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Geosciences of Azerbaijan

Volume I: Geology

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Preface

Azerbaijan occupies an area of about 87,000 km² in the unique tectonic environment (the Greater and Lesser Caucasus, Talysh Mts., Kur and Caspian Basins, etc.) that finds a corresponding reflection in the studied geophysical fields. Geological–geophysical data on the geological structure of Azerbaijan can shed light on the basic principles of evolution of the Earth, the distribution of economic minerals and seismic activity. Geodynamically, this region can be considered as a result of the interaction of several microplates—fragments of the Afro-Arabian and Eurasian lithospheric plates. The deep understanding of both near-surface and deep geological structure of Azerbaijan may be realized only on the basis of comprehensive combined analysis of tectonic, stratigraphic, morphological, lithological features and various geophysical fields (ground, shipborne, airborne and satellite observed) examination. A number of important mineral resources are concentrated there: besides well-known hydrocarbon reserves (Azerbaijan is the oldest hydrocarbon province in the world), here was found a number of large polymetallic, copper, gold-bearing, iron ore, and other deposits.

Separate attention was paid to stratigraphy and lithology, geomorphology, neotectonics, hydrogeology, petrophysical parameters, seismological monitoring, qualitative and quantitative geophysical field examination and modelling. Environmental and near-surface investigations reflect examination of mud volcanoes, solving different ecological, technical and hydrogeological problems. Many tens of developed models clearly illustrate application of advanced geophysical–geological methodologies.

This book not only generalizes all previous publications in Russian and Azerbaijani languages (and partially—in English), but reflects many unpublished materials and principally new geoscientific data obtained during the recent years. Our view is that only skillful aggregation of various geological and geophysical methods, supported by the latest advances in the analysis of satellite data and extensive use of unmanned vehicles will make a significant leap in all the areas of the geosciences in Azerbaijan.

The authors of this book have been working in Azerbaijan and adjacent areas for many years and developed a lot of new methodologies, approaches and different kinds of models (geological, paleontological, geochemical, geophysical, etc.) for this region.

In the book preparing was used the results of long-term work of the Institute of Geology and Geophysics of the Azerbaijan National Academy of Sciences, including eight volumes of “Geology of Azerbaijan” and numerous domestic and International publications. Many chapters and sections were significantly reduced since the book volume is limited. Nevertheless, we hope that the presented materials allow to obtain a bright impression about the main directions of the geological–geophysical studies in Azerbaijan.

Chapter VI in second Volume “Geodynamics and Seismology” is prepared in cooperation with scientists from the Massachusetts Institute of Technology. Authors of this chapter are F. Kadirov, S. Mammadov, M. Floyd, R. Reilinger, A. Alizadeh and L. Eppelbaum.

A great assistance in the book preparing we received from our colleagues: E.K. Alizadeh, Ch.S. Aliyev, A.A. Feyzullayev, Yu.H. Israfilov, A.D. Ismailzadeh, T.N. Kangarli, A.Sh. Mukhtarov and G.J. Yetirmishli. We wish also to express our gratitude to all researchers from

Azerbaijan and other countries (first of all, from the USA, France, Italy, England and Germany) whose scientific results have been analysed in this book.

This book may be useful for geoscientists and engineers working in Azerbaijan and similar regions, students of different specialties studying geology, geophysics and environment of complex tectonic regions, and for a wide range of readers who want to get acquainted with the unusual geological–geophysical phenomena of this beautiful country.

Akif A. Alizadeh
Ibrahim S. Guliyev
Fakhraddin A. Kadirov
Lev V. Eppelbaum

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About the Authors

Akif A. Alizadeh received M.Sc. (1956) from the Azerbaijan Oil Academy, Ph.D. (1961) and D.Sc. (1969) from the Geological Inst. of the Azerbaijan Academy Sciences. More than 40 years he occupied a position of Director of Geology and Geophysics Institute of the National Academy of Sciences (ANAS). In 2013 he was elected as President of ANAS. Professor Akif A. Alizadeh is the author of more than 370 publications including 8 books. Akif A. Alizadeh's main scientific filed is a regional stratigraphy of the Cretaceous deposits in Azerbaijan. He together with followers developed stratigraphic scheme of Cretaceous deposits, analyzed numerous paleonto-

logical–stratigraphic materials and generalized the modern ideas of geological processes. His researches designed the basis of sedimentary and volcanogenic–sedimentary formations, distribution and development of the Cretaceous fauna. Professor Akif A. Alizadeh's many years investigations enabled to formulate the principal concepts of study of the Cretaceous Mollusk fauna (belemnites) in Azerbaijan and adjacent regions. His researches cover classification, phylogeny and morphofunctional analysis, the principles of paleobiogeographic zoning, examination of ecological and paleontological problems. Professor Alizadeh himself identified the stages of spatial–temporal distribution for the Cretaceous Invertebrates in the Mediterranean and revealed here appropriate paleobiogeographic taxons. Study of morphogenesis in historical aspect, definition of tendency in population's nature alteration, identification of heritable morphological changes allowed him to restore a general evolution process of various belemnoid groups. Professor Alizadeh carried out fundamental research for the biogeochemical zonation of the Cretaceous basins in the Caucasus and for examination of geochemical conditions of Paleobasins as evolution factor. Analysing the microstructural, chemical and crystallochemical peculiarities of matters in skeleton formations of fossils, he revealed the patterns of migration and concentration for various chemical elements, paleophysiological peculiarities for some taxons. Professor Alizadeh created a description of geochemical ecology for the Cretaceous Invertebrates. Under his advising for the first time absolute values of paleotemperatures of Azerbaijan Cretaceous basins were determined by isotopic paleothermometry method.

Ibrahim S. Guliyev received M.Sc. from the Azerbaijan Oil Academy in 1970, and Ph.D. from the Moscow (VNIGNI) in 1978 and D.Sc. in 1989 from the Moscow State University. Since 1970s he has been working at the Geology and Geophysics Institute of the Azerbaijan National Academy of Sciences (ANAS) where he now occupies position of a Director of Oil and Gas Institute. Since 2013 he is a Vice President of ANAS. Professor Ibrahim S. Guliyev is the author of more than 100 publications including 10 books. Scientific interests of Ibrahim S. Guliyev cover geology and geochemistry of oil and gas, basin modelling and mud volcanism. Under his supervision and participation have been conducted original investigations of a gas regime in folded areas with the assessment of amount of discharge of carbonaceous gases and their distribution in the surficial atmosphere. His studies of the hydrocarbonaceous systems of rapidly subsiding basins (on example of the South Caspian basin) are of a special practical importance. Other scientific interests of Prof. Ibrahim S. Guliyev include results of basin's simulation, investigations of rates and range of generation, migration and accumulation of hydrocarbons in the terms of rapid subsidence as well as studies of isotopic–geochemical properties of the organic matter, oil, gas and water enabled to determine the depth of generation and preservation of hydrocarbons in the South Caspian basin.

Fakhraddin A. Kadirov received M.Sc. from the Azerbaijan State University in 1972, Ph.D. from the Geophysical Institute of the Georgian Academy of Sciences in 1984 and D.Sc. from the Geological and Geophysical Institute of the Azerbaijan National Academy of Sciences (ANAS) in 2000. Since 1974 up to now he has been working at the Geology and Geophysics Institute of ANAS where occupied positions of Researcher and Senior Researcher; now he is the Head of the Earth Physics Department. In 2013 he was elected as Academician-Secretary of the Earth's Science Division of the ANAS Presidium. Professor Fakhraddin A. Kadirov is the author of more than

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Lev V. Eppelbaum received M.Sc. from the Azerbaijan Oil Academy in 1982, and Ph.D. from the Inst. of Geophysics (Azerbaijan), Geophysical Inst. of Georgia and Mining Academy (Moscow) in 1989. In 1982–1990 he worked as geophysicist, Researcher and Senior Researcher at the Institute of Geophysics in Baku (Azerbaijan). In 1991–1993 Eppelbaum completed postdoctoral studies in the Dept. of Geophysics and Planetary Sciences at Tel Aviv University; at present he occupies a position of Assoc. Professor at the Dept. of Geosciences. He is the author of more than 330 publications including 7 books and about 130 articles. His scientific interests cover potential (magnetic, gravity,

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