Environmental and social changes recorded in the charcoal remains of Arslantepe (Anatolia) from 3350 to 2000 years BC

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Summary: *Charred wood remains, coming from the Turkish tell of Arslantepe (Malatya), have been studied to reconstruct the vegetation history and the palaeoclimate features of the site. Considerable amounts of charcoal remains from five different archaeological periods, since 3350 years BC to 2000 years BC, have been analyzed. The anthracological investigation provided a rather short list of woody* taxa *(11 in all), with important changes along the five investigated periods. Both human choices and environmental causes can be advocated to explain increase/decrease of key* taxa*. The interpretation of* taxa *has permitted to recognize two different landscapes, one mainly characterized by woody steppe elements, the other by riparian vegetation ones. The first and the last of the investigated archaeological periods, occurring between 3350-3000 and 2500-2000 years BC respectively, show important similarities, with overwhelming presence of hygrophilous* taxa*. In the central three periods woody-steppe landscape has been evidenced by wood remains. As a matter of fact these periods are considered to have been rather unstable from a climatic point of view in the Near East. The $^{13}C/^{12}C$ ratio in fossil plants allows reconstructing palaeoclimate, giving the possibility to exclude problems related to the human selection of wood.*

Key words: *charcoal, eastern Anatolia, isotope analysis, Late Chalcolithic, Early Bronze Age*

INTRODUCTION

The site of Arslantepe (*Arslan* = Lion, *Tepe* = mound) is located in the Malatya plain (Turkey). Today is a hill, 30 m high (Fig. 1), formed by a series of settlements built and abandoned/destroyed in five thousand years of almost uninterrupted occupation (Table 1).

FIGURE 1. The Arslantepe hill and the archaeological excavations.

Excavations of "La Sapienza" University of Rome at the site have been carried out uninterruptedly since 1961, bringing to light extraordinary remains of past prehistoric and protohistoric cultures of Eastern Anatolia. The excavation is still in progress, the oldest archaeological level dates back to the 7th millennium BP, the youngest is of Byzantine times. The amount of archaeobotanical remains is extraordinary both in quantity and importance.

As shown in Table 1, five different populations featured the archaeological periods analyzed. They are characterized, as indicated by the archaeological evidence by different cultures and social organizations.

The most ancient period analyzed is called VI A. The excavation has brought to light both public monumental buildings as the palace with temples and storage areas in which economic, religious and administrative activities were performed, and also élite residences. They are the evidence of the emergence of the first states. A big fire destroyed the whole settlement. After that, the whole 3rd millennium BC was characterised by a continuous occupation with superimposed villages, some of which fortified and more permanent (e.g. VI D), whilst others more seasonal and ephemeral (e.g. VI B1).

Chronological sequence	Period of Arslantepe	Calendar years BC	Contemporary civilization in Mesopotamia
Early Bronze Age III	VI D	2500 - 2000	Protodynastic III b, III Ur dynasty
Early Bronze Age II	VI C	2750 - 2500	Protodynastic II - III a
Early Bronze Age I	VI B1/VI B2	3000 - 2750	Period of Jemdet Nasr and Protodynastic
Late Chalcotithic 5	VI A	3350 - 3000	Late Uruk Culture

TABLE 1. Chronology of Arslantepe

METHODS

The identification of charcoals was carried out at the reflected light microscope and then, for detailed wood identifications, a Nomarski microscope (phase contrast

microscope with differential interference contrast) was used.

Carbon isotope analysis was carried out to evaluate environmental changes on two selected *taxa*, deciduous *Quercus* and *Juniperus*. According to Farquhar *et al.* (1989) the stable carbon isotope contained in plants depends on several environmental factors. So the comparison of isotopic ratios from different periods can be related to changes in humidity (Hall *et al*., 2008; Riehl *et al*., 2008). $^{13}C/^{12}C$ ratio analyses were performed by combustion in an Elemental Analyser coupled with isotope ratio mass spectrometer.

DATA AND RESULTS

All the investigated periods have included charred remains of woods, seeds and fruits. Eleven different wood *taxa* and one monocot taxon have been recognized (Table 2); the majority of charcoals have been identified at the genus level.

Period of Arslantepe	Chronological sequence	List of *taxa*
VI D	Early Bronze Age III (2500 – 2000 BC)	deciduous *Quercus* *Populus* sp. *Alnus* sp. *Pinus sylvestris*/*montana* gr. *Juniperus* sp. *Ulmus* sp. *Fraxinus* sp. *Pistacia* Rosaceae Cf. *Arundo*
VI C	Early Bronze Age II (2750 – 2500 BC)	deciduous *Quercus* *Populus* sp. *Alnus* sp. *Pinus sylvestris*/*montana* gr. *Juniperus* sp. *Fraxinus* sp. Cf. *Arundo*
VI B2	Early Bronze Age I (2900 – 2750 BC)	deciduous *Quercus* *Populus* sp. *Alnus* sp. *Juniperus* sp. *Ulmus* sp. *Fraxinus* sp. *Pistacia* *Tamarix*
VI B1	Early Bronze Age I (3000 – 2900 BC)	deciduous *Quercus* *Populus* sp. *Alnus* sp. *Juniperus* sp.
VI A	Late Chalcotithic 5 (3350 – 3000 BC)	deciduous *Quercus* *Populus* sp. *Alnus* sp. *Pinus sylvestris*/*montana* gr. *Juniperus* sp. *Ulmus* sp. *Fraxinus* sp. *Rosaceae* Cf. *Arundo*

TABLE 2. List of taxa *(in order of abundance) found at Arslantepe.*

The assemblages found indicate that wood resources were mainly exploited from two local ecological communities, the woody steppe (composed by deciduous and semi-deciduous oaks with rosaceans) and the riparian vegetation. The last is from wet environments, including both hydrophilous (mainly alders and poplars with a slow amount of tamarisks) and possibly hygrophilous (elms and ashes) *taxa*. A considerably minor contribution is from mountain *taxa* (pines and junipers). The comparison of the relative *taxa* abundances in the single periods indicates that woodland-steppe elements are very abundant for half a millennium, during the Early Bronze Age, from 3000 to 2500 years BC (VI B1, VI B2 and VI C periods). On the contrary hydrophilous elements are quite important during the Late Chalcolithic (VI A) and at the end of the Early Bronze Age (VI D), while woodland-steppe elements and mountain ones show opposite values in these two periods.

The isotope data confirms the results of traditional archaeobotanical analysis, suggesting that periods with higher amount of trees of wet environments were more humid. Moreover, they show instability of climate during the Late Chalcolithic according to palaeoenvironmental proxy.

The modern samples have more negative values than the archaeological ones. This indicates that present day climate conditions are drier than the past ones.

DISCUSSION AND CONCLUSIONS

At Arslantepe, during more than one millennium a number of important changes in timber use are found. Preliminary investigations suggest that also the isotope carbon ratios from selected *taxa* underwent important changes.

Further analyses will make clearer the climatic trends that occurred from the Late Chalcolithic to the Early Bronze Age (Masi *et al*., work in progress). By means of charcoal studies, it becomes evident that only using a multidisciplinary approach it will be possible to discern among natural and anthropic factors in the shaping of past plant landscape.

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