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# CLIMATE AND ITS HISTORICAL & CURRENT IMPACT

With environmental issues becoming an increasingly acute concern for countries worldwide, Turkey is a country of prime interest in the field of climate studies. Due to its location, it presents an area ripe for exploring and understanding climate development and the history of global environmental change within the context of contemporary international relations. Lake sediments, tree-rings, speleothems and peat deposits represent valuable natural 'archives' of environmental change which have been under-explored in both Turkey and the wider Black Sea region. This research programme into the vegetation and climate history of the region focuses on changes in vegetation, water resources, landscape stability and hazards in Turkey, the Black Sea area and much of the wider Middle East over time. It also provides a key context of interaction concerning human use of the landscape from prehistory to the present day.

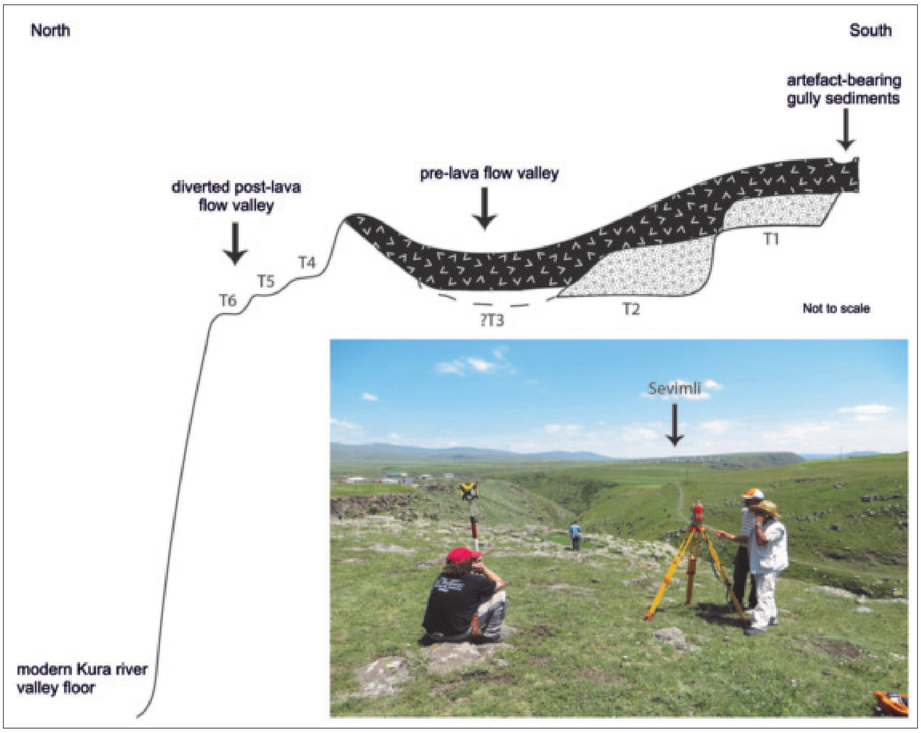
## Quaternary environments in northeastern Turkey: a context for early human occupation and migration

Darrel Maddy | Newcastle University
With Tuncer Demir, Tom Veldkamp, Serdar Aytaç, Philip Glauberman and Jeroen Schoorl

This is the second year of our three-year pilot project designed to identify the potential significance of the Quaternary sedimentary record of the upper catchment of the Kura river in northeastern Turkey. Our overall aim is to understand the evolution of the Kura catchment during the last 2.5 million years within the context of dramatic regional tectonic and climate-driven environmental changes. Specifically, we want to assess the importance of the Kura river valley as a potential migration pathway for early hominins from Asia into Europe. Based upon our earlier BIAA-funded research in western Turkey, we now believe the earliest securely-dated hominins in western Turkey arrived sometime around 1.2 million years ago (Maddy et al. in review; also Lebatard et al. 2014). However, it is likely that hominins roamed across the Kura catchment much earlier, especially as early hominins (*H. erectus ergaster georgicus*; see Lordkipanidze et al. 2013) arrived at Dminisi in Georgia around 1.8–1.6 million years ago (Gabunia et al. 2000). The timing of these early arrivals relies on finding hominin remains or artefacts within securely-dated sedimentary deposits. Establishing a reliable stratigraphy and chronology for the sedimentary and volcanic sequence in the Kura catchment will take many years, but this pilot study will inform our future work programme, allowing the targeting of key areas of interest, thus helping to make future research more efficient and effective.

Our first field season identified a number of immediate areas of interest, and during our second visit we concentrated our efforts in one of these areas, focusing on surface mapping and the description of outcrops close to the village of Sevimli. Our initial work in this area, northwest of the village, identified the possible occurrence of three high-level river terraces buried beneath basaltic lava flows flanking the deeply incised (>140m) narrow modern valley. However, observations were limited to one surface exposure in the underlying sediments, restricting confirmation of a fluvial origin to only one of these terrace levels. We sampled the overlying basalts for Ar-Ar age estimation last year, but these samples are currently being analysed, with results due later this year. Significantly, however, the terrace sequence is cross-cut by a large NNE–SSW trending normal fault, downstream (east) of which the terraces appear vertically offset (downwards) by up to 80m relative to those upstream (west), suggesting substantial post-depositional fault movement along this fault. This fault is one of many similar trending faults to cut across this part of the Kura valley. These faults form part of a series of structures which transfer strike-slip motion from the Dursunlu fault system (which forms the western limit of the Ardahan basin) eastwards across to the large Kura fault system which extends northwards into Georgia. This strike slip motion is believed to be coeval with the onset of motion along the north Anatolian fault system and thus begins around 7 million years ago, which constrains a maximum age for the higher terrace sequence. It is likely, however, that these terraces are much younger, a question we should be able to answer once we receive the outcome of the Ar-Ar age estimation from these lavas.

This year we focused on the area south of the Kura incised valley, where a small northward draining tributary has cut a small canyon, exposing, in places, the sediments beneath the overlying lava flows. Our field observations when combined with detailed survey of the outcrops, obtained using a Pentax total station, suggest the presence of up to six terraces above the level of the modern incised



Generalised sketch of the outcrops observed in a south–north draining tributary of the Kura river south of Sevimli. Inset shows members of the research team preparing to take detailed measurements of outcrop heights.

valley. The two highest levels (T1 and T2 on the figure above) comprise discrete gravel bodies, the lower of which has a thicknesses in excess of 15m. Both have internal sedimentary structures consistent with their interpretation as fluvial deposits. The unusual thickness of the lower gravel unit suggests possible linkage to the motion on an adjacent NNE–SSW trending fault (with which the tributary is aligned). Both T1 and T2 are overlain by a lava flow which flowed northward to levels beneath the base of the observed outcrop of T2 gravels. We infer that this flow entered a contemporary valley floor at the T3 level, although no exposures beneath the lowest basalt have yet been observed. It is possible that these fluvial deposits are equivalents of the three terraces already identified northwest of Sevimli and, given their lithological content, it is likely that they were deposited by an ancestral Kura river.

The geometry of and flow structures in the lava suggest flow into an active valley floor at the T3 level. This ancestral T3 valley would thus have been blocked by this lava, forcing the river to find an alternate course. The surface morphology strongly suggests that this rerouting occurred north of the previous valley where we identified a further three strath terraces (T4–T6) cut at progressively lower levels. We have sampled a number of lava outcrops for Ar-Ar age determination in order to help constrain the timing of this terrace sequence. Alas, currently none of the outcrops in this older sequence have yielded human artefacts, but the search continues.

Cutting into the basalt sequence on the flanks of the incised tributary valley, and therefore younger, is a gully system, which is, in part, in-filled with sandy sediments. These sediments yielded a significant number of artefacts made from semi-fine-grained volcanic, either dacite or fine basalt, rock, an abundant local raw material. None of the artefacts display evidence of rolling or reworking by water and there is only minor edge damage which is most likely related to time spent on the surface. No retouched tools were recovered. The dorsal flake scar patterns and the faceted striking platforms are suggestive of prepared core technology, possibly centripital or recurrent Levallois. It is not possible, however, to assign the artefacts to any strict temporal period, but they are clearly Palaeolithic.

The timing and origin of the gully system is currently obscure. The gully system appears to drain into the main northward draining tributary which drains a small graben system to the south. This actively subsiding area is bounded by two east–west oriented normal faults which appear to cross-cut, and thus, at least in part, post-date the NNE–SSW oriented faulting. How this drainage system evolved in response to these fault movements, volcanism and climate-driven change remains a key question for our next field season.

Our current fieldwork has confirmed the preservation of artefact-bearing sediments, but the stratigraphical complexity of the sedimentary record from this part of the Kura catchment will keep us busy for many years. Things may become clearer once our first geochronological age estimates are available. In the interim, we will continue our pioneering field observation programme.

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