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CARBON ISOTOPE COMPOSITION OF ARCHAEOBOTANICAL REMAINS FOR THE PALAEOCLIMATIC RECONSTRUCTION

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ABSTRACT: Masi A. *et al.*, Carbon isotope composition of archaeobotanical remains for the palaeoclimatic reconstruction (IT ISSN 0394-3356, 2011)
A long-lived Anatolian archaeological site (Arslantepe, Malatya plain) was investigated under a palaeoclimate perspective. Identified plant charred macroremains underwent an isotopic analysis to determine carbon isotope composition. The results obtained are used to assess the degree of climate changes in the site and its surroundings.

RIASSUNTO: Masi A. *et al.*, La composizione isotopica del carbonio di resti archeobotanici per la ricostruzione paleoclimatica. (IT ISSN 0394-3356, 2011)
Un sito dell'Anatolia, caratterizzato da una lunga occupazione, è stato preso in considerazione per una ricostruzione paleoclimatica. Alcuni resti vegetali carbonizzati sono stati sottoposti ad analisi isotopica per determinare la composizione isotopica del carbonio. I risultati ottenuti contribuisscono a comprendere i cambi climatici del sito e del territorio circostante.

Key words: plant macroremains, isotopes, archaeological site, climate change

Parole chiave: macroresti vegetali, isotopi, sito archeologico, cambiamento climatico

The site of Arslantepe (Arslan = Lion, Tepe = mound) is located in the Malatya plain (eastern Turkey, central Anatolia). Today is a hill, 30 m high (Fig. 1), formed by a series of settlements built and destroyed in five thousand years of almost uninterrupted occupation (table 1).
Arslantepe has been bringing to light extraordinary remains of past prehistoric and protohistoric cultures of Eastern Anatolia. The excavation is still ongoing, the oldest archaeological level dates back to the 7th millennium BP, the youngest is of Byzantine times.
Excavations of "La Sapienza" University of Rome at the site have been carried out uninterruptedly since 1961, bringing to light a lot of archaeobotanical material coming from the entire succession of occupation of the site.

Fig. 1, Arslantepe. Aerial photograph of the site
Arslantepe. Fotografia aerea del sito.

The archaeobotanical studies highlighted the presence of various botanical *taxa* preserved by charring, belonging to arboreal and crop species. Great variety was found, the diversity in cultivated *taxa* and the selective use of wood can be either due to a choice or even to environmental availability.
The charcoal assemblages (Fig. 2) of the

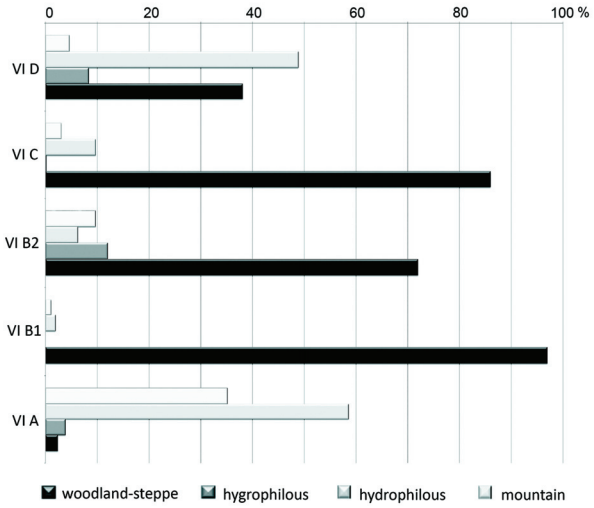

Fig. 2, Arslantepe. Charcoal changes in the five investigated periods. Percentage diagram of ecological groups (see text)
Arslantepe. Cambiamenti nei carboni nei cinque periodi indagati. Diagramma percentuale dei gruppi ecologici (vedi testo)

GENERAL CHRONOLOGICAL SEQUENCE	PERIOD OF ARSLANTEPE	CALENDAR YEARS B.C.	CONTEMPORARY CIVILIZATION OF NEAR EAST
Late Roman and Byzantine age	I		
Iron age	II - III	1100 -712	Neo-Hittite kingdoms
Late Bronze age II	IV	1600 - 1200	Middle Hittite kingdom and Hittite empire age
Late Bronze age I	V B	1750 - 1570	Old Hittite kingdom
Middle Bronze age	V A	2000 - 1750	Age of old Assirian colonies
Early Bronze age III	VI D	2500 - 2000	Protodynastic III b, III Ur dynasty in Mesopotamia
Early Bronze age II	VI C	2750 - 2500	Protodynastic II - III a in Mesopotamia
Early Bronze age I	VI B2 / VI B1	3000 - 2750	Jemdet Nasr and Protodynastic in Mesopotamia
Late Calcholitic 5	VI A	3350 - 3000	Late Uruk Culture in Mesopotamia
Late Calcholitic 3-4	VII	3800 - 3400	Old and middle Uruk Culture in Mesopotamia
Late Calcholitic 1-2	VIII	4250 - 3900	End of Ubaid culture in Mesopotamia

Table 1, Arslantepe. Chronological periods
Arslantepe. Periodi cronologici

investigated archaeological site 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 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.

As important structural changes are found between the various periods of Arslantepe, it is not clear if the important variations found in plants use by the successive settlers are due to cultural choices or to environmental changes.

A contribute comes from the study of the stable carbon isotope carried out both on ancient and present-day plants. The relationship between the fractionation of carbon isotope and climate condition is well known.

The $^{13}C/^{12}C$ ratio depends mainly on moisture stress and isotopic ratio of atmospheric CO_2 (FARQUHAR G.D. *et al.,* 1989).

Such independent information of environmental variations permits to discriminate between cultural and environmental change (HALL G. *et al*., 2008; RIEHL S. *et al*., 2008). $^{13}C/^{12}C$ ratio analysis were performed by combustion in a Elemental Analyzer (Carlo Erba, EA1108) coupling with isotope ratio mass spectrometer (Delta plus XP Finnigan) via the Finnigan MAT Conflo II interface at IGG-CNR of Pisa.

More than one hundred charred samples of deciduous *Quercus* and *Juniperus* were analyzed. They come from five archaeological periods of Arslantepe, ranging from late Chalcolithic V (5350-5000 BP) to Early Bronze Age III (4500-4000 BP). The variability of data is high, however a $d^{13}C$ variation is present and some trends recognizable. The data coming from fossil assemblages are compared with those from living plants of the same genus in order to reconstruct past environment and climatic trend through more than one millennium.

REFERENCES

FARQUHAR G.D., EHLERINGER J.R. & HUBIK K.T. (1989) - *Carbon isotope discrimination and photosynthesis*. Annual Review of Plant Physiology **40**, 503-537.

HALL G., WOODBORNE S.M. & SCHOLES M. (2008) - *Stable carbon isotope ratios from archaeological charcoal as palaeoenvironmental indicators*. Chemical Geology, **247(3-4)**, 384-400.

RIEHL S., BRYSON R. & PUSTOVOYTOV K. (2008) - *Changing growing conditions for crops during the Near Eastern Bronze Age (3000-1200 BC): the stable carbon isotope evidence*. Journal of Archaeological Science, **35**, 1011-1022.

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