The Hevsel Gardens: archives of human activities and of the past and present evolution of the River Tigris at Diyarbakır

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EDITOR'S NOTE

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The study is realized in the frame of a scientific collaboration programme between Dicle University Ziya Gökalp Education Faculty Geographical Education Department Head Dr. Sabri Karadoğan, and the CNRS and Paris 1 University’s Physical Geography Laboratory (LGP, France) A-Rank Researcher Catherine Kuzucuoğlu. The study contributes to the AMIDA Project, which is co-ordinated by Dr. Martine Assénat from Montpellier University (CRISES, France), the Diyarbakır Metropolitan Municipality, and the French Institute for Anatolian Studies in Istanbul (IFEA, Turkey).

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Introduction: context of research

The Tigris valley is a special area that requires examination from both archaeological and geomorphologic perspectives (Algaze et al. 1991; Parker and Creekmore 2002; Karadoğan and Kozbe 2013; Kuzucuoğlu 2014). In spite of this high interest, the knowledge of the geographical context of the region in the past is still restricted. As lakes and valley floors contain the best archives that would reduce this international information gap, we have set up a research project on the Upper Tigris watershed. Draining a large part of Upper Mesopotamia up to the eastern Anatolian highlands, this watershed must contain indeed the morphological and sedimentary data capable of defining (i) today’s dynamics of the hydrosystem and fluvial ecosystem on a regional (e.g. the river watershed) and local (e.g. Diyarbakır City and Hevsel gardens) scales, whether controlled by man or by natural context (geology, climate, vegetation), (ii) the evolution of the climatic and environmental contexts in the region during the last glacial (Upper Pleistocene) and today’s interglacial period (the Holocene), and consequently (iii) the geographical context of human societies’ evolution in the River Tigris valley from the earliest Prehistory to the modern times (Fig. 1).

In this frame, the study of fluvial archives aims at understanding river dynamics today and in the more or less recent past, focusing namely on the river regime (timing, magnitude, regularity of floods, and relations to climate), the sedimentation modes and sediment types, the changes in bed types and location, the bank-bed-valley floor erosion, the terrace records, the substratum constraints etc.

I. Scope and approach

A series of general questions conducts our approach and methods.

• What kind of events, what kind of records, framed in which chronology can we expect from the study of (i) the stepped terraces which are clearly recognizable in the landscape on both sides of the river valley and (ii) the various sediment fills and river morphology changes also recognizable in the valley bottom?

The study of these terraces and valley fills is expected to allow evidencing different phases of sedimentation and erosion, and identifying the causes and processes of changes in dynamics, (Kuzucuoğlu et al. 2004). In this prospect, we expect from a focus on the connections between the terraced Hevsel gardens and today’s environmental dynamics, to provide results contributing to the reconstruction and understanding of the river imprints over the geographical formations in the valley through time.
Figure 1 - Diyarbakır, at the entrance of the Tigris gorge before crossing the Taurus range

The City controls one of the two main routes to resources in Eastern Anatolian, central Anatolian plateaus and Caucasus

Legend:
1. Main mythic mask/f with obsidian outcrops used during Prehistory;
2. Ergani copper mines;
3. Prehistoric regions concerned by the use/ diffusion of Eastern Anatolians minerals and rock resources, the seasonal pasturing of migrating herds, the access and routes from and to central Anatolia, Mesopotamia, Caucasus (yellow dots are the well-known sites typical of these regions);
4. Main passes through the Taurus (Tigris and Euphrates);
5. Diyarbakır City;
6. Main cities

Background image: 2015 LANDSAT TM satellite image distributed by Google Earth

• What kind of relationships was established in the past between human societies, the river dynamics (floods, low waters, erosion, lateral translation, incision, navigability etc.), its valley and terraces (topography and resources such as soil and vegetation, humanized landscape such as roads, walls, dams, canals, mills...)?

Answering this question requires the detailed reconstruction of both the palaeoclimatic and the palaeohydrological contexts of the region. This objective can be reached with the study of various indicators contained in the geomorphologic and sedimentary archives, whether their nature is stratigraphic, biologic, chemical, mineralogic etc. Such archives exist in the valley bottom and slopes, and in closed depressions especially those that have been occupied by a lake (Kuzucuoğlu et al. 2011).

II. Methods

After an exploratory field survey was realized in February 2014, the mission that took place in May 2014 focused on the zone of interest for the AMIDA project: the Hevsel gardens at the foot of the Diyarbakır City walls.
Figure 2 - The terraces of the River Tigris at Diyarbakır on the right bank below the City Walls

Photographed from the left bank

A second area also attracted our attention and efforts because of its richness in lakes: the river valley between Bismil and Batman. The results obtained in that latter area being out of scope of this paper on the Hevsel gardens and Diyarbakır area, they are not presented here.

Figure 3 - An open section in terrace sediments inside the Hevsel Gardens
Methods applied in 2014 for the study of the Hevsel gardens are:

**On the field**

1. Looking for open sections (Fig. 3), and drawing them;
2. Identifying former beds and distinguishing possible terraces using (a) apparent water and clay content of sediments; (b) soil types, (c) land use and vegetation type (cultivated trees, planted vegetable gardens, crops) as they are also adapted to characteristics of soils and water content;
3. GPS data are measured at more or less regular intervals along a transect-line established through the valley from the right bank of the river active bed, to the foot of the city walls (Diyarbakır city door). Intervals between positioning points narrowed when topography evidenced a morphological step.
4. Coring aimed at collecting sediments accumulated in the terraces. The approach was exploratory, before a more complete study of several meters-thick alluvial sequences with a motor-mounted-coring truck device. Exploratory equipment used was hand-manipulated 2 cm-wide-open gauges expected to be able to penetrate easily sandy and gravely sediments (Fig. 4). Despite the thin diameter of the gauges, this hand coring in terraces was extremely difficult.

First, the upper 50 cm were sampled with a soil auger. This “surface” sample is unsuitable for analyses and dating because it is impacted by agricultural practices. Below -50 cm, gauges were 2.5 cm in diameter screwed to as many 0.5 m or 1 m-long drives. After retrieval, sediments facies and stratigraphy were described on the spot with a 1 cm precision depth. Apart from possible interesting layers (e.g. carbonate crust), sampling was planned to be restricted to $^{14}$C dating suitable sediments (organic matter-rich sediments.)
In the office

1. Drawing the stratigraphic log of the coring;
2. Drawing the topographic profile based on the GPS data;
3. Interpreting the LANDSAT TM 2014 composite satellite imagery made available by Google Earth on Internet. Interpretation is based on distinguishing visually surface data captured by the satellite sensors. “Colours” (more or less black and white) and their intensities (from 0 to 256) are considered to record the vegetation cover (type and density) and the soil surface conditions (sediment types and water content). This differentiation between surface colours and colour intensities provides the distinct elements used in the mapping of the terrace scarps and past riverbeds.
4. Drawing a map of terraces (scarps, flats) and former river beds (filled channels). The mapping uses the information delivered by the satellite interpretation described above.

III. Results

Profile of the terraces

Walking through the right-bank side of the flood valley through the Hevel gardens, we measured altitudes with a GPS, noting topographical scarps between flatter surfaces.

The profile obtained exposes an incision/sedimentation succession forming embedded terraces recording major changes in the river dynamics and sediment load. Resulting from a progressive side-translation of the River Tigris south-eastwards (away from the basalt cliff) which contributed up to recent times to their preservation and to the
preservation of the Hevsel Gardens, these stepped terraces also record a history of the valley and of the river, which is rhythmmed by periods of sedimentation followed by periods of incision, in a general context of deepening of the valley (Bridgland and Westaway 2008).

Figure 5 - The alluvial terraces embedded in the right bank of the River Tigris valley

Evidence for major changes in the river dynamics and sediment load through time

Combining topography and altitude measurements, we obtained the profile shown in Fig. 5. In this profile, the 7 to 21 numbers correspond to the measurement sites, while the 1 to 5 numbers in circles rank upwards the flat surfaces separated by scarps. These five surfaces correspond to five terraces (“T1” to “T5”) above today’s flood plain (“T0”) “T0” is not shown on Fig. 5.

Mapping right-bank river terraces and river beds

Confronting the satellite interpretation with data from the GPS-based topographic profile, allowed us to transfer the SRTM-based data on the spot-scale (GPS data) and along the topographic profile to the valley-scale in Fig. 5. A map (Fig. 6) is produced, based on both the field data collection (GPS data and field observation) and the interpretation of satellite imagery. In the legend, each of the 1 to 5 surfaces is defined by its mean altitude relative to that of today’s riverbed of the Tigris (“T1”). Besides, “T3” seems to be composed of two sub-levels between +9 and +17m (Figs. 5 and 6).
Figure 6 - Map of the River Tigris terraces in the Hevsel gardens

Based on both GPS based topographic profile, and satellite imagery interpretation
Background image: 2014 LANDSAT TM satellite image distributed by Google Earth

Geological cross-section, from valley floor to Diyarbakır city walls
(Fig. 7)

This cross-section is based on GPS-based profile of the terraces, with the addition of exposures of old alluvium (Fig. 3), basement rocks (Fig. 8), volcanic flows (Fig. 9). These exposures outcrop in sections open by roads or any other kind of natural or artificial vertical erosion below the walls, in terraces, in the gardens.
Outcrops recognized during our Hevsel Gardens survey produced several surprises:

1. A terrace immediately below the City Walls (GPS point 21 on profile Fig. 5) is not an accumulation terrace as it truncates the substratum (= a reddish clay photographed in Fig. 8). Either it is an erosion terrace, or it is man-made.

2. The oldest terrace at + 56 m (GPS point 20 on the profile Fig. 5, coloured in brown in Fig. 6), is a stepped terrace. In the geomorphologist’s “lexicon”, a “stepped terrace” is a kind of contrary (with regards to the genetics of the form) to “embedded terrace”. The “stepping” is formed (like here) by the bedrock outcropping below the alluvial deposit constituting the...
terrace, and within its limiting scarp which is incised in the bedrock (a usual sign of river response to tectonic uplift).

3. In addition, in the gardens at the scarp-limiting terrace T5, a basalt outcrop forces water running over the surface of T5 to flow as a waterfall over the scarp (Fig. 9).

16 This outcrop suggests the occurrence, at Diyarbakır, of two distinct basalt flows (Westaway et al. 2009), an information that would be very important for the study of the city walls. If correct, this observation means that a fault controls the right bank of the valley.

17 Terraces survey however suggests that this outcrop in the garden may result from the breaking of the Diyarbakır basalt flow in two parts: one remained at its initial altitude forming the plateau; the other own fell down ca 100 m (in the gardens).

**Figure 9 - A basalt outcrop forms a waterfall in the Hevsel gardens**

Note: see position of the outcrop on the geological cross-section (Fig. 7)

18 The estimated magnitude of the fault movement or fall would be ca 100 m high, possibly more. According to terraces elevations, the possible fault seems to have caused -or partly caused- the 20 m scarp separating T6 from T5 (Fig. 7). The occurrence of a fault breaking the Diyarbakır City lava flow would explain the SE migration of the riverbed, and the terrace stepping, which follows the accentuation of the curve incised by the riverbed south-eastwards from Diyarbakır location.

19 This also means that (i) there will be some difficulty to distinguish climatic causes from tectonic causes with regard to the evolution and change of river dynamics; (ii) a well-constrained chronology is needed, which is now expected from coring programmes.

L’Hevsel à Amida-Diyarbakır
Results of preliminary coring (2 core spots in the Hevsel gardens)

Sediments in the valley should provide indications about the time and space distribution of the elements composing the hydrosystem in both the recent and remote past. Together with the field study as exposed above, a complementary exploration of sediments was realized by coring the sediments in the valley. In May 2014, two spots were cored in the Hevsel Gardens.

Figure 10 - Location of Core Spots 1 and 2

According to satellite imagery and to field observation, the two spots were chosen in a channel fill (a former bed of the river: Fig; 10) which has been abandoned at the foot of the scarp limiting “T2” above “T1” (Fig. 5).
Figure 11 - Stratigraphy of the 2.5 m long sequence from Core Spot 1 in Hevsel Gardens

Core retrieved from a secondary channel abandoned at the foot of the T2 scarp dominating T1
Note: Coordinates of Core spot 2: 37° 54' 11.69''N – 40° 14' 44.69''E

The results concern the stratigraphy and the facies analyses of the sediments cored. Only the sequence from the Core Spot 1 could be interpreted in a time sequence. At Core Spot 2, we have been able to retrieve only 90 cm representing a superficial part of the fill, non-usable for our purposes.

The facies analyses and the stratigraphy of Core Spot 1 (Fig. 11) are typical of the abandonment of a lateral channel (a former active bed); the grain size of the river sediment thinners upwards. From gravelly at the base, the sediments become sand-enriched; at the end of the process only clay is deposited, in a calm and waterlogged environment favourable to the tree and herb vegetation. The corer could not reach, however, the older sediment formation in which the abandoned channel was formerly incised at the end of the accumulation period of “T1”.

Because of the lack of samples suitable for 14C dating, both from the sections identified and from the sequences cored, no sample could be sent for dating. Logically, there was no sense in realizing laboratory analyses if the samples could not be set into a chronological frame. Nevertheless, we estimate both “T1” terrace, and the cored abandoned river bed, to date Late Holocene, most probably Middle Ages at the earliest, or end of the Little Ice Age after AD 1860.

IV. Plans for 2015 and following years

In order to achieve our scientific goals, both regarding the Hevsel Gardens and the Tigris River Valley, we plan a series of operations for 2015 and the following years.
Two scopes and approaches at different time and space scales

On the **valley-scale, i.e. the terraces and valley fills at Diyarbakır, its Gardens and down to the palaeo-Tigris valley** (Fig. 12), the most important problems to be answered by further studies of the records of the geomorphological (field studies) and sediment (core studies) archives should head towards reconstructing:

1. in the valley: (i) the terrace ages and modes of formation; (ii) the evolution of the river regime and bed styles, as well as the deposition vs erosion dynamics; (iii) the rapidity of riverbed translation changes over the flood plain; (iv) the role of tectonism and of gypsum dissolution in the overall evolution of the valley at Diyarbakır. Impacts of both factors may have, even today, tremendous impacts on the management (water use, barrages etc.) and future dynamics.

2. in the Hevsel Gardens: (i) the content and age of the sediments constituting the geological formation and soils sustaining the Diyarbakır gardens; (ii) the impact of man-made terracing on the natural environment; (iii) the evolution of the gardens, e.g. in relation to erosion, flood-related soils...

On the **regional scale, i.e. the Upper Tigris valley and basin**, we will also search for geomorphological and geological data, which can possibly record the past hydrodynamic and environmental evolution of the River Tigris valley and of its basin (Fig. 13). Geological phenomenon related to tectonism (e.g. Bridgland et al. 2007), volcanism (e.g. Westaway et al. 2009; Türe cane 2014), climate (e.g. Robinson et al. 2006) and karst (Doğan 2005) will be taken into account. As far as reconstructions of climate are concerned, we hope to be able to focus on:

1. the relationships between climatic conditions and the development of human societies: agricultural practices, animal husbandry, centralizing power, resilience to social changes etc., (e.g. Laneri et al., 2012);

2. the rapid climate changes (the RCCs: e.g. Weninger et al. 2009) which are known to be somewhat acquainted with cultural changes, whether on the long-scale (such as Late Neolithic development, choices in production types) or on the short-scales (civilisation collapses at the ends of the 3rd and 2nd mill. BC and the 1st mill. AD: Kuzucuoğlu & Marro 2007).
Figure 12 - The Hevsel Gardens at Diyarbakır: The heart of the River and City histories

Figure 13 - The River Tigris at Diyarbakır: The meeting place of local to regional geological records
In the field

Collecting indications about older phases of the river regime and morphology needs coring with a motorized device capable of crossing and sampling thick layers of coarse sediments such as sand (banks, bars, migrating islands, overbank flood deposits) and gravels (river bedload, islands).

This future coring work in the gardens will be defined according to the profile of the Hevsel terraces obtained in 2014. Accordingly, we shall work on detailing the geomorphologic and geologic (stratigraphy, sedimentology, structure) cross-section of the river valley, from the top of the relief in which the valley is incised to the flood plain.

The coring will also concern both banks of the valley: the right bank (explored in 2014) from the river through the gardens up to the city; and the left bank of the river, facing Diyarbakır where GPS data collection, mapping terraces etc. will also be performed.

In the laboratory and the office

Samples from the cores will be analysed in the laboratory. According to aim of analysis and availability of material, the following analyse may be needed: the sedimentology (grain-size, magnetic properties, mineralogy, organic content, soil structure), the geochemistry (inorganic and organic carbon, nitrogen), the biologic proxies (pollen diatoms, molluscs, phytoliths). In addition, $^{14}$C chronology (on organic matter) and K-Ar dates (on lavas) will be performed, depending on funding.

Also depending on funding, Master and hopefully Doctorate students must be involved in the research programme, both for various analyses and/or also for data based satellite/GPS data (GIS treatments). These students’ researches will concern the geomorphology, as well as the effects of regional and global climate changes. They will especially focus on the succession of events (hydrologic, climatic, geologic) that have impacted the landscapes and the societies (land use, social history, settlements). Among these events, processes related to tectonism (uplifts, earthquakes, fault activity impacts on surface morphology) and karst (existence of any underground gypsum dissolution impacts?) must be explored with attention.

Conclusion

Environment and environmental systems have memories. Our researches ambition studying the objects capable of retaining and delivering to us parts of this memory. What happens today to the river and valley systems at Diyarbakir depends of course of today’s Man’s decisions and deeds. But it fundamentally depends on the history of the system. Forgetting the past in the analysis of dynamic systems, is more than an error. Our responsibility towards our future, and the future of environmental systems that sustain us, makes it a fault. If we want to understand what happened in the Tigris Valley and the Diyarbakir Gardens since at least the Assyrian Empire, i.e. the time when the gardens are first evoked in cuneiform texts 3000 years ago, we must thus absolutely think inside the temps long (the “long duration” approach: see Braudel 1987). The memory of the system indeed, i.e. the century to pluri-millennium-scaled changes
imposed by the substratum context, the volcanic activity (e.g. see Annex 1), the climate conditions, the deposition and erosion dynamics, the tectonic uplift and associated earthquakes, the impacts of past human activities and management etc... (e.g. see references in Annex 2), strongly constrains the dynamics and the future of the environment.

32 The Hevsel Gardens are such objects capable of containing information about the “temps long” of the City of Diyarbakır. Besides, the terraces sustaining the Hevsel Gardens also record hydrological and climatic changes in the valley, from the Last Glacial to the Holocene, until today.

33 To date, no age, no stratigraphy, no sedimentology are available for the Hevsel gardens and the Tigris terraces at Diyarbakır. Figures 5 to 7 show clearly that defining and dating the landscapes previous to the gardens, or during the activity period of the gardens need coring all terraces.

34 Our 2014 coring experience shows that future coring in recent and old alluvium must be performed with a motorized corer, which will be able to break through gravel layers. Only this way will we be able to reach layers and deposits from different periods in the formation of today’s river flood plain and terraces.

35 In the Upper Tigris watershed, we plan to study the geomorphologic and climatic records, which will provide for the wider space (regional) and time (Braudelian temps long) of the history of environment in the region and in the river’s life span.

36 In the frame of this history of the river basin, our expected results should enlighten periods of stability and instability in the fluvial dynamics. Such a reconstruction must be set in relation to the occupation of the region by human societies. Indeed, due to its primary role in the appearance of agriculture, the whole Tigris basin is critical for the humanity’s history (Fig. 1) (e.g. Karadoğan and Kozbe 2013), from the Pre-Pottery Neolithic period (PPN: e.g. Özdoğan 2007; Kuzucuoğlu 2014) to the Middle Ages (Ottoman Empire), from the end of the Younger Dryas (11400 years ago to the 8.2 cal BP rapid event (e.g. Weninger et al. 2009), from the Akkadian Empire at the 4.2 ka cal BP climatic crisis to the end of Hittite Empire during the 3.2 ka cal BP climatic crisis, from the Assyrian wars to the arrival and retreat of the Roman Empire, from the Byzantine to the arrival of the Seljuks... Our time-scope thus covers in the basin: (i) the Last Ice Age (especially since its maximum 35-16.000 years ago: e.g. Sarıkaya et al. 2011), (ii) the Late Glacial, which saw the first Fertile Crescent human settlements in the Upper Tigris basin, (iii) the Holocene, when this region became a centre for the development of plant and animal domestication techniques and of urbanisation as well as State formation.
BIBLIOGRAPHY


APPENDIXES

The Karacadağ Volcanism and Its Impact on the Tigris Valley in the Area of Diyarbakır. Preliminary state of the art

It is important to integrate volcanism in our study for three main reasons:

1. volcanism not only produces interesting forms, but it is capable of modifying other landforms in extreme manners. Basaltic flows especially are capable of filling-in river valleys; they can also force changes in river flow directions when they cut (and dam) a valley, sometimes definitively; they preserve geological formations and old landforms below them as they are very resistant to later erosion;
2. because in-fillings and dammings cause river flow interruptions, they often also produce lakes. Lake sediments and levels are good indicators of environment/climatic changes;
3. it is easy (although expensive) to date basaltic flows. Such flows (and other eruptive products) are thus very useful for setting chronological frames to climatic and environmental events in the area (see below).

Presentation

West of Diyarbakır, the Karacadağ basaltic shield volcano (1945 m) is the largest volcano of Turkey (and the Middle East?). It is formed by an abundant fissural activity that emitted lavas forming today a N-S oriented accretion cupola-shaped shield west of Diyarbakır (Fig. 13). The longest of the flows eastwards reached the area of Diyarbakır and of the River Tigris present valley where a flow remain forms, for example, a high promontory overlooking the river valley left bank. Two periods of activity are known: (i): 11 to 10 Million years (Ma), i.e. Upper Miocene; (ii) 6.7-6.6 Ma, i.e. Transition Miocene-Pliocene; (iii) 1.9 Ma to 100 ka (ka = 100,000 years), i.e. Quaternary (Türkecan 2015).

The basaltic lava flows below the City walls of Diyarbakır

Several authors, from Haksal (1981) to Westaway et al., (2009), have studied the Quaternary activity of the volcano. This activity produced many cones and craters which top today the preceding Miocene lava accumulation on the N-S backbone of the shield. Cones and craters emitted very fluid basaltic flows which flow eastwards in direction of today’s River Tigris valley. With ages of 1.2 to 1.07 Ma (Westaway et al. 2009), the Diyarbakır flows belong to an early phase of this Quaternary activity. These ages pre-date very coarse alluvium fossilized below the basaltic flow (visible at Mardin Gate in Diyarbakır: Fig. 7). The Early Pleistocene alluvial deposits belonged to a sheet-flow type hydraulic system that can be visualized when looking at similar (although later) alluvium pieces blanketing the plateau surface formed by these very lava flows east of Diyarbakır. When the Diyarbakır flows were emitted, the collector-drain transporting the pre-basalt alluvium was located roughly at the same place as today’s River Tigris (Fig. 13), although it may have had a flow direction different from that of today. Today’s River Tigris flows now ∼60–70 m below the floor of the Early Pleistocene alluvium fossilized by the lava flow forming Diyarbakır City eastern cliffs (Fig. 7).

The sedimentary-volcanic succession at the right bank of the River Tigris valley south of Diyarbakır

South of Diyarbakır, the river crosses a deep and narrow gorge incised into a geological series topped on both sides by the Early Pleistocene basalt flows. Outflowing from the gorge, the river turns eastwards, forming an elbow eastward (Fig. 14). This elbow was triggered during Upper Miocene or Upper Pliocene (?) by the building up of the Karacadağ volcano which is obviously set over a former drain used by a palaeo-river Tigris flowing west toward a palaeo-Euphrates (Fig. 14). According to dates published in Westaway et al., (2009), these flows are Middle Pleistocene aged (600-430 ka ago). They cover a sedimentary series formed by alternations of coarse alluvium and red clays, which record a lake-like environment with a highly varying level (Fig. 15). This lake
landscape and surrounding alluvial fans thus possibly dates Early Pleistocene. It may have resulted from the hydraulic disorganization created by the lava dams across the west-oriented palaeo-Tigris. The top of this sedimentary series is positioned ∼21–22 m above today’s riverbed, meaning that only the last 20m of the River Tigris incision dates Middle and Upper Pleistocene. This observation and calculation may not be transposable upstream the gorge since, if we are right in assuming that there is only one lava flow at Diyarbakır, a fault-movement contributed to 20m of the 70m apparent incision of the river at Diyarbakır.

Figure 14 - The elbow of the Tigris River where the river abandons its pre-Karacadağ valley

Figure 15 - Mio-Pliocene sedimentary deposits fossilized by the Middle Pleistocene lava flows

Sections on the right bank of the River Tigris elbow south of Diyarbakır
A Preliminary Exhaustive Reference List applied to the Upper Tigris, classified by main subject

Geology and Geomorphology in the River Tigris valley and basin (Diyarbakır region and related references)


Sediments and terraces, archives of climate


**Past climates and human societies**


**Tigris Archaeology**


**NOTES**

1. The Last Glacial: 115,000 to 15,000 years ago; the Late Glacial: 15,000 to 11,400 years ago; the Holocene: 11,400 years ago to today.
2. Upper Miocene is dated 11.6 to 5.3 Ma ago.
3. 5.3 to 2.6 Ma ago

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4. The words “Quaternary” and “Pleistocene” are equivalent
5. Plio-Pleistocene transition is dated 2.6-1.9 Ma; Early Pleistocene is dated 1.9 - 0.5 Ma; Middle Pleistocene is dated 0.5 to 0.12 ka; Upper Pleistocene is the period covering the last 115 ka.

ABSTRACTS

Environment and environmental systems have memories which become heritages common to several civilizations. The river and valley systems at Diyarbakır are such a heritage, whose future depends first today on our decisions and deeds, but also on the history of the system dynamics. This history is recorded in the terraces stretching along the river flood plain, and in the relationships between the river and the substratum that it incises. In 2014, we investigated the Hevsel gardens, which correspond to river terraces stepping at the foot of the city walls (right bank), but also at the foot of the plateau over which the University is built (left bank). The results presented here fix the general context of our further studies (2015): 1) a topographic profile of the terraces from the foot of the City walls to today’s active bed; 2) the map of the terraces on the right bank of the river at Diyarbakır (corresponding to Hevsel gardens); 3) a preliminary geological section from the City to the river; 4) the stratigraphy of a sediment core retrieved from an abandoned channel of the river in one of its youngest terraces. Finally we expose our plans for future studies, which will investigate not only (1) deep cores to be set in terraces of different ages at the Diyarbakır location, but also other parts of the watershed such as (2) the remnants of a river network allowing the Tigris to join the Euphrates West of the Karacadağ volcanic massif, and (3) possible sediment archives contained in the collapsed bottom of dolines in the Bismil vicinity.

INDEX

Geographical index: Diyarbakır, Hevsel gardens
Keywords: Holocene, Tigris, Terraces

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