

'... whenever men can form no idea of distant and unknown things, they judge them by what is familiar and at hand'.

– Giambattista Vico

REVISITING THE “ASIATIC MEDITERRANEAN”: EARLY HOLOCENE HIGHSTANDS AND HYDROLOGICAL CONNECTIVITY ACROSS THE PONTO-CASPIAN BASIN

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Summary. Understanding hydrological change across the Ponto-Caspian region during the Late Pleistocene–Early Holocene transition remains a key challenge in Quaternary science. While existing models emphasise climate forcing and glacio-isostatic adjustment, a number of geomorphological, sedimentary, and biological observations are not easily reconciled within current frameworks.

This study synthesises evidence from the Caspian, Black Sea, Mediterranean, and adjacent regions, with particular focus on the geomorphology of Azerbaijan. Raised terraces, high-elevation strandlines, and apparent wave-modified mud-volcano surfaces occur at levels significantly above the widely accepted Khvalynian highstand (~+50 m a.s.l.), suggesting the possibility of previously unrecognised hydrological conditions. Additional lines of evidence include ostracod faunal turnovers, shifts in salinity-sensitive taxa, anomalous sedimentary records, and indications of changing basin connectivity across Eurasia during the Early Holocene.

Taken together, these observations support the interpretation that regional hydrology was more dynamic and complex than commonly assumed. Rather than a single-event framework, the data are more consistent with a multi-phase system involving fluctuating water levels, episodic basin overflow, stratified flow regimes, and variable connectivity between the Black Sea, Caspian Sea, and neighbouring basins. In this context, earlier concepts of an enlarged Pleistocene “Asiatic Mediterranean” are reconsidered as a working hypothesis.

The study also re-examines the Black Sea reconnection debate, suggesting that alternating phases of outflow and inflow through the Bosphorus may better explain available evidence than either strictly catastrophic or purely gradual models. Broader regional comparisons, including North Africa and the Arctic margin, indicate that hydrological and environmental changes during this interval may have been temporally clustered.

While the interpretations advanced here remain provisional, they highlight the need for integrated, multidisciplinary investigation. Future work should prioritise geochronological dating of strandlines and terraces, sediment coring, hydrodynamic modelling, and DEM-based palaeoshoreline reconstruction. The distinctive geomorphology of Azerbaijan may prove central to resolving outstanding questions concerning Eurasian Quaternary hydrology.

Keywords: *Ponto-Caspian region, Early Holocene, Caspian Sea level, Black Sea hydrology, Quaternary palaeohydrology, basin connectivity, marine transgression, glacio-isostatic adjustment, palaeoshorelines, “Asiatic Mediterranean”*

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Introduction

Following a presentation in 2011 at the Institute of Geology and Geophysics in Azerbaijan (GIA), evidence was presented for extreme former flood levels in the Caspian Sea, inferred from raised terraces, strandlines, and erosion features on mud volcanoes. This work led to the paper “The Ice Age Rise and Fall of the Ponto-Caspian: Ancient Mariners and the Asiatic Mediterranean” (Gallagher, 2011), in which a major

phase of Ice Age freshwater flooding was proposed. This event was interpreted as forming a vast inland water body – the “Asiatic Mediterranean” (AM) – representing a greatly expanded Ponto-Caspian basin. A subsequent Early Holocene marine inundation was also suggested, initially associated with strandlines at ~222 m above sea level (a.s.l.), now revised to ~312 m a.s.l. These elevated strandlines and associated erosional features indicate flooding on a scale

that is difficult to reconcile with conventional models of Caspian Sea-level change, particularly the widely cited Khvalynian highstand of approximately +50 m a.s.l. (Arslanov et al., 2016). It is therefore possible that geomorphological evidence for higher flood stages has been overlooked or treated as anomalous, along with its broader implications for regional hydrology.

The present study builds on this earlier work and addresses three principal observations: a prominent raised terrace, high-level strandlines, and wave-erosion features on mud volcanoes. These features have prompted a wider investigation into the possibility of large-scale flooding across Ice Age Eurasia, followed by a significant marine incursion during the Early Holocene. To avoid repetition, this paper should be read in conjunction with Gallagher (2011).

If flood levels approached ~312 m a.s.l., much of the Ponto-Caspian basin would have been inundated, with potential overflow through the lowest available outlet toward the Sea of Marmara, raising the possibility that such discharge contributed to erosion of the Bosphorus. Additional lines of inquiry include possible faunal incursions from the Arctic, supported by interpretations of petroglyph imagery that may depict marine species such as whales and northern seabirds within the Caspian region. While speculative, such evidence warrants consideration where it aligns with environmental and archaeological data.

1. Aim and Objectives

This paper summarises a range of unresolved observations and paradoxes relating to flood events in the Ponto-Caspian region during the Late Quaternary and Early Holocene. The review

draws on field observations, radiocarbon data, published literature, and evidence for the physical, chemical, and biological impacts of extreme transgressions. Broadly, the evidence points to two contrasting flood regimes: an Ice Age freshwater phase and a major Early Holocene marine inundation. The scale of the latter suggests it may have substantially modified or obscured earlier geomorphological evidence, contributing to the complexity and uncertainty of regional interpretations. Accordingly, the paper begins by examining a series of key anomalies from which further deductions may be drawn.

1.1. Geomorphology of a 50 km long raised terrace north of Sumgayit

A representative section of the terrace near Gilazi (Fig. 1) has been described as a Khvalynian alluvial plain (Arslanov et al., 2016). It comprises a gently sloping aggradational surface extending from ~126 m a.s.l. to a pronounced escarpment at ~100 m a.s.l., followed by a steep descent to ~26 m a.s.l. From this level, the surface continues to slope gradually toward the Caspian Sea, with smaller scarps indicating episodes of both abrupt and progressive water-level change.

The principal concerns relating to this terrace are as follows:

1.1.1 First: The terrace sediments are generally interpreted as alluvial, yet no major river occurs along the level terrace between Sumqayit and Gilazi. The Samur River source hypothesis remains problematic because the terrace reaches ~126 m a.s.l., well above the accepted Khvalynian highstand.



Fig. 1. Section of a 50 km long raised terrace near Gilazi. The foot of the terrace corresponds to the spillover at the Manych spillway, while the terrace top at ca 126 m a.s.l. may represent the spillover elevation from the Asiatic Mediterranean. (R. Gallagher)

1.1.2 Second: An abrupt break between ~100 m and 26 m a.s.l. suggests rapid Caspian water-level fall, implying reduced inflow or rapid basin drainage.

1.1.3 Third: The Khvalynian transgression is typically divided into Early and Late phases, associated with terrace levels at ~50 m and 0 m a.s.l. (Dolukhanov et al., 2009). However, no clear erosional surface corresponding to the ~50 m level is evident in Fig. 1, despite the susceptibility of alluvial sediments to water erosion. This presents a dilemma: either the established Khvalynian chronology is incomplete, or the ~50 km terrace represents a later, larger depositional event superimposed on earlier surfaces – potentially linked to a younger marine inundation (see Section 3.1.1).

The base of the escarpment at ~26 m a.s.l. may correspond to the spillover threshold into

the Manych Corridor via the Zunda Tolga sill (Semikolennykh, Panin, Zazovskaya, 2025), suggesting geomorphological significance. By extension, the upper level at ~126 m a.s.l. may represent a former overflow threshold from the proposed Asiatic Mediterranean. Similarly, higher terraces (e.g. ~167 m a.s.l.; Gallagher, 2011) may reflect marine inundation rather than stable palaeoshorelines (Leontyev, 1963), a point supported by evidence from mud volcano erosion discussed below.

1.2. Strandline Geomorphology

No accepted explanation exists for the triple strandlines at ~222 m a.s.l. in the Gilazi Valley (Gallagher, 2011, Fig. 2). A comparable set identified in the Tartar River Valley (Figs. 3-4) reaches ~312 m a.s.l., suggesting a potentially related flood event.

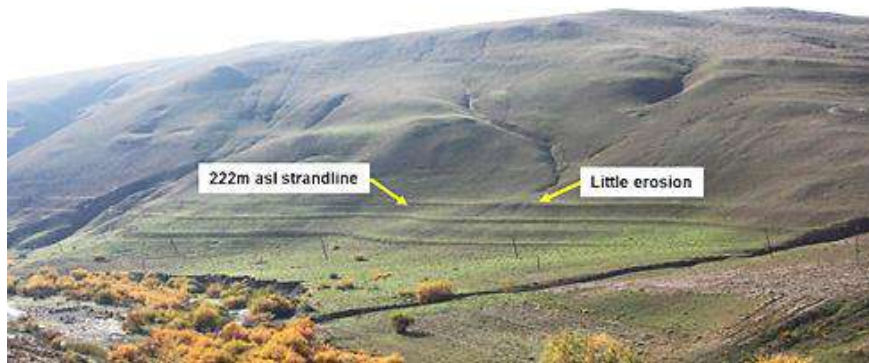


Fig. 2. Gilazi Valley triple strandlines. (GPS – 40°52'35.46"N, 49°11'22.48"E). With little stream erosion these are considered to be relatively recent. (Pers comm) (R. Gallagher)



Fig. 3. Tartar River Valley strandlines at 312 m a.s.l. (GPS – 40°21'6.58"N, 46°52'21.67"E), (Google Earth)



Fig. 4. Triple strandline locations, Tartar River and Gilazi Valley. Note that the Tartar site is exposed to the Caspian Sea while the Gilazi site is sheltered. (Maphill)

A key issue is the ~90 m elevation difference between the two sites. If broadly contemporaneous, this may reflect local geomorphological controls: the confined Gilazi Valley could have restricted inflow, whereas the more open Tartar Valley, connected to the Kura system, may have experienced fuller inundation. This implies a complex, possibly oscillating water-level response during an extreme event.

Although water may have reached ~312 m a.s.l. long enough to form distinct strandlines, it was likely short-lived, with evidence near Cheyildagh indicating a subsequent fall in level (Fig. 5).

1.3. Mud Volcano Wave Action Erosion

Mud volcanoes are short-lived, highly erodible landforms, making them sensitive indicators

of wave action. At Boyuk Kanizadagh (Figs. 6-7), a ~2 km section of the seaward flank appears missing, suggesting marine erosion and implying that floodwaters persisted long enough to reshape exposed slopes. Further evidence may come from the Two Brothers (İki Qardaş) mud volcanoes, once mapped but now reduced to submerged shoals, possibly indicating prolonged erosion over decades to centuries. Techniques such as OSL dating could help constrain the timing and duration of such flooding.

The pale coloration on the lower slopes of Boyuk Kanizadagh is unlikely to represent a simple stratigraphic horizon given the overlapping nature of mud flows and may instead reflect erosional or environmental processes (see 3.2.2.2).

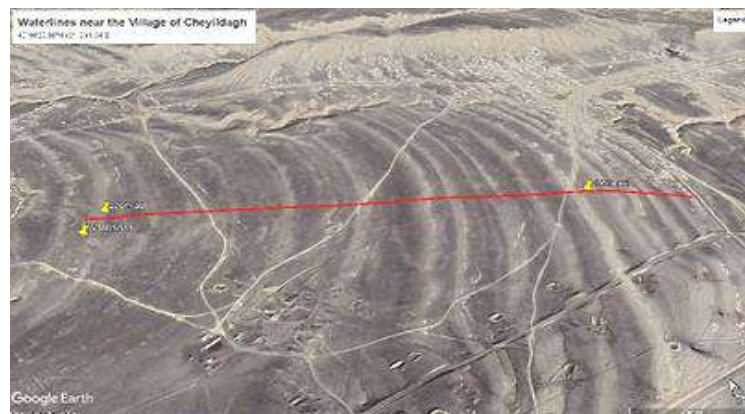


Fig. 5. Satellite view of watermarks/strandlines near the village of Cheyildagh in the vicinity of the Daviladagh mud volcano. (GPS – 40°16'20.38"N, 49°12'41.34"E. This may represent a falling water level. (Google Earth)



Fig. 6. Boyuk Kanizadagh flank facing the Caspian Sea. (GPS – 40°8'29.15"N, 49°22'54.86"E). Key features are the angle of erosion, erosion gullies, foot extension and a distinct white colouration. (R. Gallagher)



Fig. 7. Image of Boyuk Kanizadagh showing an anomalous 2 km long seaward face of the mud volcano, caused by wave action attack. (PeakVisor.com)

Strong evidence of wave erosion is also observed at the Daviladagh South Mud Volcano (Figs. 8-9), where terrace-like benches and smoothed slope breaks occur on the southern flank. Here, softer mud deposits appear to have been preferentially eroded, exposing underlying limestone and producing rounded, laterally con-

tinuous features. Satellite imagery shows contrasting preservation between younger, intact mud flows and older, more eroded surfaces, suggesting differential exposure to marine conditions. This may indicate a relatively recent inundation event, consistent with strandline evidence from the Gilazi Valley.



Fig. 8 An oblique view of Daviladagh South mud volcano showing eroded mud drape overlying tilted limestone stratigraphy. (GPS – 40°15'45.27"N, 49°18'49.17"E). (R. Gallagher)

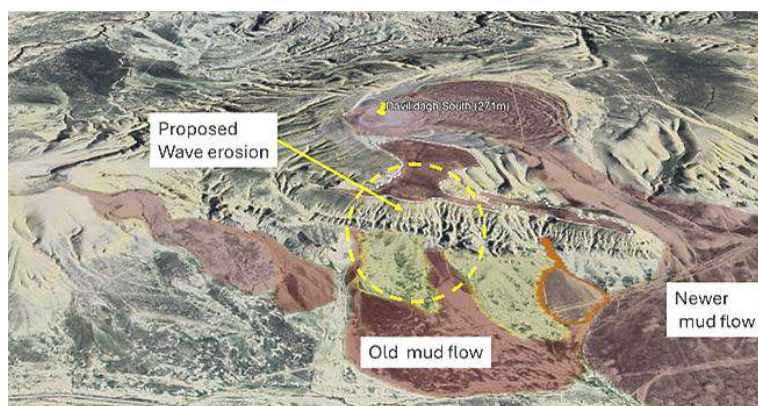


Fig. 9. Satellite image of Daviladagh mud volcano with highlighted mud flow and eroded flank. (Google Earth)

If correct, these observations point to a large-scale marine transgression across the Ponto-Caspian basin, potentially reaching elevations exceeding 260 m a.s.l. While difficult to reconcile with conventional models, this interpretation arises directly from the geomorphological evidence and warrants further investigation.

2. Factors concerning the Asiatic Mediterranean

The term “Asiatic Mediterranean” (AM) was introduced by Eduard Suess to describe a vast inland water body that, at times during the late Tertiary and Quaternary, may have linked the Black, Caspian, and Aral seas, and possibly extended into western Siberia. Earlier geologists, including Humboldt, Marny, Chikhachev, and Murchison, had similarly proposed the existence of an extensive interconnected system of continental waters.

Within this framework, Eurasian water balance during the Ice Ages becomes critical. It is possible that onshore ice sheets periodically blocked northward drainage of major Siberian Rivers, diverting flow toward the Caspian basin. Combined with meltwater input and climatic variability, such conditions could have sustained repeated expansions of a large intracontinental water body – the proposed Asiatic Mediterranean (Gallagher, 2011).

This raises several key questions: What evidence supports the existence and extent of such a water body, including palaeoshorelines? What barriers constrained it, and what volumes of discharge were involved? Where and how might it have drained – possibly toward the Aegean – and is there sedimentary evidence of such out-

flows? Could seasonal melt cycles have produced widespread flooding and layered deposits? What were the geomorphological, climatic, and ecological consequences, and how might such a system have influenced early human populations?

These issues are explored in the sections that follow.

2.1. Evidence for the Asiatic Mediterranean

Both direct and indirect evidence for a large lake can be inferred from the following:

2.1.1. Radiocarbon Dating

To constrain the age and former elevation of the Ponto-Caspian basin, bulk mollusc samples were collected from coastal benches in Azerbaijan and Bulgaria. As indicators of past water levels, such deposits provide evidence for palaeodrainage patterns and Quaternary Lake or sea-level fluctuations, particularly during the last Ice Age. The radiocarbon results are as follows in Table 1.

Bulk shell sampling is subject to uncertainties, including age mixing, reservoir effects, and contamination, and results depend in part on preparation methods such as bleaching or acid etching. Despite these limitations, the aim was to establish relative ages across elevations within the proposed Asiatic Mediterranean. Several results (Table 1) approach the radiocarbon detection limit (~40,000 BP), suggesting a Late Quaternary transgression reaching elevations of up to ~126 m a.s.l. Further sampling, ideally from securely stratified *in situ* material, is recommended.

Table 1

Radiocarbon dating results of Bulk Mollusc samples from the Caspian and Black Seas

COUNTRY	General Location(GPS coordinates available)	Elevation above global sea level (m)	MEASURED AGE	13C/12C	CONVENTIONAL AGE
AZERBAIJAN	Gobustan at 8m	8 m	26110 +/- 180 BP	+2.5 o/oo	26560 +/- 190 BP
	Gobustan 18 to 30m	18 – 30 m	28520 +/- 210 BP	+1.1 o/oo	28950 +/- 220 BP
	Gobustan 80 to 85m	80 – 85 m	14310 +/- 70 BP	+1.6 o/oo	14750 +/- 80 BP
	Terrace top near Gobustan.	100 m	32460 +/- 480 BP	+2 o/oo	32910 +/- 510 BP
	Gobustan 125m	125 m	16770 +/- 100 BP	+1.6 o/oo	17210 +/- 100 BP
	Gobustan shell midden, ca 40°6'43.26"N 49°22'46.65"E	113 m	4190 +/- 30 BP	+1.9 o/oo	4630 +/- 30 BP
	Qobu terrace near rock shelter	140 m	40730 +/- 530 BP	+1.1 o/oo	41160 +/- 530 BP
	Gobustan shell midden 40°6'43.26"N 49°22'46.65"E	113 m	4190 +/- 30 BP	+1.9 o/oo	4630 +/- 30 BP
BULGARIA	Thracian Cliffs	126 m	29010 +/- 170 BP	+2.8 o/oo	29470 +/- 170 BP
	Thracian Cliffs	77 m	39200 +/- 490 BP	+2.7 o/oo	39650 +/- 490 BP

Source: BetaLab. Note that most dates are well within the C14 half life test limits. Shells prepared by acid etching.

2.2. Floodwater

Flooding may have been driven by discharge from major Eurasian river systems, including the Volga, Lena, Irtysh, Ob, and Yenisei, whose combined flow – based on modern estimates – approaches ~59,000 m³/s, far exceeding that of the Volga alone. During glacial periods, however, northward drainage into the Arctic may have been blocked by exten-

sive ice sheets, leading to river diversion and ponding (Mangerud et al., 2004; Baker, 2007).

Under such conditions, water may have accumulated in the West Siberian proglacial basin (Glacial Lake Mansi) before overflowing via the Turgai Spillway into the Ponto-Caspian basin (Fig. 10). This would have fed an enlarged endorheic system – the proposed Asiatic Mediterranean – potentially with intermittent discharge to the world ocean.

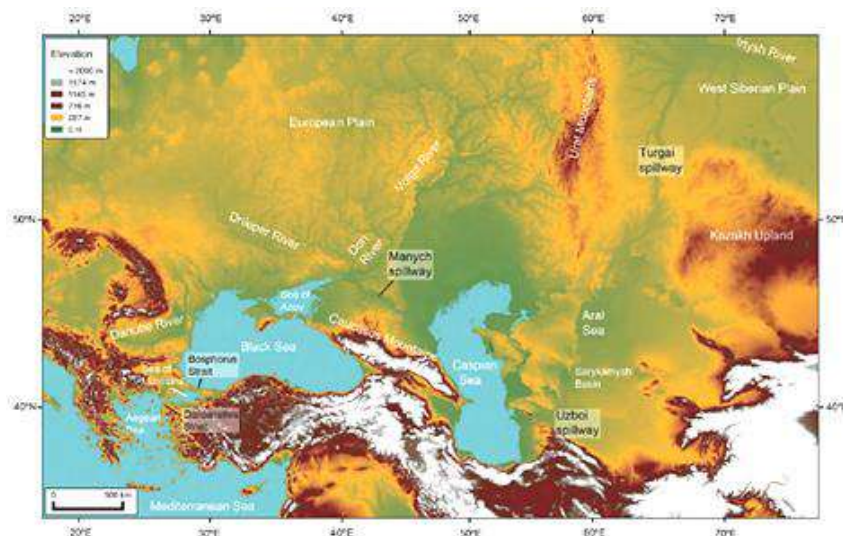


Fig. 10. Topography of large-scale lowland basins and the Manych, Turgai, and Uzboi spillways. The base map is SRTM data. (Komatsu et al., 2015)

2.2.1. Caspian Sea Palaeocoastline

Radiocarbon ages from elevations above ~100 m a.s.l. suggest the presence of an ancient coastline, investigated using the PeakVisor platform (3D Maps and Peaks Identification). For comparison, terraces north of Baku were examined alongside Aral Sea palaeoshorelines, as both basins would have been contiguous above ~100 m a.s.l. (Figs. 11-12). In both cases, terrace surfaces occur near ~126 m a.s.l., with a pronounced escarpment at ~100 m a.s.l.

A schematic profile of the Mansi–Usturt region (Fig. 13) shows a similar pattern, with a palaeocoastline at ~120 m a.s.l. descending to a distinct scarp at ~20+ m a.s.l., possibly marking an overflow threshold toward the Manych Corridor. These step changes may

reflect shifts in basin water balance and hydrological connectivity.

2.2.1. Turgai Spillway

Previously, the Turgai Spillway was noted to lie at ~125 m a.s.l. (Gallagher, 2011), consistent with modern topography. However, this presents a paradox, as deglacial reconstructions suggest a substantially lower active spillway floor. The Turgai Valley – now a low-relief, largely dry corridor – clearly carried significant flow during the Pleistocene (Кесъ, 1939). Borehole data reveal 15-18 m of pebbly alluvial sands overlain by clay, indicating high-energy discharge, while wood and peat from depths of 76 m and 34 m yield radiocarbon ages of ~28.8 ka and ~19.1 ka (Астахов, Гросвальд, 1978; Komatsu et al., 2015).

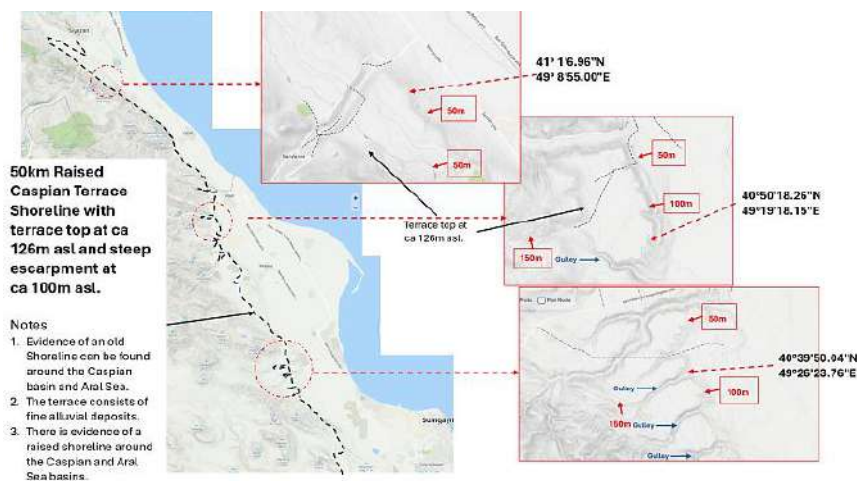


Fig. 11. Palaeo terraced coastline North of Baku. Terrace top is at ca 126 m a.s.l. This may represent the upper limit of the Asiatic Mediterranean prior to its spillover to the world ocean. (Peakvisor/R. Gallagher)

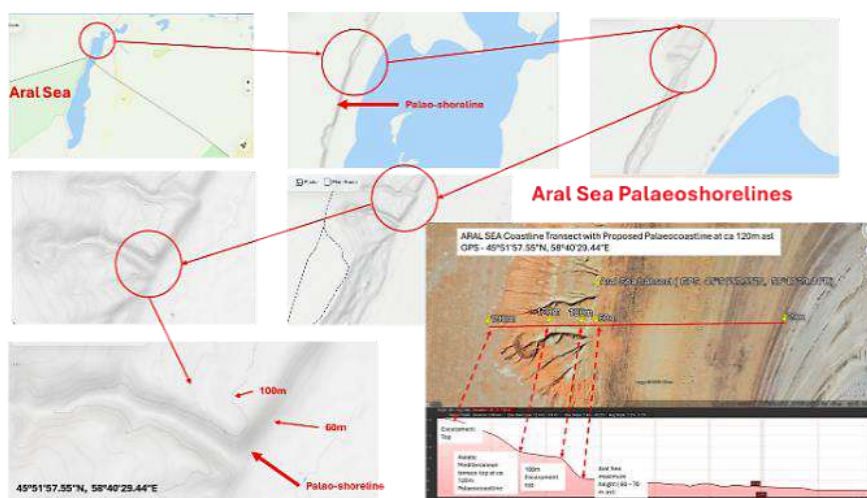


Fig. 12 Aral Sea shore lines showing a terrace top at ca 126 m a.s.l., a sudden drop in water level at ca 100 m a.s.l. and the recognised upper level of the Aral Sea at ca 60-70 m a.s.l. (45°51'57.55"N, 58°40'29.44"E). (Peakvisor/R. Gallagher)

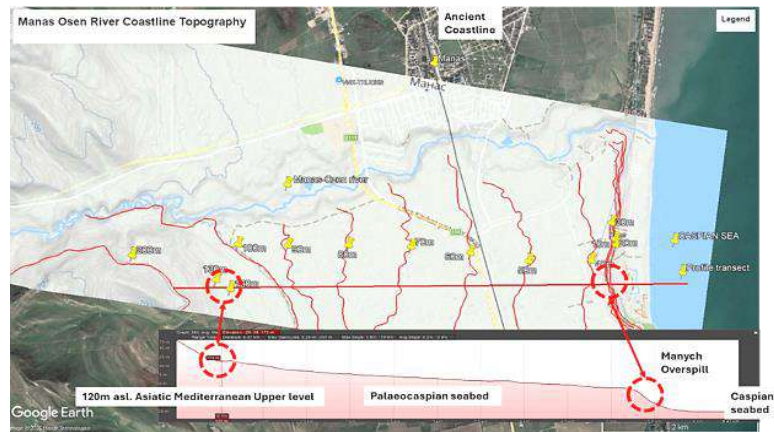


Fig. 13. Topographical schematic of the Manse Osen Coastline in north Caspian/Russia, showing the proposed palaeocoastline at ca 120 m a.s.l., with a steep scarp above 20 m a.s.l. The former latter may represent overspill to the Manych corridor. (Google Earth/Gallagher)

These data imply that the spillway floor during deglaciation may have been far below its present ~125 m elevation. Indeed, Glacial Lake Mansi has been reconstructed at ~60 m a.s.l. (Mangerud et al., 2004), leaving a discrepancy of over 60 m that requires explanation.

One possibility is substantial post-19 ka sediment infill, raising the spillway to its current level. Supporting this are scabland-like features and elongated mounds within the Turgai Valley, suggestive of high-energy flooding capable of transporting and depositing large sediment volumes (Komatsu et al., 2015; Fig. 14). Such processes may represent the waning stages of a major flood event.

Seasonal discharge through the spillway would also be expected to deliver fine sediments into the Caspian, potentially forming laminated, varve-like deposits. This may account for the fine stratification observed near Gobu, close to Baku (Fig. 15).

2.2.2. Russian River Water Balance

If the prominent terrace at ~126 m a.s.l. marks the upper limit of the proposed Asiatic Mediterranean, the key question becomes how such a water level was achieved. One possible answer lies in the combined discharge of the great Russian river systems, the estimated magnitudes of which are summarised in Table 2.

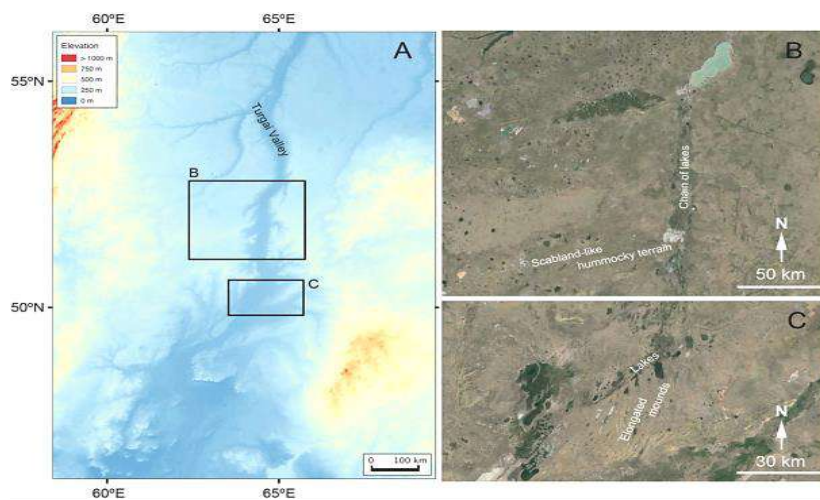


Fig. 14. Some unusual landforms distributed along the valley may indicate catastrophic flow events. Images include: - a chain of lakes; scabland-like hummocky terrain and parallel elongated mounds. (Komatsu et al., 2015)



Fig. 15. Laminated sediment layers at the entrance to the Gobu Valley
Elevation 0 m a.s.l. possible varves. (R. Gallagher)

Table 2

Estimated annual discharge of major Russian rivers

Volga	~250 km ³ /yr
Lena	~540 km ³ /yr
Irtys	~95 km ³ /yr
Ob	~395 km ³ /yr
Yenisei	~620 km ³ /yr

The combined discharge of these rivers is ~1,900 km³ per year – a substantial freshwater flux. For context, the Caspian Sea (~78,000 km³) could theoretically be filled in ~41 years at this rate, ignoring losses.

Extending this to the wider Ponto-Caspian system, the present combined volume of the Black Sea (~547,000 km³), Caspian (~78,000 km³), and Aral (~1,100 km³) is ~626,300 km³. A preliminary estimate suggests that raising this system to ~126 m a.s.l. would require a total volume of ~0.8 million km³, implying an additional ~173,700 km³ of water.

At an inflow of ~1,900 km³ per year, this volume could be supplied in roughly 90-92 years. While simplified and subject to losses (e.g. evaporation and seepage), this first-order estimate suggests that a greatly expanded Ponto-Caspian basin could have formed on relatively short timescales.

This rough calculation necessarily relies on several assumptions: that inflow genuinely averaged 1,900 km³ per year, that evaporation losses were negligible, that the basins already contained approximately their present water volumes, and that all additional inflow contributed directly to raising the combined lake sys-

tem toward 126 m a.s.l. What is significant, however, is that even allowing for substantial uncertainties, a timescale of 90-92 years is very short when compared with the duration of a glacial cycle.

If radiocarbon evidence and palaeocoastlines support the existence of an enlarged Asiatic Mediterranean, its formation is not implausible and may have influenced Ice Age dynamics. While such shoreline evidence is clearer in the Caspian and Aral basins, it is less obvious in the Black Sea. To address this, comparable terrace features were examined in major river systems, particularly the Sakarya in Turkey and the Danube.

2.2.3. Sakarya River and Lake Sapanca

Lake Sapanca (40°43'N, 30°15'E) lies at ~31 m a.s.l., just east of the Gulf of İzmit along the North Anatolian Fault and is thought to have formerly drained toward the Marmara basin (Nazik, Meriç, Avsar, 2012). Despite being freshwater, sediment cores contain marine and brackish microfossils, indicating a past connection between the Black Sea and Marmara (Leroy et al., 2009; 2010). Its proximity to the Sakarya River has led to suggestions of a former hydrological link via that corridor (Nazik et al., 2011), with the youngest microfossils indicating a Holocene incursion.

Various mechanisms have been proposed – tectonic uplift, bird transport, tsunami inundation, and seiche effects – but none fully resolve the evidence. In particular, uplift studies argue against a Holocene Black Sea–Marmara connection (Yaltırak et al., 2012), leaving the presence of marine microfossils an unresolved paradox.

This paradox may be resolved if Black Sea levels were significantly elevated during the Pleistocene due to diverted Siberian discharge. Under such conditions, overspill through the Sakarya Gorge could have routed Ponto-Caspian waters – and aquatic species – via Lake Sapanca and the Gulf of İzmit into the Marmara basin.

It is further proposed that a larger Early Holocene marine inundation may have followed a similar pathway, potentially contributing to incision or modification of the Bosphorus (see Section 3.3.2). The presence of mid-Pleistocene species in the Sapanca record may therefore represent proxy evidence of earlier Black Sea overspill, consistent with the concept of an enlarged Asiatic Mediterranean.

Erturaç et al. (2021) analysed a four-step fluvial terrace sequence of the Sakarya River in the Adapazarı Basin using stratigraphy, geometry, and luminescence dating (Fig. 16). Terrace formation was linked to Black Sea-controlled base-level changes, with highstands during MIS 5a (~84-72 ka), MIS 3 (~40-30 ka), and MIS 1 (~9 ka-present). An average uplift rate of ~0.78 mm/yr was proposed.

While plausible, this interpretation is complicated by the North Anatolian Fault being predominantly strike-slip, with mainly horizontal motion. The 1999 İzmit earthquake, for example, showed minimal regional uplift (Barka et al., 2002), raising questions about the extent to which vertical tectonics alone can explain the terrace elevations.

Despite limited evidence for vertical displacement, terraces T3 and T4 occur at ~60 m and ~106 m a.s.l., raising doubts that uplift alone explains their elevations. An alternative, consistent with the Asiatic Mediterranean hypothesis, is that they partly represent former palaeocoastal levels of a high Black Sea/Lake

phase. While speculative, this possibility warrants consideration. Terrace elevations along the Sakarya are summarised in Table 3.

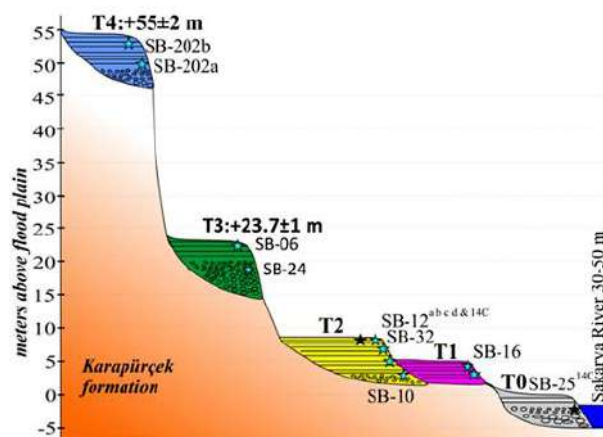


Fig. 16. Sakarya River terracing, sample locations and elevation above the river flood plain. **Not to scale.** (Erturaç, 2021)

2.2.4. River Danube

A preliminary review of the Danube terrace record shows extensive staircases typically attributed to climate-driven river behaviour (Vandenbergh et al., 2004 Armaş et al., 2019). Aggradation is associated with glacial stages (MIS 2, 4, 6), while incision relates to interglacials (MIS 1, 5), reflecting shifts in discharge and sediment supply. Terraces commonly occur at relative heights of ~20 m, ~50 m, and ~100 m above the river. These levels broadly overlap with terrace elevations observed along the Sakarya River and within the Caspian basin. While no direct correlation is implied, this correspondence may warrant further investigation, as wider hydrological controls – potentially linked to fluctuations in the proposed Asiatic Mediterranean – could have influenced phases of terrace formation across the region.

Table 3

Summary of terracing details giving name, elevation and difference in age

Sample site	Terrace top	Elevation in masl	Age	Terrace top Difference in m	Difference in age	Rate of increase from previous TT in m.	Rate of increase in mm/yr
Ref Fig11	T0	27.5	760	na	na	na	na
SB16B	T1	32.5	1160	5	400	80	12.500
SB12D	T2	36.2	1830	3.7	670	181	5.522
SB06C	T3	60	30040	23.8	28210	1185	0.844
SB202B	T4	106	71880	46	41840	910	1.099

2.2.5. Potential Alluvial origin of Loess

Continuing with the Danube, a map of European loess distribution broadly resembles the proposed outline of the Asiatic Mediterranean (Fink, 1977; Figs. 17-18), with major deposits across the Danube basin, Germany, Poland, Ukraine, Romania, and the North Caucasus.

Loess is typically interpreted as a Quaternary, wind-blown sediment derived from glacial and periglacial processes, forming widespread blankets of fine silt. However, its occurrence far from former ice margins raises questions about transport mechanisms (Smalley, 1995).

An alternative possibility is that, if a large Pleistocene Asiatic Mediterranean existed, major river systems could have delivered vast quantities of suspended sediment into this basin. As water levels later fell, exposed fine sediments may have been reworked by wind to form loess. This

mixed fluvial–lacustrine–aeolian origin was previously explored by Gallagher (2013) and echoes earlier views, including Darwin’s (1846) suggestion of water-laid fine deposits.

While modern research confirms that most loess is primarily aeolian, the Asiatic Mediterranean hypothesis may point to a more complex origin for some deposits, involving interaction between fluvial, lacustrine, and atmospheric processes.

2.2.6. Fate of the Ice Age River

Two implications stand out. First, the possibility that a land bridge once spanned the Bosphorus – constraining discharge from a major Pleistocene river system – can no longer be dismissed outright (Gallagher, 2011). If the enlarged Ponto-Caspian basin repeatedly overflowed, the central question becomes unavoidable: where did this vast volume of water, and its sediment load, ultimately go?

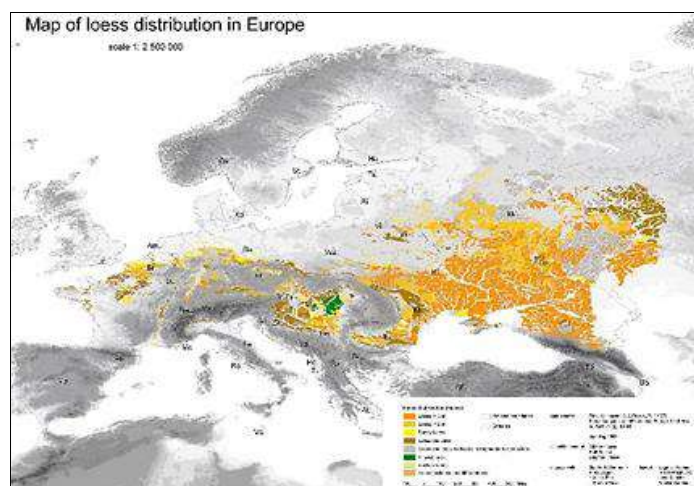


Fig. 17. Map of the Loess Distribution in Europe. (Fink, 1977)



Fig. 18. Montage of Eurasia flooded to +126 m a.s.l., with an outline ancient coastline with palaeo-settlements Red line is the estimated route of the Ice Age River. (Google Earth/R. Gallagher)

The conventional view routes this discharge through the Marmara into the Aegean. Yet available evidence suggests that significant freshwater outflow into the Aegean may not have occurred at scale until ~10 ka BP (Aksu et al., 2002). This sits uneasily with expectations. If large, long-lived river systems operated across Eurasia during the Quaternary, they should have delivered immense quantities of fine sediment to their outlet zones.

The northern Aegean does preserve Late Quaternary muds, clays, and sapropels – products of mixed riverine, Black Sea, and marine inputs (Roussakis et al., 2004; Pehlivanoglou, Tsirambides, Trontsios, 2000). Yet much of this sedimentary record appears comparatively young. The question therefore sharpens: if such discharge persisted over extended timescales, where is the expected volume of sediment?

This mismatch between predicted and observed sediment accumulation points to a gap in current reconstructions – one that may hint at alternative drainage pathways, episodic megaflood behaviour, or more complex basin dynamics than presently recognised.

A possible answer to this puzzle may lie beyond the Ponto-Caspian, in the North Sea and English Channel. Before exploring this, it is useful to consider Palaeolithic settlement patterns: if a vast intracontinental lake existed, where were human populations located?

A reconstruction of Eurasia inundated to +126 m a.s.l. (Fig. 18; Floodmap.net (Flood Map: Elevation Map, Sea Level Rise Map); Hofecker, 2005) shows most archaeological sites positioned above the inferred lake level, often near rivers or along its margins. Such locations would have provided clear advantages – access to freshwater, food resources, and transport routes. Several sites are linked to mammoth hunting, suggesting strategic occupation of productive landscapes, possibly including seasonal movement toward southern wintering areas.

If the proposed Pleistocene river system did not discharge primarily toward the Aegean, then an alternative possibility emerges that overflow was, at times, diverted northwest toward the Baltic and North Sea. During glacial periods, the immense weight of continental ice sheets depressed northern Europe, potentially reshaping drainage pathways and opening routes that no longer exist.

Seen in this light, Doggerland may represent more than a passive glacial landscape. While its sediments are conventionally interpreted as glacial and glaciofluvial, with finer deposits restricted to low-energy environments (Cameron et al., 1992; Cotterill et al., 2017), the possibility remains that episodes of large-scale Eurasian freshwater discharge contributed to its development.

If such a system operated, even intermittently, it would imply a far more dynamic and interconnected hydrological network across northern Eurasia than is currently recognised – one capable of redistributing not only water, but sediment, ecosystems, and potentially human movement on a continental scale.

Of particular interest is the Norwegian Trench, a deep coastal depression extending into the Skagerrak (Fig. 19). Conventionally, it is attributed to repeated Quaternary ice-stream erosion, acting as a major drainage corridor for the Fennoscandian Ice Sheet. Yet its scale – reaching depths of ~700 m, far below the surrounding North Sea floor – raises the question of whether glacial processes alone fully account for its excavation (Rise et al., 2005; Sejrup et al., 2005).

If a large Pleistocene river system discharged into the Baltic, it is conceivable that flow continued westward toward the Skagerrak and into the Norwegian Trench. Under such conditions, substantial freshwater discharge may have interacted with, or even augmented, glacial drainage systems. Rather than acting solely as an ice-stream conduit, the trench may at times have functioned as part of a broader meltwater–river network.

While speculative, this possibility invites reconsideration of the trench not simply as a product of ice, but as a feature shaped by the combined effects of ice and water operating at continental scale.

2.2.7. Other Observations and Considerations

2.2.7.1. Climate

A large Eurasian inland water body would likely have influenced regional climate by enhancing evaporation and atmospheric moisture, potentially intensifying snowfall in downwind regions and contributing to feedbacks affecting glaciation.

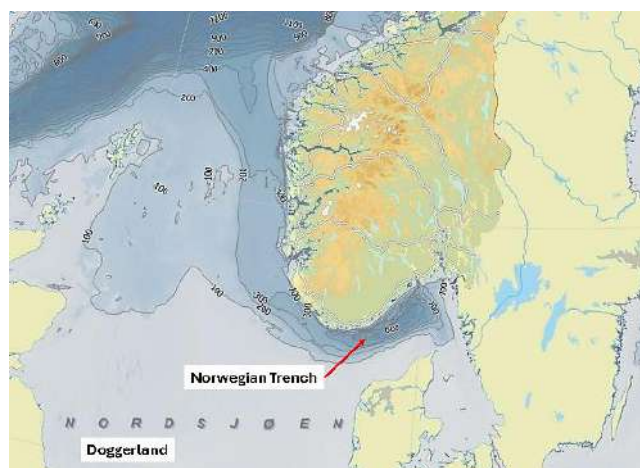


Fig. 19. Shows the location of the Norway Trench (or Channel) as it skirts the Norwegian coast. Could the Ice Age River augment the ice stream in carving the trench? (Rise et al., 2005)

2.2.7.2 Glaciers in Turkey

Pleistocene glaciation in Anatolia was primarily controlled by moisture supply from the Mediterranean and Black Seas, with precipitation rather than temperature acting as the dominant factor (Sarıkaya, Çiner, 2015). During low sea-level conditions (~ -120 m), reduced basin extent may have limited moisture availability.

If an Asiatic Mediterranean existed, its expanded surface could have provided a significant additional moisture source. Combined with prevailing winds, this may have enhanced snowfall and contributed to increased glaciation across Anatolia.

2.2.7.3. Onshore Ice Sheet Collapse and Release of Asiatic Mediterranean Water

A key question concerns the potential collapse of an ice dam and rapid drainage of the freshwater Asiatic Mediterranean into the Arctic, possibly via the Kara–Barents sector. Based on earlier estimates, such a release could have involved $\sim 173,700$ km³ of water – comparable to, or exceeding, major outbursts from Glacial Lake Agassiz ($\sim 100,000$ - $160,000$ km³), which are known to have affected ocean circulation and climate (Teller et al., 2002).

A discharge of this scale could have produced significant geomorphological and oceanographic effects, including high-energy seabed features such as the relict sand waves documented on the Barents shelf (King et al., 2014; Bøe et al., 2009), as well as short-term reductions in ocean salinity.

In climatic terms, such an event may be considered analogous to Heinrich-type freshwa-

ter forcing. While not a classical Heinrich event, a large Eurasian outburst could have freshened surface waters, weakened deep-water formation, and disrupted the Atlantic Meridional Overturning Circulation, potentially altering North Atlantic circulation patterns and promoting increased iceberg discharge.

This raises the possibility that collapse of Eurasian ice sheets, combined with drainage of a large inland water body, may have contributed to poorly understood freshwater-forcing episodes during the Quaternary. While speculative, this hypothesis warrants further investigation.

3. Factors Concerning a Marine Deluge

This section presents key evidence for a major marine flood and its wider implications. Observations are necessarily concise, focusing on critical anomalies, with references provided to support further investigation and independent assessment.

3.1. Elevated 126 m Terracing and its 100 m Escarpment

3.1.1. Raised Terrace North of Sumgayit

The key issues are the elevation of the ~ 126 m terrace and the source of its alluvium. If a major flood is considered, prolonged inundation and gyre-driven transport (Fig. 20) could have delivered silt to the terrace, suggesting it formed from flood-derived sediments rather than solely from the Samur River.

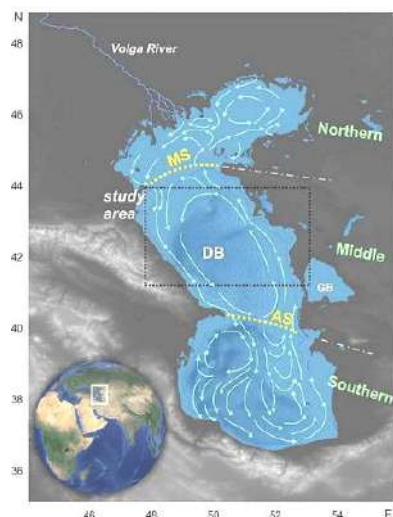


Fig. 20. Bathymetric map of the Caspian Sea with major bottom currents and location of study area; **DB** – Derbent Basin, **MS** – Mangyshlak Sill, **AS** – Absheron Sill, **GB** – Gara Bogaz Bay. (Levchenko et al., 2018)

3.1.2. Proposed explanation of the 100 m asl terrace escarpment

As noted earlier, the ~75 m drop along the terrace marks a major geomorphological event, possibly linked to increased outflow from the Ponto-Caspian system. It may correspond to development of the Bosphorus spillway, with the escarpment descending to ~26 m a.s.l. – close to the Manych Corridor threshold between the Caspian and Black Sea basins.

3.2. Strandlines and Mud Volcanoes

3.2.1. Strandlines

Azerbaijan’s mud-volcano terrain, composed of soft, easily eroded material, pre-

serves numerous strandlines and watermarks that may indicate substantial past transgressions (Figs. 4-9).

The Tartar River Valley strandlines were visited in January 2026 (Fig. 21), confirming their presence, although drone imagery – useful for detailed morphological analysis – could not be obtained due to licensing restrictions.

3.2.2. Mud Volcano Geomorphology as a Potential Archive of Former Caspian Highstands

Two mud volcanoes in eastern Azerbaijan – Daviladagh South and Boyuk Kanizadagh – preserve geomorphic features that may indicate prolonged inundation or shoreline reworking. Their soft, erodible deposits make them particularly sensitive recorders of such events.

3.2.2.1. Daviladagh South Mud Volcano

As noted earlier, Daviladagh South Mud Volcano preserves clear evidence of major inundation (Figs. 8, 9, 22), including wave-cut benches, strandlines, abrasion surfaces, stepped slope breaks, and contrasts between eroded older flows and fresher deposits, alongside more resistant limestone outcrops. These features are consistent with prolonged stillstands and wave reworking, making the site a strong candidate for chronological testing. Using a conservative flood level of ~172 m a.s.l., reconstruction (Fig. 23) indicates a flood extent across Eurasia that would require connection with the Arctic Ocean – pointing to a transgression on a scale that challenges existing models of Quaternary flooding.



Fig. 21. Lower of three strandlines in the Tartar River Valley at ~GPS – 40°20'42.73"N, 46°51'25.30"E. (R. Gallagher)



Fig. 22. Montage of Daviladagh S. Mud volcano with sea level set at 172 m a.s.l. to highlight terracing and watermarks ranging from 191 to 230 m a.s.l. (Floodmap.net/R. Gallagher)



Fig. 23. Using Daviladagh as a proxy tidal gauge, this represents the extent of a Eurasian flood level at 172 m a.s.l. Note extensive flooding in the UK, France and Mediterranean/Red Sea. (Floodmap)

3.2.2.2. Boyuk Kanizadagh

Boyuk Kanizadagh presents one of the most striking geomorphic signatures in the region. It's pale lower slopes and sharply modified seaward face (Figs. 6, 7, 24) contrast with more intact flanks, producing a pronounced asymmetry. The Caspian-facing side appears truncated and embayed, with evidence of material loss and a pale horizon near ~115 m a.s.l., while sub aerial erosion has only lightly modified the remaining slopes. This imbalance is difficult to attribute to normal weathering alone. Instead, it suggests sustained, directional erosion – consistent with repeated wave or current attack on

weak mud-volcanic deposits. The morphology reads less like gradual decay and more like a surface stripped back by energetic water acting from a single dominant direction.

If this interpretation is correct, Boyuk Kanizadagh records not just inundation, but prolonged exposure to high-energy conditions. As such, it offers a rare opportunity for testing: high-resolution topographic survey could confirm shoreline geometries, while luminescence (OSL) dating of reworked sediments may establish when – and for how long – this erosion took place.

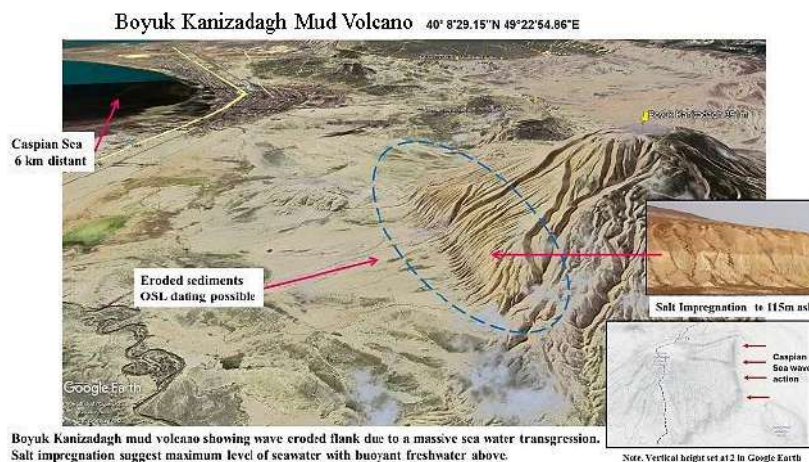


Fig. 24. Montage of Boyuk Kanizadagh showing its proximity to the Caspian Sea, cone asymmetry, pale (salt?) horizon, subaerial gullying and runoff erosion and wave attacked flank. Enhanced vertical height. (Google Earth/R. Gallagher)

3.2.2.3. Salt and Marine Ingression

This mud volcano, previously illustrated in Gallagher (2011, Fig. 10) and Fig. 6, displays a horizontal white layer at ~115 m a.s.l. Rather than a conventional strandline, this may represent a zone of salt impregnation, supported by field observations indicating salinity. It is suggested that rising waters deposited or fixed salts onto the clay surface, marking the upper limit of a marine transgression, possibly reflecting a salinity boundary. Geochemical testing and comparative mapping of nearby mud volcanoes are recommended to evaluate this interpretation.

3.2.2.4. Mud Volcano Composition, Colour and Comparison with Chocolate Clays

Mud-volcano ejecta in Azerbaijan is typically dark brown (Fig. 25), raising a possible link with the widespread Khvalynian “chocolate clays.” Both share similar mineral assemblages – dominated by illite and smectite with subordinate kaolinite – reflecting sediment source and depositional conditions (Bayramova et al., 2023; Musaelyan, 2022; Свиточ, Макшаев, 2015). While these clays are generally attributed to northern sources, local input from Azerbaijan’s mud volcanoes cannot be excluded.



Fig. 25. Boyuk Kanizadagh soil brown colouration. Note white (salt?) surface colour. (R. Gallagher)

Around 400 mud volcanoes occur across Azerbaijan, with over 140 offshore, though many extinct examples survive only as eroded remnants. Their soft composition makes them highly susceptible to rapid degradation, consistent with the significant erosion observed at sites such as Daviladagh South and Boyuk Kanizadagh.

Further evidence comes from the top of a nearby mesa (Fig. 26), where Early Quaternary brackish-water molluscs (*Dreissena* and *Cardiidae*) were identified, Yanina, pers. comm., suggesting former aquatic conditions and considerable erosion.

Taken together, these observations indicate substantial Quaternary erosion and support the possibility of a larger former inland water body influencing the region.

3.2.3. Missing Kura River Delta

Little or no sediment deposition occurred at the Kura Delta between ~9000 and 2000 BP (Hoogendoorn et al., 2005; Fig. 27), suggesting sediment may have accumulated farther upstream. This is consistent with a higher Caspian level during the early Holocene, possibly due to marine transgression. Supporting evidence may come from a shell midden at Gobustan dated to 4190 ± 30 BP (Table 1), which lies several kilometres inland under accepted sea-level reconstructions (Rychagov, 1997). This discrepancy raises the possibility that the Kura River discharged into a higher-standing basin. Further radiocarbon dating along the Kura corridor could help test this hypothesis.



Fig. 26. Fresh looking mollusc fragments on top of a 170 m a.s.l. mesa. Identified as molluscs of *Dreissena* and Early Quaternary *Cardiidae* (Tamara Yanina). Mesa elevation is (GPS – 40°14'11.70"N, 49°19'35.01"E. (R. Gallagher)

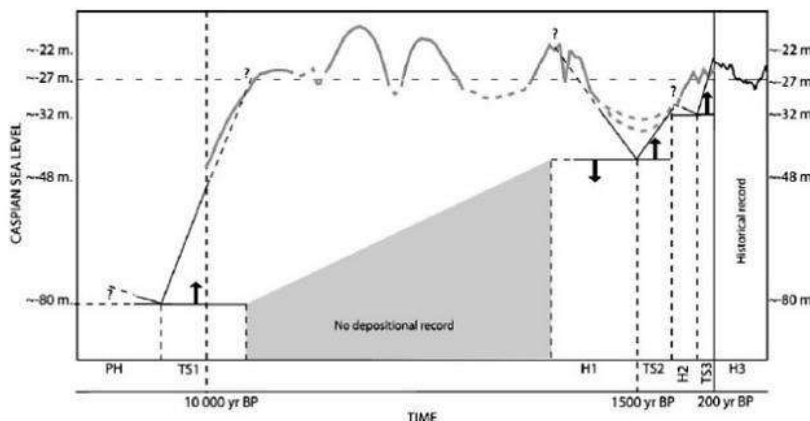


Fig. 27. Geochronological representation of the different phases of delta development superimposed on the Holocene Caspian sea-level curve. (Hoogendoorn, 2005)/(Rychagov, 1997)

3.3. Caspian and Black Seas

3.3.1. Data synthesis and paradoxical interpretations

Late Pleistocene–Holocene sea levels in the Caspian and Black Seas were highly variable and often diverged from global eustatic trends (Yanko-Hombach, Kislov, 2018), giving rise to three key paradoxes:

- **Paradox 1:** The Early and Late Khvalynian transgressions (MIS 3 and Late Glacial) are well documented, but their water sources remain uncertain and difficult to explain by conventional hydrology.
- **Paradox 2:** While some Caspian and Black Sea level changes align with climatic shifts, others do not, raising questions about inconsistent climate–sea-level relationships.
- **Paradox 3:** Proposed major Black Sea outflows via the Bosphorus are difficult to reconcile with reconstructed basin-level fluctuations during the same period.

These paradoxes may be better understood within the framework of an Asiatic Mediterranean and a subsequent marine flood, potentially requiring a reassessment of conventional Quaternary hydrology.

Paradox 1 may reflect ponding of Siberian river discharge within an enlarged inland basin, partly constrained by a Bosphorus land bridge and operating independently of eustatic sea level. **Paradox 2** suggests Black Sea level changes were not solely climate-driven, but influenced by this broader system. **Paradox 3** relates to a possible marine deluge, discussed further below.

3.3.2. Bosphorus Origins

The Bosphorus is widely interpreted as an incised valley formed subaerially, with evidence for southward outflow from the Black Sea and delta formation south of the strait from ~10 ka BP (Hiscott et al., 2002, 2007; Aksu et al., 2002). Within the proposed framework, limited glacial-period overflow may have established this southward-flowing valley, while a later, more powerful marine outflow – driven by a basin-level gradient – could have deepened the channel and sculpted its steep morphology. This enhanced flow may also have eroded and bisected earlier deltaic deposits, leaving the anomalous paired delta remnants observed today (Fig. 28).

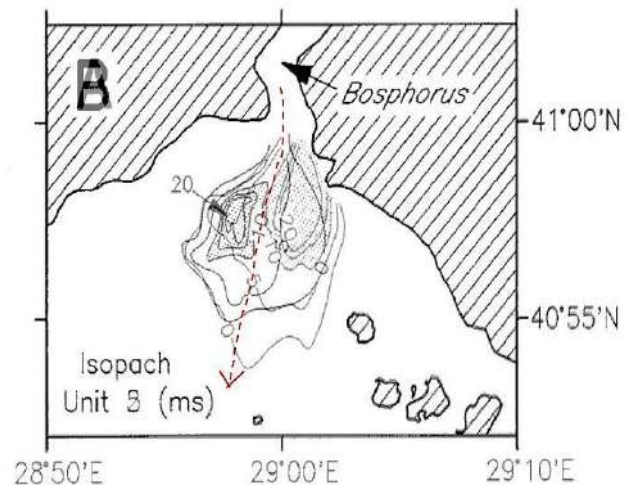


Fig. 28. Superimposed isopach maps of depositional deltaic lobes showing a gap between lobes. This suggests an erosion event due to significant outflow from the Bosphorus indicated by the red dashed arrow. (Hiscott, 2007)/Gallagher

3.3.3. Norway Lobster in the Aegean and Adriatic

Further evidence for possible northern marine ingress is the presence of the European lobster (*Homarus gammarus*) in the Aegean and Adriatic. Genetic studies suggest links to northern populations, potentially indicating dispersal via a Baltic–Arctic–Black Sea route rather than through Gibraltar (Triantafyllidis et al., 2005; Fig. 29).

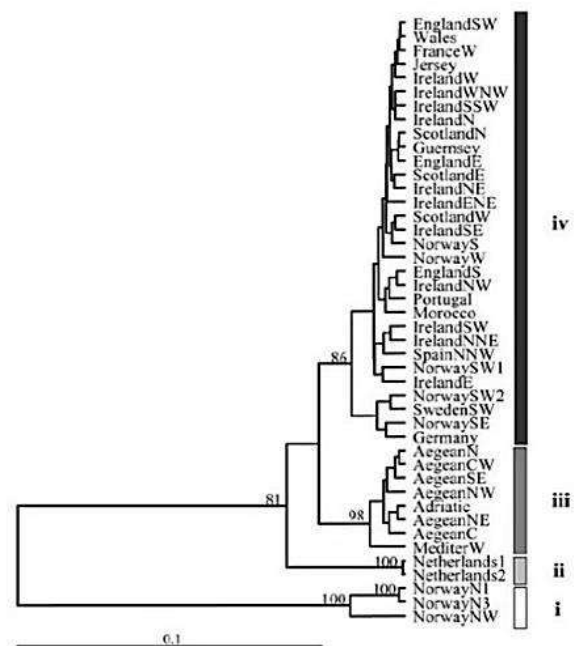


Fig. 29. Norway Lobster *H. gammarus* dendrogram showing relationship among 44 European population. Genetically Norway and Netherlands are close to the Aegean and Adriatic. (Triantafyllidis et al., 2005)

4. Discussion

These observations highlight persistent discrepancies in current interpretations, suggesting that a broader regional perspective may be needed. Considered together, the hypotheses of a flooded Ice Age Eurasia and a subsequent marine inundation offer a framework within which disparate evidence may form a more coherent picture of Quaternary change. The following sections examine additional lines of evidence as further “pieces of the puzzle,” testing the possibility and mechanisms of a major flood event.

4.1. Traditions of the Flood

Sir Joseph Prestwich argued that a large body of water once occupied parts of north-western Europe and was catastrophically released, helping to form features such as the English Channel and linking geological evidence with widespread flood traditions (Prestwich, 1893-1894). He cited raised beaches, widespread loess deposits, other anomalies and “*ossiferous fissures*” containing the skeletal remains of both carnivores and herbivores and lacking signs of predation. Some fissures, such as those at Mont de Sène in Santenay France, (~521 m a.s.l.), may reflect animals fleeing uphill from rising waters before becoming trapped. Although undated at the time, many of these sites have not been re-examined with modern methods. Renewed investigation could provide valuable evidence for the timing and nature of large-scale flooding in Western Europe.

4.2. Mediterranean Flood Evidence

4.2.1. Nile Delta Turtlebacks

“Turtlebacks” or geziras are elliptical sandy ridges rising ~30 m above the Nile Delta, composed of Ethiopian-derived sediments and dated to ~10-5 ka BP (Rowland et al., 2012; Fig. 30). They are generally interpreted as fluvial features formed during the African Humid Period.

An alternative possibility is that they formed under transgressive conditions within an enlarged Mediterranean highstand, with later regression and Nile erosion, leaving them as residual features. If so, this could indicate an Early Holocene transgression exceeding expected eustatic levels and a Mediterranean shoreline extending farther inland toward Cairo.

4.2.2. Faiyum Origins

The Faiyum Depression Lake is generally interpreted as a Nile-fed basin formed by overflow from the Bahr Yussef, with levels fluctuating in response to climate and Nile discharge during the African Humid Period (Marks et al., 2018).

An alternative possibility is that a higher Mediterranean transgression caused backflooding within the Nile system, with elevated downstream levels promoting overflow into the depression via the Bahr Yussef (~25 m a.s.l.). Strandlines within the basin (Fig. 31), reaching ~31 m a.s.l., indicate repeated lake-level changes (Sandford, Arkell, 1929). Their generally narrow form suggests short-lived stillstands, possibly representing receding shorelines from a larger, transient lake.

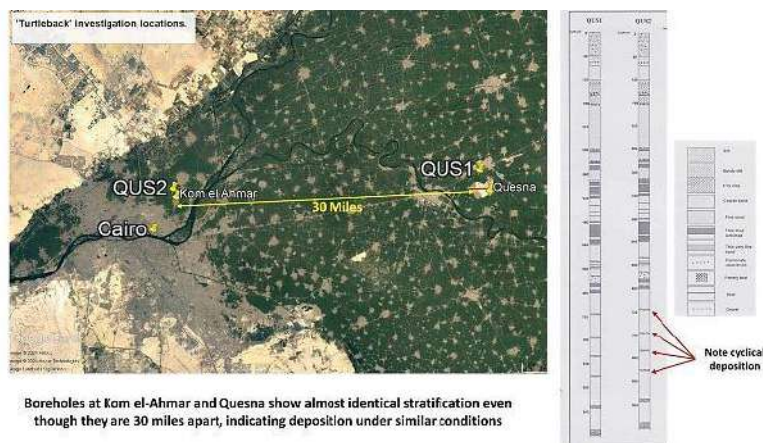


Fig. 30. Location of two near identical turtleback sites separated by 30 miles. (Google Earth/ Gallagher) (Rowland et al., 2012)

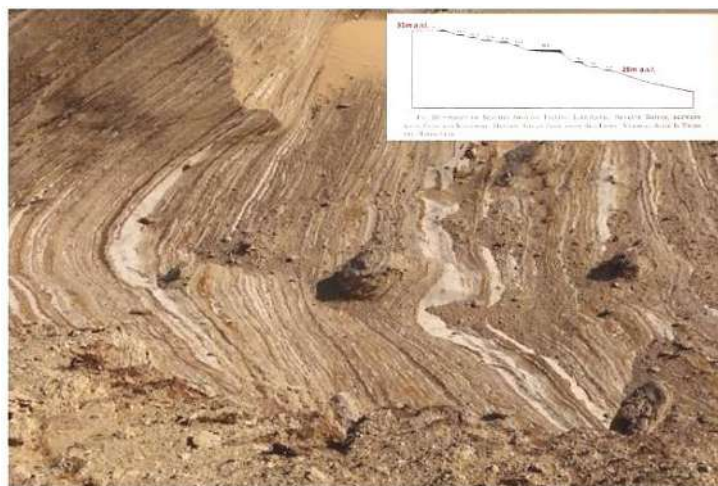


Fig. 31. A series of strandlines in the Faiyum depression with an upper height of ~31 m a.s.l., marking the successively lower levels of the Qarun lake shore. From Fig. 20 (Sandford, Arkell, 1929)

4.2.3. Israel Mega Tsunami

A megatsunami affected the Israeli coast around 10 ka BP, with run-up heights of ~16-40 m and inland inundation of up to ~3.5 km. It is recorded as a marine sand layer burying Neolithic settlements such as Atlit and Dor, likely triggered by a submarine landslide or seismic event (Shtienberg et al., 2020). Its timing broadly coincides with other Early Holocene flooding events, including formation of Lake Qarun, and may warrant further consideration in a wider regional context.

4.2.4. Italy, Lake Bracciano's Submerged Neolithic Site

Neolithic dugout canoes (pirogues) from La Marmotta (~5700-5200 BC) represent the earli-

est known Mediterranean boats and demonstrate unexpectedly advanced water transport (Gibaja et al., 2024). Some vessels reach ~10 m in length, yet the site lies ~300 m from Lake Bracciano's shore at ~11 m depth and over 160 m a.s.l., raising questions about their intended use.

Given the lake's inland setting and limited modern connection via the Arnone River, such large craft appear excessive for local use alone. One possibility is that they were also used on the Mediterranean, implying easier access in the past. Under a higher sea-level scenario (~176 m a.s.l.), Lake Bracciano could have been connected to the Mediterranean, functioning as a sheltered harbour (Fig. 32). If so, La Marmotta's abandonment may reflect falling water levels and loss of access to the sea.

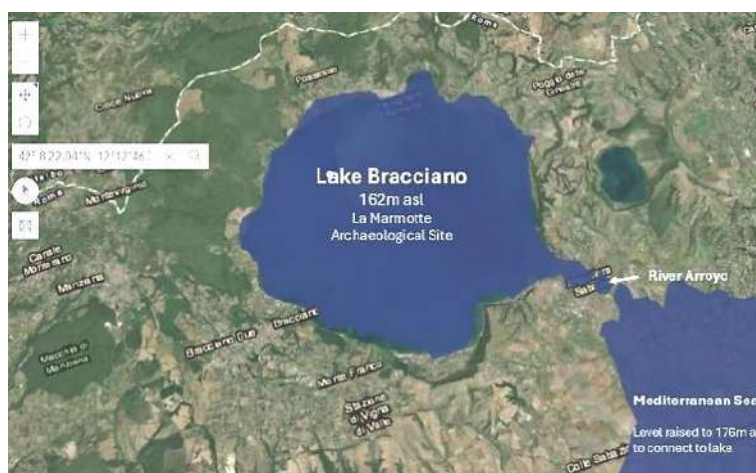


Fig. 32. Lake Bracciano as an embayment of the Mediterranean, with Sea level at 176 m a.s.l. (Google Earth/Gallagher)

4.2.5. Arabian Quaternary Paleohydrology

Further evidence of a possible Early Holocene deluge comes from the Arabian Peninsula, where deeply incised canyons breaching the ~200 m Tuwaiq Escarpment and large alluvial fans suggest a major palaeohydrological event (El Bastawesy, 2014).

Radiocarbon dates (~9,500-5,800 BP) indicate a Holocene age, but conventional rainfall estimates may be insufficient to explain the scale of erosion, implying either extreme precipitation or a large-scale water-release event. While the geomorphology confirms significant flooding, its precise cause remains uncertain.

4.3. Giant ripples, Longitudinal Sand Waves/Dunes and Oriented Lakes

If marine inundation reached elevations of ~150 m a.s.l., as suggested by mud volcano strandline evidence in Azerbaijan, the fundamental question becomes: what mechanism could drive water to such heights? One speculative possibility is that large-scale Earth-system changes – such as shifts in ocean circulation or redistribution of tidal energy – may have displaced water masses toward higher latitudes.

If such processes operated, their effects might not have been confined to a single region. Comparable signatures could be expected more widely, raising the question of what geomorphological imprint sustained, high-energy marine flow would leave on an inundated landscape.

One possible answer lies in the formation of large-scale bedforms. As noted for the Barents

Sea, powerful currents can generate extensive transverse features aligned with flow direction. This invites comparison with the longitudinal dune fields of the Simpson Desert and similar ridge systems found globally (Fig. 33). These remarkably uniform, inactive and vegetated landforms extend over great distances and frequently occur alongside salt pans.

While typically interpreted as aeolian in origin, their scale, consistency, and elevation raise the possibility that some may record more complex formation histories. At the very least, they illustrate the kinds of geomorphic patterns that sustained, high-energy flows are capable of producing.

Table 4 provides selected examples of their locations and elevations.

Explanations for these landforms vary. In Australia, many dune systems are attributed to persistent subtropical anticyclonic wind regimes (Australian National Botanic Gardens, 2016). The linear dunes of the Simpson Desert are thought to have been most active during the Last Glacial Maximum, with activity declining into the Early Holocene and stabilisation occurring after ~10 ka BP (Hesse, 2010; Fitzsimmons et al., 2007). However, this wind-based explanation may not fully account for the occurrence of similar ridge systems across widely separated regions, including examples at higher elevations. Their broader distribution suggests that additional factors may be involved and warrants further comparative investigation.



Fig. 33. Examples of Longitudinal dunes or possible sandwaves from Australia and Namibia. (Google Earth/Gallagher)

Table 4

Examples of linear ridge, dune, and possible sandwave fields

Country	Type/Note	Average Elevation (m a.s.l.)	GPS Coordinates
Argentina	Sandwave field	85	35°34'39.05"S 61°59'16.96"W,
	Salinas de Ambagasta	118	29°18'49.21"S 64°27'52.39"W
Canada	Sandwave field?	143	68° 1'12.77"N 129° 0'11.69"W
	Sandwaves?	19	69°24'54.70"N 131° 5'30.22"W
	Sandwaves?	93	72°16'56.87"N 105°59'10.11"W
Alaska	Elongated Lake, Tractor Lake	12	70°56'32.15"N 157°12'19.19"W
Russia	Lake Chany?	105	54°45'19.24"N 78° 3'0.53"E
	Yuzny Island?	29	71°43'8.07"N 52°17'27.66"E
	Lena Delta	7	73°29'18.10"N 124°19'16.77"E
	Volga Delta	-22	46° 8'44.89"N 47°35'30.71"E
Australia	Simpson Desert	100	25° 2'16.42"S , 136°54'5.67"E
Namibia	Linear dunes	1120	24°47'14.58"S 19°16'13.81"E
Senegal	Linear dunes, static	52	15°19'28.66"N 15°51'3.77"W
Mauritania	Linear dunes	51	17°54'3.05"N 14°56'53.91"W
Zimbabwe	Linear dunes	975	19°28'52.32"S 26°35'36.51"E
South Africa	Linear dunes	844	27°27'2.66"S 20°34'58.85"E
Kazakhstan	Sandwave	383	44°16'16.06"N 69°24'31.28"E

The Baer Knolls of the Volga Delta and those near the Ural River have been interpreted as subaqueous features, not aeolian and analogous to longitudinal bedforms of the Brahmaputra (Badyukova, 2016). However, they more closely resemble submarine sand waves formed from Brahmaputra-derived sediments in the Bay of Bengal (Kuehl et al., 1997; Gallagher, 2018). Models invoking persistent east–west currents raise hydrodynamic questions. An alternative is stronger north–south flow, possibly linked to past Arctic incursions. Further geomorphological and sedimentological study is needed to distinguish between these interpretations.

A possible related sand wave phenomenon occurs in the Arctic in the form of “oriented lakes.” In Alaska, these are attributed to persistent winds generating waves that erode lake margins and elongate basins (Carson et al., 1962). In Russia, similar lake–ridge assemblag-

es have been interpreted as relict glacial lineations later modified by thermokarst processes (Grosswald, Hughes, Lasca, 1999). More recent studies likewise link their orientation to prevailing winds, with lake axes aligned parallel to dominant airflow and shaped by thaw subsidence, lateral expansion and drainage cycles (Hinkel et al., 2005).

However, if large-scale flooding affected Eurasia and the Arctic margin, an alternative mechanism may be considered. Under higher sea levels, low-lying coastal plains – such as parts of northern Alaska and the Lena Delta in Russia – would have been submerged and exposed to marine currents. Sustained flow could have generated large seabed bedforms, which, upon emergence, became relic ridges and depressions that later filled with water. These features may then have evolved into elongated lakes comparable to those observed today (Figs. 34-35).

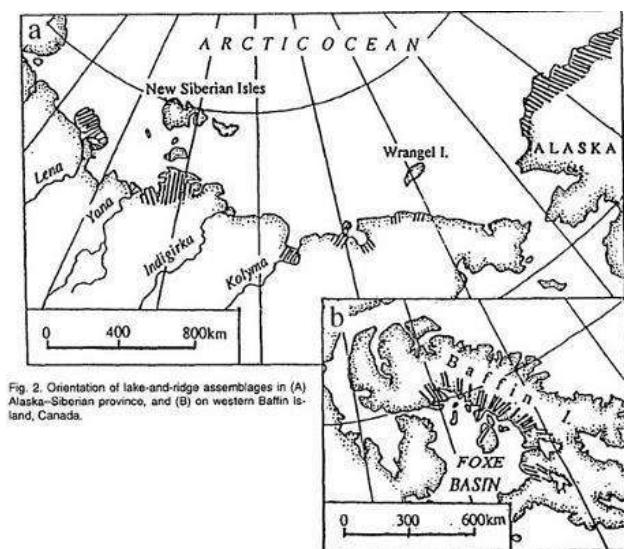


Fig. 2. Orientation of lake-and-ridge assemblages in (A) Alaska-Siberian province, and (B) on western Baffin Island, Canada.

Fig. 34. Location of lake and ridge assemblages bordering the Arctic Ocean. (Grosswald, Hughes, Lasca, 1999)

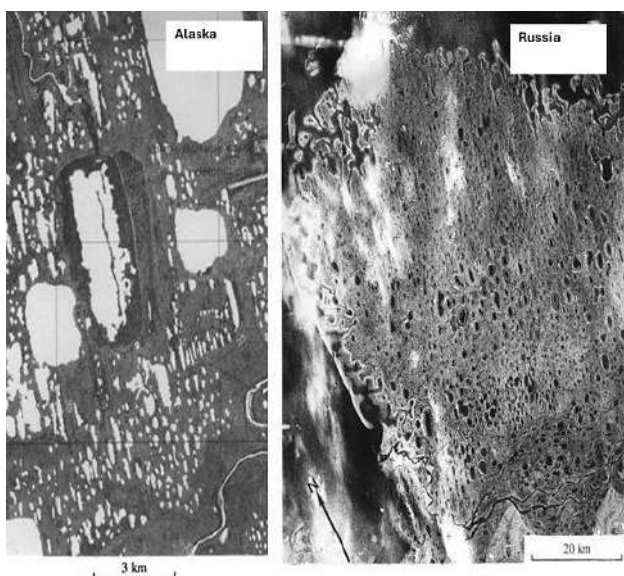


Fig. 35. Appearance of lake and ridge assemblages in Alaska and Russia. (Grosswald, Hughes, Lasca, 1999)

Of additional interest is the chronology of some “yedoma” ridge systems, where peat yields radiocarbon ages of ~9.5-7.5 ka (Grosswald, Hughes, Lasca, 1999; Fig. 36). This broadly coincides with other major environmental changes discussed above, although no direct causal link is established.

Comparable ridge-and-lake patterns occur elsewhere, including Canada (Allenby, 1989) and northeastern Bolivia (Plafker, 1964), where two distinct orientation sets – sometimes near right angles – suggest multiple phases of landscape development under changing controls (Fig. 37). Together, these observations point to

a global geomorphological phenomenon that may benefit from broader comparative study.

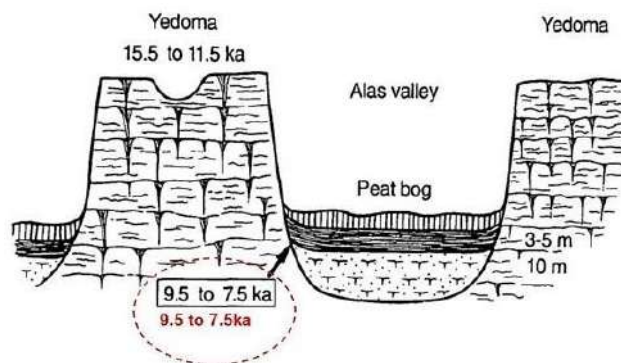


Fig. 36. Relationship of transverse yedoma ridges and intermediate thermokarst thaw valleys. Dates to Early Holocene (Grosswald, Hughes, Lasca, 1999)

4.4. Evidence of Flooding in Scotland and Western Europe

Several sites in Scotland may indicate episodes of prolonged inundation. Of particular interest are a distinctive 1 m fossil-poor sediment layer in Loch Assynt and the discovery of whale remains – including a blue whale (*Balaenoptera musculus*) – within the Firth of Forth.

4.4.1. Loch Assynt

Loch Assynt is an intriguing site, lying at ~66 m a.s.l. and ~8 km from the present coast, and ice-free since at least c. 17 ka BP. Sediment cores have been used to reconstruct environmental change across the Late Glacial–Early Holocene transition using multiple palaeoenvironmental proxies.

Within this sequence, “Unit II,” deposited toward the end of the Younger Dryas, represents a low-salinity transitional phase during basin freshening. It is characterised by poor carbonate preservation, sparse invertebrates, and an absence of chironomid insect (Boomer et al., 2012; Fig. 37).

Age–depth modelling suggests that upper Unit II sediments – alternating sands and silts – date to ~10 ka BP (Figs. 38 and 39). As chironomids are sensitive to salinity, their absence may indicate unfavourable conditions. One interpretation is that these sediments record a short-lived disturbance, possibly a marine incursion during the Early Holocene. However, alternative explanations, including catchment instability, cannot be excluded without further study.

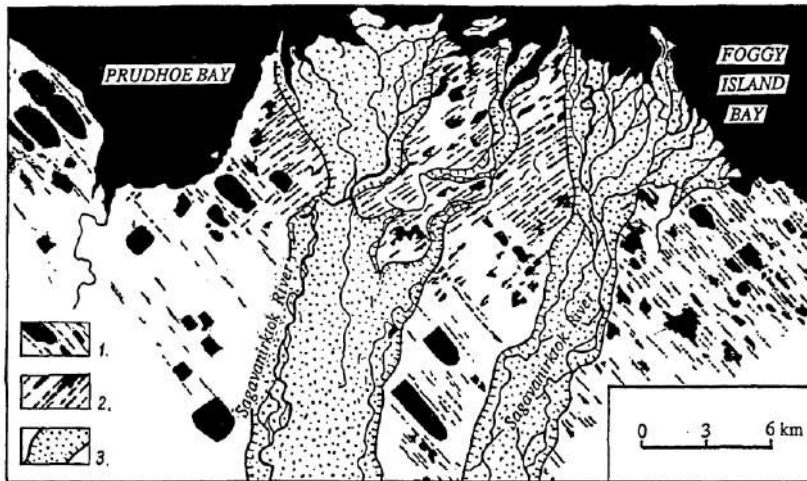


Fig. 37. Two sets of oriented ridges in Alaska. Note: a similar set of ridges are in Bolivia suggesting a common mode effect. (Grosswald, Hughes, Lasca, 1999)

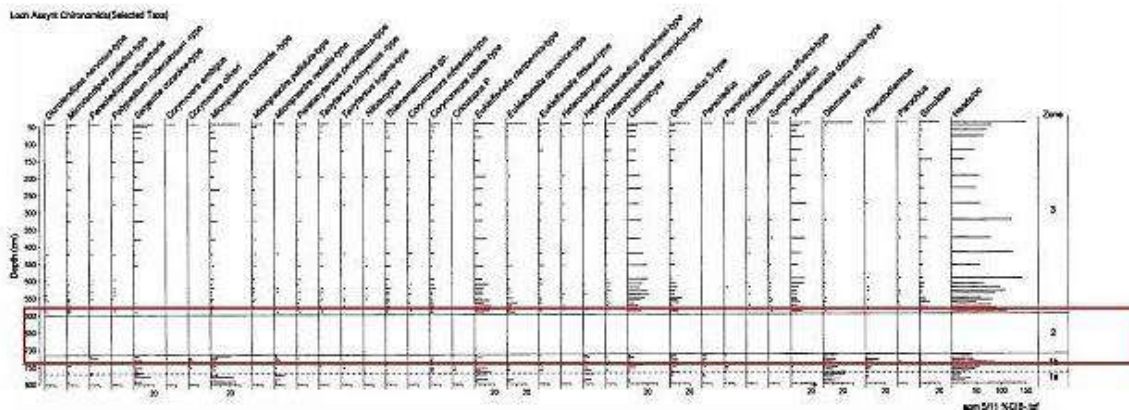


Fig. 38. Highlighted are represents an approximate 1m discontinuity in sedimentation with no chronomids present. (Boomer et al., 2012)

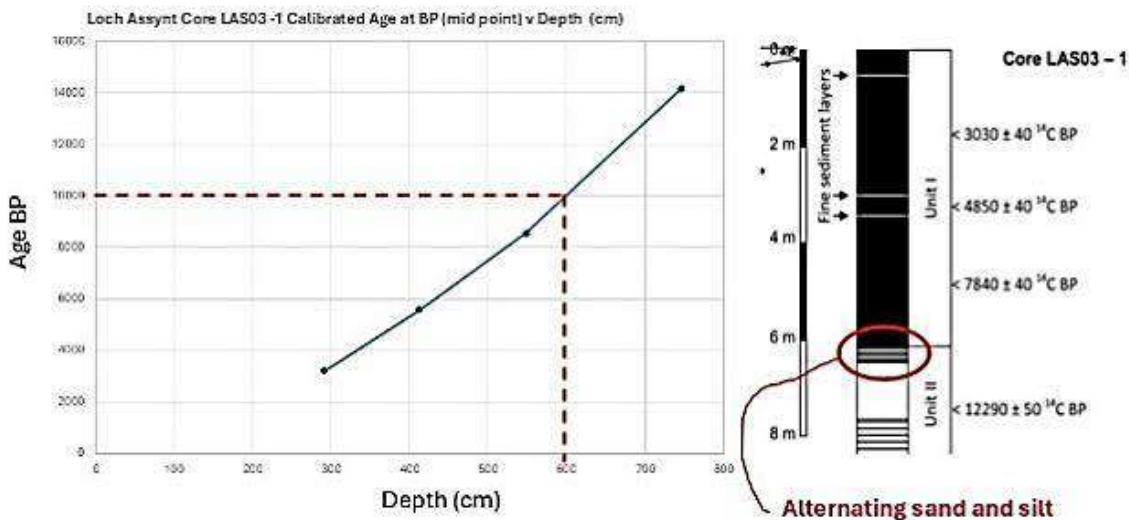


Fig. 39. This diagram shows the top of Unit II, a region that is devoid of chironomids. Their absence may be associated with a marine flood and unfavourable breeding conditions. (Boomer et al., 2012/Gallagher)

4.4.2. Missing Gap in Hunter-Gatherer settlement in Scandinavia

Jensen et al. (2020) propose dividing the Early Mesolithic Maglemose culture into two phases – an Early and a Late Complex – separated by a ~600-year hiatus in archaeological evidence around 10,300 cal BP (Fig. 40). This gap is interpreted as the result of environmental change disrupting lake-based hunter-gatherer lifeways and leading to temporary abandonment of these landscapes.

This finding is significant in demonstrating how hydrological change and shifting lake environments can reorganise human settlement patterns. In the context of a marine deluge hypothesis, such disruption might also reflect reduced accessibility or submergence of parts of the landscape.

4.4.3. Beached Whales in Scotland’s Firth of Forth and Relative Sea Level

Sixteen whale remains have been reported from Early Holocene deposits in the Firth of Forth, most discovered during eighteenth–nineteenth century drainage and agricultural works (Clark, 1947; Fig. 41). These span ~9,500-7,000 cal BP, indicating multiple strand-

ings over ~2,500 years rather than a single event. At that time, relative sea level was higher, and the Forth estuary extended farther inland, with tidal flats and channels allowing whales to move inland before becoming stranded. Preservation was aided by rapid burial in low-oxygen sediments, with later emergence of the carse lands driven by glacio-isostatic uplift (McMaster, 2024). Of particular note is a blue whale from Airthrey (University of Stirling), found at ~8-20 m OD (McMaster, 2024; Fig. 42). Its elevation provides a relative sea-level marker when adjusted for tidal range and sediment effects. Current interpretations attribute such inland strandings to the Early Holocene Transgression, driven by postglacial sea-level rise combined with ongoing isostatic rebound (Smith et al., 2010; Smith et al., 2019). However, given broadly synchronous evidence for elevated water levels in regions unaffected by glaciation, including the Caspian and Mediterranean, it is worth considering whether local models are complete. Early Holocene sea-level histories may have included short-lived, high-energy marine incursions or non-linear events not fully captured in existing shoreline reconstructions.

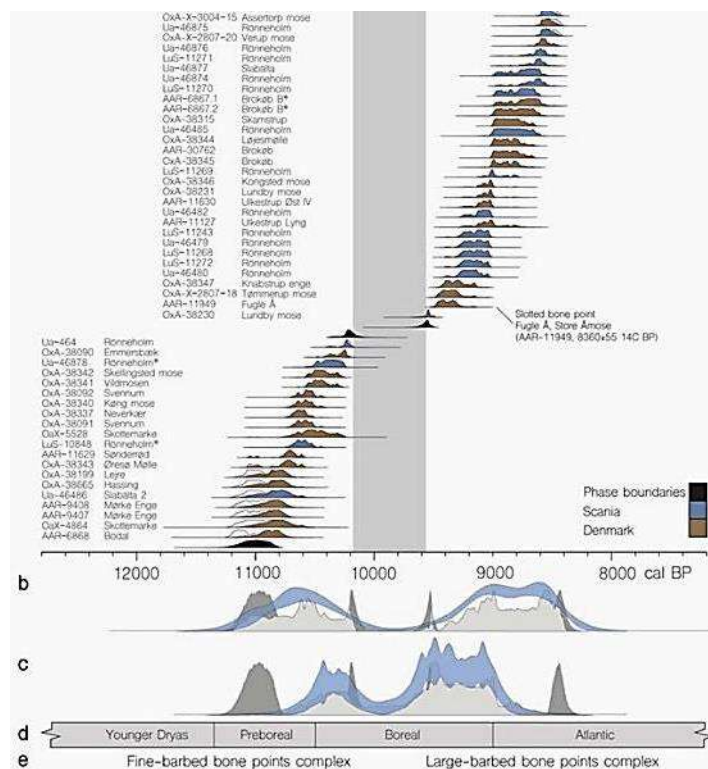


Fig. 40. Diagram showing 600-year gap in lake zone occupation, followed by a change in culture. Land possibly submerged (Jensen et al., 2020)

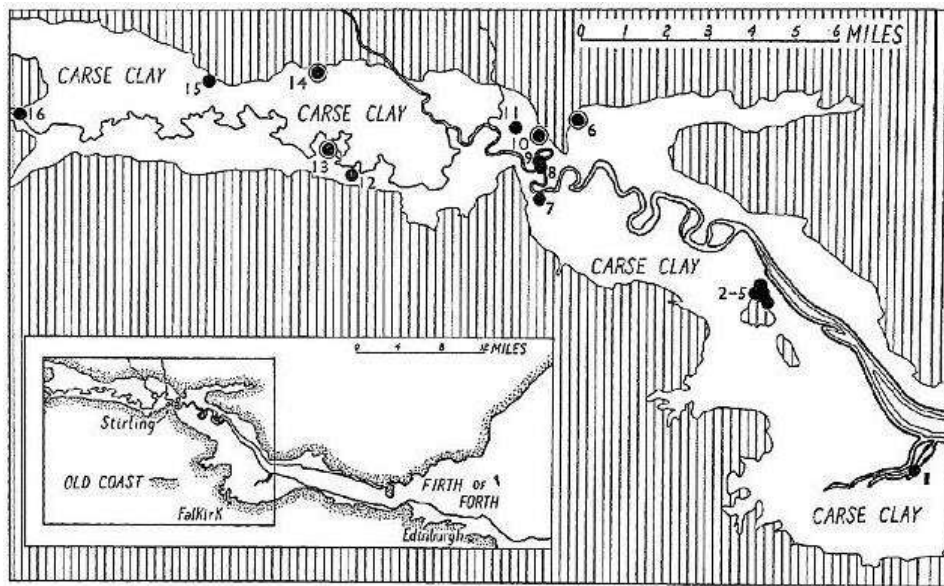


Fig. 41. Location of 16 whales stranded in the Firth of Forth, Scotland in the Early Holocene with a Blue Whale at Site No. 6. At Airthrey Castle at Stirling (Clark, 1947)

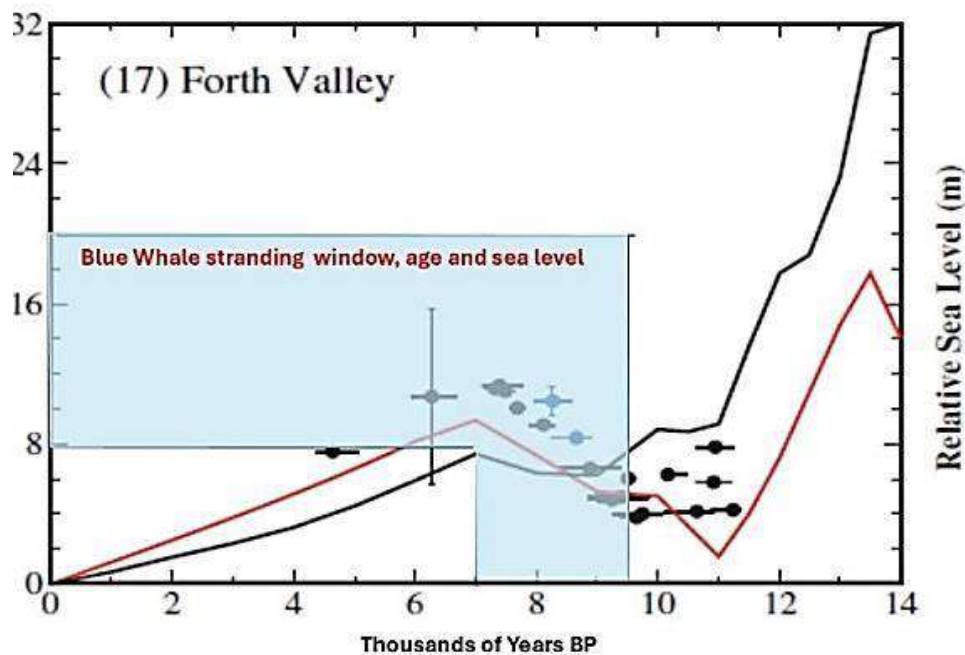


Fig. 42. Airthrey Castle Blue Whale stranding. A comparison of the age range and height above relative sea level. Graph highlights the Early Holocene Transgression (Lambeck et al., 2014, McMaster, 2024), R. Gallagher

Rather than a single catastrophic flood, the evidence may reflect a more complex interplay of basin reconnection, regional hydrology, and time-transgressive sea-level change – issues central to ongoing debate surrounding Early Holocene events, including the Black Sea flood hypothesis (Ryan, Pitman, 1998; Aksu et al., 2002; Major et al., 2006; Yanko-Hombach et al., 2007).

4.5. Black Sea Flood Theory

The hypothesis that the Black Sea experienced a catastrophic marine flood in the Early Holocene – when rising Mediterranean waters overtopped the Bosphorus and rapidly filled a lower freshwater basin – has long been debated. Popularised by Ryan and Pitman (1997), the idea stimulated extensive research but remains controversial.

Alternative interpretations argue against a sudden breach. Aksu et al. (2002) proposed persistent two-way exchange through the Bosphorus, while Major et al. (2006) suggested Mediterranean inflow began earlier (~10.2-9.2 ka cal BP), well before the commonly cited flood date of ~7.6 ka BP. The central questions therefore remain: when did seawater first enter the Black Sea, and was this process abrupt or gradual?

A key difficulty is that the Black Sea is widely reconstructed as largely fresh or low-salinity around 7.6 ka BP, complicating models requiring substantial marine inflow. Both end-member scenarios thus face hydrological challenges. In this context, Gallagher (2011) raised the possibility – albeit speculative – of marine ingress from the north via the Arctic, supported here by strandline and mud-volcano evidence from Azerbaijan suggesting a substantial inundation. Under a more complex scenario of raised relative sea levels, Bosphorus discharge and Mediterranean inflow may have operated simultaneously: i.e. rising Mediterranean levels allowed inflow into the Marmara, while a developed Bosphorus channel permitted denser saline water to enter the Black Sea beneath outflowing fresher surface waters.

Such a mechanism would imply a multi-phase, dynamic history involving basin reconnection, stratified flow, and evolving water balance, rather than a single event. The persistence of relatively fresh surface waters could be explained by strong river inflow during this transitional phase, even as saline intrusion developed at depth.

Classical sources may offer indirect support. The Black Sea’s early designation as *Axenos Pontos* (“Inhospitable Sea”), later softened to *Euxeinus Pontos*, and accounts of waters breaking toward the Bosphorus (Diodorus Siculus..., 1933), while not geological evidence, may reflect cultural memory of significant hydrological change.

4.6. Green Sahara

During the African Humid Period, beginning around 10 ka BP, the Sahara rapidly became wetter and more vegetated before returning to arid conditions by ~7.3 ka BP (Fig. 43; Blanchet et al., 2013; Blanchet, Frank, Schouten, 2014). This transition is generally attributed to orbital (Milankovitch) forcing, with enhanced seasonal insolation driving monsoonal intensification. Dust and marine sediment records indicate that similar humid phases recurred throughout the Late Quaternary. Climate models reproduce Sahara greening when orbital forcing is combined with land-surface feedbacks, although the speed and magnitude of change remain difficult to fully capture (McGee et al. 2013).

The timing is notable: the African Humid Period broadly overlaps with intervals proposed for persistent Black Sea outflow (Aksu et al., 2002; Gallagher, 2011). While this may be coincidental, it raises the possibility of wider regional hydrological linkages beyond rainfall alone.

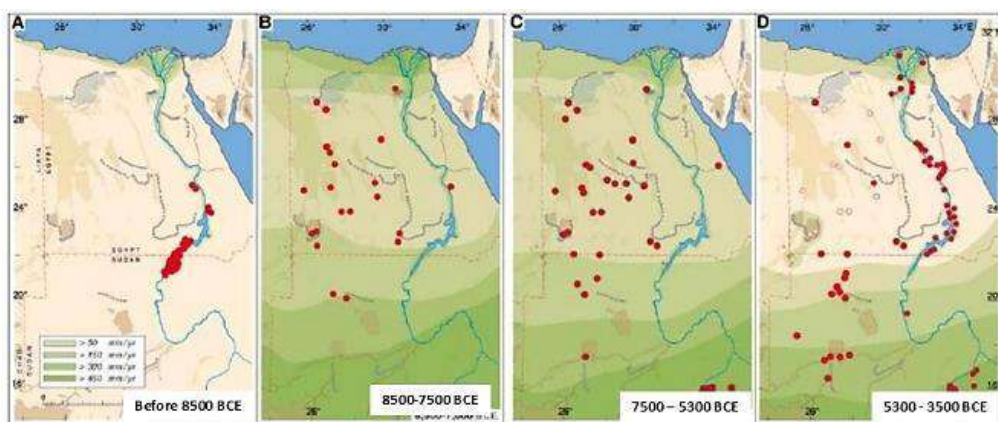


Fig. 43. The Green Sahara. In the Early Holocene there are difficult to explain asynchronous changes in vegetation, runoff and erosion in the Nile River Watershed (Blanchet et al., 2013)

Evidence discussed here suggests that relative sea-level changes may also have affected parts of the Arctic and Ponto-Caspian region during this time. One speculative interpretation is that broader climatic or geographic reorganisation influenced moisture belts and hydrological gradients.

4.7. Biological Changes in the Caspian

If the Caspian experienced significant seawater ingress, it is reasonable to consider whether this was accompanied by the arrival of Arctic or marine species. The possible presence of cetaceans has been discussed previously (Gallagher, 2011). The Caspian seal (*Pusa caspica*), closely related to the Arctic ringed seal, provides clear evidence of past northern biogeographic exchange, with divergence generally placed in the Middle–Late Pleistocene (Aladin, Plotnikov, 1993). Additional ecological patterns are also noteworthy. Despite high biomass productivity, the Caspian has relatively low species diversity, and biological abundance declines sharply below ~100 m depth – often interpreted as evidence of stratification or environmental stress. Genetic studies of relict Arctic taxa, such as *Mysis*, further support past northern connections and subsequent basin isolation (Väinölä, 1995; Gallagher, 2018).

There is also evidence for later species incursions. For example, *Cerastoderma glaucum* appears to have entered the basin during the Early Holocene, implying intervals of marine connectivity or elevated salinity (Nikula, Väinölä, 2003). Comparable changes are recorded in the Aral Sea, where a ~10 ka BP event (Boomer, 2012) saw brackish taxa replaced by freshwater species, likely reflecting major hydrological reorganisation linked to river rerouting. This suggests a degree of regional synchrony.

Taken together, biological and micropalaeontological evidence indicates substantial hydrological change across the Caspian and Aral basins during the terminal Pleistocene–Early Holocene transition. These shifts – encompassing faunal turnover, changing salinity regimes, and episodes of connectivity – point to a dynamic and complex basin history, not fully captured by simple lake-level reconstructions.

4.8. Human Impacts and Migrations.

In addition to physical and biological effects, major flooding would have had significant impacts on human populations. While Ice Age water-level rise was generally gradual, sudden ice-dam failure could have caused rapid shoreline retreat. Such events likely triggered phases of human dispersal: an initial movement around ~9.5 ka BP, followed by a later phase between ~7-6 ka BP as environments degraded and the Caspian became more isolated.

In this context, it is notable that Flinders Petrie proposed a Caucasus origin for early Egyptian civilisation:

“It appears...that the cultural connections of the earliest Egyptians...point to the Caucasus region...giving strong grounds for regarding that region as the homeland of the earliest civilisations of the Egyptians.” — Petrie (1926), *Origin of the Book of the Dead*

Petrie offered no mechanism for such movements. In light of the flood hypotheses considered here, including possible large-scale inundation and migration, his suggestion may warrant renewed interdisciplinary evaluation.

Summary

A detailed timeline of events is provided in Appendix 1.

This study argues that the geomorphology of Azerbaijan warrants renewed scientific attention. Raised terraces, high-elevation strandlines, and marine erosion of mud volcanoes are difficult to reconcile with conventional Caspian Sea-level models. In particular, landforms well above the widely accepted +50 m Khvalynian highstand may represent misidentified features or previously unrecognised hydrological phases.

The paper further suggests that a large Pleistocene freshwater system linking the Black Sea, Caspian Sea, and Aral basin remains a plausible working hypothesis, potentially sustained by diversion of Siberian Rivers during glacial maxima. In this context, earlier concepts of an enlarged “Asiatic Mediterranean” may merit reconsideration.

Early Holocene flood histories were likely more complex than single-event scenarios imply. Evidence from the Caspian, Black Sea, Mediterranean, and surrounding regions points

to interacting processes, including global sea-level rise, glacio-isostatic adjustment, basin overspill, salinity stratification, and episodic marine incursions. The Black Sea Flood debate may therefore be better framed as a multi-phase hydrological transition rather than a simple catastrophic versus gradual dichotomy.

Biological and sedimentary records – such as ostracod turnovers, species incursions, and ecological stratification – also indicate significant environmental reorganisation during the Late Quaternary–Early Holocene transition. These changes would likely have affected human populations through settlement disruption, migration, and the development of flood traditions (Chekhovskaya, 2018).

At the same time, hypotheses involving extreme marine levels or continent-scale flooding remain outside current scientific consensus and require rigorous testing. Priority research should include geochronological dating of strandlines

and terraces, sediment coring, hydrodynamic modelling, DEM-based reconstructions, and integrated archaeological and palaeoecological analysis.

Overall, whether or not all interpretations advanced here are confirmed, the evidence suggests that Eurasian Quaternary flood history is not yet fully resolved. Azerbaijan, given its distinctive geomorphology and position between Arctic, Caspian, and Near Eastern systems, may preserve key evidence for understanding that history.

As Montgomery (2012) cautioned, geological records typically reflect multiple regional floods rather than a single global event. Even so, the scale and coherence of the features discussed here raise important questions.

At the heart of this study remains a simple but unresolved problem identified some 24 years ago: - what process formed the Gilazi strandlines? That is the \$64,000 question.

Appendix I

Integrated timeline of Early Holocene hydrological and ecological changes across the Ponto-Caspian, Mediterranean, Arctic-margin, and North African regions, c. 12-7 ka BP.

Date / Interval	Evidence or Event	Significance
c. 11,000-10,000 BP	Global sea level rising from lowstand	Baseline context: eustatic sea level rising rapidly, while regional basins respond variably due to GIA, sill thresholds, and river balance.
c. 10,500-10,000 BP	Onset of African Humid Period (AHP)	Sahara becomes wetter and vegetated; generally linked to orbital–monsoon forcing, though onset appears abrupt in some records.
c. 10,300 cal BP	Maglemose cultural hiatus (~600 years)	Suggests disruption of lake-based Mesolithic lifeways, likely linked to hydrological or wetland change.
c. 10,200-9,200 cal BP	Early Black Sea marine inflow (some models)	Implies reconnection earlier than the ~7.6 ka hypothesis; supports multi-phase basin evolution.
c. 10,000 BP	Aral Sea ostracod “Event II”	Freshwater taxa replace brackish species, indicating major hydrological reorganisation.
c. 10,000 BP	Southward Bosphorus flow and delta formation	Indicates development of a spillway and sustained outflow into the Marmara basin.
c. 10,000 BP	Freshwater outflow into the Aegean	Supported by geochemical and biological indicators in marine sediments.
c. 10,000 BP	Establishment of Lake Qarun (Faiyum)	May reflect Nile back-flooding from higher Mediterranean levels or increased AHP discharge.
c. 10,000 BP	Stabilisation of Simpson Desert dunes	Indicates environmental change; alternatively interpreted as relict features following earlier high-energy processes.
c. 10,000 BP	Loch Assynt anomalous sediment layer	Fossil-poor unit lacking chironomids; may reflect salinity change or hydrological disturbance.
c. 10,000 BP	Eastern Mediterranean megatsunami (Atlit–Dor)	High-energy marine event affecting coastal settlements.
c. 10,000-5,000 BP	Formation of Nile “turtle-backs” (geziras)	Generally interpreted as fluvial; alternatively may reflect deposition under higher water levels.
c. 9,725 BP	Caspian ostracod assemblage turnover	Indicates major shifts in salinity, water depth, and basin hydrology.

Date / Interval	Evidence or Event	Significance
c. 9,500-8,500 BP	Scottish raised estuary / whale strandings	High relative sea levels linked to isostatic rebound; possible regional anomalies.
c. 9,500-7,500 BP	Yedoma / oriented lake-ridge formation	Widespread geomorphic activity in Arctic regions; mechanism debated.
c. 9,500-5,800 BP	Arabian palaeohydrological phase (Tuwaiq)	Large-scale drainage and incision; rainfall alone may not explain magnitude.
c. 9,000-7,000 BP	<i>Cerastoderma glaucum</i> in Black Sea	Indicates salinity increase and episodic marine connectivity.
c. 9,000-2,000 BP	Reduced sedimentation at Kura Delta	May indicate higher Caspian levels and upstream sediment trapping.
c. 8,500 BP	Arabian gastropod dating	Additional marker of Early Holocene hydrological activity.
c. 8,000 BP	La Marmotta boats (Lake Bracciano)	Advanced watercraft at inland site; may imply different hydrological connectivity.
c. 7,600 BP	Ryan-Pitman Black Sea flood hypothesis	Widely cited but contested; alternatives favour earlier or gradual reconnection.
c. 7,300-6,000 BP	Decline of African Humid Period	Major transition to arid conditions and regional environmental reorganisation

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ПЕРЕОЦЕНКА РАННЕГОЛОЦЕНОВЫХ УРОВНЕЙ ВЫСОКОГО СТОЯНИЯ “АЗИАТСКОЙ ЧАСТИ СРЕДИЗЕМНОМОРЬЯ” И ГИДРОЛОГИЧЕСКОЙ СООБЩАЕМОСТИ ЧЕРЕЗ ПОНТО-КАСПИЙСКИЙ БАССЕЙН

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Резюме. Выявление гидрогеологических преобразований в Понто-Каспийском регионе в переходный интервал позднего плейстоцена — раннего голоцена по-прежнему представляет одну из ключевых проблем геологии четвертичного возраста. Несмотря на то, что современные модели акцентируют внимание на климатическом факторе и гляциоизостатической адаптации, многочисленные геоморфологические, седиментационные и биологические данные не всегда согласуются с существующими концептуальными представлениями.

Исследование обобщает материалы, полученные по Каспийскому, Чёрному, Средиземному морям и сопредельным территориям, с особым акцентом на геоморфологические особенности Азербайджана. Установлено, что возвышенные террасы, приподнятая береговая линия и выявленные поверхности грязевых вулканов, модифицированные волнами, фиксируются на отметках значительно выше хорошо известного Хвалынского уровня (~+50 м над уровнем моря), что позволяет предположить существование ранее неучтённых гидрологических условий. Кроме того, в исследовании рассматриваются циклы остракодовой фауны, миграции солечувствительных таксонов, аномальные седиментационные последовательности и другие индикаторы изменчивости бассейнов, проявившиеся на территории Евразии в раннем голоцене.

В целом приведённые наблюдения свидетельствуют о том, что региональная гидрологическая система была значительно более динамичной и сложной, чем предполагалось ранее. Вместо рассмотрения изолированных концепций целесообразно опираться на данные, указывающие на существование многофазных систем с колебаниями уровня воды, эпизодическими сбросами бассейнов, стратифицированным режимом течений и изменчивыми связями между Чёрным, Каспийским и соседними бассейнами. В этом контексте ранее предложенная концепция «азиатского Средиземноморья» для расширенного плейстоценового периода рассматривается как рабочая гипотеза, требующая дальнейшего уточнения.

Исследование также даёт основания для переосмысления дискуссий, связанных с повторным соединением Чёрного моря, и выдвигает предположение о фазо-изменяющихся притоках и оттоках через Босфор. Подобный подход способен более полно объяснить имеющиеся данные по сравнению с катастрофическими, либо строго линейными моделями. Более широкие региональные сопоставления, охватывающие Северную Африку и арктическую периферию, свидетельствуют о том, что гидрологические и экологические изменения в рассматриваемый период могли носить синхронный или временно кумулятивный характер.

Хотя представленные здесь интерпретации не являются окончательными, они подчеркивают необходимость проведения комплексных междисциплинарных исследований для дальнейшего уточнения рассматриваемых вопросов.

В будущих исследованиях первостепенное внимание следует уделить геохронологическому датированию береговых линий и террас, отбору ядерного материала, гидродинамическому моделированию, а также реконструкции палеобереговых линий на основе цифровых моделей рельефа (ЦМР). Уникальные геоморфологические особенности Азербайджана могут сыграть ключевую роль в решении фундаментальных вопросов, связанных с четвертичной гидрологией Евразии.

Ключевые слова: Понто-Каспийский регион, ранний голоцен, уровень Каспийского моря, гидрология Чёрного моря, четвертичная палео-гидрология, связанность бассейна, морская трансгрессия, гляциоизостатическое приспособление, палеобереговая линия, «азиатское Средиземноморье»

“ASIYA ARALIQ DƏNİZİ” KONSEPSİYASINA YENİ BAXIŞ: PONT–XƏZƏR HÖVZƏSİ BOYUNCA ERKƏN HOLOSEN YÜKSƏK SU SƏVIYYƏLƏRİ VƏ HİDROLOJİ ƏLAQƏLİLİK

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Xülasə. Pont–Xəzər regionunda Gec Pleystosen–Erkən Holosen keçidi dövründə hidroloji dəyişikliklərin dərk edilməsi Dördüncü dövr üçün həllini tapmamış elmi problemlərdən biri olaraq qalır. Mövcud modellər iqlim təsirini və buzul-izostatik tənzimləməni vurğulasa da, bir sıra geomorfoloji, çöküntü və bioloji müşahidələr mövcud çərçivələrə asanlıqla uyğunlaşdırıla bilmir.

Bu tədqiqat Xəzər, Qara dəniz, Aralıq dənizi və qonşu regionlardan əldə edilmiş dəlilləri sintez edərək, xüsusilə Azərbaycanın geomorfologiyasına diqqət yetirərək ümumiləşdirir. Yüksəkliklərə qalxmış terraslar, yüksək hündürlükdə sahil xətləri və dalğalar vasitəsilə dəyişdirilmiş palçıq vulkanı səthləri geniş qəbul edilmiş Xvalın yüksək səviyyəsindən (~+50 m mütləq hündürlük) xeyli daha yuxarı səviyyələrdə aşkar edilmişdir ki, bu da əvvəllər müəyyən edilməmiş hidroloji şəraitin mövcud ola biləcəyini göstərir. Əlavə dəlillərə ostrakod faunasının dəyişməsi, duzluluğa həssas taksonların yerdəyişməsi, anormal çöküntü qeydləri və Erkən Holosen dövründə Avrasiya boyunca hövzə bağlanılıqlığının dəyişdiyini göstərən əlamətlər daxildir.

Bütün bu müşahidələr birlikdə regional hidrologiyanın ümumi qəbul ediləndən daha dinamik və mürəkkəb olduğu şərhini dəstəkləyir. Əldə olunan məlumatlar vahid hadisə çərçivəsindən daha çox, su səviyyələrindəki dalğalanmalar, epizodik hövzə daşmaları, təbəqələşmiş axın rejimləri və Qara dəniz, Xəzər dənizi və qonşu hövzələr arasında dəyişkən əlaqəni özündə birləşdirən çoxfazlı sistemlə daha uyğunluq təşkil edir. Bu kontekstdə, genişlənmiş Pleystosen “Asiya Aralıq dənizi” haqqında əvvəlki konsepsiyalar işlək fərziyyə kimi yenidən nəzərdən keçirilir.

Tədqiqat həmçinin Qara dənizin yenidən birləşməsi problemini yenidən nəzərdən keçirərək, Bosfor vasitəsilə növbələşən çıxış və daxilolma fazalarının mövcud sübutları nə tam katastrofik, nə də yalnız tədrici modellərdən daha yaxşı izah edə biləcəyini irəli sürür. Şimali Afrika və Arktika kənarı daxil olmaqla daha geniş regional müqayisələr göstərir ki, hidroloji və ətraf mühit dəyişiklikləri zaman etibarilə eyni intervalda qruplaşmışdır.

Burada təqdim olunan interpretasiyalar ilkin xarakter daşısa da, onlar inteqrə olunmuş multidissiplinar tədqiqatların vacibliyini vurğulayır. Gələcək işlərdə sahil xətlərinin və terrasların geoxronoloji yaş təyininə, çöküntü kernlərinin tədqiqinə, hidrodinamik modelləşdirməyə və “Rəqəmsal Relyef Modeli (Digital Elevation Model – DEM) əsasında paleosahil xətlərinin rekonstruksiyasına üstünlük verilməlidir. Azərbaycanın fərqli geomorfologiyası Avrasiyanın Dördüncü dövr hidrologiyasına dair həll olunmamış məsələlərin aydınlaşdırılmasında həlledici rol oynaya bilər.

Açar sözlər: Ponto-Xəzər regionu, Erkən Holosen, Xəzər dənizinin səviyyəsi, Qara dəniz hidrologiyası, Dördüncü dövr paleohidrologiyası, hövzə əlaqəsi, dəniz transqressiyası, buzlaq-izostatik tənzimlənmə, paleosahil xətləri, “Asiya Aralıq dənizi”