

PALEONTOLOGICAL HERITAGE OF THE ULY-ZHILANSHIK RIVER BASIN (TURGAI DEPRESSION): GEOHERITAGE CONSERVATION AND TOURISM POTENTIAL

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Abstract: The aim of this study is to assess the geoheritage of the Uly-Zhilanshik River Basin in the Turgai Depression (Western Central Kazakhstan) and to evaluate its potential for conservation and sustainable geotourism development. The basin is a geoheritage area of national and international significance, preserving well-exposed Cenozoic stratigraphic sections that document paleoenvironmental evolution and hosting numerous fossil flora and fauna localities that inform regional paleoclimatic and paleoecological reconstructions. These geological and paleontological features constitute a natural archive of Earth history and provide a scientific basis for territorial planning and conservation policy. The research combined field surveys of geological and geomorphological sites with an assessment of geotouristic attractiveness of natural complexes, comparative-geographical and socio-cultural analyses, and a review of environmental protection regulations. A SWOT analysis was additionally applied to identify strengths, constraints, development opportunities, and potential risks associated with tourism growth. The study demonstrates the high scientific, educational, and touristic value of the Cenozoic sections, paleontological localities, and associated landscapes, and identifies prospects for integrating geotourism into nature conservation initiatives and regional management strategies. Key directions for sustainable development are outlined, highlighting geotourism as a practical conservation instrument and a viable alternative to resource-extractive economic models. The results support the need for targeted protection measures, responsible access planning, and the incorporation of the Uly-Zhilanshik Basin into broader geoheritage and geopark frameworks within the Turgai Depression.

Keywords: geoheritage, geotourism, Turgai Depression, Cenozoic, Central Kazakhstan, GIS Analysis, sustainable development, fossil flora and fauna, nature conservation, natural landscapes

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INTRODUCTION

In recent decades, there has been a steady increase in interest in the study and preservation of geoheritage sites, which represent unique natural formations reflecting the evolution of the Earth and the biosphere (Reynard & Brilha, 2018; Pescatore et al., 2023; Herrera-Franco et al., 2022). Geoheritage—understood as the ensemble of geological sites with scientific, educational, cultural and aesthetic value—is increasingly framed as a strategic resource for sustainable regional development, particularly in underexplored areas (Brilha et al., 2018). In parallel, geotourism not only promotes unique landscapes and landforms but also strengthens environmental awareness, supports local economies and contributes to conservation-oriented land management. Previous studies have demonstrated that geomorphological parameters — such as hypsometry, vertical and horizontal dissection of relief, slope angles, and exposure — play a decisive role in determining the tourism potential and scenic attractiveness of mountainous regions.

Using Southern Altai as a case study, Zhensikbayeva et al. (2017, 2018) showed that relief characteristics directly influence landscape observability, accessibility, infrastructure costs, and the functional suitability of territories for recreational use. Since 2021, best-practice guidance issued by IUCN's World Commission on Protected Areas has further formalized principles and procedures for geoheritage identification, risk assessment, visitor management and monitoring in protected and conserved areas, helping to translate assessment results into management action (Crofts et al., 2020).

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At the global level, geopark networks established under UNESCO have demonstrated how conservation of geological sites can be integrated with sustainable tourism, education, science popularization and territorial branding. As of 2025, there are 229 UNESCO Global Geoparks in 50 countries, reflecting a continued expansion of this model and its associated governance toolkit (statutes, operational guidelines, periodic revalidation) (UNESCO, 2025). In Kazakhstan, however, geopark development is still at an early stage; recent initiatives (e.g., the Ulytau region) illustrate momentum but also reveal regulatory and operational gaps, especially for paleontological localities (Nigmatova et al., 2024).

A noteworthy shift in 2020–2025 scholarship is the move from purely descriptive inventories toward assessment-to-management approaches. Recent bibliometric analyses confirm the rapid growth and diversification of geoheritage research, highlighting increased attention to methodological rigor, interdisciplinary integration, and applied management perspectives at the global scale (Göktaş & Boyraz, 2025). Reviews emphasize linking geosite scoring to concrete decisions about access, interpretation, carrying capacity and conservation priorities, while also recognizing methodological limitations such as expert-based subjectivity and the need for sensitivity analyses of weights and thresholds.

Systematic literature reviews similarly argue for aligning geoheritage and geotourism strategies with the SDGs and for stronger empirical validation with visitor/stakeholder data. Emerging work highlights digital tools (e.g., 3D/VR, mobile interpretation) as enablers for sites in remote or fragile settings, but stresses that their deployment should be tied to conservation outcomes rather than promotion alone (Štrba et al., 2023). Recent studies emphasize the growing role of digitalization in geoheritage and geopark management, including GIS-based analyses, digital interpretation platforms, and decision-support frameworks, while stressing the need to align technological innovation with conservation outcomes (Hermawan et al., 2025). Despite Kazakhstan's outstanding landscapes and large territory (2,724,900 km²), geoheritage remains relatively underexplored. Existing studies are geographically patchy and have focused mainly on geomorphological or historical-geological features, with limited attention to open-air paleontological exposures and their specific vulnerabilities (weathering, erosion, unauthorized collecting). Recent regional papers (Aktobe Oblast; rural tourism/geoheritage links) underscore the potential of geotourism as a lever for local development, but also reveal institutional gaps in protection regimes and visitor management frameworks that are particularly consequential for fossil sites. This situation supports the need for dedicated, methodologically robust assessments of paleontological geoheritage and for scenario-based planning of responsible access (Sergeyeva et al., 2023). Regional studies from East Kazakhstan demonstrate the considerable potential of geotourism development based on geomorphological diversity and landscape uniqueness, while simultaneously highlighting infrastructural, institutional, and management constraints that limit the effective use of geoheritage resources at the national level (Chlachula, 2019).

One such area is the Uly-Zhilanshik River Valley, located in the southern part of the Turgai Depression. Early investigations of the terrestrial vertebrate fauna of Kazakhstan laid the foundation for subsequent paleontological research in the Turgai Depression (Bazhanov, 1955). One such area is the Uly-Zhilanshik River Valley, located in the southern part of the Turgai Depression. The region exposes extensive continental Paleogene–Neogene deposits with unexpectedly rich plant and animal fossils; vividly colored outcrops form a distinctive landscape, and cultural heritage elements (mazars, mausoleums, burial sites) add interpretive value. The study of fossil plants in the Turgai Depression has a 150-year history, from the first collections by A. I. Antipov and comparisons by O. Heer with Swiss Tertiary floras, through the concept of “Turgai flora,” to ongoing research on Cenozoic assemblages (Kryshstofovich & Palibin, 1915, 1930; Borsuk, 1935; Zhilin, 1984, 2002; Nigmatova, 1998; Popova et al., 2019; Nigmatova et al., 2023; Tarasevich & Popova, 2024; Zhamangara et al., 2025a,b). Yet, the region remains peripheral for both research integration and tourism development due to the absence of systematic inventories, underdeveloped infrastructure and weak integration into national geoheritage conservation programs. Against this backdrop, recent literature on assessment frameworks and management linkages provides a timely basis for advancing from inventory to actionable planning in Uly-Zhilanshik (Štrba et al., 2023). Related and comparable recent studies (last 5 years) include: (i) a literature-based synthesis on connecting geosite assessment with geotourism development and visitor perspectives (Štrba et al., 2023); (ii) a systematic review of applied, SDG-aligned strategies in geoheritage/geotourism (Gupta et al., 2024); (iii) Kazakhstan-focused case work on the Ulytau region's geopark prospects (Nigmatova et al., 2024); and (iv) regional assessments linking rural development with geoheritage in Aktobe Oblast (Saparov et al., 2024; Sergeyeva et al., 2023). Collectively, these studies reinforce the need for site-specific risk appraisals, participatory interpretation and management-ready outputs—gaps that the present contribution aims to address

MATERIALS AND METHODS

The assessment of the geoheritage and geotourism potential of the Uly-Zhilanshik River Valley was carried out using an integrated field and analytical approach encompassing paleontological, geomorphological, ecological, cultural, and infrastructural aspects. The stepwise workflow is summarized in Figure 1.

First, an analysis of literary and cartographic sources was conducted:

- i) scientific publications, reports, and archival materials related to the geology of the Turgai Depression, the hydrography of the Uly-Zhilanshik Valley, fossil flora and fauna of the region, as well as archaeological sites were reviewed;
- ii) topographic and geological maps at a scale of 1:200,000 were used;
- iii) satellite imagery (Google Earth) was applied for preliminary landscape analysis. Paleontological studies were conducted using conventional methods.

Special attention was paid to the geolocation of key sites and their linkage to existing and potential tourism infrastructure. To assess the tourism potential, the methodology for evaluating the geotouristic attractiveness of geosites

was applied, based on an adapted scale (Višnić et al., 2016; Nigmatova et al., 2024; Kravchenko & Bogdanova, 2024; Kasenova & Dyusembaeva, 2013). For a comprehensive evaluation of the area's potential, a SWOT analysis was employed, including: strengths (uniqueness of landscapes, presence of geoheritage sites), weaknesses (infrastructural limitations), opportunities (development of geotourism and education), and threats (environmental degradation, insufficient protection).

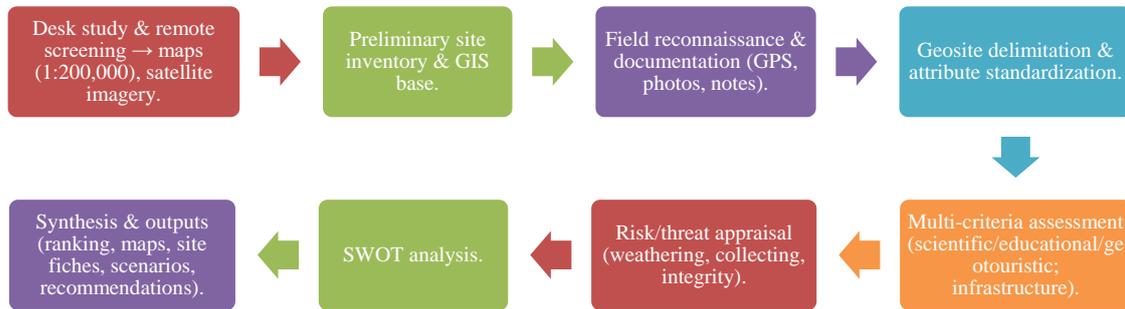


Figure 1. Workflow for assessing paleontological geoheritage and geotourism potential in the Uly-Zhilanshik River Valley (Turgai Depression), from desk study and GIS preparation through field documentation, multi-criteria assessment, risk appraisal and SWOT, to prioritization and management-ready outputs

Geographical and geological characteristics of the study area

The Turgai Depression is one of the largest tectonic structures in Kazakhstan, representing a vast tectonic trough extending from north to south and effectively cutting across the Turgai Plateau. Geodynamically, the Turgai–Syrdarya subsidence zone is generally regarded as a boundary dividing the Kazakh megacontinent into two segments—Western and Eastern Kazakhstan (Kasenova & Dyusembaeva, 2013). The depression is bounded by the spurs of the Southern Ural Mountains to the west and the Ulytau highlands to the east. To the north, it merges with the West Siberian Lowland, while in the south it transitions into the Shalkar–Tengiz Depression. The trough can be traced in the relief from the lower reaches of the Tavda River in the north to Northern Priaralye in the south, forming a connection between the West Siberian Basin and the northern part of the Turan Lowland (Kasenova & Dyusembaeva, 2013).

One of the rivers flowing through the southern part of the Turgai Depression is the Uly-Zhilanshik River (Kazakh: Үлкен Жыланшық), a right tributary of the Turgai River. The river is 277 km long, with a catchment area of 26,000 km². It is formed by the confluence of the Dulygaly-Zhilanshik and Ulken-Zhilanshik rivers, both originating in the Ulytau Mountains. The Uly-Zhilanshik flows northwestward before turning southwestward, forming an arc, and eventually discharging into the endorheic saline Lake Akkol. The valley of the Uly-Zhilanshik River is well defined but not particularly deep. It is predominantly flat, with broad floodplain areas covered by shrub thickets and meadows, and in some places, saline patches and periodically waterlogged zones. The Uly-Zhilanshik is a typical steppe river with a temporary hydrological regime: high water occurs in spring (April), while for the rest of the year the river either becomes shallow or dries up along its course. The location of the Uly-Zhilanshik River Valley and the main fossil localities are shown in Figure 2.

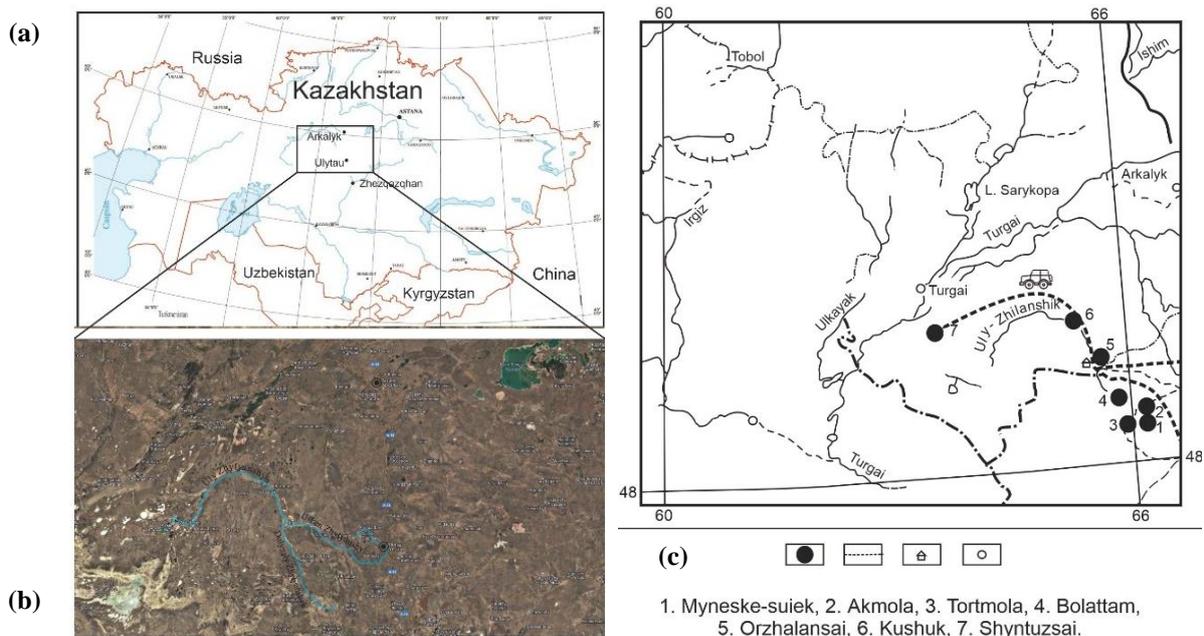


Figure 2. Map of the Uly-Zhilanshik River Valley localities (a) Kazakhstan with highlighted study area (authors); (b) Google Earth satellite view (imagery 2025-06-08); (c) fossil localities (WGS84 48–50° N, 64–66° E; ~1:1.5 M, scale bar from graticule) (Source: Created by the authors (a,c); Google Earth (b), © Google/Maxar)

Previous paleoclimatic reconstructions based on plant macrofossils from the Aktau Mountain and Kushuk localities indicate long-term climatic evolution from the Miocene to the present in Central and Southeastern Kazakhstan, providing an important regional framework for interpreting the geological and environmental setting of the Uly-Zhilanshik River Basin (Akmagambet et al., 2025). Rich fossil flora and fauna localities have been identified in the outcrops of the Uly-Zhilanshik River Valley. From these exposures, key reference stratigraphic sections of the Cenozoic of Central Kazakhstan have been described. The geological structure and stratigraphic framework of the Uly-Zhilanshik River Basin, including the main reference sections, are illustrated in Figure 3. At the base of the continental Oligocene succession lie greenish-gray laminated clays with silt admixtures and siderite concretions, assigned to a unit of Chegan-like clays, previously referred to as the Chegan Formation (Yanshin, 1953;), of Middle to Upper Eocene age. Above them, with a slight discontinuity, occur dark-gray and chocolate-brown clays, siltstones, and fine-grained micaceous-quartz sands with thin horizontal bedding and plant detritus, attributed to the Urkimbai Formation (Yanshin, 1953), dated to the Lower Oligocene (Rupelian). Higher in the section, green dense blocky clays with gypsum and siderite nodules are assigned to the Chelkarnurin Formation, dated to the upper Lower Oligocene–Upper Oligocene (Rupelian–Chattian). Overlying the Chelkarnurin deposits is a thick sequence composed of gray to dark-gray, brown, dense, plastic clays, interbedded with fine sandy and silty layers, and including seams and lenses of brown coal and lignite, designated as the Kaidagul Formation. These deposits are widely developed within the Southern Turgai Plain and along the entire Uly-Zhilanshik arc, where they crop out at the surface. The Kaidagul Formation is particularly rich in organic remains, including plant impressions and vertebrate fossils, recorded at localities such as Erzhilansay, Bolattam, Shintuzsai, Tortmola, Akmola, and Nausha. The deposits of the Kaidagul Formation are distinctly divided into two units. The lower unit is represented by fine sands and gray silty clays of varying shades, as well as lignites and seams of brown coal. Its characteristic features include clearly expressed horizontal lamination of the clays, the presence of pyrite nodules and thin siderite lenses, and the almost ubiquitous occurrence of plant remains. The upper unit is composed almost entirely of clays, highly diverse in color and texture, which gives the gullies and individual outcrops an exceptionally picturesque appearance. These deposits are distinguished by the absence of coal seams, the presence of yellow jarosite nodules in the lower part of the section, and, in most cases, an almost complete absence of plant remains. Directly above the Kaidagul Formation lie the Kushuk beds, represented by light brownish-bedded silty clays and clayey siltstones (Kushuk locality). These beds contain plant impressions and vertebrate remains. The Kushuk beds form part of the Zhilanshik saline clays that cap the Neogene deposits of the Southern Turgai region and are assigned to the Tersek Formation. Their age is dated to the upper Lower Miocene (Burdigalian) and the lower Middle Miocene (Yanshin, 1953). A complete section of the described complex, with a well-defined base and top, can be traced along the right bank of the Dulygaly-Zhilanshik River (Figure 3).

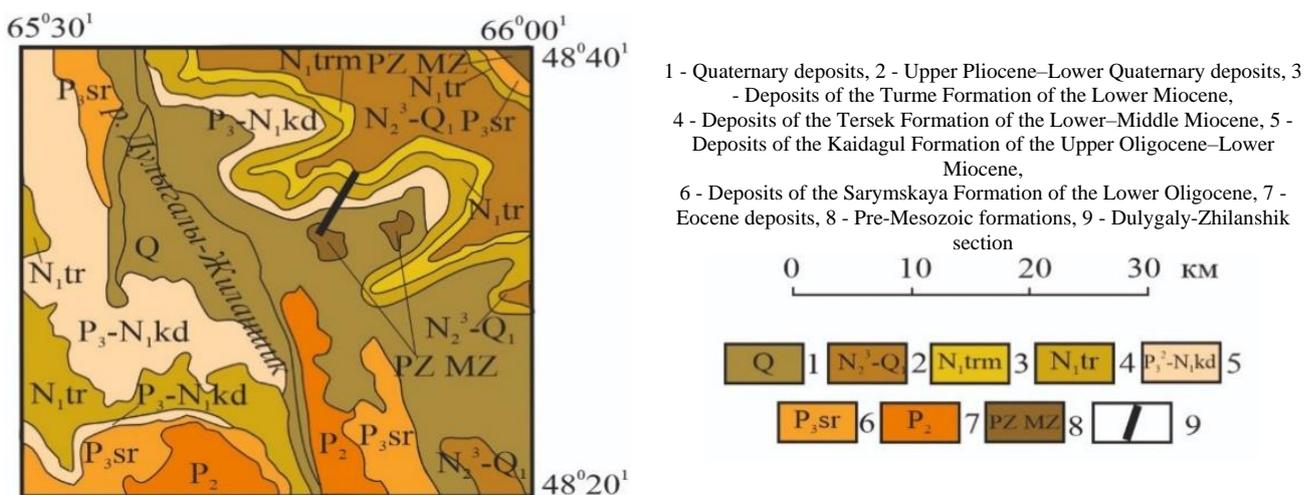


Figure 3. Geological map and composite reference section of the Dulygaly–Zhilanshik area (Sources and credits: Base geology from the Institute of Geological Sciences named after K. I. Satpayev — Geological Map of Kazakhstan, scale 1:200,000, covering 48°20'–48°40' N and 65°30'–66°00' E (Amangeldi District, Kostanay Region) (2024); cartographic rendering by the authors.)

RESULTS AND DISCUSSION

The main paleontological geosites of the Uly-Zhilanshik River Basin described below are illustrated in the Figures 4–10.

Geosite 1: Akmola Tract

The Akmola tract is located on the right bank of the Dulygaly-Zhilanshik River, 2 km north of the Akmola grave. The Akmola tract is a remarkably beautiful geoheritage site. Within a relatively small area, deposits of the Saryin and Kaidagul formations are exposed, composed of clays ranging in color from gray-green to burgundy-red. Numerous gullies and canyons give the landscape an exceptionally picturesque character. The fossil flora of Akmola, identified from leaf impressions, includes 32 species (Nigmatova, 1998; 2023), belonging primarily to tree taxa of the families *Betulaceae*, *Fagaceae*, *Aceraceae*, *Ulmaceae*, and others, as well as *Pinaceae*, *Taxodiaceae*, and *Cupressaceae*; meadow-swamp grasses are also present. Modern analogs of these fossil species are now distributed in the Atlantic states of North America, the forests of Southeast Asia, and the Mediterranean region, forming part of the vegetation of the warm-temperate zones of the globe.



Figure 4. Akmola fossil flora locality: (a) general view; (b) field camp in the Akmola Gorge (Source: Author, 2024)

Geosite 2: Myneskesuek Tract, Early Oligocene Section (points 1 and 3 in Figure 5)

The Myneskesuek tract is located on the right bank of the Dulygaly-Zhilanshik River, 6 km northeast of the Dulygaly-Zhilanshik (=Ashaly) Valley, a right tributary of the Dulygaly, and represents, in a sense, the northern continuation of the Akmola tract. The cliffs of Myneskesuek consist at the base of marine laminated clays of the Chegan Stage. Above them lie bluish-gray siltstones, up to 1 m thick, followed by dense lilac-yellow clays interbedded with thin marl layers. Overlying these is a fossiliferous bed composed of fine sandy, brownish-yellow clays containing numerous lenses enriched with iron–manganese black concretions. Fragments of ferruginized wood and bark are frequently encountered.

The entire fossiliferous bed is intensively saturated with bone material: at nearly every step on the slopes of the gentle erosional remnants, bones of terrestrial vertebrates belonging to the Indricotherium faunal complex are found, washed out by surface waters. The upper part of the outcrop is composed of lighter clays with fewer iron–manganese inclusions; their abundance decreases upward. Fossil bones are significantly rarer in this part of the formation. Overlying them, with a sharp erosional contact, are light, dense, unsorted cross-bedded sands of the Turgai Formation. Based on the composition of the flora and fauna, the age of these deposits is determined as Early Oligocene.



Figure 5. Myneskesuek tract: (a) general view; (b) exposure of the Saryin Formation

Geosite 3: Tortmola Locality

Also on the right bank of the Dulygaly-Zhilanshik River lies the Tortmola locality of Cenozoic flora and fauna (Kornilova, 1954; Tokar & Kornilova, 1974). Here, in rare lenses of humus-rich, dense siltstones, impressions of angiosperm plants have been identified, including *Phragmites oeningensis* A. Br., *Poacites laevisculus* Heer, *Populus balsamoides* Goepf., *Juglans acuminata* A. Br., *Pterocarya castaneaefolia* (Goepf.) Menz., *Magnolia ingfieldii* Heer, *Laurus primigenia* Ung., *Daphnogene ungeri* Heer, *Ziziphus tiliaefolius* Heer, *Paliurus hesperius* Berry, *Fraxinus macrophylla* Heer, *Lindera ovata* Koi., cf. *Zelkova ungeri* Kov., *Carpinus cf. orientalis* Jam., *Myrica turgaica* Korn., *Myrica* sp., (?) *Comptonia* sp., *Leucothoe (Andromeda) protogaea* (Ung.) Schimp., (?) *Daphne* sp., *Leguminosites* sp., *Rhus turcomanica* (Krysht.) Kor., *Cotinus lavrovii* L. Bud., *Phyllites* sp. The Tortmola locality, where abundant fossil plant impressions and rare vertebrate remains have been recorded, is illustrated in Figure 6. The taxonomic composition of this flora represents a mixture of subtropical and “Turgai” temperate elements, with the latter predominating. By its composition, this flora corresponds to interfluvial areas distant from wooded riverbanks and forested watershed massifs. The fauna of Tortmola is represented rather poorly—by a single rodent species of small ardinomyids, *Dulygalimys kazachstanicus* Vunogradov & Gambarjan, whose remains were found at a level 4–5 meters above the base (i.e., at the contact of the Saryin Formation deposits with the marine Eocene clays).



Figure 6. The Tortmola locality (Source: Seydali, 2024)

Geosite 4: Erzhilansay Locality

The fossil flora locality known in the literature as “Erzhilansay” (or Orzhilansay) (Zhamangara et al., 2025; Nigmatova, 1998; Kornilova, 1966) is situated in the eastern part of the Southern Turgai Plain, 1.5–2 km north of the right bank of the Uly-Zhilanshik River and 13.5 km upstream from the confluence of the Dulygaly and Ulken-Zhilanshik rivers. The Erzhilansay locality, with its exceptionally rich plant and insect fossil assemblages, is illustrated in Figure 7. The Erzhilansay locality represents an outcrop of kaolinitic clays exposed as a low, gently undulating, bean-shaped formation approximately 70 m long and 40–45 m wide, rising about 2.5 m above the plain of the third river terrace of the Uly-Zhilanshik. The weathered strata containing plant impressions stand out in light gray with a faint lilac hue among other nearby deposits. Along the bedding planes, an enormous number of impressions of leaves, fruits, vegetative shoots, and insect remains are horizontally distributed. The density of the imprints is so high that they resemble a forest litter layer. Animal remains, including turtles and a crocodile, have also been described from this site. The Erzhilansay locality has been preserved in the flat part of the river valley. However, there is growing concern regarding the threat of destruction of this unique fossil flora site under the combined impact of natural and anthropogenic factors—such as trampling due to livestock grazing and uncontrolled collection of plant remains. Atmospheric precipitation also poses a serious risk. Each excavation disturbs the established equilibrium, leading to increased erosion and the destruction of kaolinitic clays containing fossilized plant and animal remains.



Figure 7. The Erzhilansay fossil flora locality: general view and excavation site (Source: Seydali, 2024)

Geosite 5: Kushuk (Kushuk) Locality

The Kushuk fossil leaf locality is exposed in the riverbank escarpment along the right bank of the Uly-Zhilanshik River, 10 km upstream from the river’s central arc where it changes course from north to west. Here, riverbank outcrops are annually eroded by water. About 1 km north of the site, downstream along the river, are the Kushuk winter sheepfolds.

In 1912, a burial site of Cenozoic vertebrate fauna was discovered at Kushuk and 1.5 km further downstream at Kzylzhar. Since then, repeated excavations have been carried out, each time adding to the faunal assemblage of this remarkable locality (Borisov, 1915, 1939). A. A. Borisov identified new species of rhinoceroses from Kushuk—*Aceratherium depereti* Borisov. *Brachiopoterium aurelianense* var. *gailiti* Borisov. In addition, the earliest large proboscideans in Eurasia were recorded

here: mastodons *Mastodon atavus* Boriss. and *Serridentinus inopinatus* Boriss. et Bel. According to Borisyak (1915, 1939), the mastodon complex of Kushuk and Kzylzhar is closely related to the Miocene fauna of Europe but displays a more primitive character. To date, this remains the only locality of its kind. The composition of the Kushuk flora, studied from leaf impressions (Kornilova, 1960; Zhamangara et al., 2025), is also of great interest: eleven out of the 42 identified species were described as new. Although the Kushuk flora shares some similarities with the Aquitanian floras of this region, it differs in a number of characteristics, making it most closely related to the Miocene floras of Europe. Based on the analysis of both faunal and floral remains, the Kushuk beds have been assigned to the Burdigalian stage of the Miocene. The unique Early Miocene flora and fauna of the Kushuk locality, the only Mediterranean-type flora known from Kazakhstan and the Trans-Urals, is shown in Figure 8. At present, this is the only Early Miocene flora of the Mediterranean type documented in Kazakhstan and the Trans-Urals, and it has no analogues in the modern flora.



Figure 8. General view of the Kushuk fossil flora and fauna locality (Source: Seydali & Akmagambet, 2024)

Geosite 6: Shintuzsai Paleogene Flora and Fauna Locality

This locality qualifies as a paleontological geosite owing to the occurrence of diagnostic rhinocerotine remains (including giant rhinoceros forms) in situ within Paleogene deposits, together with a diverse and well-preserved plant macroflora that confers high scientific and educational value. The Shintuzsai fossil flora and fauna locality (Kornilova, 1966) is a gully (Kazakh: sai) located 40 km southeast of the town of Torgai and 3–4 km south of Lake Shintuz. This picturesque gully exposes Cenozoic deposits with greenish and yellowish hues along its slopes, containing abundant plant remains and fossil fauna. From these deposits, Biryukov (1961) described giant Rhinoceros species *Pristinotherium brevicercalae*. Later, remains of *Cylindrodontidae* and *Desmatolagus* sp. were also discovered here. The floral assemblage includes the following species: *Salvinia natanella* Schap., *Taxodium dubium* Heer, *Populus grandifera* Heer, *Populus* sp., *Pterocarya paradisiaca* Iljinskaja, *Laurus primigenium* Ung., *Laurophyllum* sp., *Cinnamomum scheuchzeri* Heer, *Cinnamomum* sp., *Sassafras turgaicum* Kornilova, *Cercidiphyllum crenatum* (Ung.) Brown., *Liquidambar europaeum* A. Br., *Cercis* cf. *turgaica* Uan., *Acer angustilobum* Heer, *Ziziphus tiliaefolius* Heer, *Pistacea oligocenica* Mar., *Andromeda protogea* Ung., *Andromeda vacciniaefolia* Heer, and *Dryandra* sp. One of the most iconic representatives of the Shintuzsai faunal complex is the giant rhinoceros *Paraceratherium* (*Indricotherium*) *transouralicum* Pavlova, 1922, whose skeletal remains are preserved in the Nature Museum of the RSE “Gylym Ordasy” in Almaty (Figure 9, 10). This unique combination of floral and faunal elements highlights the significant paleontological and botanical value of the Shintuzsai locality.



Figure 9. *Paraceratherium* (*Indricotherium*) *transouralicum* Pavlova, 1922. Nature Museum, RSE “Gylym Ordasy” (Almaty, Kazakhstan). Photo by G. S. Kondratenko; Figure 10. *Paraceratherium* (*Indricotherium*) *transouralicum* Pavlova, 1922. Nature Museum, RSE “Gylym Ordasy” (Almaty, Kazakhstan) (Source: Kondratenko, 2015)

Conservation of Geological Heritage in the Altyn Dala Nature Reserve

The Altyn Dala State Nature Reserve (Kazakh: «Алтын Дала» мемлекеттік табиғи резерваты), a specially protected natural area with legal entity status, was established on November 27, 2012. Its mission is to preserve the objects of the state natural reserve fund, including the habitats, breeding grounds, and migration routes of the saiga antelope. The reserve comprises three branches, one of which is the Uly-Zhilanshik branch—encompassing desertified steppes and a section of the Uly-Zhilanshik River. Although the geoheritage sites along the Uly-Zhilanshik River are under state protection, they require additional conservation measures. The localities of the Uly-Zhilanshik Basin merit designation as natural monuments—natural sites that demand protection due to their significant scientific, natural-historical, and educational value.

Particular attention must be given to the preservation of the Erzhilansay locality, one of the largest sites of Aquitanian-age fossil flora within the Turgai Depression. The site is threatened with destruction as a result of intensive erosion of riverbanks during spring floods and heavy rainfall. To ensure its preservation, hydrogeological studies are needed to develop recommendations for bank stabilization. It is necessary to designate the locality as a paleontological sanctuary, encompassing a strip 1–1.5 km wide from the cliff edge to the Kushuk wintering grounds along the entire exposure, install protective signs, and conduct outreach activities among the local population. Currently, the condition of these sites raises serious concern, as they are subject to the destructive impact of both natural and anthropogenic factors. Most fossil plant localities have been preserved in riverbank escarpments, where they are gradually being destroyed by water and wind erosion, atmospheric precipitation, natural undercutting, and uncontrolled collection. In this regard, the tasks of conserving these localities and carefully studying the collections already obtained are becoming increasingly urgent.

To preserve these localities, special local legislative acts must be adopted to ensure a protective regime and to restrict uncontrolled collection and removal of fossil flora materials from the territory of the Turgai Depression.

Tourism Potential of the Uly-Zhilanshik River Basin

The Uly-Zhilanshik River Basin possesses multifaceted tourism potential due to its unique combination of natural, historical-cultural, archaeological, and socio-economic resources. The region has the capacity to become an attractive destination for various forms of sustainable tourism—ranging from scientific and educational to ethnocultural, recreational, and agritourism. The basin is home to ancient burial mounds, traces of sacred complexes, and monuments that reflect the centuries-old history of nomadic civilization. These sites hold high value for archaeological and cultural tourism. In addition, the region hosts local history and ethnographic museums that can serve as key stops on tourist routes, thereby contributing to the popularization of cultural heritage.

Another important factor is the geographical proximity to the prospective “Ulytau” Geopark (Nigmatova et al., 2024), which creates opportunities for integrating Uly-Zhilanshik into a broader geotourism cluster, incorporating it into national and transregional routes, and fostering the development of joint educational and conservation programs.

Furthermore, the Uly-Zhilanshik River and its adjacent water bodies are characterized by a rich ichthyofauna, making the region promising for the development of sport and recreational fishing. This potential could be enhanced through the organization of thematic tours, fishing culture festivals, and initiatives aimed at attracting domestic tourism.

The rural areas of the basin feature guest houses, small agrofarms, and fazendas, providing favorable conditions for the development of agritourism and ecotourism. Visitors can become acquainted with traditional lifestyles, participate in agricultural activities, taste local products, and take part in ethnocultural events. Such forms of tourism contribute both to the growth of the local economy and to the sustainable use of natural resources. Overall, the tourism potential of the Uly-Zhilanshik Basin can be realized through the development of basic infrastructure, improved transportation accessibility, digitalization of information on local attractions, and cross-sectoral cooperation among governmental agencies, research institutions, and local communities. A comprehensive approach to tourism development in this region could contribute not only to the preservation of its natural and cultural heritage but also to ensuring sustainable socio-economic growth.

CONCLUSION

The results of the conducted research confirm that the Uly-Zhilanshik River Basin constitutes a geospatial area of high geological and natural-geographical significance, combining elements of scientific, educational, cultural, and recreational potential. The presence of stratigraphically valuable Cenozoic sections, unique fossil flora and fauna localities, and diverse landscape complexes makes the region an important site of both national and international geoheritage. Its systematic assessment in terms of geotourism attractiveness and resource preservation highlights the necessity of an interdisciplinary approach that integrates the principles of geoecology, environmental policy, cultural geography, and sustainable tourism. Analysis of the current state of the natural sites within the Uly-Zhilanshik Basin demonstrates that many are subject to anthropogenic impacts, resource exploitation, and degradation. In this context, the development of geotourism as a form of sustainable natural resource use can be considered not only as an alternative to the resource-extractive economic model of the region but also as a tool for environmental protection, local community engagement in preserving natural and cultural heritage, and stimulation of socio-economic activity.

A crucial component in achieving these objectives is geoeducation, which serves as a means of raising the level of ecological and geographical literacy among the population, fostering a value-based attitude toward geological heritage, and enhancing scientific interest in this territory. The summarized results of the SWOT analysis are presented in Table 1.

The conducted SWOT analysis demonstrates that the Uly-Zhilanshik River Basin has considerable potential for the development of diversified tourism, provided that infrastructural and managerial constraints are addressed.

Table 1. SWOT Analysis of the Tourism Potential of the Uly-Zhilanshik River Basin

Strengths	Weaknesses
— Rich geological and archaeological heritage	— Limited tourist infrastructure (roads, logistics)
— Historical and cultural landmarks, including museums	— Poor information availability (no online maps, guides, visitor centers)
— Diverse natural landscapes and ecosystems	— Weak promotion and marketing
— Potential for fishing tourism and birdwatching	— Lack of systematic training of personnel in geotourism:
— Existing guest houses, farms, and agritourism facilities	— Shortage of sanitary facilities, service points, and campgrounds

The region's strengths—its rich natural and cultural heritage and opportunities for agritourism—combined with the potential for integration into the “Ulytau” Geopark routes and access to state support, can form the foundation for the territory's sustainable development. However, a targeted strategy is required, focusing on ecosystem conservation, community involvement, and the development of tourism infrastructure. Thus, a platform is being established for further research aimed at specifying mechanisms for implementing sustainable geotourism, developing educational programs, and strengthening institutional support for geoheritage at both regional and national levels.

The present assessment covers key localities rather than the entire Turgai system, relies partly on expert-based scoring, and uses a qualitative risk appraisal; forthcoming work will expand site coverage, include sensitivity tests and visitor/stakeholder data, and implement instrumental monitoring to quantify degradation risks.

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