



CRITICAL CHRONOLOGICAL OVERVIEW OF THE DESCRIPTION OF QUATERNARY DEPOSITS IN THE GEOLOGICAL MAPS OF ALBANIA, SCALE 1:200,000.

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ABSTRACT: This paper aims to present a diachronic analysis of the stratigraphic and geological nomenclature used to characterise Albanian Quaternary formations over the last century. This objective is achieved through a comparative review of the geological maps of Albania (1:200,000 scale) produced by the Albanian Geological Survey. Due to the deep political, economic, and scientific isolation of Albania during the Cold War -which applied to both sides of the Iron Curtain- some of these records have remained largely inaccessible to the international scientific community. The research identifies and highlights the inhibiting impact resulting from the prolonged use of fixist concepts. Based on the interpretation of subsurface data, the study proposes a paleogeographic model that suggests the presence of incision valley-like features within the Adriatic Depression. This is introduced as a potential working hypothesis and a tentative stratigraphic marker for refining the Neogene-Quaternary boundary, specifically concerning the Gelasian Stage. This re-evaluation serves as a step towards aligning Albania's stratigraphic framework with international standards, providing insights into the paleogeographic evolution of the Mediterranean.

Keywords: Albania, Quaternary, geological maps, Gelasian Stage, incision valleys.

1. INTRODUCTION

This article aims to provide a critical, diachronic analysis of the methodologies employed for the classification and representation of Quaternary deposits within the official 1:200,000 scale geological maps of Albania and their accompanying explanatory texts. The study highlights how these formations were historically treated merely as a superficial overburden devoid of mineral value, offering a crucial key to understanding the terminological discrepancies between national cartographic nomenclature and Western academic literature.

Within this context, this work offers a critical and diachronic evaluation of the stratigraphical and geological nomenclature employed to characterise the Quaternary formations of Albania over the past century. This objective is achieved through the comparative review of the official 1:200,000 scale geological maps of Albania produced by the Albanian Geological Survey, assessing how shifting geotectonic models and historical-political conditions influenced the documentation of these deposits.

This global historical framework is of critical importance for understanding the theoretical asymmetry that emerged in Albania. While the 18th IGC in London (1948) laid the foundations for the formal chronostratigraphic status of the Quaternary -recommending that the boundary be placed based on climatic shifts within the Italian marine successions (Mauz, 1998)- Albania was entering a phase of profound political, economic, and scientific isolation due to the Cold War. This geopolitical autarky, which was rigorously applied to both sides of the Iron Curtain after 1960, prevented subsequent international debates led by INQUA and the IUGS regarding the Plio-Pleistocene boundary stratotype

(Aguirre & Pasini, 1985) from being integrated into local mapping practices in real-time. Consequently, the Albanian geological school remained a strict follower of the Soviet framework until the late 1990s, a reliance clearly reflected both in the adherence to the Geosyncline Hypothesis (Papa, 1981; Shkupi, 1984) and in the nomenclature utilised for Quaternary subdivisions within official maps.

Furthermore, during the centralised communist regime in the second half of the twentieth century (1945-1990), geological research in Albania was strictly mandated to serve state economic priorities, conditioned by the rigorous implementation of the political principle of self-reliance (Backer, 1982; Peza et al., 1974; Shkupi, 1984), focusing almost exclusively on the exploration of solid minerals and hydrocarbons (Biçoku, 2000; Vranai et al., 1997). Purely theoretical or academic investigations were dismissed by contemporary ideology as unproductive and received no state funding. This restriction, combined with the enforced application of concepts from the Geosyncline Hypothesis, prevented the recognition of the role of long-term Quaternary climatic oscillations and regional geomorphological evolution. Quaternary deposits were treated pragmatically as a barren, non-mineralised overburden, and were studied only within the framework of exploration for minerals contained within them (Biçoku et al., 1970). The sedimentological and stratigraphical complexity of these unconsolidated formations is highlighted on the maps, yet they are described briefly, accompanied by the formal statement that a detailed stratigraphical study of them is lacking (Biçoku et al., 1970).

Quaternary successions in Albania constitute an important part for evaluating critical evidence of long-term climatic oscillations, eustatic sea-level changes,

Period	Timeframe	Main Characteristics and Cartographic Output
Period of general studies	19th century to 1904	Exploratory research and fragmented observations within the Ottoman Empire. No significant geological maps published; only small-scale regional sketches (e.g., Barbarich 1905 at 1:500,000 scale).
Period of initial surveying	1905 to 1929	First comprehensive and systematic efforts to survey the national territory. Driven by military needs during WWI and institutionalized by the state in 1922. Culminated in Nowack's 1:200,000 map (1929).
Period of in-depth research	1929 to the present day	Detailed, multi-scale investigations into the complex geological structure. Heavily supported by subsurface industrial data from the mining and petroleum sectors (1957, 1967, 1983, and 2002 maps).

Tab. 1- Chronological periods of geological exploration and cartographic representation in Albania.

and neotectonic activity within the transitional zone between the Dinarides and Hellenides, particularly in the eastern part of the South Adriatic Basin (Xhomo et al., 2011). To date, they still remain generally unknown to the international scientific community. Through a critical analysis of cartographic evolution, we aim to present our perspective on the inhibiting role resulting from the prolonged application of fixist geotectonic concepts. Within such theories, the focus was restricted solely to vertical movements, explaining marine transgressions and regressions exclusively through local tectonic subsidence and uplift (Aliaj, 1998, 2000; Kearey et al., 2009; Konomi et al., 2015; Papa, 1981; Shkupi, 1984). As such, the concepts of global eustatic fluctuations of ocean levels caused by climatic changes that occurred during the Quaternary were almost entirely ignored. We think that one of the consequences that resulted from this was the inability to clearly define the Neogene-Quaternary boundary.

Conceptually, by considering the entirety of Quaternary deposits -especially in the coastal plain- as correctly documented regarding their spatial position in extent and depth, we evaluate that their revision as stratigraphic sequences must primarily begin with the precise determination of their base. This requires the establishment of a clear boundary between the Neogene and Quaternary, which has always been missing, thereby imposing the re-assignment of upper Pliocene deposits towards the Lower Pleistocene, determining which deposits considered Pliocene to date are, in fact, part of the Gelasian Stage in Albania. Within this framework, this study introduces as a potential working hypothesis the presence of incised valley features within the Adriatic Depression, identified through the interpretation of subsurface borehole data, serving as a tentative stratigraphic marker for refining this boundary.

2. MATERIAL AND METHODS

2.1. The historical evolution of geological mapping in Albania

Ironically, whilst historical data on the origins of the geographical mapping of the country are lacking, there is no shortage of information regarding its geological study and mapping. Geological research of the Albanian territory commenced during the 19th century. Initially, this research was of an exploratory nature, conducted within territories that at the time belonged to the Ottoman Empire, which included, amongst others, the regions of present-day Albania (Biçoku et al., 1970, 2003; Peza et al., 1974; Vranai et al., 1997; Biçoku, 2000, 2004, 2007; Onuzi et al., 2022). Various authors, such as Peza et al. (1974), Vranai et al. (1997), Biçoku et al.

(2003), and Biçoku (2004, 2007), have divided the history of these geological studies into different periods, ranging from two (Vranai et al., 1997) to four (Biçoku et al., 1970). However, it must be noted that some of these divisions were influenced more by ideological considerations than by research criteria.

To overcome the limitations of these earlier, ideologically influenced classifications, this study proposes a revised synthesis based on clearly defined scientific and institutional criteria. These criteria include: firstly, the organizational structure and institutionalisation of geological research in the country; secondly, the transition from localised, exploratory observations to systematic, multi-scale field surveying; and thirdly, the methodological evolution and data density utilised for map compilation. Based on these criteria, the history of geological exploration and cartographic representation in Albania is herein structured into three distinct periods (Table 1):

- The period of general studies (19th century to 1904): Characterised by exploratory research and fragmented observations within the territories of the Ottoman Empire, which partially encompassed present-day Albania.
- The period of initial surveying (1905 to 1929): Covering the first comprehensive and systematic efforts to survey the entire national territory, driven initially by military needs during World War I and later institutionalised by the state.
- The period of in-depth research (1929 to the present day): Focusing on detailed, multi-scale investigations into the complex geological structure of Albania, heavily supported by subsurface industrial data from the mining and petroleum sectors.

The research conducted during the first period did not result in the publication of any significant geological map of the Albanian territory. During this era, as noted by Biçoku et al. (2003), only a few small-scale regional sketches were published, the most notable among these being the 'Carta Geologica dell'Albania' at 1:500,000 scale, printed in Rome in 1905 and designed by Eugenio Barbarich.

After 1905, interest in geological research in the territory of Albania increased significantly, particularly during the First World War when various geologists attached to the occupying armies carried out strategic surveys. A key milestone of this practical exploration occurred in 1917, when an Italian geological team led by Léo Madalena discovered the country's first oil deposit via a drilling well in Penkovë, east of Vlorë (Diamanti, 2010).

On March 22nd, 1922, formal state geological activity commenced through the establishment of the Geological Office, marking the inception of the Albanian

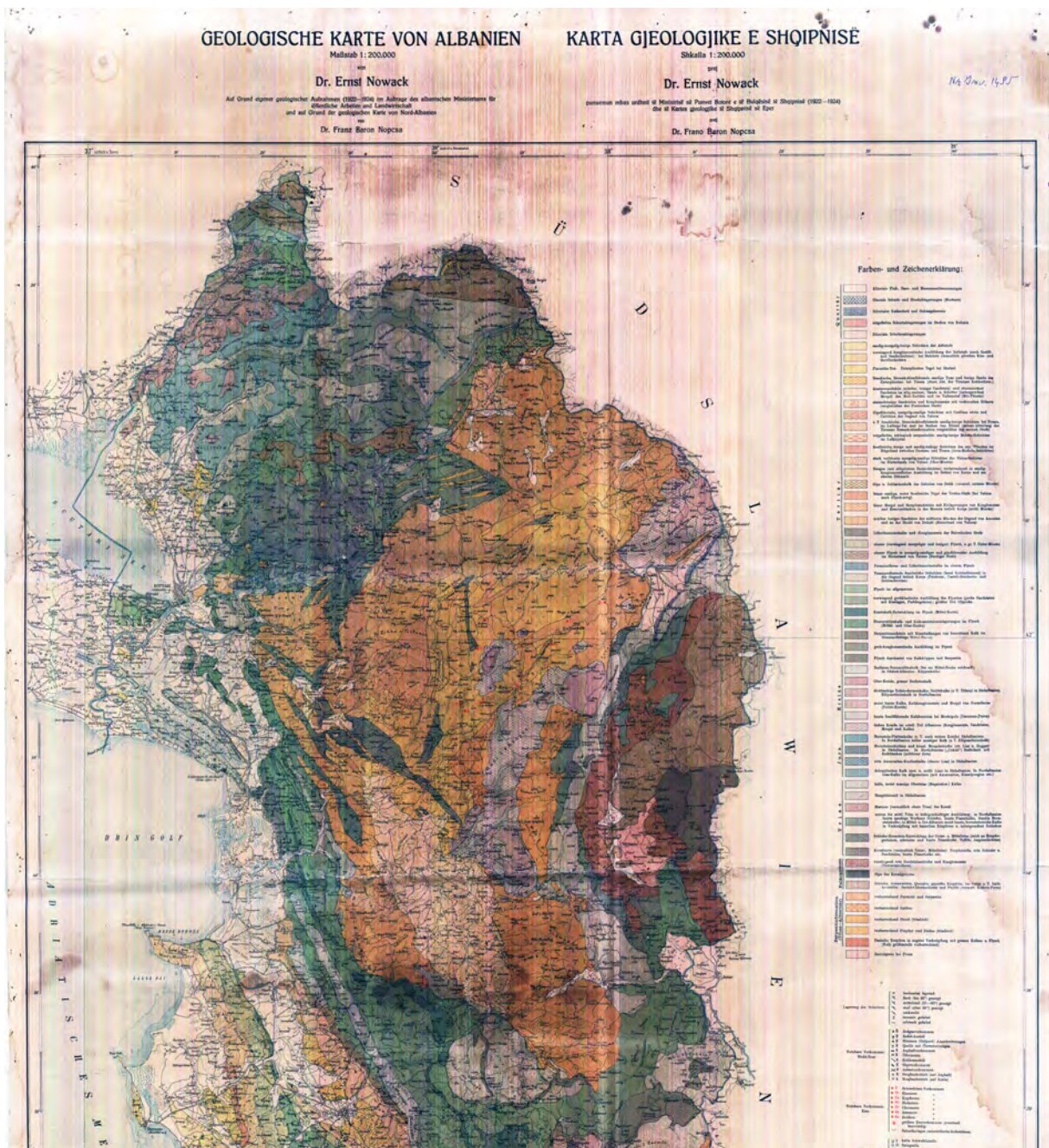


Fig. 1 - Partial illustrative presentation of 'Geologische Karte von Albanien' [Geological Map of Albania]. Scale 1:200,000. Nowack (1929a).

Geological Survey. The office director, Dr Ernst Nowack, worked for seven years, synthesising his own surveys with the contemporary works of Romanian geologist Franz Baron Von Nopscha and French geologist Jacques Bourcart. This culminated in the publication of the 'Geologische Karte von Albanien' (Geological Map of Albania) (Fig. 1) at a scale of 1:200,000 in Salzburg, Austria, accompanied by the explanatory text 'Geologische Übersicht von Albanien' in Innsbruck. This landmark publication established the 1:200,000 scale as the benchmark standard for all subsequent national geological maps analysed in this paper."

After Dr Nowack concluded his research activity, various companies, mainly Italian, undertook concessions for the exploration and exploitation of oil and other

minerals. This activity was accompanied by more detailed geological surveys by various geologists, but the most distinguished of them was certainly the Polish geologist Dr Stanislaw Zuber (1883-1947).

Zuber also designed a geological map of Albania at a scale of 1:200,000. The map remained unpublished until 2020, when the Albanian Geological Survey published it as a tribute to its author. This map lacks an explanatory text; therefore, it was not included in the analysis conducted in this paper.

Since the map published by Nowack, four other official geological maps of Albania have been published at a scale of 1:200,000, which represent the level of knowledge of the geological structure of the country up to the moment of their publication. They are as follows:

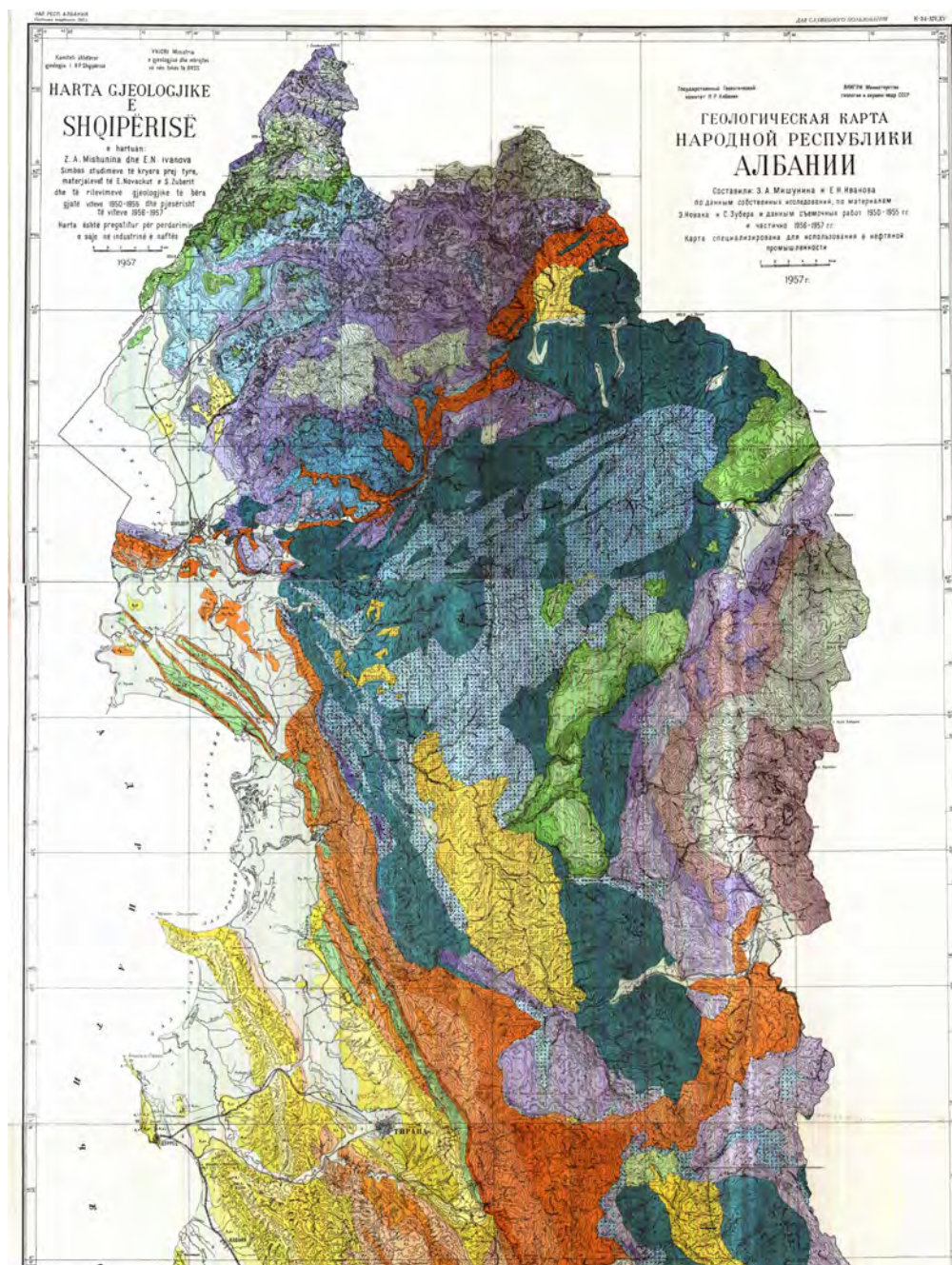


Fig. 2 - Partial illustrative presentation of 'Геологическая Карта Народной Республики Албании' [Geological Map of the People's Republic of Albania]. Scale 1:200,000. Mishunina & Ivanova (1957).

1. 'Geological Map of the People's Republic of Albania' (orig. Геологическая Карта Народной Республики Албании) (Fig. 2) was published as a joint effort between the State Geological Committee of the People's Republic of Albania and the VNIGRI Institute of Leningrad. Designed by Russian geologists Z.A. Mishunina and E.N. Ivanova, it was printed in a limited number in Leningrad in 1957. The content was structured based on field research and surveys carried out during the years 1950-1956, while also utilizing data from previous studies conducted by Ernst Nowack and Stanislav Zuber. Additionally, the map was accompanied by an unpublished explanatory text in Russian, archived in the Central Technical

Archive of Geology.

2. 'Geological Map of Albania' (orig. Harta Gjeologjike e Shqipërisë) (Fig. 3) at a 1:200,000 scale was compiled by a large group of authors from the Institute of Geological and Mining Research (ISPGJM) and published in Tirana in 1967. This work was structured based on field research and surveys carried out between 1950 and 1965 at 1:25,000 and 1:50,000 scales, and at a 1:100,000 scale for highly mountainous regions. Additionally, it was accompanied by an explanatory text in Albanian by Biçoku et al., published in 1970 under the title "Geology of Albania" (orig. Gjeologjia e Shqipërisë)

3. 'Geological Map of the Socialist People's Republic of

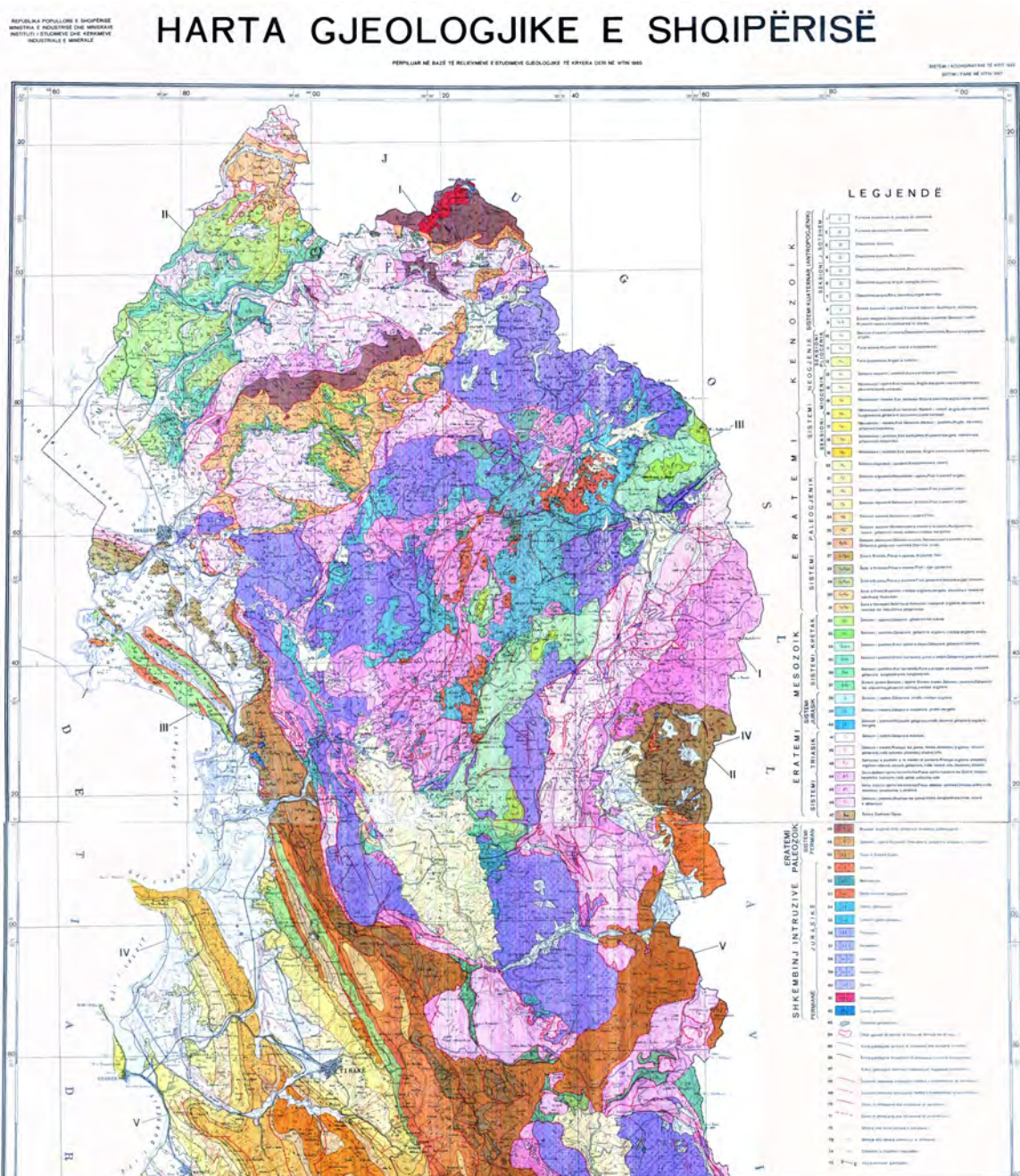


Fig. 3 - Partial illustrative presentation of 'Harta Gjeologjike e Shqipërisë' [Geological Map of Albania]. Scale 1:200,000. ISPGJM (1967).

Albania' (orig. Harta Gjeologjike e RPS të Shqipërisë) (Fig. 4) at a 1:200,000 scale was compiled as a joint venture between the Institute of Geological and Mining Research (ISPGJM) and the Institute of Oil and Gas (ING), and published in Tirana in 1983. This work was structured based on extensive field research and surveying carried out throughout the 1970-1980 period. An explanatory text entitled 'Explanatory Text of the Geological Map of the PSR of Albania at 1:200,000 scale' was prepared by Shallo et al. (1982); however, it remained unpublished and is archived in the Central Technical Archive of Geology (AQTGJ). Fifteen years later, a summarised version of this text was published by some of the original authors (Vranai et al., 1997) under the title 'Geology of Albania' (orig. Gjeologjia e

Shqipërisë).

4. 'Geological Map of Albania' (orig. Harta Gjeologjike e Shqipërisë) (Fig. 5) at a 1:200,000 scale was compiled by a large group of authors from the Institute of Geological Research (IKGJ), the Faculty of Geology and Mining (FGJM), and the Institute of Oil and Gas (ING), and published in Tirana in 2002. This work was based on the results of extensive fieldwork conducted during the two decades 1980-2000. Nine years after the map's release, its explanatory text, authored by Xhomo et al. (2011), was published under the title 'Geology of Albania (Stratigraphy, Magmatism, Metamorphism, Tectonics, Neotectonics, Palaeogeographic and Geodynamic evolution)'.

These four historical maps, alongside the pioneer-

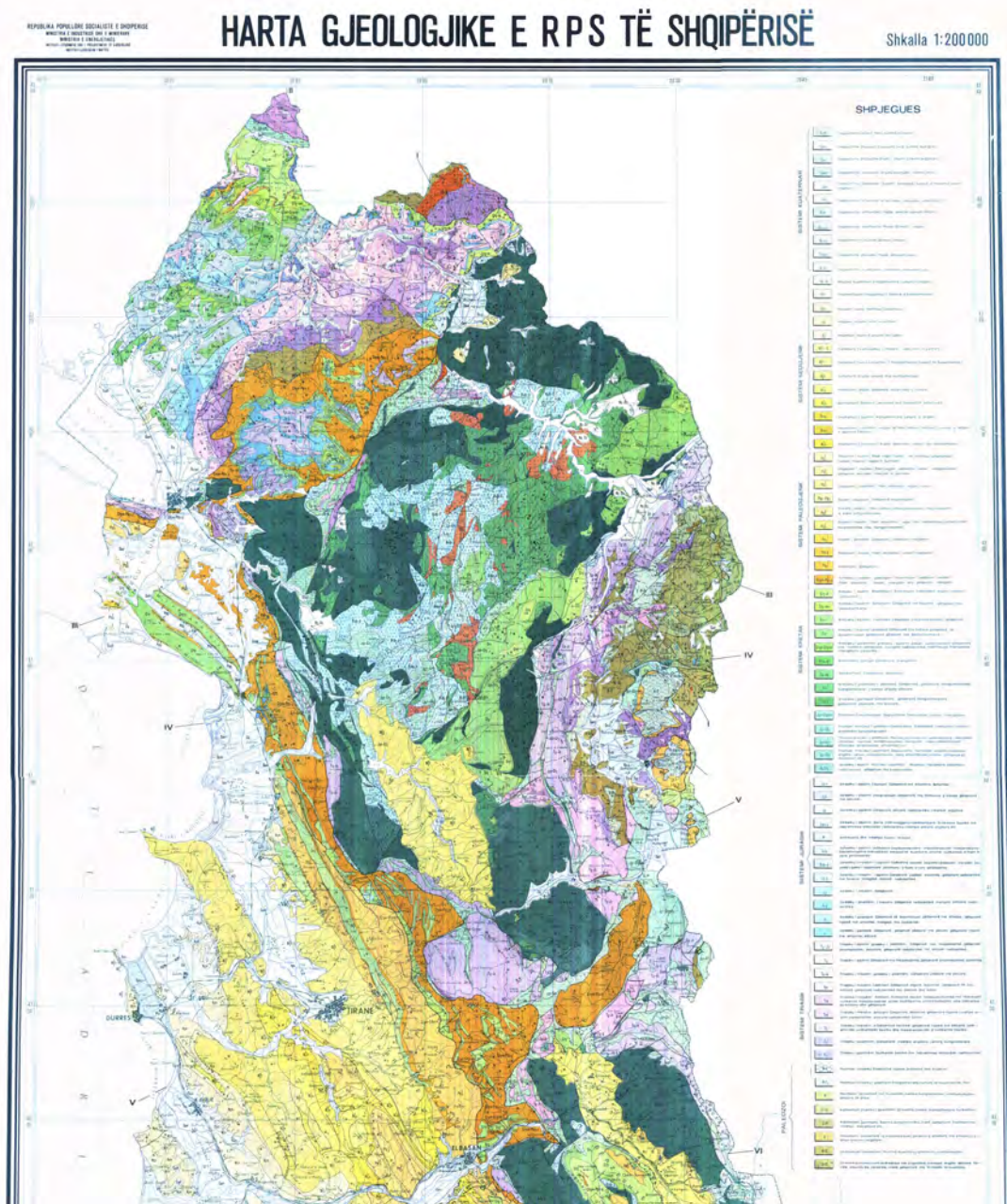


Fig. 4 - Partial illustrative presentation of 'Harta Gjeologjike e RPS të Shqipërisë' [Geological Map of the PSR of Albania]. ISPGJM & ING (1983).

ing map by Nowack (1929a), are illustrated in Figures 1 to 5. The following sections provide a comparative chronological review of how Quaternary successions were conceptualised and documented within these specific cartographic assets and their accompanying explanatory texts.

During the centralised socialist regime in the second half of the 20th century (specifically between 1945 and 1990), geological research in Albania was strictly mandated to serve state economic priorities, primarily focusing on mineral and hydrocarbon exploration. Consequently, purely theoretical investigations -often ideologically dismissed at the time as unproductive or speculative- received no state funding. This operational framework effectively prevented localized research into

non-resource-driven topics, such as long-term Quaternary climate oscillations or regional geomorphological evolution, which lacked immediate financial returns.

Historically, Quaternary deposits in Albania were largely treated as a superficial, non-mineralised overburden concealing the economically significant pre-Quaternary bedrock. The inherent stratigraphical and sedimentological complexities of these unconsolidated formations, combined with a lack of localised economic incentives under the centralised economic model, discouraged researchers from pursuing comprehensive investigations. Consequently, these deposits received minimal attention from decision-makers and mapping teams, which directly accounts for the disproportionately brief descriptions allocated to Quaternary successions

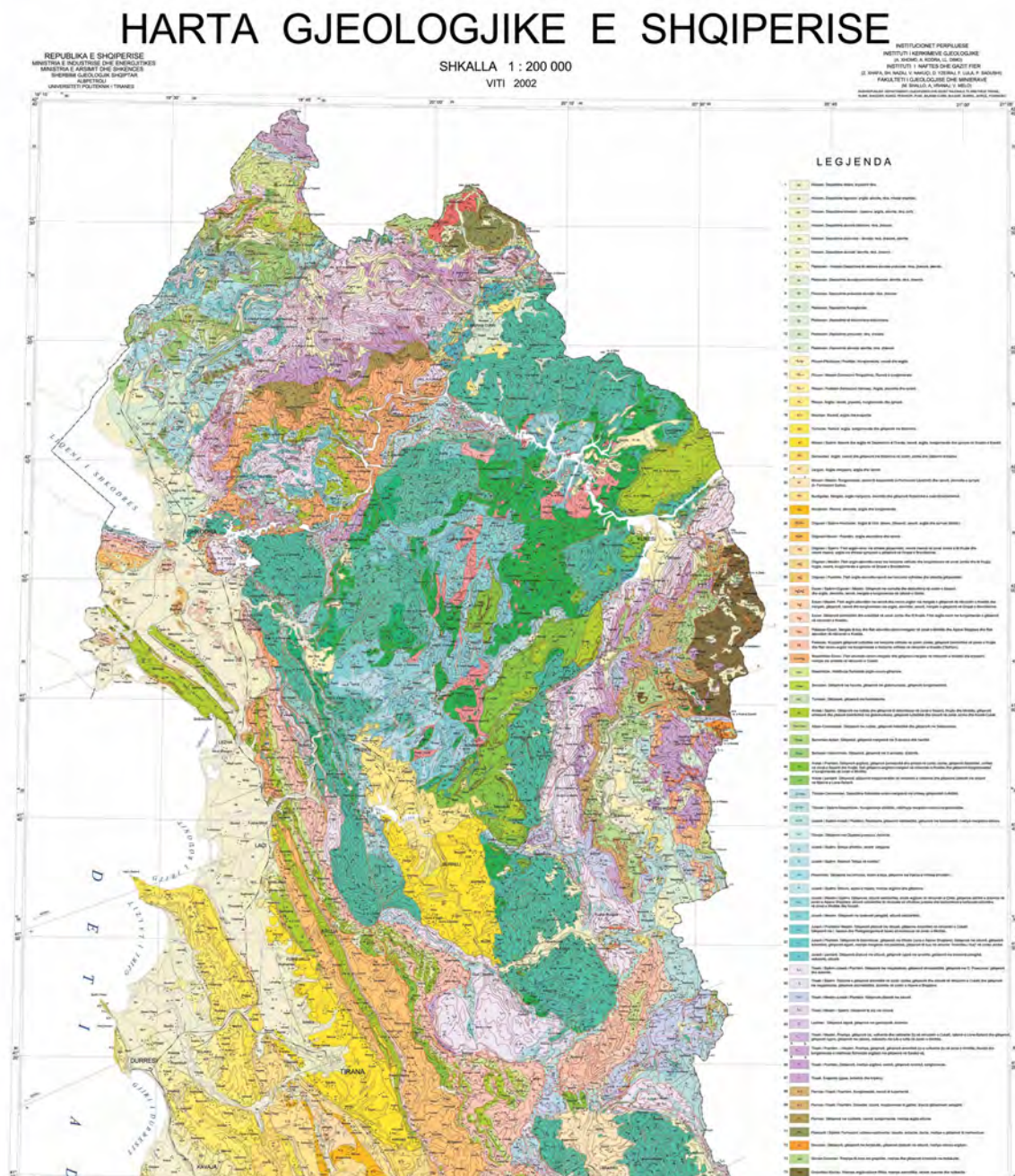


Fig. 5 - Partial illustrative presentation of 'Harta Gjeologjike e Republikës së Shqipërisë [Geological Map of the Republic of Albania]. Scale 1:200,000. IKGJ, FGJM & ING (2002).

within the accompanying map explanatory texts compared to older, resource-bearing geological units.

2.2. Geographical and geological background

Albania is in South-eastern Europe, on the western side of the Balkan Peninsula, covering an area of 28,748 km². It has extensive access to the Adriatic and Ionian seas, with a coastline of 520 km. Its geographical position extends between latitudes 39°38'N and 42°39'N, and longitudes 19°16'E and 21°04'E. On land, the territory borders Montenegro, the Republic of Kosovo, North Macedonia, and Greece (Fig. 6).

The macro-relief of the country is highly diversified, transitionally structured from low-altitude coastal plains to high-mountain systems, with an average elevation of

708 metres above sea level. The low relief zone, situated between 0 and 200 metres above sea level, encompasses approximately 23.4% of the national territory, mainly forming the Western Lowlands. Conversely, the high alpine and mountain relief zones exceeding 1,000 metres above sea level cover around 28.5% of the area, culminating at the highest elevation of 2,751 metres above sea level at Mount Korab along the eastern border (Pumo et al., 1990; Bërxolli et al., 1999).

From north to south, the country is crossed by nine main rivers, which run from east to west. Of these, only the Pavlo River flows into the Ionian Sea, while the others flow into the Adriatic Sea (Fig. 6). The average discharge of these rivers into the Adriatic Sea is estimated to be 1,495 m³ s⁻¹.



Fig. 6 - Simplified presentation of the geographical position of Albania, the countries and seas that border it, and its river network

The alluvial floodplains are located along the major river valleys and expand into the western part of the country, where the coalescence of these river systems forms the Western Lowlands -the most extensive coastal plain in the Western Balkans- (Fig. 6) (Pumo et al., 1990; Bërxioli et al., 1999). This region is predominantly of an alluvial nature; geomorphological and geoarchaeological records suggest that a significant portion of this coastal plain emerged above sea level only during the last five centuries. This rapid subaerial exposure resulted from a combination of high riverine sediment delivery and ongoing regional vertical tectonic uplift, which actively forced the regression of the coastline and the subaerial emergence of historical lagoons, swamps,

and marine bays following the stabilisation of the mid-Holocene marine transgression around 6.5-7.0 ka BP (Fouache et al., 2003; Marku, 2019). Subsequently, this pristine wetland landscape was fundamentally transformed during the 1945-1990 period through extensive state-led land reclamation and engineering schemes, which systematically drained the remaining large marshes and shallow lakes to establish the modern agricultural plains (Gruda & Fouache, 2017; IUCN, 1976).

Albania is situated in the transitional zone between the Dinarides to the north and the Hellenides to the south. This structural domain has been designated by Albanian geologists under the informal term 'Albanides' (Shkupi, 1984; Papa, 2000) (Fig. 7). This

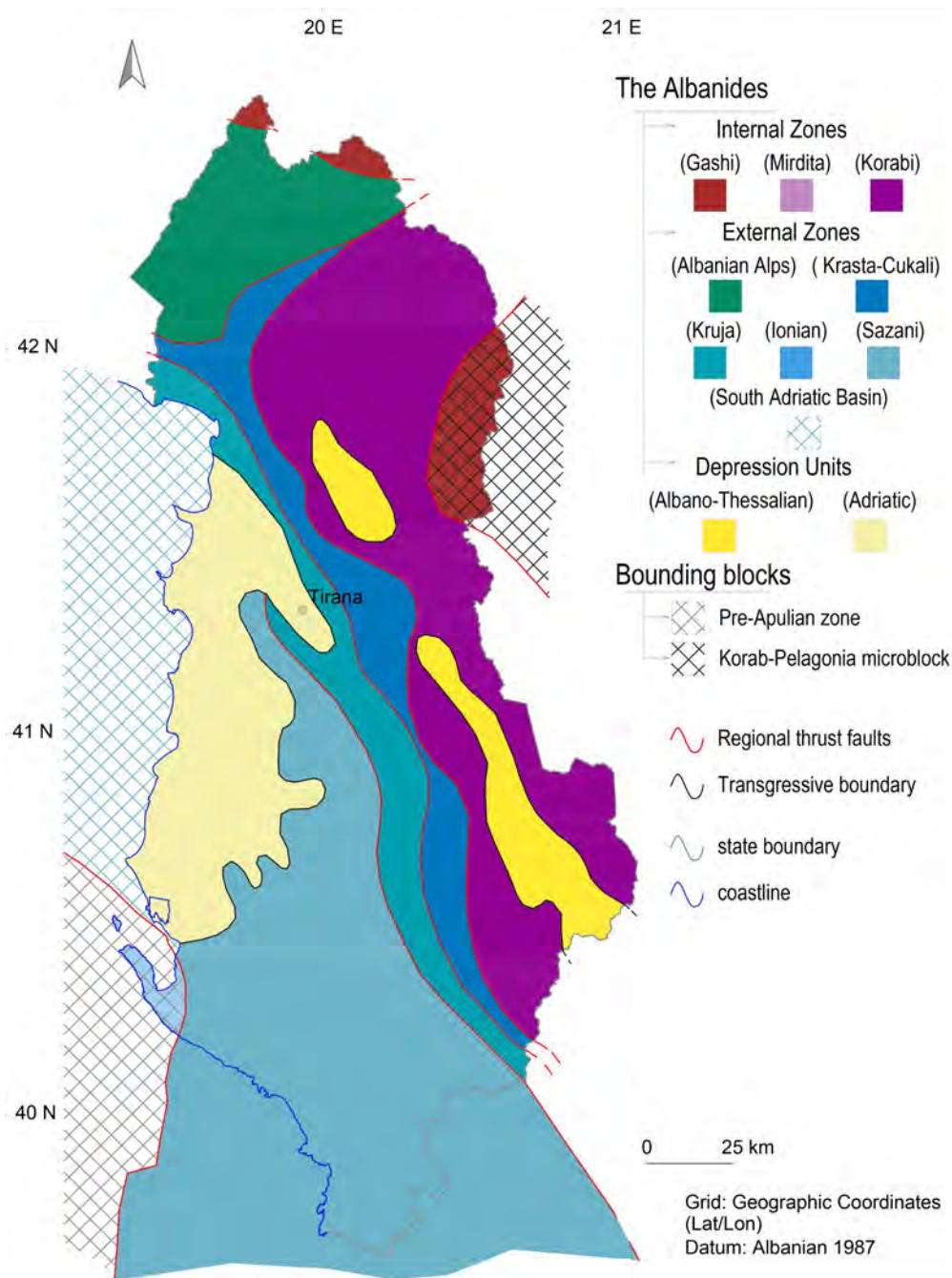


Fig. 7 - Simplified geological structure of the Albanides and their division into tectonic zones (modified by Marku after Shallo et al., 1982; Vranai et al., 1997; Hoeck et al., 2004; Dilek et al., 2007; Xhomo et al., 2011; Le Goff et al., 2015, 2019; Bourli et al., 2022).

term was first used by Peza (1967) for two reasons, both practical and scientific. To argue for the term Albanides and to formalise it within the international scientific community, only one serious attempt by Papa (1970) is known.

"In a broader regional context, the Albanides are positioned within a compressional geodynamic regime, actively squeezed between the Adriatic (Apulian) microplate to the west and the Korab-Pelagonia continental microblock to the east, which together act as the bounding blocks of this tectonic vise."

Structurally, the Albanides are divided into two main domains: the Inner Albanides and the Outer Alba-

nides, which are further subdivided into distinct isopic tectonic zones (represented as Internal and External Zones in Fig. 7). Overlying these structural units, two major molasse-filled depressions developed: the Albano-Thessalian Depression (inner troughs) and the coastal Adriatic Depression (categorised as Depression Units in Fig. 7).

The lithostratigraphic architecture of these domains spans from the Palaeozoic to the Cenozoic, encompassing complex volcano-sedimentary, magmatic, and sedimentary successions.

The oldest basements are primarily terrigenous formations of Ordovician to Devonian age, localised in

Geodynamic Domain	Tectonic Zone / Structural Unit	Dominant Lithofacies	Chronostratigraphic Position
Internal Zones	Gashi Zone	Magmatic and metamorphic rocks (granitoids, schists)	Paleozoic to Mesozoic
Internal Zones	Mirdita Zone	Ophiolites (Mesozoic magmatic remnants of Tethyan oceanic basin)	Mesozoic
Internal Zones	Korabi Zone	Terrigenous formations (sandstones, shales) and conglomerates	Ordovician to Devonian
External Zones	Albanian Alps	Thick platform carbonates and neritic limestones	Mesozoic to Cenozoic
External Zones	Krasta-Cukali Zone	Pelagic limestones, radiolarites, and syn-orogenic flysch	Mesozoic to Paleogene
External Zones	Kruja, Ionian, Sazani Zones	Thick carbonate platforms, neritic/pelagic limestones, and thick flysch sequences	Mesozoic to Cenozoic
External Zones	South Adriatic Basin	Marine pelitic-psammitic successions and evaporites	Mesozoic to Cenozoic
Depression Units	Albano-Thessalian Depression	Thick molasse-filled sedimentary troughs (sandstones, siltstones, clays)	Cenozoic (Paleogene to Neogene)
Depression Units	Adriatic Depression	Thick molasse, deltaic sands, clays, and conglomerates (Helmasi and Rogozhina suites)	Cenozoic to Quaternary

Tab. 2 - Simplified structural and lithostratigraphic synthesis of the Albanides.

the innermost sections (the Korabi Zone within the Internal Zones, Fig. 7). Mesozoic and Cenozoic formations exhibit the widest surficial distribution, dominated by thick carbonate platforms, syn-orogenic flysch sequences, and post-orogenic molasse deposits. Magmatic activity is prominently represented by Mesozoic ophiolites, which cover approximately 10% of the country's territory and represent remnants of the Tethyan Mirdita oceanic basin (embedded within the Mirdita Zone, Fig. 7).

The regional geological framework of the Albanides is traditionally illustrated based on a structural-isopic zoning approach, delineating major geotectonic zones according to their unique depositional environments, sedimentary facies evolution, and structural deformation patterns, rather than strict chronostratigraphic stages. To guide readers unfamiliar with the regional geology, the structural subdivisions shown on the map, along with their main lithofacies and chronostratigraphic positions, are systematically synthesised in Table 2.

3. RESULTS

In this section, we present an analytical overview of the methods and criteria implemented by the original authors to classify Quaternary deposits and define their status across the five historical 1:200,000 scale geological maps of Albania, ordered chronologically from the oldest to the most recent editions (Fig. 1 to 5). To conduct this critical summary, both the graphical data from the map legends and the documentation provided in the original explanatory notes have been systematically taken into account.

Nowack (1929a), on his map (Fig. 1), distinguishes five main types of Quaternary deposits: 1) diluvial gravel deposits (orig. *Diluviale Schotterablagerungen*); 2) reddish debris deposits in the Kolonja and Peshkopia basins (orig. *Rotgefärbte Schuttablagerungen im Becken von Kolonja und Peshkopia*); 3) diluvial limestone debris and slope breccia (orig. *Diluvialer Kalkschutt und Gehängebreccie*); 4) diluvial debris and block deposits (moraines) (orig. *Diluviale Schutt- und Blockablagerungen (Moränen)*); 5) alluvial, fluvial, lacustrine, and marine deposits (orig. *Alluviale Fluß-, Seen- und Meeresanschwemmungen*).

Within the 1957 map (Fig. 2), Quaternary formations receive only a brief documentation. Such a concise treatment may be considered acceptable, given that the map was compiled specifically for the oil indus-

try and hydrocarbon exploration-fields where Quaternary deposits held little relevance at the time.

Comparing the map legend with the explanatory text, it can be noted that the authors did not follow a consistent approach in naming these deposits. For instance, on pages 14-15 of the manuscript in Russian, in Chapter 5, 'Stratigraphy and Facies' (orig. *Стратиграфия и фации*), the 25 stratigraphic units into which the authors divided the deposits of Albania are listed. Here, the Quaternary deposits are numbered 24 and are named 'Post-Pliocene' (orig. *Постплиоцен*). Conversely, when these deposits are described-very briefly on a single page at the end of Chapter 5 (pages 68-69 of the manuscript in Russian) -they are titled 'Quaternary deposits' (orig. *Четвертичные отложения*).

In this text, although at the time it was written the 18th IGC (London, 1948) had already decided to define the Neogene-Quaternary (later Pliocene-Pleistocene) boundary, no data are provided regarding this boundary, which would be referred to as the Plio-Quaternary by later authors (e.g. in the 1967 map).

In this regard, it can only be assumed that the deposits subsumed by the authors within the 'Astian Stage' (orig. *Астийский ярус*) are considered to represent the uppermost part of the Neogene, forming the contact between the two periods. These deposits are described under this historical, informal term on pages 66-68 of the Russian manuscript, constituting subchapter 23 of Chapter 5.

In the explanatory text, the authors mention the great diversity in both the material composition and facies character of the Quaternary deposits. They divide them into the following five genetic types: 1) marine deposits; 2) alluvial deposits; 3) lacustrine-marsh deposits; 4) diluvial deposits; 5) eluvial-diluvial deposits.

The division of these genetic types mentioned in the explanatory text is not graphically reflected on the map. Here, the Quaternary is presented at the rank of a System, but without further subdivision. Furthermore, the summary stratigraphic column provided in the explanatory text ends with the Neogene (Astian) deposits at the top, without including the Quaternary deposits at all.

The stratigraphic description of the Quaternary deposits in the text of the 1967 geological map occupies five pages within the chapter 'Cenozoic Era'. The authors mention the wide distribution of Quaternary depos-

its and the insufficient extent of their study from a stratigraphic point of view. This level of knowledge led the authors to rely on genetic criteria for the division of these deposits, distinguishing several genetic types (Biçoku et al., 1970). The Quaternary deposits are classified at the rank of a system, which the authors name the Quaternary (or Anthropogenic) System. The subdivisions within this system are presented in Table 3.

The Quaternary System is divided here into two parts (subdivisions corresponding to series), which are named 'old' and 'modern' (or 'actual', orig. *i sotëm*). In the map legend, these Quaternary deposits are placed above an undefined Neogene-Quaternary boundary. According to the authors, such deposits are spread across the internal depressions (currently known as the Albano-Thessalian Depression). In their designation (Pliocene-old Quaternary), we find the only reference to the 'old Quaternary' series.

They are followed by undivided Quaternary deposits, of 'fully or partially glacial genesis'. The authors emphasise that they do not have sufficient evidence to determine the age of these deposits but assume that they 'may belong to the newer Würm glaciation' (Biçoku et al., 1970). Given that this glacial period ended shortly before the beginning of the Holocene (referred to by the authors as the 'modern Quaternary series'), it can be deduced that the undivided Quaternary deposits here belong to the old Quaternary series.

The application of terms such as 'Pliocene-old Quaternary', 'Anthropogenic', 'old', and 'new' demonstrates that these stratigraphic designations were heavily influenced by the Soviet geological school of the 1950-1967 period, pioneered by Alexei Pavlov, Valerian Gromov, and Ksenia Nikiforova (Pavlov, 1922; Gromov et al., 1960). This school established a distinct system rooted in Marxist-Leninist ideological principles, which conceptualised the emergence of humankind (*Homo sapiens*) as a transformative, planet-wide geological force.

In Chapter VIII, 'A Brief History of the Geological Development of Albania', the authors admit that during the early Quaternary, the deposits found at high hypsometric elevations were of glacial genesis. Thus, in a sense, they attempt to place the glacial deposits within the older part of the Quaternary (i.e. the Pleistocene).

System	Section (corr. Series)	genetic type
Quaternary (Anthropogenic)	Modern (Actual)	1. undivided 2. diluvial, colluvial, solifluctional 3. proluvial 4. lacustrine, marshy 5. lagoonal 6. marine
	Old (Early)	1. lacustrine - glacial 2. glacial
Neogene - Quaternary	Pliocene - Old Quaternary	n/a

Tab. 3 - The stratigraphic division of the Quaternary used in ISPGJM (1967) and Biçoku et al. (1970)

Their interpretation of the timing of formation suggests a glaciation that occurred at the end of the Pleistocene, albeit without sufficient evidence. No facts are provided by these authors to support the use of glacial deposits as markers for the beginning of the Quaternary, nor is there sufficient argument to confirm that they belong to the end of the Pleistocene.

Throughout the text, although rarely, the authors attempt to provide palaeontological arguments for the dating of the deposits, such as data on the presence of *Conger* sp. in the undivided Pliocene-Quaternary deposits, and *Cardium* sp. and *Cerithium* sp. in the lagoonal deposits of the Modern series.

Regarding the 1983 geological map, Shallo et al. (1982) and Vranai et al. (1997), like their predecessors, mention in both versions of the explanatory texts the lack of detailed studies on the stratigraphy of the Quaternary. Instead, they rely on morphogenetic criteria for the classification of Quaternary deposits. This classification is presented in Table 4.

Here, the deposits were included in two systems. The oldest deposits, classified as Upper Pliocene-old Quaternary (Pleistocene?), were described as part of the Quaternary in the explanatory texts of Shallo et al. (1982) and Vranai et al. (1997), whereas in the map legend, they were included in the Neogene System. The remaining deposits were included in the Quaternary System on the map. It is worth noting the continued use -as previously in ISPGJM (1967) and Biçoku et al.

System	Section (corr. Series)	stage (orig. Kati)	index	genetic type
Quaternary	Holocene	modern Quaternary	Q ₄	1. marine 2. alluvial 3. proluvial 4. marshy 5. diluvial 6. modern mixed
	Pleistocene	upper Quaternary	Q ₁₋₃	Q ₃ 1. proluvial (Q ₃)
		middle Quaternary		Q ₂ 1. colluvial (Q ₁₋₃) 2. alluvial (Q ₁₋₃)
		lower (old) Quaternary		Q ₁ 3. mixed (Q ₁₋₃)
Neogene	Neogene - Quaternary	upper Pliocene – old Quaternary (Pleistocene?)	N ₂ - Q ₁	1. lacustrine 2. lacustrine-proluvial 3. lacustrine-alluvial

Tab. 4 - The stratigraphic division of the Quaternary used in ISPGJM & ING (1983), Shallo et al. (1982), and Vranai et al. (1997).

1967 Map	1983 Map	Gromov et al. (1960)	Shkupi (1984)	Meço (1985)	Current ICS Scheme
Q ₄	Q ₄	Modern / Recent	Koha e sotme (Modern)	Versilian	Holocene
Q _g	Q ₁₋₃	Upper Neopleistocene	Kuaternari i sipërm (Upper Quaternary)	Tyrrhenian	Upper Pleistocene
N/A		Middle Neopleistocene	Kuaternari i mesëm (Middle Quaternary)	Milazzian	Chibanian
N/A		Middle Neopleistocene	Kuaternari i mesëm (Middle Quaternary)	Milazzian	Chibanian
N/A		Lower Neopleistocene	Kuaternari i poshtëm (Lower Quaternary)	Sicilian	Calabrian (upper part)
N/A		Eopleistocene	Kuaternari i poshtëm (Lower Quaternary)	Sicilian	Calabrian
N/A		Eopleistocene	Kuaternari i poshtëm (Lower Quaternary)	Sicilian	Calabrian
N/A		Eopleistocene	Kuaternari i poshtëm (Lower Quaternary)	Emilian / Calabrian	Calabrian (lower part)
N ₂ -Q ₁	N ₂ -Q ₁	Eopleistocene	Pre Quaternary	Astian	Gelasian

Tab. 5 - Chronostratigraphic correlation framework of Quaternary nomenclature used in Albanian geological maps and academic literature with the International Chronostratigraphic Chart (ICS scheme).

(1970)- of the term 'old' (orig. *i vjetër*) instead of 'early' (orig. *i hershëm*). In later Albanian literature (e.g. Shkupi, 1984), the term 'old' was replaced with 'early'.

At the rank of series, the authors divided the deposits of the Quaternary System into the Pleistocene and Holocene. However, they also utilised another classification which, when compared with the indexes used, again indicates the rank of series, although it was intended to determine the rank of stages. In this classification, the deposits belonging to the Pleistocene were divided, starting from the oldest, into 1) Lower (old) Quaternary; 2) Middle Quaternary; 3) Upper Quaternary, while those belonging to the Holocene were equated with the Modern Quaternary.

Thus, an effort was made to present the division of the Quaternary series into stages, though it was not expressed correctly. Following the publication of the official 1983 map -which reflected the institutional state line and left Quaternary successions largely undivided within a single (Q₁₋₃) block- a pronounced conceptual and theoretical asymmetry emerged within contemporary Albanian academic literature. This contrast is clearly evidenced by the two primary theoretical publications of the period: the Geological Dictionary by Shkupi (1984) and the stratigraphic text by Meço (1985). Shkupi (1984) proposed a hybrid model where the series column (Pleistocene/Holocene) remained vacant, elevating instead a purely relative four-fold subdivision (Lower, Middle, Upper, and Modern Quaternary) to the rank of stages. Conversely, Meço (1985) introduced the definitive framework of the Mediterranean (Italian) school to Albania for the first time, formally dividing the system

into series (Pleistocene and Holocene) and incorporating the classical stages, namely the Calabrian, Emilian, Sicilian, Milazzian, Tyrrhenian, and Versilian. This terminological fragmentation demonstrates that, in the complete absence of absolute geochronological field data, local researchers independently attempted, primarily for pedagogical purposes, to import parallel theoretical schemes to bridge the stratigraphic gap left by the official geological maps (Tab. 5).

In that map, among the genetic types of the Quaternary, only the proluvial deposits of the Pleistocene and all types included in the modern Quaternary are presented within a clearly defined stage (the Upper Quaternary and the modern Quaternary, respectively). The remainder of these types belong to an undefined age range, the undivided Pleistocene (lower Quaternary-upper Quaternary: Q₁₋₃).

There are some slight advances in the 2002 geological map related to the study of deposits belonging to the Quaternary. Here, once again, the wide distribution and diversity of the genetic types of Quaternary deposits is emphasised, where none of their 'forms' (continental, intermediate, or marine, as well as their combinations) is missing (Xhomo et al., 2011).

According to the authors, during the period following the publication of the 1983 map, the ¹⁴C method was used for age determination of the marshland deposits in Maliq, while the spore-pollen method was applied to the lacustrine deposits of Koplik (Xhomo et al., 2011). The terrace levels of the Vjosa, Osum, and Devoll rivers were also subdivided, enabling the distinction of several Pleistocene units. For the first time, an attempt was

System	series	subseries	index	genetic type
Quaternary	Holocene	late (historic)	Q _h	1. alluvial 2. proluvial 3. diluvial, colluvial, eluvial 4. alluvial-marsh 5. marsh and lacustrine-marsh 6. lagoon 7. marine
		early		
	Holocene - Pleistocene	n/a	Q _{p-h}	1. alluvial-proluvial
	Pleistocene	late	Q _p	1. alluvial 2. proluvial 3. talus breccia cones 4. glacial 5. lacustrine
		middle		
		early (lower)		
Neogene (?)	Pliocene - lower Pleistocene	n/a	N ₂ -Q _p	1. lacustrine 2. lacustrine-proluvial 3. lacustrine-alluvial

Tab. 6 - The stratigraphic division of the Quaternary used in IKGJ, FGJM & ING (2002) and Xhomo et al. (2011).

made to correlate geological periods with archaeological classifications (Pleistocene with Palaeolithic, and Holocene with Mesolithic and Neolithic). For the classification of these deposits, the genetic criterion was again followed. This classification is presented in Tab. 6.

In that map and its explanatory text, the Quaternary is divided into the Holocene and Pleistocene series. These series were further subdivided into subseries, the names of which referred to the names of the series, in contrast to the 1983 map where these divisions referred to the name Quaternary. The Pleistocene was divided into three subseries: 1) Upper (late) Pleistocene; 2) Middle Pleistocene; 3) Lower (early) Pleistocene, while the Holocene was divided into two subseries: 1) Upper (late/historical) Holocene; 2) Lower (early) Holocene.

The establishment of a temporal division with an indefinite boundary between the Holocene and Pleistocene, featuring deposits of alluvial and proluvial genesis, is distinguished here for the first time. It is not clearly clarified by the authors whether these deposits span the entire Lower (early) Pleistocene-Upper (historical) Holocene time range, or only the Upper Pleistocene-Lower (early) Holocene range.

Once again, as in the 1983 map, the boundary between the Neogene and the Quaternary -presented here as Pliocene-Lower Pleistocene- remains vague. On the map, the formations of this time interval are shown in the colour corresponding to the Pliocene, which suggests that the authors include them within the Neogene; however, in the text, they are described as being within the Quaternary.

Unlike the cases of the previous maps cited above, the terms 'system', 'series', and 'subseries' are not mentioned here; therefore, we have deduced them based on the indices used by the authors on the map and in the explanatory text. Although the accompanying text provides a division of the Holocene and Pleistocene series into subseries, such a division is not reflected on the map, where the deposits are presented only with indices indicating their affiliation at the rank of series (Q_h , Q_p and Q_{p-h}).

4. DISCUSSION

As part of the study of the geological structure of Albania, several 1:200,000 scale maps were published at different periods, with intervals ranging between 10 and 30 years. These maps reflected the new data collected up to the time of their publication.

Since Quaternary deposits did not present any significant economic interest, there was no dedicated, systematic study of them for almost 50 years. Nevertheless, the authors of these maps endeavoured, as far as possible, to reflect the data they were able to collect within the permitted constraints.

In all maps, morphogenetic criteria were followed for the nomenclature and chronological ordering of these deposits. Despite differences in geographical distribution or naming conventions, the deposits follow a consistent chronological trend: Pliocene-Pleistocene, Pleistocene, Pleistocene-Holocene, and Holocene. The terminology used varies across the maps, yet generally reflects the global trends prevalent at the time of their publication.

Only the 1929 explanatory text provides a specific description of the geological history of Quaternary deposits. The authors of subsequent maps remained silent on this period when describing the geological evolution of the Albanides in their respective chapters. Nevertheless, Biçoku et al. (1970), Shallo et al. (1982), Vranai et al. (1997), and Xhomo et al. (2011) briefly note that the Albanian landscape attained its present-day form during

the Quaternary.

None of the explanatory texts, with the exception for Biçoku et al. (1970), provide data regarding the specific glacial period to which the glacial or glaciogenic-mixed deposits belong (Fig. 8). However, by examining the stratigraphic sequence in the map legends, it can be inferred that most authors adhere to the view expressed in the 1967 text -referencing Bourcart (1920, 1922)- that these belong to the Würm glaciations. This leads to the conclusion that, according to current data and formal ratifications (Gibbard et al., 2010), they should be assigned to the Upper Pleistocene, occurring within the range of 0.126 Ma to 0.012 Ma. Nevertheless, there is currently insufficient evidence to either fully validate or reject this conclusion.

According to external Albanian academic publications of that period, the lower boundary of the Quaternary (Pleistocene) was cited as 1.5 ± 0.5 Ma (Shkupi, 1984) and 1.8 Ma (Meço, 1985). Highlighting these values is crucial to demonstrate that despite their availability in contemporary Albanian academic literature, they were omitted from the official map texts and stratigraphic schemes. The map authors were unable to apply these theoretical boundaries to the mapped units because systematic Quaternary investigations and independent chronological constraints were lacking.

The boundary between the Neogene and the Quaternary (Pliocene and Pleistocene) remains poorly defined across all Albanian geological maps and their texts from 1929 to 2011. Nowack (1929a, 1929b) treats it as the division between the Tertiary and the Quaternary, placing various deposits of the Astian facies (orig. *Astistufe*) at the top of the Tertiary. Similarly, Mishunina & Ivanova (1957) and Biçoku et al. (1970) position Quaternary deposits above both the Astian facies and undivided Pliocene units. According to these authors, both units are part of the Pliocene Series and succeed the Piacenzian Stage.

In Biçoku et al. (1970), the Quaternary begins with undefined Neogene-Quaternary deposits, which the authors incorporate within the Quaternary System.

Shallo et al. (1982) present the Pliocene as undivided and, in contrast to Biçoku et al. (1970), include the undefined Neogene-Quaternary deposits within the Neogene, positioning them at its top. A similar stratigraphic arrangement for these deposits was adopted by Xhomo et al. (2011).

The 'Astian' is an outdated term that was used until the 1980s (Rio et al., 1998). Since it did not fully meet the criteria of a formal stage, it was more frequently described as the 'Astian facies'. Stratigraphically, it was positioned at the top of the Tertiary, chronologically succeeding deposits of Piacenzian age. Subsequently, this interval was occupied by the Calabrian Stage, which was defined in 1985 as the earliest stage of the Pleistocene (Head et al., 2008). Concurrently, Meço (1985) identified the Calabrian Stage as the base of the Quaternary, positioning it above the Astian, which served as the top of the Neogene in his geochronological table. However, the subdivisions presented by Meço (1985) were not adopted in any published or unpublished works between 1985 and 2002, nor were they incorporated into the 2002 map and its accompanying explanatory text.

In Albania, the term 'Astian' has not been formally used since the early 1980s, as evidenced in Shallo et al. (1982), Vranai et al. (1997), and ISPGJM & ING (1983). Nevertheless, the term persisted informally until the mid-1990s, predominantly amongst petroleum geology researchers (Marku, 2018). Thus, despite the adaptation of terminology, the issue regarding the Neogene-

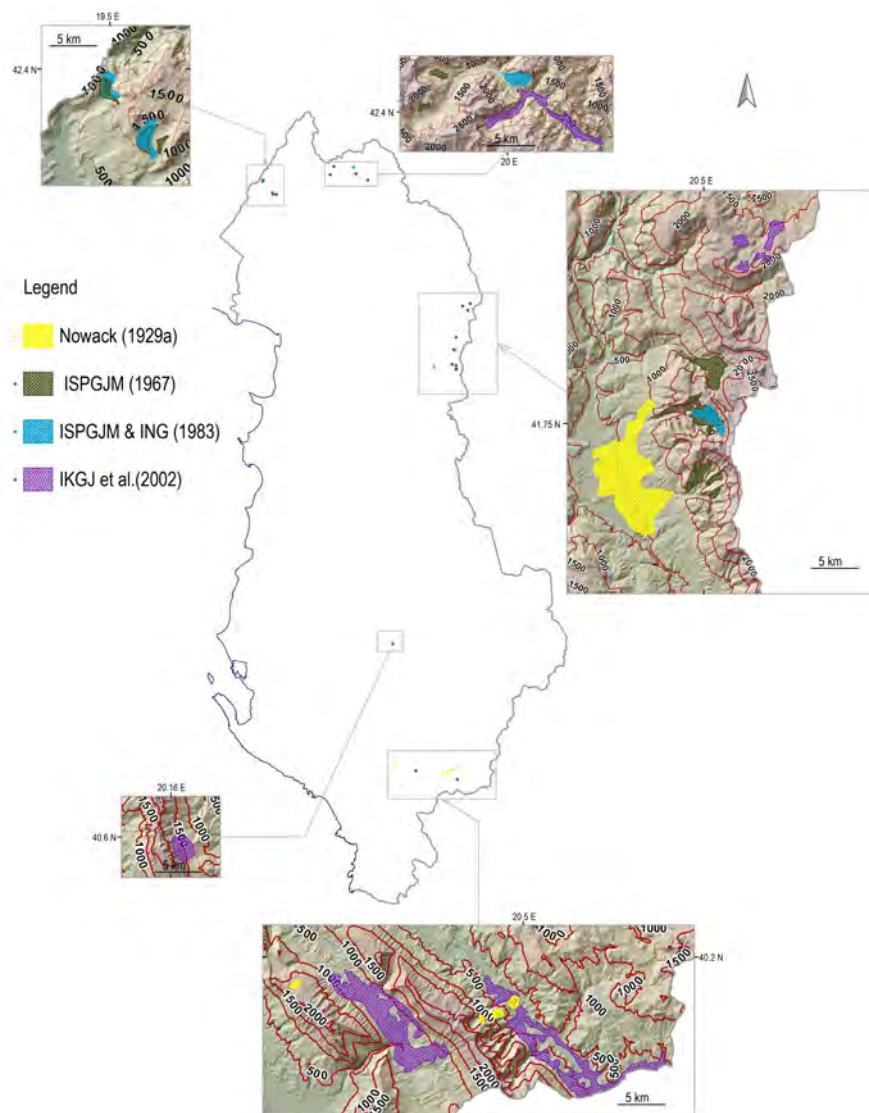


Fig. 8 - Comparative synthesis of glacial deposit boundaries across the reviewed maps, excluding Mishunina & Ivanova (1957).

Quaternary (Pliocene-Pleistocene) boundary remained unresolved. The only modification was to the naming convention itself, without further addressing the complexities of this boundary. This stagnation was undoubtedly due to the limited significance attributed to Quaternary deposits in Albania and the insufficient level of research conducted upon them.

Marku (2018) conducted 3D modelling using data from all shallow boreholes carried out in the Adriatic Depression between 1950 and 1990. This study identified features resembling incised valleys at certain locations along the lower boundary of what was previously considered the 'Astian facies'. Given that both the Gelasian and Calabrian stages -units formerly included within the 'Astian facies'- comprise these time intervals, it was suggested that these incision valleys might serve as markers for the lower Pleistocene boundary. The suggestion was based on the well-established fact that the Quaternary is a geological period characterised by global climatic fluctuations. Its earliest stage, the Gelasian, is marked by the initial signs of global cooling and

an associated eustatic sea-level fall, which likely forced rivers to erode more deeply, creating incised valley systems as they progressed towards the sea.

As described above, Albania is crossed by seven major rivers flowing from east to west, which transect the Adriatic Depression. This geographical setting supports the hypothesis that incision valley-like features could have been formed; consequently, these may be assumed as indicators of the cooling that occurred during the Gelasian Stage at the onset of the Quaternary. Based on this suggestion, the deposits previously attributed to the 'Astian facies' should be re-examined to formally establish the Neogene-Quaternary boundary in Albania. Such a re-evaluation might lead to the partial or complete inclusion of these deposits within the Quaternary System.

Biçoku et al. (1970) and the corresponding 1967 map describe the Piacenzian facies as being composed of blue clays, with the Astian facies -consisting primarily of sandstones and conglomerates- positioned stratigraphically above it.

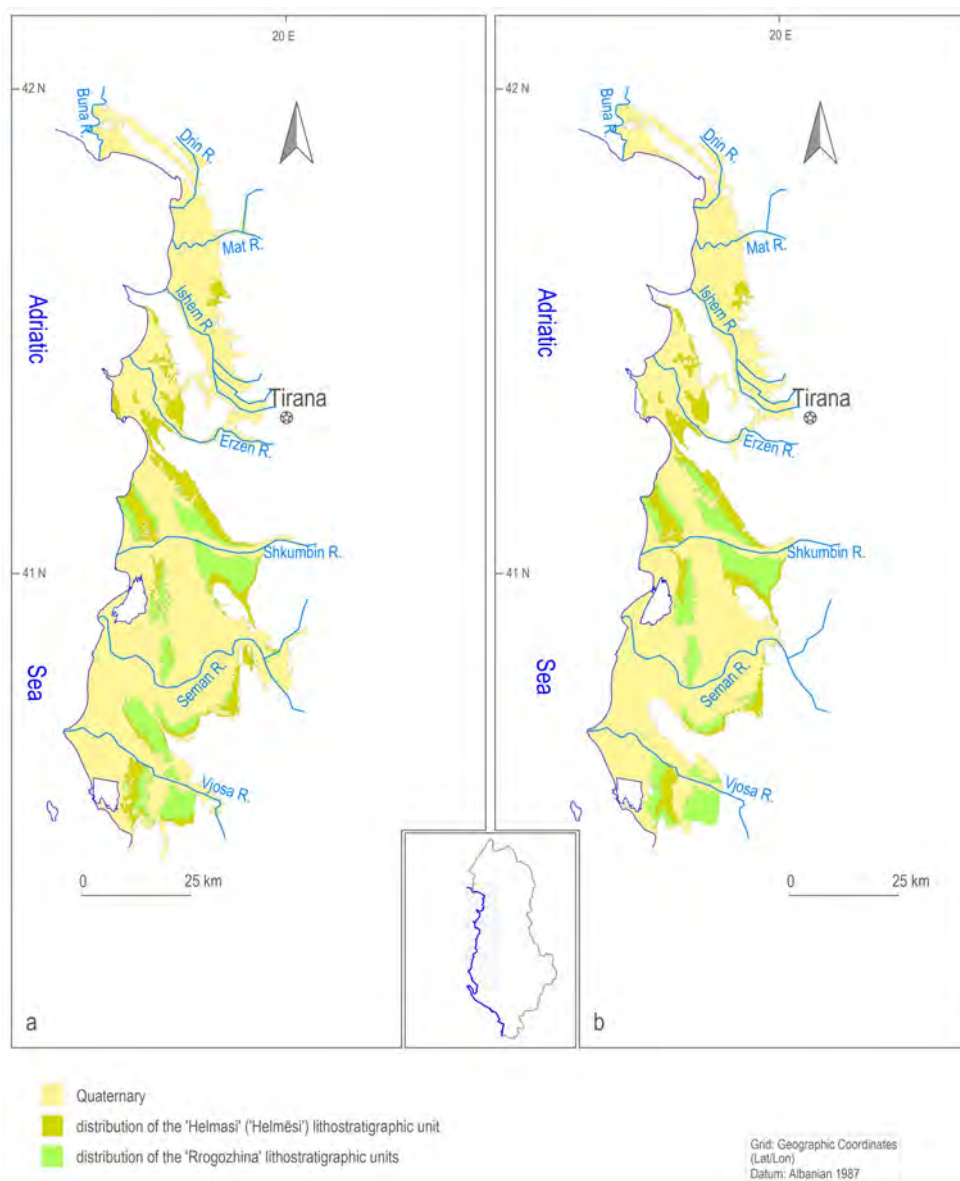


Fig. 9 - Comparative distribution of the 'Helməsi' ('Helməsi') and 'Rrogozhina' lithostratigraphic units. (A) Mapped distribution as "suites" according to ISPGJM & ING (1983) and Shallo et al. (1982). (B) Updated distribution as "formations" according to IKGJ et al. (2002) and Xhomo et al. (2011).

In Shallo et al. (1982), Vranai et al. (1997), and the 1983 map, the terms 'Piacenzian' and 'Astian' were abandoned. Instead, three types of Pliocene deposits were identified: Pliocene (clay, sand, and coal), Pliocene (the 'Helməsi' suite, consisting of siltstones), and Pliocene (the 'Rrogozhina' suite, comprising sandstones and conglomerates) (Fig. 9a).

In Xhomo et al. (2011) and the corresponding geological map (IKGJ et al., 2002), it seems we encounter a logical inconsistency when comparing their work with the current divisions of the Pliocene. While the Pliocene on the global geochronological scale is divided into two stages (Zanclean and Piacenzian), here the deposits are classified as Pliocene (undivided), Lower Pliocene (the 'Helməsi' formation, composed of clays, siltstones, and sandstones), Middle Pliocene (the 'Rrogozhina' formation, composed of sandstones and conglomerates), and above these are placed the deposits belonging to Pliocene-Lower Pleistocene, composed of sandy con-

glomerates and clays (Fig. 9b).

It should be noted that the 2011 text was published with significant delay and was based on data pre-dating 2001. At that time, the Gelasian Stage -defined in 1998 (Rio et al., 1998)- had not yet been incorporated into the Quaternary, an inclusion that only occurred in 2009 (Gibbard et al., 2010). Consequently, during the period when the map and text in question were being designed and published, the Gelasian was still considered the third and uppermost division of the Pliocene.

Following this logic, it can be concluded that the 'Pliocene-Lower Pleistocene' division occupied the position of the Gelasian Stage within the Albanian territory. However, this division is only identified within the Albano-Thessalian Depression. In the Adriatic Depression, where this division is absent, Pleistocene deposits lie directly above the 'Rrogozhina' formation ('suite' in 1983). Consequently, we maintain that the markers of Gelasian deposits may be present within this unit, alt-

though their identification requires independent chronostratigraphic evidence.

A notable issue regarding the Quaternary deposits of the Adriatic Depression, situated along the Albanian coastline, is the absence of *Arctica islandica* - a primary benchmark for the onset of the Quaternary in the Mediterranean. Its identification would significantly simplify the establishment of the Neogene-Quaternary boundary. A definitive explanation for this absence remains elusive. It may be attributed to a lack of targeted research, or alternatively, the prevalent high-energy depositional conditions, evidenced by the presence of conglomerates, may have been unsuitable for the survival of this species. This latter hypothesis is further supported by Italian researchers (e.g. Monegatti & Raffi, 2001; Roveri & Taviani, 2003), who have noted that the species' proliferation was ecologically restricted to stable, fine-grained substrates.

The 'Helmësi' and 'Rrogozhina' suites in Shallo et al. (1982), as well as the 'Helmësi' and 'Rrogozhina' formations in Xhomo et al. (2011), are broadly equivalent in their geographical distribution to the 'Astian facies' formations described by Biçoku et al. (1970).

Biçoku et al. (1970) emphasised that, based on faunal assemblages and significant lithological similarities, the upper part of the Albanian Pliocene correlates with the 'Astian facies' deposits of the Mediterranean Pliocene.

Continuing this discussion, it must be emphasised that despite the stratigraphic complexities discussed, there has been a persistent lack of targeted research on Albania's Quaternary deposits. Even after 1990, significant interest remained limited among both national and international researchers. Amongst foreign scholars, the first study was conducted by Mathers et al. (1999), who utilised remote sensing methods -specifically 1986 high-resolution Landsat TM imagery and 1943 aerial photographs- to perform a geological interpretation of the Adriatic Coastal Plain. They suggested that its formation resulted from a progradational process. Furthermore, under the direction of Eric Fouache, several multidisciplinary geomorphological studies were carried out, the results of which were disseminated through two key publications (Fouache et al., 2003, 2010).

Runnels et al. (2009) investigated these deposits for archaeological purposes in the area between Fier and Ardenicë, delineating a tentative coastline position for the onset of the Holocene.

A study undertaken by Uncu (2011) culminated in the construction of a paleogeographic development model for the lowland area north of Lezhë during the Holocene.

There is a fundamental difference in the conceptual models used by the Albanian researchers who constructed the maps reviewed in this paper and those of international scholars. The Albanian model was traditionally based on the Geosyncline Hypothesis -a fixist theory used to explain the tectonic development of the Earth before the widespread acceptance of Plate Tectonics.

In their concise critique of this theory, Kearey et al. (2009) point out that "this usage is not recommended, and the term 'geosyncline' must be recognised as no longer relevant to plate tectonic processes."

While a detailed explanation of geosynclinal geotectonics is beyond the scope of this paper, it is crucial to emphasise that this theory fails to recognise eustatic sea-level change as a significant driver. According to this model, marine transgression is attributed solely to tectonic subsidence, rather than to an increase in global ocean water volume. Similarly, regression is explained

through tectonic uplift -namely normal regression- thereby excluding the concept of forced regression.

As a fixist theory, it fails to account for global sea-level variability, directly contradicting established evidence of continuous eustatic oscillations throughout the Quaternary period.

This conceptual framework also underlies the paleogeographic reconstruction of the Adriatic Coastal Plain, which has been presented as a flexure zone (Konomi et al., 2015) infilled with sediments transported by rivers from the peneplanation of the continental hinterland (Papa, 1981).

In Albania, the concepts associated with this theory only began to be gradually superseded by the principles of Plate Tectonics at the turn of the new millennium.

5. CONCLUSIONS

Based on the chronological and critical review of Albania's official 1:200,000 scale geological maps (1929, 1957, 1967, 1983, and 2002) alongside their accompanying literature, the following conclusions are drawn:

- Cartographic Evolution and Paradigms: The representation of Quaternary deposits in Albanian geological cartography experienced a purely terminological evolution rather than a methodological one. It shifted from basic lithostratigraphic units in 1929, through rigid Soviet-influenced concepts of the Geosyncline Hypothesis (1957-1983), to the introduction of Western nomenclature (Pleistocene and Holocene) in the 2002 edition. Despite these changing labels, the mapping approach remained strictly dependent on genetic and morphogenetic criteria across all editions.
- The Neogene-Quaternary (N-Q) Boundary Gap: Across all historical map editions, the precise N-Q boundary remained chronostratigraphically undefined and variable. This was driven not only by a historical lack of dedicated Quaternary field studies and the ideological dismissal of non-resource-driven research during the centralized economy period (1945-1990), but also by a persistent lack of interest from both national and international researchers in the period after 1990.
- Modern Correlation Challenges: Achieving a reliable correlation between Albania's historical cartography and modern international chronostratigraphic schemes remains highly challenging due to the chronic absence of absolute numerical dating and the long-standing isolation from Western stratigraphic nomenclature. Even the latest 2002 map edition maintains a temporal division with an indefinite boundary between the Holocene and Pleistocene, making it difficult to establish the precise chronological position and duration of these transitional sedimentary successions.
- The 3D Subsurface Model and N-Q Boundary Hypothesis: Previous research (Marku, 2018) notes the presence of potential incised valley features within the uppermost Pliocene successions (the Rrogozhina formation, historically mapped as 'Astian facies'). Although constrained by data limitations, this localized model allows for the tentative proposal of a new working hypothesis: these incised valleys likely record forced regressions linked to global eustatic sea-level drops during the Gelasian cooling. Consequently, it is suggested that the actual trace of the local Neogene-Quaternary boundary may extend into these deeper deposits, offering a tentative target for future high-resolution chronostratigraphic verification and establishing an open framework for future national and international collaborative research.

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