Food strategies and supplies: inferring crop provenience from carbon and nitrogen stable isotopes analysis

Angela Stellati, Girolamo Fiorentino

Laboratory of Archaeobotany and Palaeoecology, Dipartimento di Beni Culturali, Università del Salento,
via D. Birago 64, 73100, Lecce, Italy

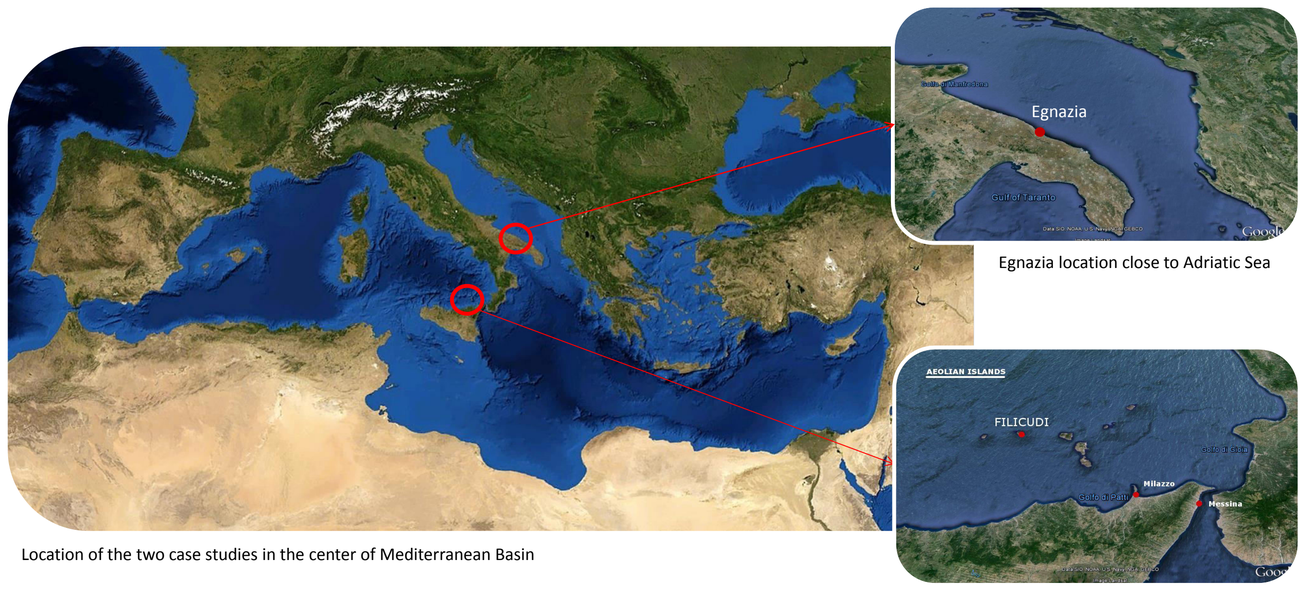
angela.stellati@gmail.com; girolamo.fiorentino@unisalento.it

INTRODUCTION

Mediterranean landscape and seascape, with its chains of islands, archipelagos and peninsulas, encouraged maritime explorations since Upper Paleolithic/Mesolithic onward (Cherry 1981; Broodbank 2006). Particularly the Italian Peninsula, extended in the middle of the Mediterranean Basin, became a focal and stopover point in the trades.

In this work we focused on two archaeological sites located in Southern Italy related to two periods with different historical and economical challenges: the Bronze Age village of Filo Braccio, in the Aeolian Archipelago, and the Roman city of Egnazia, in Apulian region.

In order to assess the impact that trades may have had on local economy over the time a series of isotopic analyses have been carried out on archaeobotanical materials.



Location of the two case studies in the center of Mediterranean Basin

Egnazia location close to Adriatic Sea

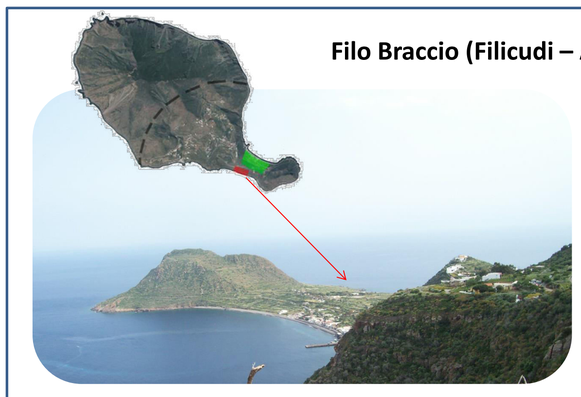
Filicudi island in the Aeolian archipelago where the village of Filo Braccio was settled

THEORETICAL BACKGROUND

In archaeobotanical research stable isotopes analyses have become an essential tool for defining climate changes and agricultural practices: a significant relationship between the growing-site conditions and the isotope signature in plants have been observed (Fiorentino *et alii* 2015). Particularly, carbon isotopes composition ($\delta^{13}C$) is linked to photosynthetic pattern and provide informations about water availability and climate fluctuations (rainfall regime); while stable nitrogen isotopes ratio ($\delta^{15}N$), linked to the metabolic processes, reflect the nutritional status of the soil.

IRMS analyses on archaeobotanical remains recovered at Filo Braccio and Egnazia were used to define subsistence strategies (Fiorentino *et alii* 2012) in two key periods in the history of Mediterranean trades (Bronze Age and Roman Period).

Filo Braccio (Filicudi – Aeolian Islands)



Location, on the Filicudi island, of Filo Braccio village (EBA – *Capo Graziano* I cultural phase) and the useful cultivable land

In assessing the productive potential of an insular volcanic contexts, as in the case of the Aeolian archipelago, we have to consider two foundamental features: limited water availability and extent of cultivable land (Speciale *et alii* in press).
Isotopic analyses can enhance the knowledge on these topics by informing on the relationship between plants and their growth environment.

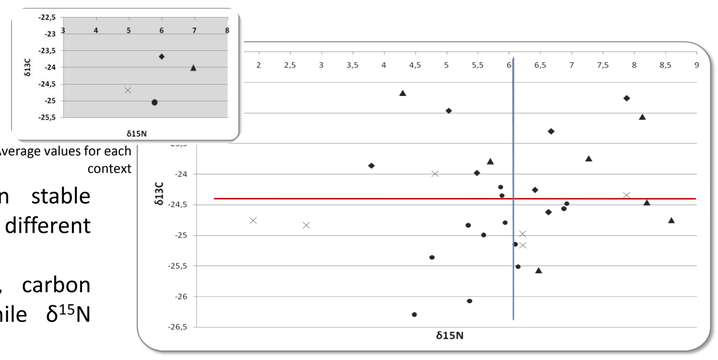
ARCHAEOLOGICAL CONTEXTS ANALIZED: huts and a multifunctional open area from the same chronological period

ARCHAEOBOTANICAL REMAINS

- Charcoals: twigs of presumed local *taxa* - *Erica arborea*, *Juniperus* sp., Prunoideae

- Caryopses: *Hordeum vulgare*

ISOTOPIC PARAMETERS: $\delta^{13}C$, $\delta^{15}N$

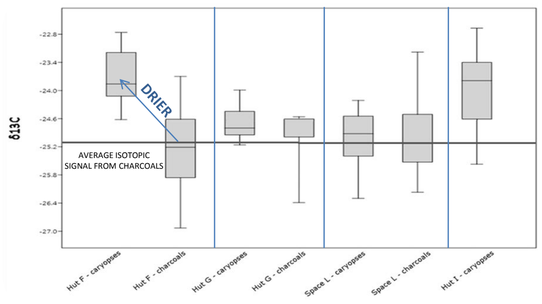


Average values for each context

Correlation of carbon and nitrogen stable isotopes detected on caryopses of different contexts shows a dispersion of values.
If we consider the average values, carbon isotopes appear more scattered while $\delta^{15}N$ values are concentrated.

Correlation between $\delta^{13}C$ and $\delta^{15}N$ of caryopses (different symbols correspond to the archaeological contexts analyzed): in red average values of $\delta^{13}C$, in blue average values of $\delta^{15}N$

WHAT DOES THIS MEAN?



$\delta^{13}C$ variations in charcoals and caryopses recovered in the four contexts of Filo Braccio

Data from caryopses reveal that they are grown on similar soil, probably within the same volcanic archipelago (average $\delta^{15}N$ ranges from 4,96 ‰ to 6,95 ‰).
The dispersion of carbon values instead indicates that caryopses from the four contexts have been subjected to a different water input and then grown on distinct harvesting areas.
$\delta^{13}C$ of caryopses was compared with that of charcoals recovered in the same contexts (our local carbon isotope marker, also considering the physiological differences between different plants).

1) Stable carbon isotopes results show that there is no overlapping in the values of kernels and charcoals for Hut F, as the barley caryopses give a drier signal (average value = 24,00 ‰);
2) Values from Hut I indicate that kernels have drier values than the average one;
3) $\delta^{13}C$ of caryopses from Hut G and Space L are in line with data from charcoals.

Isotopic analyses conducted so far on the village of Filo Braccio shed light on land management and the self-subsistance of this Bronze Age community and on local trades within the archipelago.

Egnazia (Apulia region)

The Roman city of Egnazia is settled on the Adriatic coast of Apulia region on the base of the Murgia hills. These geomorphological features make this region particularly suitable for cereal cultivations.
Moreover Egnazia has played a central role in the trades through the Apulian hinterland and the Mediterranean Basin during the Roman period and the Late Antiquity.
Archaeobotanical and biochemical analyses were performed to define land use and the potential incidence of cereal imports on local economy during two periods: Late Antiquity and Medieval phase.

Location of Egnazia on the base of Murgia hills and its aerial view

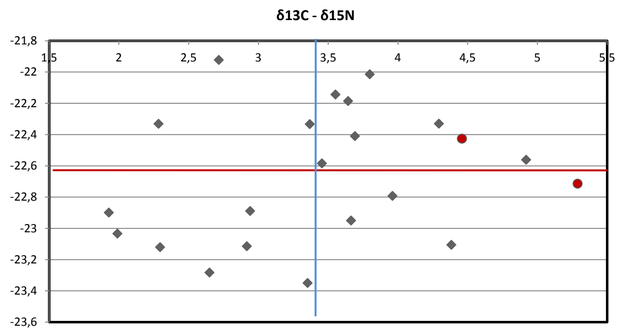
ARCHAEOLOGICAL CONTEXTS ANALIZED: a Late Antique phase in the *thermae* area (VII cent. A.D.) and a Medieval hut (XIII cent. A.D.)

ARCHAEOBOTANICAL REMAINS

- Charcoals: twigs of presumed local *taxa* - *Pistacia lentiscus*, *Olea europaea*, *Rhamnus/Phillyrea*

- Caryopses: *Triticum aestivum/compactum*

ISOTOPIC PARAMETERS: $\delta^{13}C$, $\delta^{15}N$



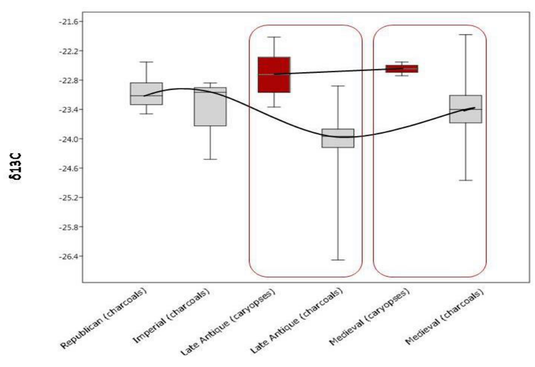
Correlation between carbon and nitrogen stable isotopes in Late Antique (grey diamond) and Medieval grains (red dot). In red average values of $\delta^{13}C$ of all samples, in blue average values of $\delta^{15}N$ of all samples.

	average $\delta^{13}C$	average $\delta^{15}N$
Late Antiquity	3,29	-22,67
Medieval	4,87	-22,57

Correlating carbon and nitrogen stable isotopes of caryopses we notice that the overall $\delta^{13}C$ values settle on an average of -22,62‰ (very similar for the two phases). Looking instead at $\delta^{15}N$, we can see a wide variation from a minimum of 1,93‰ and a maximum of 4,92‰.

WHAT DOES THIS MEAN?

These differences in nitrogen stable isotope values may be linked to different harvesting area.
In order to verify land use strategies carbon stable isotopes analyses on charcoals (our isotopic local fingerprint) have been performed.
Plotting of data, on a diachronic scale, shows differences in isotopic signal of local vegetation compared to that of kernels for the same period.



$\delta^{13}C$ variations in charcoals and caryopses from Republic Period to Middle Ages

The inhabitants of Egnazia during the two historical period considered, characterized by different climate conditions, define distinct land use strategies aimed to ensure the same suitable growth conditions for cereal cultivation.

Isotopic analyses of archaeobotanical materials of Filo Braccio and Egnazia show the big potential of this kind of analyses to investigate local economic strategies and past trades in the Mediterranean Basin.

References

Broodbank C., 2006. The origins and early development of Mediterranean maritime activity. *Journal of Mediterranean Archaeology* 19: 199–230; **Cherry J.F., 1981**. *Pattern and process in the earliest colonization of the Mediterranean islands*. Proceedings of the Prehistoric Society 47: 41-68; **Fiorentino G., Caracuta V., Casiello G., Longobardi F., Sacco A., 2012**. Studying ancient crop provenance: implications from d13C and d15N values of charred barley in a Middle Bronze Age silo at Ebla (NW Syria). *Rapid Commun. Mass Spectrom.* 26, 327–335; **Fiorentino G., Ferrio J.P., Bogaard A., Araus J.L., Riehl S., 2015**. Stable isotopes in archaeological research. *Veget Hist Archaeobot*. 24, 215-227; **Speciale C., D'Oronzo C., Stellati A., Fiorentino G.** *Ubi minor… deinde summa? Archaeobotanical data, paleoeconomical issues and spatial analysis in the prehistoric villages of the Aeolian Archipelago*. Scienze dell'antichità (IN PRESS)