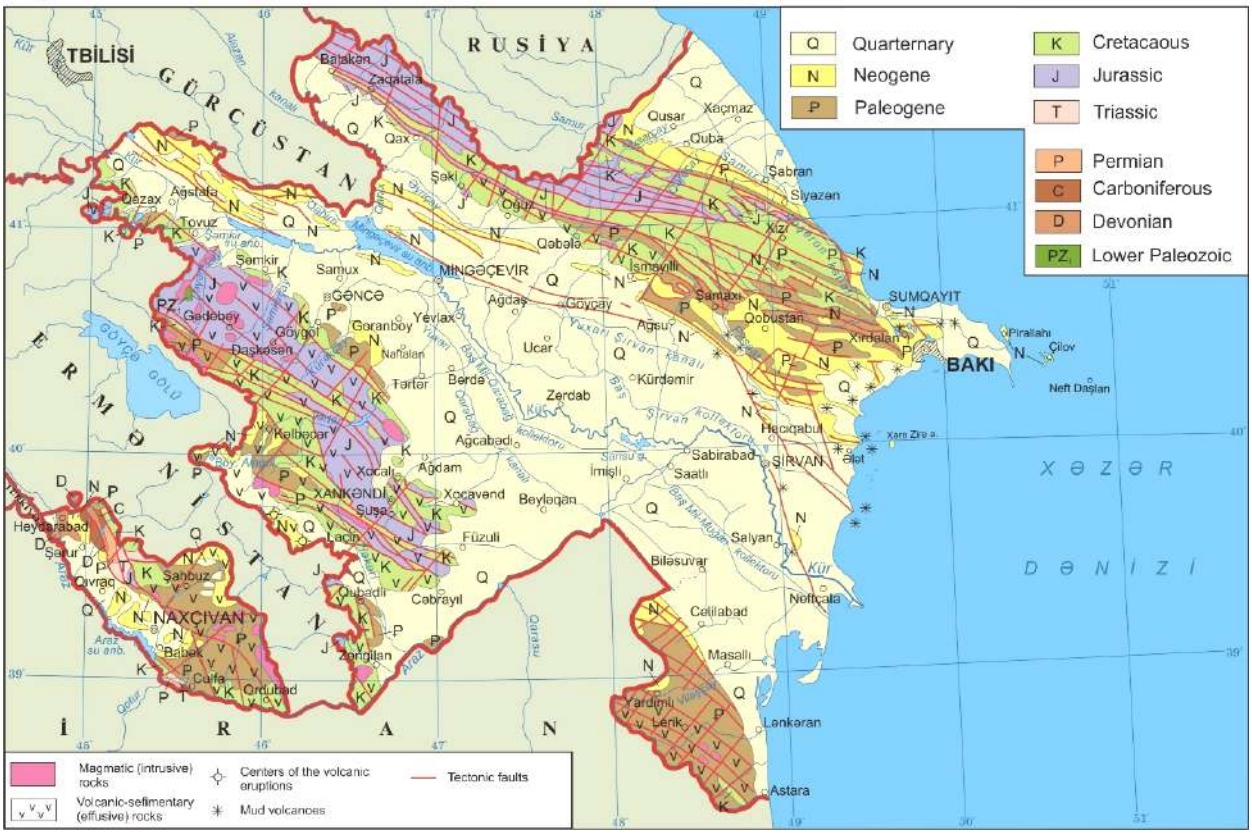



**Fig. 1.** Geological map of Azerbaijan




**Fig. 2.** The famous palaeontologists of Azerbaijan: 1 – Musa Aliyev; 2 – Aliashraf Alizadeh; 3 – Gambay Alizadeh; 4 – Dunya Agalarova; 5 – Jalil Khalilov; 6 – Damir Gadjiyev

Over the course of 70 years of the history of the Soviet Azerbaijan, local scientists conducted fundamental scientific research and published important findings in the fields of the Phanerozoic paleontology and stratigraphy (mollusks, brachiopods, foraminifera, ostracods, spores-pollen, etc.). Great contribution to the formation and development of this research area in Azerbaijan had been made by the outstanding Russian and Soviet scientists, such as I.M.Gubkin, N.B.Vassoevich, V.V.Weber, V.V.Bogachev, D.V.Nalivkin, Yu.A.Orlov, B.S.Sokolov, V.I.Zhamoida, N.P.Luppov, V.V.Drushchits, V.A.Vakhrameev, V.I.Kacharava, L.Sh.Davitashvili, etc. Regional stratigraphers compiled stratigraphic schemes of different-scale geological surveys which had covered the entire territory of Azerbaijan.

These schemes (Халилов, 1978) were developed based on the results of complex studies implemented by the Azerbaijani macro- and micropaleontologists. These scientists developed detailed reference sections of the Devonian, Cretaceous, Paleogene and Neogene stratigraphy of the Lesser and Greater Caucasus systems. Also, they prepared detailed stratigraphic schemes (up to the identification of faunal zones) of the Mesozoic, Paleogene and Neogene sequences of both systems (Ализаде Ак.А., 1972; Ализаде К.А., 1977; Алиюлла, 1970, 1977; Халилов и др., 1973; Халилов, Ализаде Ак.А., 1970; Касимова, 1970; Ализаде, Мамедов, 1970 a, b; Ализаде, Гаджиев, 1975; Бабаев, 1970). Another important achievement of the Azerbaijani stratigraphers was the creation of a biostratigraphic scheme of the country's Quaternary deposits. The Azerbaijani scientists have published the results of important studies dedicated to the micromorphology of foraminifers, ostracods, mollusks, brachiopods and pollen spores (Мамедов, 1992; Векилов, 1969, 1962; Атаева, 2007; Агаларова и др., 1961; Джабарова, 1967; Джафарова, 2006; Касумова, 1966). Using scanning electron microscope (SEM) in the carried-out investigations helped identify new micromorphological features and trace onto-phylogeny of the morphological elements of a number of studied micropaleontological groups of the fauna, such as ostracods, nanoplankton, etc. (Koshkarly, Mamedova, 1997).

Analysis of the micromorphological evolution of various micropaleontological fauna groups allowed establishing the taxonomic rank of the studied signs which had represented a value for the stratigraphy of oil and gas deposits.

In 1990s, the Institute of Geology of Azerbaijan had continued biostratigraphic studies of the main oil-gas deposits. In particular, investigation of the Neogene deposits of the Eastern Azerbaijan and the South Caspian basin has provided evidences to an assumption that the basement of the Productive Series should be located at a glacio-eustatically low sea level. Study of the Azerbaijan's famous Pliocene Productive Series which contains about 26 billion barrels of the oil equivalent, allowed characterizing its' stratotype section covering the time interval between 3.4 Ma (upper boundary) and 5.5 Ma (lower boundary) (Fig. 3).

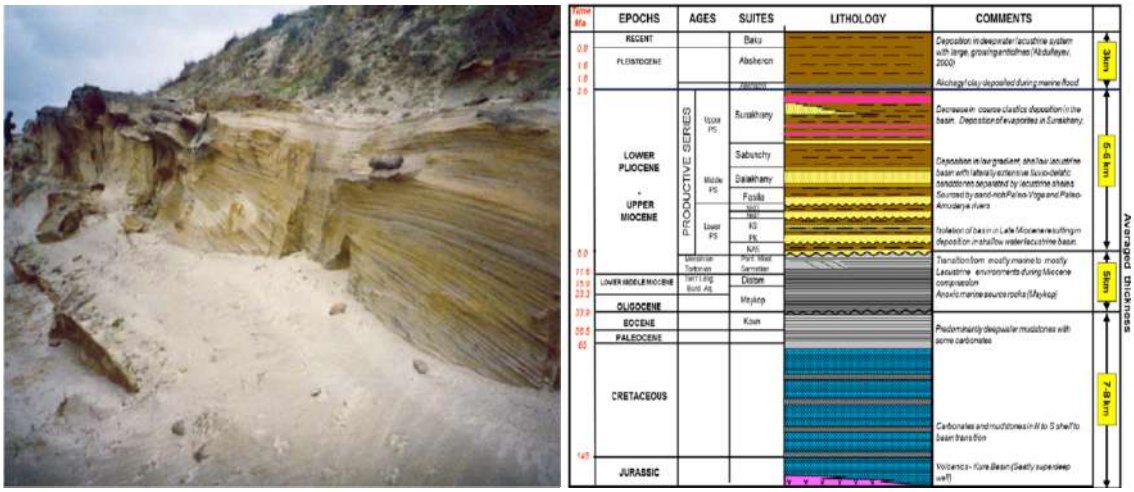



**Fig. 3.** Kirmaky section, Stratotype of Productive Series of Azerbaijan.
Stratigraphic column for South Caspian Basin (Javanshir et al., 2014)

The study outcomes were summarized in a monograph "Productive Series of Azerbaijan" (Ализаде и др., 2018, Vol. 1, 2).

The Paleogene of Azerbaijan has been sufficiently studied. The stratigraphic division of the Paleogene deposits is based on macrofauna, plankton foraminifers and nanofossils (more than 10 biozones of the standard Martini's scale (Martini, 1970) have been discovered in Azerbaijan). Several detailed nano-zone sequences have been identified among Eocene and Oligocene deposits. The biostratigraphic studies of Neogene, Paleogene and Cretaceous formation were implemented based on a program developed in Azerbaijan back in 1978 for the biostratigraphic studies of the calcareous nanofossils. Several interesting papers on nanofossils were published in 1990, such as "Regional Paleogene stratigraphic scheme of the Azerbaijan" (Ализаде К.А. и др., 1989), "Biostratigraphic and stratigraphic Atlas of the Cretaceous, Paleogene, Neogene, and Quaternary strata of Azerbaijan and South Caspian basin" (Koshkarly, Mamedova, 1997), "Geology of Azerbaijan. Stratigraphy. Volumes 1, 2" (2007), "Geosciences of Azerbaijan" (Alizadeh et al., 2016).

Special mention should be made of a radiometric scale of the Azerbaijan's Late Cenozoic, developed by Azerbaijani specialists in close collaboration with scientists and specialists of St. Petersburg State University specialized in absolute geochronology. These studies brought significant clarifications into the understanding of the Neogene stratigraphy of Azerbaijan and the Caspian region (Fig. 4), dating the Pontian regiostage as Upper Miocene, and the Productive Series as Lower Pliocene deposits (Чумаков и др., 1988 a, b).

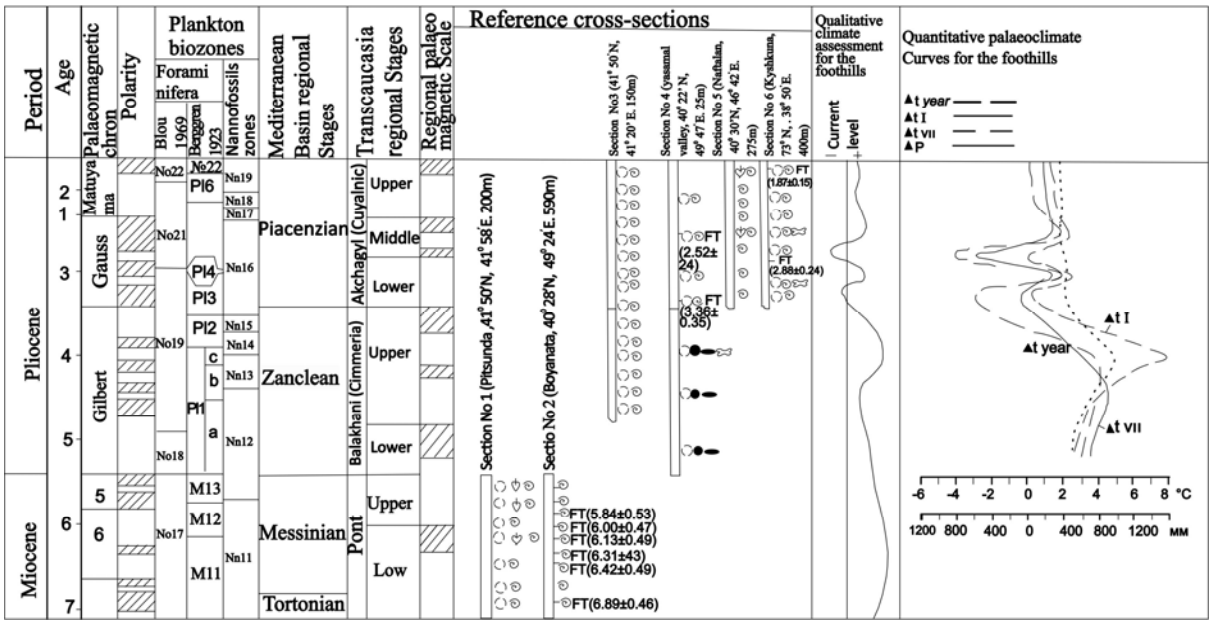



**Fig. 4.** Chronostratigraphic scale of Pliocene of South Caucasus (Мамедов, 1991)

Based on the latest data on the origin of the Caspian Sea and the formation of its main structures, 18 paleogeographic maps were compiled and included in the zootomic atlas "Paleogeographic atlas of shelf regions of Eurasia for the Mesozoic and Cenozoic shelves of Eurasia" (Атлас палеогеографических карт, 1992).

Many works of the Azerbaijani paleontologists are devoted to Quaternary period of Azerbaijan (2.5 Ma). This interest is due to a decisive role of this period in the formation of modern Earth's surface. As is known, the Quaternary period is generally very contrasting due to sharp climatic transformations (Fig. 5), multiple continental glaciation events and repeated changes in landscape and climatic belts of the region.

The data produced as a result of many years of the studies had made it possible to develop a Pleistocene climate-stratigraphic division chart of the Caspian Sea and correlate it with the paleogeographic events of the Black Sea and the European continent. Azerbaijani specialists have revealed a close connection between the Quaternary transgressions and regressions of the Caspian Sea and the climatic events in the northern latitudes. It has been established that the scale of the Caspian Sea's transgression and regression, as well as of the glaciation area of the East European Plain, tends to decrease from more ancient

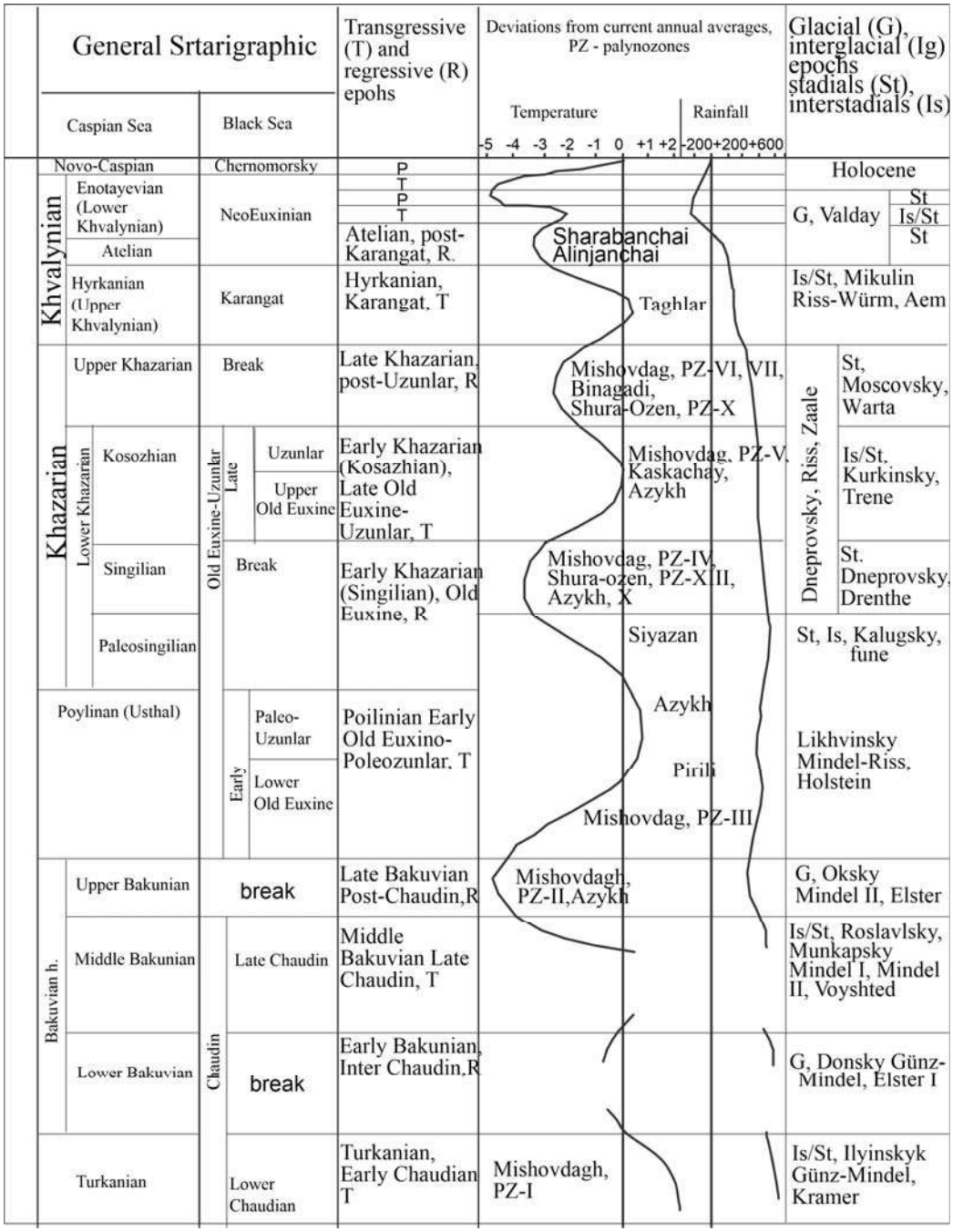



**Fig. 5.** Climatostratigraphic scheme of the Caspian Sea Pleistocene (Велиев и др., 2004)

to more recent epochs. Generalization of accumulated factual material on macro- (remains and imprints) and micro- (pollen and spores) remains of the plants playing a leading role in the interpretation of paleolandscape and paleoclimatic reconstructions, made it possible to identify the main evolution stages of landcover and climate for the territories of the Caucasus (Early epochs of the Cenozoic – Eocene, Oligocene, Miocene) and Azerbaijan (Late Cenozoic – Pliocene, Pleistocene). 1:2500000 scale vegetation maps were compiled for individual chronological sections of the Cenozoic era, 8 of which were included in the National Atlas of Azerbaijan (Tağıyeva və b., 2014).

Restored landscapes formed due to the climatic changes of the Pleistocene interglacial periods, provide valuable information about changes in modern landscape components and can be used to make climate change and anthropogenic intervention based forecasts. These studies resulted in preparing and publishing of the "Palaeontological Atlas of Quaternary Systems of Azerbaijan" (2017). Serving as a summary of the past studies, the Atlas presented results of the stratigraphical study of Azerbaijan's Quaternary deposits based on the analysis of macro- and microfauna remains of Pleistocene and Holocene.

Another noteworthy important international initiative pursuing the study of Azerbaijan paleogeography was implemented within the framework of the program "The dynamics of the interaction between the Natural environment and Primitive Man" (Беличко и др., 1980; Гаджиев и др., 1979; Мамедов и др., 1982; Сулейманов, 1979, 1982). The basis for carrying out these studies was laid back in 1960s by a discovery of the Paleolithic men's sites (Damdzhily, Azykh, Taglar) in the territory of the Garabagh region of Azerbaijan. Azykh site is a unique archaeological monument illustrating more than 1 Ma of the Paleolithic Human evolution in a single cave complex. Discussions about it continue to this day. Located at one of the migration routes of the *Homo erectus* from Africa to Europe, the Garabagh region surpasses all other parts of the South Caucasus in terms of the number of discovered archaeological sites. Today, prehistorical sites of the Lesser Caucasus region are studied together by paleogeographers and archaeologists from the Azerbaijan National Academy of Sciences, and the scientists from Japan and Germany. The research project called "Absolute and relative chronology of the Neolithic monuments of Garabagh" is implemented together with the German Archaeological Institute.

Within the Cenozoic Era, the Neogene (Miocene and Pliocene) are the two most interesting periods in the history of the Earth's evolution. Azerbaijani scientists have implemented comprehensive palaeobotanical (spores-pollen, dinoflagellates, diatoms) and microfaunistic studies of marine sediments on the western flange of the South Caspian Basin (part of the Eastern Paratethys), in order to elaborate on and clarify its' stratigraphy (Fig. 6) (Байрамова и др., 2021).

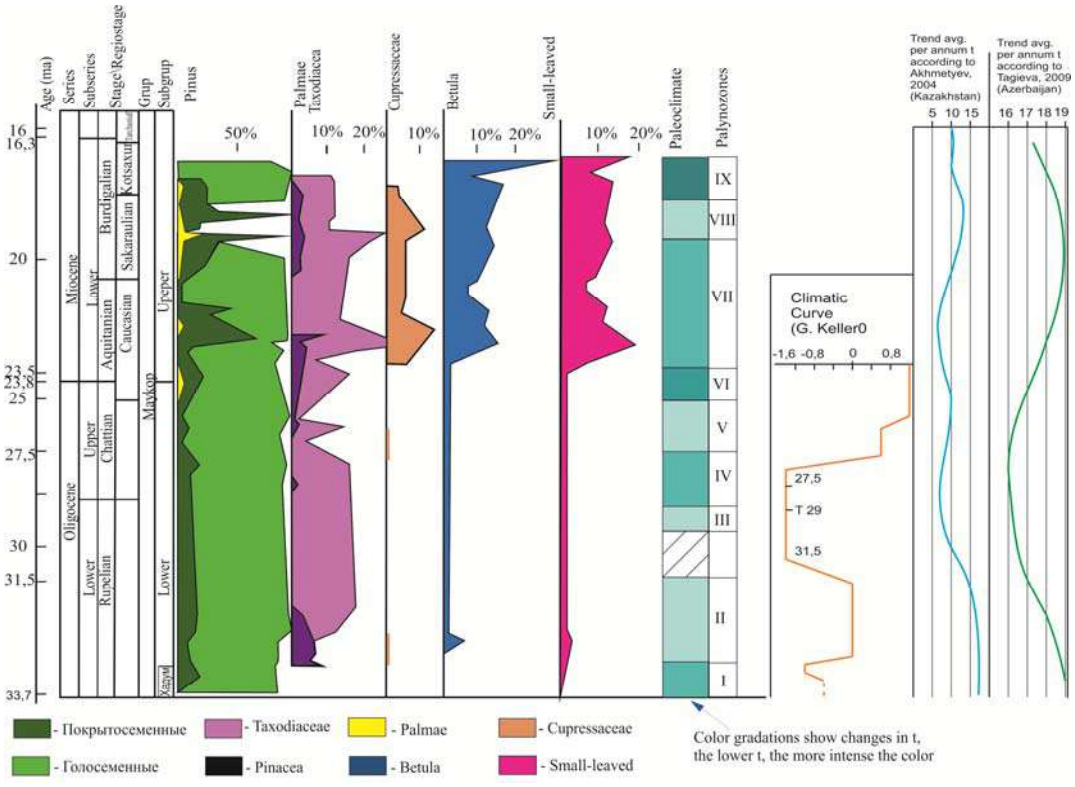



**Fig. 6.** Changes in the paleogeographic conditions of the Maykop time of the Shamakhi-Gobustan region by palynological data (Байрамова и Тагиева, 2023)

The research carried out in this area has allowed correlating and identifying paleopalynological zones of the oil-gas bearing, Maykopian and Diatom formation of Azerbaijan, as well as to study the change in environmental conditions and vegetation in the stratigraphic sequences of geological periods. Based on the phytoplankton study results, the origin of dispersed organic matter and changes in its catagenesis degree have been studied. To make these studies efficient, the Institute of Geology has been equipped with a full set of up-to-date equipment, including optical and scanning electron microscopes and the required computer software.

A few words should be said about the current state of paleontological studies of vertebrates. The history of these studies in Azerbaijan covers a period of 150 years (since 1870). Stratigraphically, the studies cover the time interval from the Cretaceous to the Holocene. In total, remains of more than 500 vertebrate species have been identified in Azerbaijan, including more than 140 fishes, 10 amphibians, 12 reptiles, 140 birds and 205 mammal species.

The studies resulted in the development of a special catalogue characterizing more than 500 species and subspecies belonging to 5 classes. The catalogue reflects the systematic confinement of different species in the sequence of their appearance in the evolution process. To the extent possible, each of the catalogued fossils was provided by a card index identifying the location of the discovery and storage place of the fossil, as well as the people who found and characterized the discovery. It should be noted that this is only the first stage of research and work on the catalogue will be continued, since a large amount of the discovered fossil vertebrates must be re-identified and placed in the collection funds of the Natural History Museum of Azerbaijan (NHM).

Intensive systematic excavations on the paleontology of vertebrate animals were carried out by employees of the NHM of Azerbaijan, as a result of which the museum's collections were replenished with new fossil materials from the Binagadi burials (suburbs of Baku), the Mingachevir reservoir (west of Azerbaijan) and other sites. Thus, tens of thousands of the bones belonging to different vertebrate species (reptiles, birds, mammals), as well as a large number of plant and arthropod remains were discovered at the Binagadi site (Fig. 7) only. Recently, the collection has been further enriched by new, previously undescribed species of birds, bats and plants.

During excavations in the vicinity of the Mingachevir reservoir, a whole skull (without the lower jaw) of a southern elephant (Fig. 8) was discovered.

After a sharp drop in the water level of the reservoir, numerous bones remain of the postcranial skeletons and skulls of the southern and forest elephants (Fig. 9) were discovered.

There is a large accumulation of different vertebrate species discovered for the first time since 2012 in the vicinity of the Mingachevir reservoir, on the spurs of the Bozdagh and Garaja ranges (composed of Absheronian and Bakunian deposits) (Fig. 10).

The discovered species include primitive bull *Bos* sp. (Fig. 13), bison – *Bison* sp., buffalo – *Bubalus* sp. (Fig. 11), forest elephant – *Palaeoloxodon antiquus* (Fig. 12), ancestor of the giant deer – *Praemegaceros verticornis* (Fig. 15) (both species were first discovered in Azerbaijan); two species of the ancient Merki rhinoceros (Fig. 16) – *Stephanorhinus hundsheimensis* and *Stephanorhinus kirchbergensis*, skull of a trogonteria elephant or Wüsti elephant bones of the postcranial and cranial skeleton of the Stenon horse – *Equus stenonis*, ancient cabaloid horse *Equus* sp., giant deer *Megaloceros giganteus*, red deer *Cervidae* (Fig. 14.)

Together with bone remains, there are many Early Paleolithic Man's tools (Fig. 17), discovered in the Mingachevir site.

As a result of the studies, it was established that the surroundings of the Mingachevir reservoir are unique, having no analogues in the world in terms of the area, relief and the annual number of discovered fossils. It was concluded that to organize its' protection, the site must be given the status of a "Natural Monument" of global significance.

Research has shown that the Merk's rhinoceros (Fig. 16) from the Garaja site (*Stephanorhinus kirchbergensis*) is a typical species of the Late Villafrancian – Early Galerian complexes of the Western Europe (analogues of the Tamanian faunal complex).

Stratigraphic spread of this taxon in the Eastern Europe is currently unknown due to the fragmentation of previously identified Early Pleistocene rhinoceroses in this area.

In 2021, a large skull fragment belonging to a forest straight-tusked elephant, as well as more than 2 m long tusk fragment of a forest elephant (Fig. 18) were discovered in the Garaja site.

Along with the abundance of animal bone remains, the Mingachevir site is characterized by rich variety of various Pleistocene flora species, represented by fossilized trunks (Fig. 19) of large and small trees and shrubs (typical forest vegetation). This speaks for the assumption that during the described period, the area represented a habitat with semi-open forest-steppe type landscapes dominated by the steppe areas interspersed with tree and shrub vegetation.



**Fig. 7.** Binagadi burial of the Quaternary fauna and flora. Turtles bones



**Fig. 8.** Southern elephant *Archidiscodon meridionalis*



**Fig. 9.** Forest elephants *Mammuthus trogontherii*



**Fig. 10.** Mingachevir reservoir. Bozdagh and Garaja



**Fig. 11.** Fragment of the skull of the fossil buffalo *Bubalus* sp. from the Upper Bakunian deposits



**Fig. 12.** Forest elephant *Paleoloxodon antiquus*



**Fig. 13.** Fragments of the horns and lower jaw of the bull *Bos* sp.



**Fig. 14.** Ancient cabaloid horse *Equus* sp.; Giant deer *Megaloceros giganteus*; Red deer *Cervidae*



**Fig. 15.** The ancestor of the giant deer *Praemegaceros verticornis*



**Fig. 16.** Merki rhinoceros *Stephanorhinus hundsheimensis, Stephanorhinus kirchbergensis*



**Fig. 17.** Early Paleolithic Man's tools. Garadja



**Fig. 18.** Tusk of a straight-tusked elephant *Paleoloxodon antiquus.* Mingachevir, Garadja site

Spine paleontologists continued their studies in the vicinity of Pirakashkul village located on the south-eastern termination of the Greater Caucasus mountains. There, in the upper parts of the southern slope of Gara-Islam Mountain, numerous whale bone fragments were first discovered in the diatomic deposits.

In 2012-2013, in the vicinity of the Shamkir reservoir (Fig. 20), lower jaw fragments of a Stenon horse, and a tooth of a Southern elephant (Fig. 21) were discovered.



**Fig. 19.** Fossilized trunks of trees. Garadja



**Fig. 20.** Shamkir reservoir




**Fig. 21.** Lower jaw fragments of a Stenon horse. A tooth of a Southern elephant

In 2020, specialists of the NHM discovered a large new deposit of the Maykopian flora (tree trunks) and vertebrate fauna (cetaceans, cartilaginous bony fishes) (Fig. 22), located in Greater Caucasus at the foothills of Jangi Mountain.

As to international relations, Azerbaijani scientists continue to actively participate in the implementation of international programs, conducting joint research with several foreign institutions. Thus, the Institute of Geology and Geophysics, together with the Institute of Geography (Azerbaijan), as well as the Institute of Applied Geosciences, University Montan Leoben and Geocentre NAWI Graz Austria, are conducting joint micropaleontological, mineralogical and geochemical investigation of the previously unstudied Miocene deposits of Azerbaijan (Gobustan). Close ties are also maintained with the Paleontological Institute and the Geological Institute of the Russian Academy of Sciences (Fig. 23).

Azerbaijani palaeogeographers work closely with the evolutionary geography department of the Institute of Geography of the Russian Academy of Sciences, conducting joint research consisting in the study of changes in natural environment and the correlation of events that occurred during the Quaternary period in Azerbaijan and Eastern Europe. It is known that the development of new research methods requires the training of qualified personnel. In this regard, Azerbaijani young scientists acquire grants for conducting scientific research and opening startups to implement new projects. They are also gaining internships at leading universities in Europe and Russia. Another noteworthy example of the international cooperation is the research conducted jointly by the Azerbaijani paleontologists and stratigraphers, and the geological services of Russia, Kazakhstan, Central Asian states, and China.

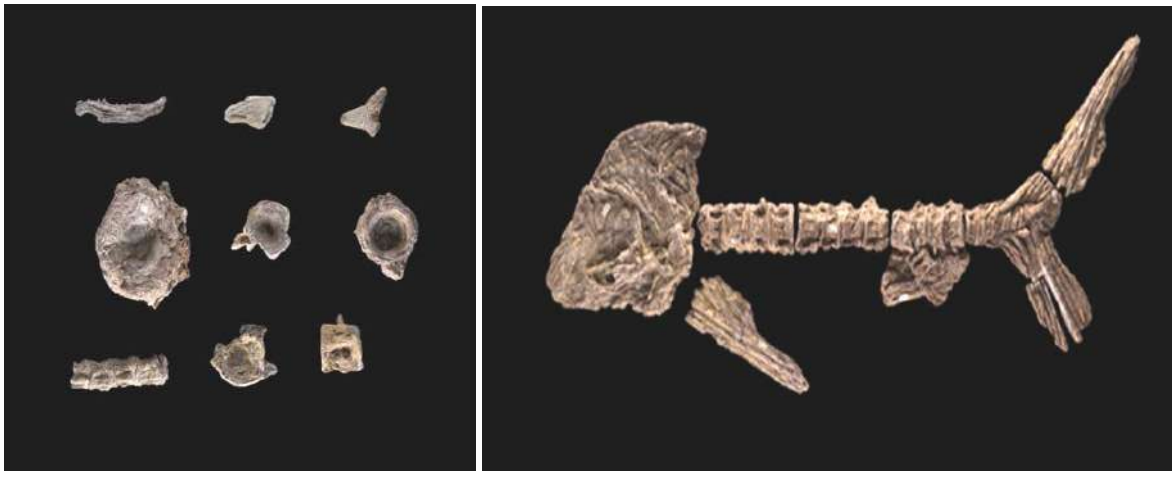


**Fig. 22.** Cetaceans, cartilaginous bony fishes. Tunes. Jangi



**Fig. 23.** Scientist from Azerbaijan, Austria, and Russia

Thus, over the past 30-40 years, fundamental research has been carried out in the field of stratigraphy and paleontology in Azerbaijan, producing interesting scientific results. At the same time, the ongoing complex global study of the oceans – the Earth's superstructures, has allowed geologists, including stratigraphers and paleontologists, to take a new look at the World Ocean, which occupies 3/4 of the Earth's surface. This branch of geology – the geology of the bottoms of the seas and oceans, had almost fallen out of the specialists' interest before drilling of "Challenger" 1968 allowed judging about the ocean's lithosphere. This, of course, was a revolution in geology, giving rise to a plenty of thoughts and forecasts for the future. Knowledge of the World Ocean's floor made it possible to pose and solve problems of global stratigraphic correlation within the time interval of the Mesozoic through the Quaternary. Tremendous role in this progress was played by a monographic study of nanofossils, microfauna, and the salt content of the waters.

Nowadays, the scientific community of Azerbaijan is focused on this type of the correlative stratigraphic studies. It is planned to pay close attention to determining the stratotypes of the boundaries – large Phanerozoic stratons. One of such stratotype sections is the Dorasham section (Fig. 24) in Nakhchivan (Julfa canyon). It is useful for studying the Permian-Triassic boundary on the territory of Azerbaijan.

This section (Fig. 24) has got everything to be recognized by the international scientific stratigraphic community as a reference for solving the problem of stratigraphic boundaries between Permian and Triassic periods.

The most important problem of the Azerbaijani stratigraphy and paleontology remains the solution of some unsolved problems of the Quaternary stratigraphy. In this regard, it is important to thoroughly study the relationships and the places of transition of the continental Quaternary sediments to marine facies. It is necessary to implement more detailed investigation of the problem of accurate identification of the distribution boundaries of marine Caspian transgressions, starting from the Bakunian stage and up to the Khazarian, Khvalynian and other transgressions. Comparisons of faunistically characterized Caspian terraces with similar modern continental deposits are also of great interest. Finally, we believe it is important to begin a detailed dissection of the Quaternary lavas of the Garabagh plateau and the river basin of Tartar.



**Fig. 24.** Julfa canyon. Stratotype of the Upper Permian

In the future, serious attention should be paid to conducting modern research on basin stratigraphy – sequence-stratigraphy with mandatory paleobiogeochemical and facies analysis. As is known, the latter is associated with the study and modelling of the sedimentation stages.

As before, there is a high demand for the development of seismostratigraphic studies in the geosciences, as this is one of the key methods of theoretical stratigraphy enabling the wide use of mathematical and IT methodology in solving specific geological tasks. Very important is the correlation of continental, terrigenous and volcanic formations on a biostratigraphic basis. Paleontologists and stratigraphers of Azerbaijan are planning to implement interesting studies of the stratigraphy of the Caspian shelf sediments.

It is an urgent task to study the stratigraphic layers illustrating various stages of the development of life throughout the Phanerozoic. Today, Azerbaijani paleontologists pay special attention to the study of the evolution of ecosystems, problems of paleobiogeography, evolutionary morphology, regularities of the evolution process and problems of biomineralization. In the coming years, Azerbaijan National Academy of Sciences is planning to implement the Program "Evolution of the Biosphere" (2024-2030). These studies will be carried out at the intersection of paleontology, geochemistry, biogeochemistry, and lithology. As it comes to how purely paleontological and paleobiogeographic problems are addressed in Azerbaijan, special mention should be made of the studies covering the evolution of a biota. It is important to create section-by-section chronostratigraphic and paleogeographic reconstructions of the territory of Azerbaijan with clarification of cause-and-effect relations, as well as to implement quantitative and qualitative assessment of the nature-climatic changes. Studies of the prehistorical ecology shall target the reconstruction of natural and climatic conditions that existed on the territory of the Paleolithic sites of Azerbaijan, and the study of interaction between the natural environment and the primitive societies.

In conclusion, let me say a few words about how almost the entire toolkit of a geologist, paleontologist-stratigrapher has changed in the 21st century. Today, this toolkit is based on automated research systems that are embodied in specialized user-friendly software, freeing a researcher from a routine manual work. Recent years were marked by a significant increase in the intensity of scientific contacts and exchanges within the global scientific network. Global international projects with the participation of scientists from many countries, including Azerbaijan, have become more common. High reputation of the Institute of Geology and Geophysics gained from its' participation in dozens of international contracts, guarantees that the institute will successfully meet the today's requirements and initiate several of its' own projects.

I would like to recall the words of the outstanding Austrian biologist and ethologist Konrad Lorenz: "*When we scientifically explain one of the wonderful phenomena of nature, this explanation is in no way like an unmasked wizard. The true reasons are grander and more amazing than the most beautiful myth.*"

Therein lies all our love of science!

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## СОВРЕМЕННОЕ СОСТОЯНИЕ ПАЛЕОНТОЛОГО-СТРАТИГРАФИЧЕСКИХ ИССЛЕДОВАНИЙ В АЗЕРБАЙДЖАНЕ

**Али-Заде Ак.А.**

*Министерство науки и образования Азербайджанской Республики, Институт геологии и геофизики, Азербайджан AZ1143, Баку, просп. Г.Джавида, 119*

***Резюме.*** История изучения ископаемых палеонтологических остатков в Азербайджане подразделяется на несколько этапов в зависимости от степени интенсивности исследований, масштаба стратиграфического охвата, а также участия в них национальных кадров. В 50-80-е годы XX века приоритетом было объединение специалистов по возрастным группам ископаемых остатков (например, юрские аммониты, меловые иноцерамы, аммониты и белемниты, палеогеновые нуммулиты, миоценовые

пелециподы и т.д.). Позднее, к концу девяностых годов прошлого столетия приоритеты фундаментальных исследований несколько сместились в область изучения эволюции экосистем, палеобиологии, событийной биостратиграфии и т.д.

У истоков развития палеонтолого-стратиграфических исследований в Азербайджане стояли такие корифеи, как академики: М.М.Алиев, Г.А.Ализаде, профессора А.Г.Халилов, Д.М.Халилов, Д.А.Агаларова. Деятельность этих учёных сопровождалась бурным развитием палеонтологических и стратиграфических идей, изучением беспозвоночной ископаемой фауны, фитоостатков (включая нанофоссилии). Так, к концу XX века детально были уже изучены почти все архистратиграфические группы фауны, их эволюция, а также палеоэкологические, палеобиологические, палеобиогеохимические и другие аспекты условий их обитания.

Как сегодня принято говорить, это действительно был «золотой век» науки, в том числе и палеонтолого-стратиграфической. Главным действующим лицом этого прогресса в науке и её практических делах, конечно, был исследователь – классный специалист, и только высококвалифицированные кадры азербайджанской палеонтолого-стратиграфической науки динамично поднимали планку её достижений всё выше. Среди них видные специалисты палеонтологи: Т.А.Гасанов, К.М.Султанов, Х.Алиюлла, Б.Г.Векилов, А.Б.Аббасов, Р.Г.Бабаев, Ш.А.Бабаев, М.Р.Абдулкасумзаде, Г.А.Алиев, Р.А.Алиев, Р.О.Кошкарлы, Р.Н.Мамедзаде, О.Б.Алиев, Э.З.Атаева, Х.Ш.Алиев и другие.

Таким образом, широкий размах фундаментальных палеонтолого-стратиграфических исследований позволил азербайджанским учёным создать серьезную палеонтолого-стратиграфическую базу геологических исследований в Азербайджане. Продолжение планомерного и систематического развития регионального геологического изучения территории Азербайджана привело в итоге к созданию фундаментальной формационно-стратиграфической и геохронологической основы, опирающейся на комплекс современных методов и достижений в области палеонтологии, стратиграфии, изотопной геохронологии, фациально-палеогеографического анализа и историко-геологического синтеза.

***Ключевые слова:*** *Палеонтология, стратиграфия, Азербайджан, продуктивная серия, климатостратиграфическая схема, Азых*

## AZƏRBAYCANDA PALEONTOLOJİ-STRATİQRAFİK TƏDQİQATLARIN MÜASİR VƏZİYYƏTİ

**Əlizadə Ак.А.**

[1]*Azərbaycan Respublikasının Elm və Təhsil Nazirliyi, Geologiya və Geofizika İnstitutu*
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***Xülasə.*** Azərbaycanda paleontoloji qalıqların öyrənilmə tarixi müvafiq tədqiqatların intensivliyi, stratiqrafik yaş intervalı, həmçinin bu tədqiqatlarda milli kadrların iştirakı dərəcəsindən asılı olaraq bir neçə mərhələyə bölünür. XX əsrin 50-80-ci illərində paleontoloji qalıqların tədqiqatı zamanı mütəxəssislərin geoloji yaş qrupları üzrə birləşməsi prioritet idi (məsələn, Yura ammonitləri, Təbaşir inoseramları, ammonit və belemnitləri, Paleogen nummulitləri, Miosen pelesipodları və s.). Daha sonra ötən yüzilliyin doxsanıncı illərinin sonunda fundamental tədqiqatların prioritetləri bir qədər dəyişərək ekosistemlərin təkamülünün, paleobiologiyanın, biostratiqrafik hadisələrin öyrənilməsi kimi sahələrə üstünük verildi.

Azərbaycanda paleontoloji-stratiqrafik tədqiqatların təməli akademiklər Musa Mirzə oğlu Əliyev, Qambay Əsgər oğlu Əlizadə, professorlar Əbdülhəmid Yusif oğlu Xəlilov, Cəlil Mustafa oğlu Xəlilov, Dünya Ələkbər qızı Ağalarova kimi korifeylər tərəfindən qoyulmuşdur. Bu alimlərin fəaliyyəti paleontoloji və stratiqrafik ideyaların sürətli inkişafı, qədim onurğasız faunanın və floranın (nanofossillər də daxil) öyrənilməsi ilə müşayiət olunurdu. Beləliklə, XX əsrin sonuna qədər, demək olar ki, bütün arxistratiqrafik fauna qrupları, onların təkamülü, həmçinin onların yaşam şəraitinin paleoekoloji, paleobioloji, paleobiogeokimyəvi və başqa aspektləri ətraflı öyrənilmişdi.

Bu dövr, həqiqətən, elmin, o cümlədən paleontologiya-stratiqrafiya elminin "qızıl əsri" – intibah dövrü idi. Elmdə və onun praktiki tətbiqində bu tərəqqinin əsas hərəkətverici qüvvəsi, əlbəttə, tədqiqatçılar – yüksəkixtisaslı mütəxəssislər idi. Yüksəkixtisaslı kadrlar Azərbaycanın paleontologiya-stratiqrafiya elminin nailiyyətlərinin dinamik inkişafının təkanverici qüvvəsi idi. Onların arasında paleontologiya üzrə görkəmli mütəxəssislər T.A.Həsənov, Q.M.Sultanov, X.Əliyulla, B.Q.Vəkilov, A.B.Abbasov, R.Q.Babayev, Ş.Ə.Babayev, M.R.Əbdülqasımzadə, Q.A.Əliyev, R.Ə.Əliyev, R.O.Qoşqarlı, R.N.Məmmədzadə, O.B.Əliyev, E.Z.Atayeva, X.Ş.Əliyev, V.B.Ağayev, Ç.Ə.Tahirov və başqalarının adları xüsusi qeyd edilməlidir.

Beləliklə, fundamental paleontoloji-stratiqrafik tədqiqatların geniş miqyas alması sayəsində Azərbaycan alimləri respublikada geoloji tədqiqatların ciddi paleontoloji-stratiqrafik bazasını yaratmaq imkanı əldə etdilər. Azərbaycan ərazisinin regional geoloji tədqiqinin planauyğun və sistematik şəkildə davam və inkişaf etdirilməsi yekunda müasir metodlara və paleontologiya, stratiqrafiya, izotopların geoxronologiyası, fasial-paleocoğrafi analiz və tarixi-geoloji sintez sahələrində nailiyyətlərə söykənən fundamental formasion-stratiqrafik və geoxronoloji təməlin yaradılması ilə nəticələndi.

***Açar sözlər:*** *paleontologiya, stratiqrafiya, Azərbaycan, Məhsuldar seriya, iqlimstratiqrafiya sxemi, Azıx*