RAPPORT SUR LE PROJET EU-ARTECH 07/**

TOWARDS A MATERIALITY OF PILGRIMAGE?
Characterizing obsidian from Neolithic Göbekli Tepe
(Urfa Region, SE Turkey)

QUELS TEMOIGNAGES MATERIELS POUR UNE DIFFUSION CULTURELLE ?
Caractérisation des obsidiennes du site néolithique de Göbekli Tepe
(Région d'Urfa, SE Turquie)

1. Introduction

Le traitement de l'expérience EU-ARTECH 07/** n'ayant pu être réalisé que très récemment, ce rapport se limitera à un strict rapport d'analyse. Le non fonctionnement du détecteur Basse Énergie a limité l'acquisition de données (teneurs en éléments 'légers' Na→Fe) mais a néanmoins permis l'obtention d'informations utilisables pour la plupart des échantillons.

Le responsable anglais de l'expérience, le Dr. T. Carter, sera dans notre laboratoire du 13-23 mai prochains. L'exploitation des données deviendra alors effective avec d'une part la préparation d'une publication et d'autre part celle d'un rapport EU-ARTECH détaillé (voir par exemple par le même Investigateur Principal un précédent rapport sur l'expérience EU-ARTECH 07/21, en annexe).

2. Contexte scientifique

A Göbekli Tepe, site archéologique situé dans la région d'Urfa au sud-est de la Turquie, repose un complexe tout à fait remarquable de pierres ovales. Les données radiocarbones associées datent ces structures des X^{e} et IX^{e} millénaire BC (Pre Pottery Neolithic A-Pre Pottery NeolithicB). Les interprétations actuelles dépeignent Göbekli Tepe comme un site rituel, probablement le plus vieux temple en pierre jamais découvert (cf. Lewis-Williams & Pearce, 2006).

L'obsidienne est un phénomène relativement rare à Gobekli Tepe. Elle ne représente que près de 1 % de l'assemblage lithique. L'étude de provenance de ces artefacts contribuera sans doute à clarifier les rapports inter-régionaux au début du Néolithique au Proche Orient.

3. Expériences réalisées et résultats

Une étude de provenance a été réalisée sur 100 pièces archéologiques.

Afin de sauvegarder l'intégrité de ces échantillons, nous avons procédé à une analyse élémentaire non-destructive sous faisceau d'ions (PIXE) en utilisant le faisceau extrait sur le système AGLAE du Centre de Recherche et de Restauration des Musées de France (C2RMF, Paris).

Un balayage 500 × 500 µm, systématiquement réalisé, a permis de contrôler l'homogénéité de chaque artefact (présence d'inclusions cristallines, etc.).

La présence d'un seul détecteur Si(Li) sur la ligne ne nous a permis que de déterminer les teneurs relatives de sept éléments, Manganèse, Fer, Gallium, Rubidium, Strontium, Zinc et Zirconium.

Une comparaison avec les données obtenues par notre équipe dans des conditions similaires sur des obsidiennes provenant des sources potentielles du Proche-Orient (Delerue, 2007 ; Poupeau et al., 2008 – en prep.) permet d'exclure pour les obsidiennes de Göbekli Tepe une provenance du Nenezi Dağ (Figure 1). La Figure 2 permet, à partir des rapports Rb/Ga, Sr/Ga et Zr/Ga, de constater que les échantillons appartiennent à trois groupes géochimiques discrets, celui des obsidiennes du Göllu Dağ, de Bingöl A et Bingöl B. Le bilan de l'étude est reporté dans le tableau 1.

4. Références

Delerue S., 2007. L'obsidienne dans le processus de néolithisation du Proche-Orient (12000-6500 BC), *Thèse de doctorat*, Université de Bordeaux, France.

Lewis-Williams D. & Pearce D. 2006 An accidental revolution? Early Neolithic religion and economic change, *Minerva*, **17**, 29-31.

Dr F.-X. Le Bourdonnec
Avril 2008

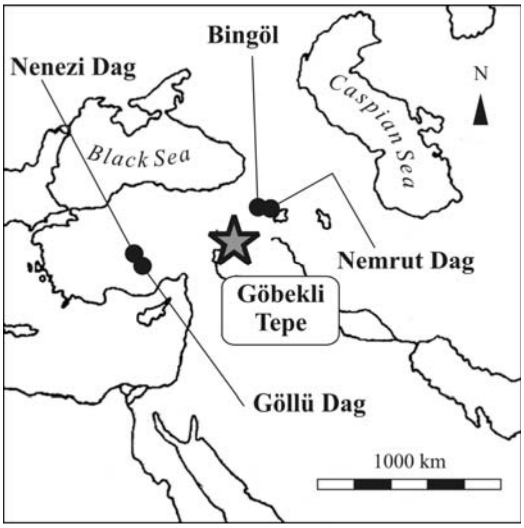

Figure 1 : Localisation du site de Göbekli Tepe et des sources potentielles d'obsidienne du Proche Orient.

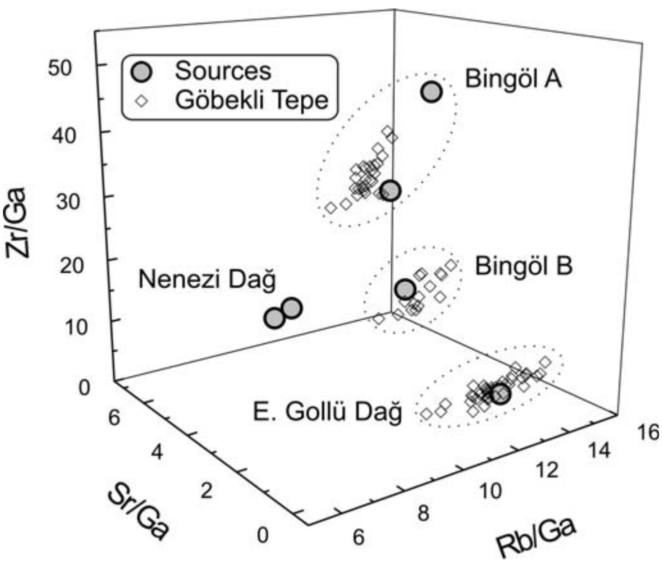

Figure 2 : Différenciation des obsidiennes du site de Gobekli Tepe à partir de leurs teneurs normalisées en Zr, Sr et Rb.

Tableau 1 : Bilan de l'étude de provenance des artefacts.

Sources	N
Göllu Dağ Est	41
Bingöl A	38
Bingöl B	15
Indéterminée	6
TOTAL	100

REPORT ON THE PROJECT EU-ARTECH 07/21

Obsidian Industries of Prehistoric Çatalhöyük (Turkey). *Chaînes Opératoires*: PIXE and Provenance Studies, Procurement Strategies in the Context of Near-East Neolithization Processes

Project Overview

This project was designed as an extension of a major obsidian characterization program initiated in 1999 dedicated to the sourcing of artifacts from the famous prehistoric site of Çatalhöyük in central Anatolia's Konya Plain (Mellaart 1967). This project is multi-faceted in terms of its archaeological and archaeometric research aims, and involves a number of laboratories and analytical methods (**Table 1**). Carter and Poupeau have been involved from the outset as the primary archaeologist and archaeometrist respectively (Carter 2006; Carter *et al* 2005a, 2005b, 2006; Poupeau *et al* 2005 *inter alia*).

The work consisted of PIXE measurements at AGLAE to source 46 obsidian artifacts from Early Neolithic and Early Chalcolithic levels at Çatalhöyük (*ca*. 7000-5500 cal BC). These analyses were supplemented with a new series of 13 geological source samples from Cappadocia and Eastern Anatolia. The research focused on how obsidian exchange can act as a marker for other processes in the Neolithic, not least inter-regional connections during periods of major socio-economic changes in the larger Near Eastern world, such as the spread of agriculture and the subsequent shift to pastoralism.

Data

All measurements were undertaken at C2RMF on the external beam line of the AGLAE facility (Calligaro *et al* 1996, 2002), whose two (SiLi) detectors allowed the simultaneous detection of 'light' elements Na, Al, Si, Mg, K, Ca, Ti, Mn and Fe and of 'heavy' elements Fe, Zn, Ga, Rb, Sr, Y, Zr and Nb. Detailed analytical procedures and data treatments are described elsewhere (Le Bourdonnec *et al* 2005; Lugliè *et al* 2007).

1. <u>Early Neolithic</u> – 40 artifacts from Çatalhöyük East (c. 7000-6300 cal BC). Using a bivariate plot of Zr .v. Zn three major compositional groups can be discerned (**Figure 1**). Most of the obsidian can be assigned to sources in southern Cappadocia, while five pieces had elemental compositions associated with eastern Anatolian sources.

2. <u>Early Chalcolithic</u> – 6 artifacts from Çatalhöyük West (c. 6300-5500 cal BC). As before, a bivariate plot of Zr .v. Zn distinguishes three major compositional groups (**Figure 2**), two relating to sources in southern Cappadocia, while a single sample has a chemical fingerprint associated with an outcrop in northern Cappadocia.

3. <u>Geological sources</u> – 13 samples were analyzed (**Figure 3**), including two pieces from Sirça Deresi, part of the East Göllü Dağ compositional group (Poidevin 1998, 115-121, Fig. 9) an important addition to the project's data-base (Poupeau *et al* 2005). The remaining samples derived from eastern Anatolian sources, namely: Suphan Dağ, Meydan Dağ, Bingöl-peralkaline and Nemrut Dağ (southeastern Anatolia / Lake Van region), plus Pasinler and Erzurum (northeastern Anatolia).

Results

While the bulk of the artifacts appear to have been – unsurprisingly – made from Çatalhöyük's main southern Cappadocian sources of East Göllü Dağ and Nenezi Dağ, the results have provided us with new information pertaining to the relative proportions of these raw materials' consumption through time, as well as their relationships with specific tool technologies. The analyses also demonstrated that a few artifacts were made of Eastern Anatolian obsidian, the first time that raw materials from this region have been attested in a central Anatolian context, *ca*. 660-825 km to the west. These data shed important light upon relations between the two regions at an important time of cultural and socio-economic reconfiguration in the Near East and Anatolia, namely the westward expansion of the Neolithic out of a central Anatolian core, together with a move to pastoralism in Turkey and the Levant. The latter resulted in the abandonment of most major sites with the exception of Çatalhöyük that subsequently developed into a 'Neolithic super-site', with a proportion of its obsidian arguably then arriving in the form of gift exchange and bridewealth from outsiders wishing to align themselves with such an important community.

Inter-Laboratory Analyses

Four of the artifacts run on the PIXE had already been analyzed by Dr. M.S. Shackley of UC Berkeley using ED-XRF, another of the larger research group's long-term participants (Carter and Shackley *in press*). These artifacts had produced what were considered to be interesting and anomalous trace-elemental data. These samples were re-analyzed to (a) corroborate the original findings, (b) use them as part of an inter-laboratory comparison and calibration project (with more samples to follow).

Products

A number of products are already in the process of being prepared for publication, with papers detailing the Neolithic and Chalcolithic data-sets, plus a lead-off article announcing the first discovery of Eastern Anatolian peralkaline obsidians at Çatalhöyük. There will also be a paper focusing on the inter-laboratory / instrumental aspects, two posters at the GMPCA *Archéometrie 07* conference (Aix-en-Provence), and other articles.

References

Calligaro, T., MacArthur, J. D. and Salomon, J. (1996), 'An improved experimental setup for the simultaneous PIXE analysis of heavy and light elements with a 3-MeV proton external beam', *Nuclear Instruments and Methods in Physics Research Section B* 109/110: 125-128.

Calligaro T., Dran J.-C., Moignard B., Pichon L., Salomon J. and Walter P. (2002), 'Ion beam analysis with external beams: recent set-up improvements', *Nuclear Instruments and Methods in Physics Research B* 188: 135-140.

Carter, T. (2006), 'City of glass: The role of obsidian at Çatalhöyük', in M. Haydaroğlu (ed.), *Çatalhöyük: From Earth to Eternity*. Yapı Kredi Kültür Sanat Yayıncılık, Istanbul: 39-44.

Carter, T., Conolly, J. and Spasojević, A. (2005a), 'The chipped stone', in I. Hodder (ed.), *Changing Materialities at Çatalhöyük: Reports from the 1995-1999 Seasons*. McDonald Institute Monographs and BIAA, Cambridge: 221-83 & 467-533

Carter, T., Poupeau, G., Bressy, C. and Pearce, N.J.P. (2005b), 'From chemistry to consumption: towards a history of obsidian use at Çatalhöyük through a programme of inter-laboratory trace-elemental characterization', in I. Hodder (ed.), *Changing Materialities at Çatalhöyük: Reports from the 1995-1999 Seasons*. McDonald Institute Monographs and BIAA, Cambridge: 285-305 & 535-57.

Carter, T., Poupeau, G., Bressy, C. and Pearce, N.J.G. (2006), 'A new programme of obsidian characterization at Çatalhöyük, Turkey', *Journal of Archaeological Science* 33(7): 893-909.

Carter, T. and Shackley, M.S. (*in press*), 'Sourcing obsidian from Neolithic Çatalhöyük (Turkey) using Energy Dispersive X-ray Fluorescence', *Archaeometry* [accepted July 2006].

Le Bourdonnec F.-X., Delerue S., Dubernet S., Moretto Ph., Calligaro T. , Dran J.-C. and Poupeau G. (2005), 'PIXE characterization of Western Mediterranean and Anatolian obsidians and Neolithic provenance studies', *Nucl. Instr. Methods in Physics Research B* 240: 595-599.

Lugliè C., Le Bourdonnec F.-X., Poupeau G., Atzeni E., Dubernet S., Moretto P. and Serani L. (2007), 'Early Neolithic obsidians in Sardinia (Western Mediterranean) : the Su Carroppu case', *Journal of Archaeological Science* 34: 428-439.

Mellaart J. (1967) *Çatal Hüyük, A Neolithic Town in Anatolia*, Thames and Hudson, London.

Poidevin, J.-.L. (1998), 'Les gisements d'obsidienne de Turquie et de Transcaucasie: géologie, géochemie et chronométrie', in M.C. Cauvin, A. Gourgaud, B. Gratuze, N. Arnaud, G. Poupeau, J.L. Poidevin and C. Chataigner (eds.), *L'Obsidienne au Proche et Moyen Orient: Du Volcan à l'Outil*. Maison de l'Orient Méditerranéen, British Archaeological Reports, International Series 738, Archaeopress, Oxford: 105-203.

Poupeau, G., Delerue, S. Carter, T., de B. Pereira, C.E., Miekeley, N. and Bellot-Gurlet, L. (2005) 'How homogeneous is the "East Göllü Dağ" (Cappadocia Turkey) obsidian 'source' composition?', *International Association of Obsidian Studies Bulletin* 32: 3-8.

Laboratory	Samples	Techniques	Publication
Grenoble (CNRS)	100 (101)	ICP-MS; ICP-AES	Carter *et al* 2005, 2006
Aberystwyth	35	LA-ICP-MS	Carter *et al* 2005, 2006
Berkeley #1	42	ED-XRF	Carter & Shackley *in press*
Bordeaux (IRAMAT-CNRS)	100	PIXE; SEM-EDS	*in prep*
Berkeley #2	58 (65)	ED-XRF	*in prep*
Paris (C2RMF-CNRS)	43 (46)	PIXE	*in prep* (This report)
Stanford	45	ICP-AES	*in prep*
TOTAL	**423 (434)**		

Table 1: The analysis of obsidian from Çatalhöyük: laboratories, methods, number of samples and status of work; figures in parentheses represent inter-lab duplicate analyses.

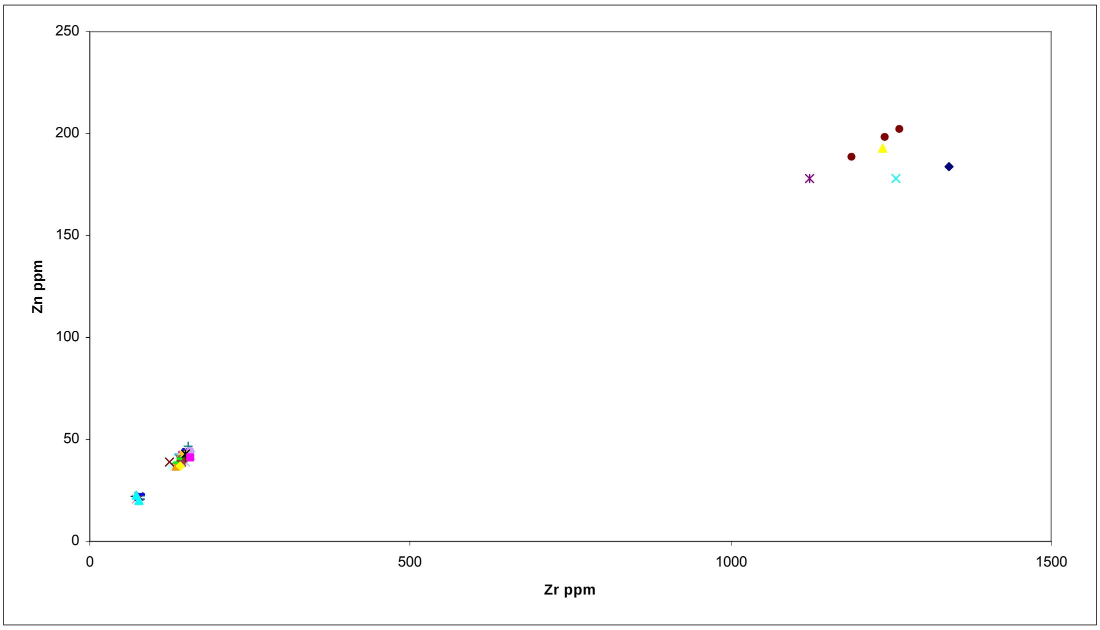

Figure 1: Bivariate Zn-Zr diagram for 40 samples of obsidian from Early Neolithic contexts at Çatalhöyük East.

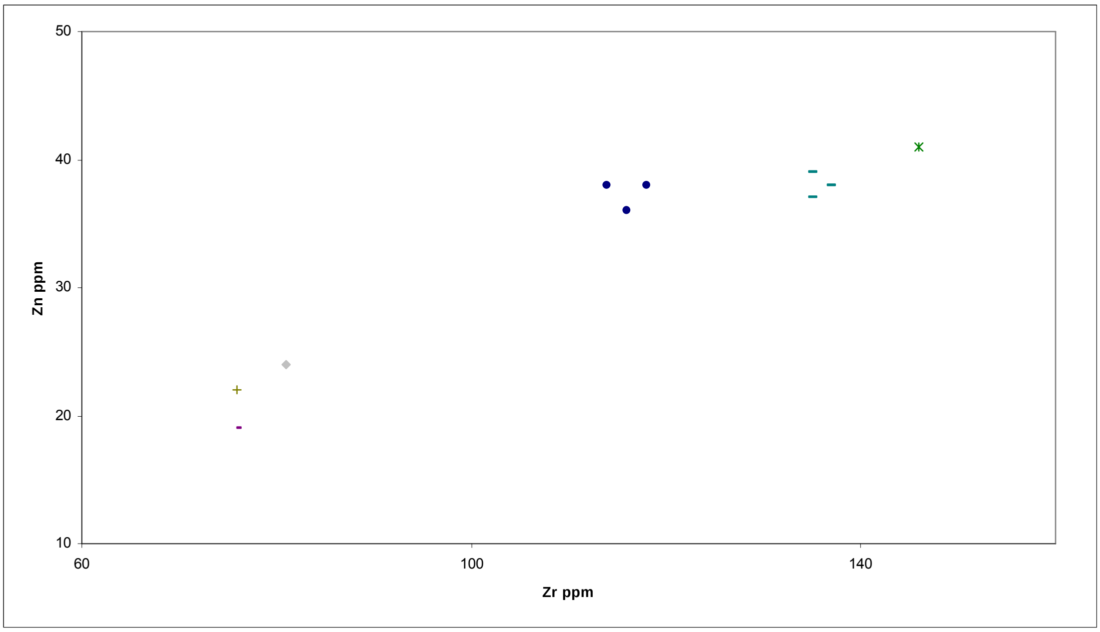

Figure 2: Bivariate Zn-Zr diagram for 6 samples of obsidian from Early Chalcolithic contexts at Çatalhöyük West (note different scale to **Figure 1**).

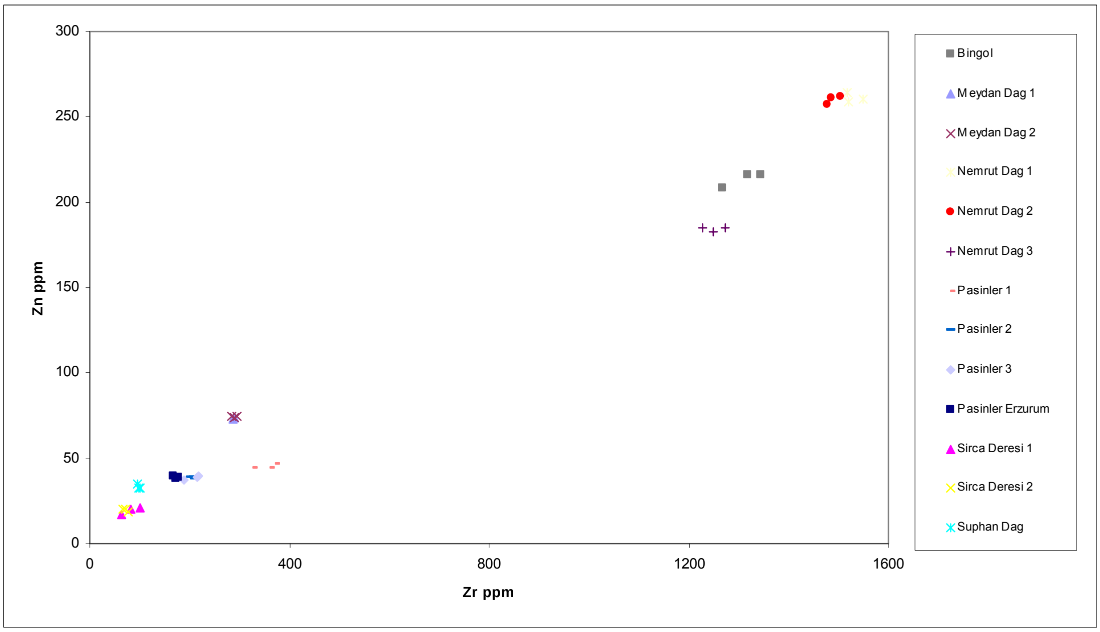

Figure 3: Bivariate Zn-Zr diagram for 13 samples of obsidian from various Anatolian geological sources.