INTERNATIONAL SPECIALIZED WORKSHOP

THE DATING AND PROVENANCE OF OBSIDIAN AND ANCIENT MANUFACTURED GLASSES

DELPHI, GREECE
21-24 FEBR. 2008

Co-organizers :

- Laboratory of Archaeometry, University of the Aegean, Greece
- Virginia Department of Historic Resources, Virginia, USA

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PROGRAM

21 February, Thursday

Arrivals
Welcome Cocktail at DELPHI PALACE HOTEL

22 February, Friday

(25 minute oral presentations + 5 minutes of questions. Please specify in advance your presentation requirements e.g., PowerPoint versions, overhead projectors)

MORNING SESSION: ANCIENT GLASS STUDIES
CHAIR: Robert TYKOT

9.00 – 9.30 Artemios Oikonomou, Nikos Zacharias Konstantinos Beltsios Pavlos Triantafyllidis, Konstantinos Ioannides (University of Ioannina, NCSR Demokritos, University of the Peloponnese) ***"Characterisation and provenance studies of archaeological glass artefacts from mainland Greece and the Aegean"*** (artemOikonomou@yahoo.com) [page 7]

9.30 – 10.00 Julian Henderson (Nottingham University) ***"Analysis and provenance of ancient glass from the Middle East"*** (julian.henderson@nottingham.ac.uk) [page 8]

10.00 – 10.30 Caroline Jackson (Sheffield University) ***"On the provenance of early Roman glasses"*** (c.m.jackson@sheffield.ac.uk) [page 9]

10.30 – 11.00 Laure Dussubieux and Chapurukha M. Kusimba, (The Field Museum of Natural History, USA) ***"Glass vessels in Sub-Saharan Africa: compositional study of some samples from Kenya"*** (ldussubieux@fieldmuseum.org) [page 10]

11.00 – 11.30 COFFEE BREAK

11.30 SESSION: OBSIDIAN HYDRATION DATING
CHAIR: Julian HENDERSON

11.30 – 12.00 Ioannis Liritzis, Christopher M. Stevenson, Nick Laskaris, Steve Novak, Wal Ambrose, Th. Ganetsos (University of the Aegean; Virginia Department of Historic Resources) ***"IR-PAS and SIMS of obsidian: aspects of alternative dating and average palaeo temperature determination"*** (liritzis@rhodes.aegean.gr; chris.stevenson@dhr.virginia.gov). [page 11]

12.00 – 12.30 Wal Ambrose and Steven W. Novak (Australian National University, Evans Analytical) ”***The 25 year hydration of obsidian at 10-40 °C*** “(wra410@coombs.anu.edu.au) [page 13]

12.30 – 13.00 Steven W. Novak and Christopher M. Stevenson (Virginia Department of Historic Resources & Evans Analytical Group) “***Aspects of SIMS depth profiling for obsidian hydration dating”*** (snovak@eaglabs.com). [page 14]

13.00 – 13.30 Ioannis Liritzis and Nick Laskaris (University of the Aegean) ***“The SIMS-SS obsidian hydration dating method”*** (liritzis@rhodes.aegean.gr ; nick.laskaris@gmail.com) [page 15]

13.45 LUNCH at Restaurant of Delphi Palace Hotel

17.00 EVENING SESSION: OBSIDIAN CHARACTERIZATION & PROVENANCE I
CHAIR: Michael GLASCOCK

17.00 – 17.30 Nikos Zacharias (NCSR Demokritos & University of the Peloponnese) “***TL and OSL techniques as characterisation and dating tools of glass material: a review”*** (zacharias@ims.demokritos.gr) [page 16]

17.30 – 18.00 Gerard Poupeau et al. (University of Bordeaux III) “***Raman spectroscopy, Mossbauer, and magnetic susceptibility in obsidian characterization and provenance”*** (gerard.poupeau@u-bordeaux3.fr)

18.00 – 18.30 Robert Tykot (University of South Florida) ***”Distinguishing obsidian subsources and reconstructing exchange patterns in the Central Mediterranean”*** (rtykot@chuma1.cas.usf.edu) [page 17]

18.30 – 19.00 Patrick Ryan Williams, Laure Dussubieux, Donna J. Nash (The Field Museum of natural History & The University of Illinois, Chicago) “***Provenance of Peruvian Wari obsidian: comparing INAA, LA-ICP-MS, and portable XRF”*** (ldussubieux@fieldmuseum.org) [page 18]

20.00 DINNER at local piano music restaurant INIOHOS in the center of Delphi Town.

23 FEBRUARY, SATURDAY

MORNING 8.30 – 12.30: GUIDED VISIT TO DELPHI MUSEUM & THE SANCTUARY

13.30 LUNCH at Restaurant of Delphi Palace Hotel

16.30 EVENING SESSION: OBSIDIAN CHARACTERIZATION & PROVENANCE II
CHAIR: Chris STEVENSON

16.30 – 17.00 Michael D. Glascock (University of Missouri) and Martin Giesso (Northeastern Illinois University), ***"New perspectives on obsidian procurement in Tiwanaku, Bolivia"*** (GlascockM@missouri.edu) [page 19]

17.00 – 17.30 Trudy Doelman, Robin Torrence, Vladimir Popov, Nikolai Kluyev, Irina Pantukhina, Igor Sleptsov (Australian Museum & Russia), ***"Selection, use and distribution of volcanic glasses in Primorye, far east Russia"*** (trudy.doelman@arts.usyd.edu.au ; robint@austmus.gov.edu) [page 20]

17.30 – 18.00 A.M. De Fransesco, Vincenzo Francaviglia, M. Bocci, G.M. Crisei. (University of Calabria & CNR Rome),**"Archaeological obsidians provenance of several Italian sites using non destructive XRF method"** (defrancesco@unical.it ; vincenzo.francaviglia@itabc.cnr.it) [page 21]

18.00 – 18.30 Gerard Poupeau et al (University of Bordeaux III) "***Provenance studies of Near Eastern & Western Mediterranean obsidians by PIXE, EMP-WDS, and SEM-EDS/MS"*** (gerard.poupeau@u-bordeaux3.fr)

18.30 – 19.00 Glenn Summerhayes (University of Otago, New Zealand) "***Network patterns in obsidian trade in the Pacific"*** (glenn.summerhayes@stonebow.otago.ac.nz) [page 22]

19:00 – 19:30 C. M. Stevenson and P. R. Mills (Virginia Department of Historic Resources, University of Hawai at Hilo) ***"A re-examination of volcanic glass hydration dating in Hawaii: a case study from Kahalu`u Habitation Cave, Hawai`i Island."*** (chris.stevenson@dhr.virginia.gov). [page 23]

20.00 DINNER at local traditional restaurant "to patriko mas'.

24 FEBRUARY, SUNDAY

DEPARTURES

AIM of the Workshop

Intensive investigations and technological progress obliges the frequent updating of interdisciplinary scientific disciplines. From our assessment of current archaeological glass studies, it becomes apparent that after every ten years it is necessary to provide a new synopsis. Many new advances have been developed since the last summary for obsidians published in 1998 (S. Shackley 1998 *Archaeological Obsidian Studies: Method and Theory*, Plenum Press, New York). New experimental procedures and understandings, novel methodological developments, and insightful applications have all emerged.

In this International Workshop, it is our goal to bring together examples of recent investigations that reflect new developments in the field of glass studies. This Workshop will not be simply a synthesis of the existing literature. Rather, we hope to incorporate contributions that summarize and build upon previous research but also present new and previously unpublished results. We have also widened the scope of the Meeting to include ancient glasses since many of the problems and applications in this field are directly related to research on natural glasses.

THEMATICS

The structure of the Workshop is straightforward and consists of three sections; dating, characterization and provenance of obsidian and ancient glass.

Characterisation and Provenance Studies of Archaeological Glass Artefacts from Mainland and Aegean Greece

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While significant knowledge about antiquity glassmaking has been accumulated through archaeometric studies, glass production issues like provenance and transfer of technology during the Greek antiquity of the historical period remain still ill-understood. This work aims at presenting analytical data from Aegean and Mainland sites towards the characterisation of glass bead collections with the application of electron microscopy equipped with energy dispersive X-ray microanalysis (SEM-EDX), non-destructive x-rays fluorescence (XRF) and Luminescence (TL/OSL) spectrometry. An attempt will be presented as regards the potential origin (local or imported) of the glasses recovered by using compositional and other markers.

The Provenance of Ancient Glass in the Middle East

Julian Henderson

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Ancient cuneiform texts and classical authors make it plain that the Middle East was an important area for glass production in antiquity. Over the past 20 years or so archaeological excavations have revealed a number of primary production sites for raw glass. Chemical analyses of raw glass from such production sites such as Beirut, (Lebanon), Bet Eli'ezer and Jalame (Israel) and Raqqa (Syria) have provided us with models for glass production technologies in the 1^{st} millennium AD. However, there are no such production sites for Bronze Age glass and moreover there is a question as to whether major, minor and trace compositions of 1^{st} millennium AD glasses *always* provide a geographical provenance. This paper will review precisely whether it is possible to provenance ancient soda-lime glass in the Middle East with a combination of analytical techniques, some of which have only recently been used on any scale in the context of ancient glass. These new techniques include thermal ion mass spectrometry (TIMS) to determine strontium, neodymium and oxygen isotope signatures and Thermal ion Mass Spectrometry (ToF-SIMS), with a sub-micron resolution and great analytical sensitivity to chemically characterise the impurities in opacifying crystals. The $^{143}Nd/^{144}Nd$ signatures determined by TIMS provides information about the geological age and type of silica used in glass production; $^{87}Sr/^{86}Sr$ signatures provide information about the age and type of lime used in glass production. The lime is thought to mainly be present in plant ash and aragonite mineral in shell fragments (in sand), with possible contribution from calcium-baring feldspars.

On the Provenance of Early Roman Glasses

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Roman glass is known for its compositional homogeneity, a feature which has been related to the use of sand and a natron (or trona) alkali in production. Recent work has suggested that, at least for 4th century and later Roman glasses, a small number of discrete compositional groups can be identified. These groups have been interpreted in terms of mass production of raw glass at specific locations in the eastern Mediterranean, which was then distributed to specialist glass working centres elsewhere in the Empire. For earlier Roman glasses a clear picture relating to production location and organisation has not yet emerged. This paper examines the composition of first century Roman glasses found in Northern Europe to determine whether any such compositional patterning can be seen in glasses from the early Roman Empire. Initial findings suggest that there are some discrete differences between groups of differently coloured glasses which are not wholly related to manufacturing practices, but which may be characteristic of the use of specific glass forming raw materials at differing manufacturing centres. These compositional characteristics will be discussed in the light of the continuing debate around the organisation of glass production and distribution in the Roman world.

Glass Vessels in Sub-Saharan Africa: Compositional Study of Some Samples from Kenya

Laure Dussubieux and Chapurukha M. Kusimba

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Chemical characterization studies on ancient artifacts have yielded tremendous data for understanding the history of technology and interregional interactions, including networks of trade and technology transfers. Although research in the chemical composition of ancient glass from Sub-Saharan Africa is a recent one, interest has been growing among historians of technology and anthropologists. Archaeological evidence for ancient glass vessel is known at virtually all urban sites in Africa. However, since no elemental and chemical analyses have been carried out on that type of material, the making, distribution, and use of glass vessel in Sub Saharan Africa remains poorly known. Provenancing of Africa glass has remained controversial and conjectural at best. Where, when, and how did ancient Sub Saharan Africans procure their glass? Archaeological data suggests a number of sources but no clear regions predominate. This paper will discuss the results of chemical analysis determined using Laser Ablation – Inductively Coupled Plasma – Mass Spectrometry (LA-ICP-MS) we recently carried on a small but representative sample glass vessel fragments from the Swahili town of Mtwapa in Kenya (ca. ACE 900 to 1750). The results are compared with compositions of contemporaneous glass artifacts recovered from different regions known to have had relations with East Africa, including Middle-East, India and Southeast Asia. The results provide very valuable data for discussing the possible sources and provenance of African glass vessel and take us beyond the conjectural and intuitive sourcing so common place in discussions of technology transfer in Africa.

IR-PAS and SIMS of Obsidians. Aspects on Alternative Dating and Average Palaeotemperature Determination: Preliminary Results

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Obsidian hydration dating is a method of wide utility throughout many parts of the globe where prehistoric peoples exploited surface and subsurface deposits of natural glass for the manufacture of stone tools. The high densities of broken tools and manufacturing waste products are found in numerous archaeological contexts and can be used to link past activity to a particular point in time. This information allows archaeologists to chronologically order a societies developmental history.

Over the last ten years intensive research into this subject has resulted in a much greater understanding of water diffusion into natural glasses and has provided important guidance in modelling the hydration process. One of the most recent innovations is the development of an age estimation procedure using secondary ion mass spectrometry. Termed SIMS-SS, hydrogen profiles of the diffused water layer may be used to estimate the age of an artefact without reference to other chronological controls such as radiocarbon dating or time sensitive artefacts such as ceramics [1-7]. The high analytical cost associated with the SIMS-SS approach is a limitation to wide application of the method in archaeology. Then, one of us (IL) proposed to CMS the start of a Research Project towards a step further [8]. Initially we (IL & CMS) developed a calibration that correlates the shape of the SIMS-SS profile with the infrared water spectra at 1630cm^{-1}. The same archaeological samples used in the SIMS/^{14}C comparison are used to establish the SIMS-IR calibration, which will then be used to establish the occupational phases of archaeological sites. Preliminary results from a set of world-wide obsidians indicate that the calibration can be successfully developed [9].

IR-PAS will be used to measure the concentration of diffused water in the hydrated archaeological layers. The absorbance values for the water (H_2O) peak at 1630 cm^{-1} have been used in this analysis.

Preliminary results using samples of known age as determined by SIMS-SS and IR-PAS measurements have developed a near linear relationship between are area of the water peak at 1630 cm^{-1} and the area under the SIMS profile over Xs.Cs (Xs= surface saturation depth, Cs= water concentration at Xs). In this case the IR values correlate with the SIMS profile areas and also the ages before present.

Further, obsidians hydrated under controlled laboratory conditions at constant temperatures T of 10, 20, 30 and 40 ^{o}C for 15 years are measured by SIMS and IRPAS. Linear correlation between T and SIMS and IRPAS parameters may be used to determine average burial temperatures of obsidians.

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SIMS Hydration Measurements from 25-year Controlled Temperature Exposures of Obsidians

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Obsidians from three separate volcanic provinces in Papua New Guinea have been exposed to controlled temperatures of 10°C, 20°C, 30°C, and 40°C, for up to 25 years in saturated vapour pressure enclosures at normal air pressure. The aim of the experiment is to provide hydration rate constants at normal terrestrial temperatures for archaeological dating purposes. This is an attempt to by-pass the conventional practice of using a secondary hydration rate determination from associated radiocarbon dates. The hydration developed at normal terrestrial temperatures is too slow to provide measurable effects in the space of a few years. For this reason we employed the very precise hydration depth measurements provided by SIMS. The results confirm the value of the strategy and provide basic hydration rate constants for each of the obsidian source specimens. The SIMS results show a poor correlation of temperature to the characteristic hydrogen concentration profile within the obsidian. This relationship requires further field and laboratory research.

Aspects of SIMS Depth Profiling for Obsidian Hydration Dating

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Secondary ion mass spectrometry (SIMS) is an ideal tool for measuring hydrogen (H) profiles for use in obsidian hydration dating (OHD). This technique has been used for some years to obtain dates for archaeological specimens but is not always a straightforward process. Measurements have been collected using both magnetic sector and quadrupole-based SIMS instruments, with apparently comparable results. The quadrupole-based instrument may provide a simpler analysis in terms of charge compensation and requires less sample preparation. Although early measurements were made using O^- bombardment with positive ion detection, modern instruments using Cs bombardment with negative ion detection should provide superior backgrounds for H analysis. Analysis of natural obsidian surfaces may be subject to problems due to surface roughness, cracking or the presence of natural inclusions or vesicles [1]. We present SEM and AFM images of some natural artefact surfaces to show that surface roughness is usually under 10 nanometers. Images of SIMS craters show that roughness in the crater bottom is typically much less than the rate of fall of the H profile, indicating little error in the thickness of the hydration layer. Sputtering rates measured for a suite of obsidians from archaeological sites show a variation of less than 4%, indicating that an external standard can be used to calibrate the sputtering rate within the typical measurement error. For the hydration layer thickness measurement, the important parameter is the thickness of the hydration layer, as measured at the ½ fall of the H profile. Repeat measurements indicate this thickness can be measured to within ±1% on some samples. Excellent correlation between SIMS and infrared spectroscopic measurements indicate the ability of SIMS to provide highly quantitative measurement of H in obsidian.

References

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Further assessment of the SIMS-SS obsidian hydration dating method

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The SIMS-SS dating method of obsidians has been advanced since 2002 [1]. The surface saturation (SS) of water is a layer which occur in the initial diffused region of H+ profile (H+ concentration to depth profile). The determination of this depth as well as the appropriate fitting 3rd order polynomial were cumbersome and initially ware approached with an iterative sliding regression procedure as the point where regressions change slope and a best fitting polynomial of the whole profile. Subsequently the SS layer was located through derivatives and sliding regressions of the diffused region and the best fitting polynomial (best Rsq) [2, 3]. In this study the determination of SS, as well as, the criteria for the selection of suitable obsidian sampling areas and profiles, is made through an assessment of MATLAB based dating software, incorporating spectral data of AFM and TABLECURVE 2D software [4, 5]. The new software procedure includes fitting of the profile, linear regressions, the theoretical diffusion curves, calculation of ages for different fitting polynomials for the whole and parts of the profile, calculation of the residuals between fittings and measured profiles (Rsq). It was found that the correct fitting polynomial which is used in the age equation can be safely defined from the hyperbola/ parabola plot of Rsq versus point number of tail, where the turning point is the end point beyond which the tail is removed. Examples are given for dated obsidians with earlier procedures.

Referencess

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TL and OSL Techniques as Characterisation and Dating Tools of Glass Material: A Review

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Luminescence Dating stand of the most powerful and worldwide applied techniques for the chronological estimation of inorganic material like pottery, stones, mortars, sediments, etc, in archaeology and geology. Archaeological glass artefacts (mosaic tesserae[1,2], beads[3,4], faience, etc) and glass of volcanic origin (tephra glass, obsidian[5]) have been exploited during the last years for their dosimetric and dating properties using various luminescence techniques (conventional TL, red-TL, CW-OSL and LM-OSL). The study review and comments on the results highlighting the use of luminescence as a very promising tool for characterisation and dating of glass material.

References

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Distinguishing obsidian subsources and reconstructing exchange patterns in the central Mediterranean

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While the existence of multiple outcrops or subsources of obsidian is known in many parts of the world, studies to record, categorize, and distinguish such geological subsources have been limited, and little research has been done on archaeological material to investigate the actual usage of specific subsources. In Sardinia, it has been demonstrated that multiple subsources on Monte Arci may be chemically distinguished, and that their usage in northern Sardinia and in Corsica and elsewhere changed over time, suggesting that such factors as quality, accessibility, and socioeconomic organization impacted their actual usage. In the Mediterranean, the ability to chemically distinguish between subsources on Pantelleria, and on Melos, has also been demonstrated, but few studies on archaeological materials have addressed sourcing and trade issues beyond the general island sources. Recent detailed geological survey and chemical analysis (using LA-ICP-MS, INAA, and XRF) has fully documented, characterized, and been able to distinguish between multiple subsources on Pantelleria, but also for Lipari and Palmarola, thus expanding the utility of such studies for detailed studies of obsidian procurement and trade in the central Mediterranean. Some analytical results on the usage of these subsources, at archaeological sites in Sicily, peninsular Italy, Croatia, Tunisia, and elsewhere, are now available and will be presented.

Provenance of Peruvian Wari Obsidian: Comparing INAA, LA-ICP-MS, and portable XRF

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For the past several years, researchers on the border between the two largest Pre-Inca civilizations in the Andes, Wari and Tiwanaku, have been investigating the role of long distance exchange in the development of early empires. Obsidian has played a principal role in this research. Early work focused on destructive analysis that yielded high precision results, though analysis could only be undertaken on small retouch flakes recovered in excavation and survey. This sample includes 89 flakes processed via INAA reported by Burger et al (2000) from surface collections and 15 retouch flakes processed via INAA collected in excavations by Williams and Nash. More recently, LA-ICP-MS was employed to test provenance of 26 flakes from excavation contexts excavated by Williams and Nash. None of these samples, though, was based on characterizing whole obsidian tools. The assumption that characterizations of obsidian debitage actually represent the sources of raw materials for tools remained untested. However, recent use of non-destructive portable XRF, though less precise and less accurate than other techniques, allow us to characterize all 258 obsidian tools recovered in over a decade of excavations from the sites. The combination of high precision results on small flakes and non-destructive surveys of whole artifacts provide a compelling argument for the employment of multiple methodologies in assessing obsidian provenance in the Andes.

New perspectives on obsidian procurement and exchange at Tiwanaku, Bolivia

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Tiwanaku was an important center of Andean civilization from A.D. 500 to 1000. Its urban inhabitants had access to exotic lithic raw materials, including obsidian. Samples from three obsidian quarries and 147 obsidian artifacts from eight different sectors in the prehistoric city of Tiwanaku and 33 obsidian artifacts from seven other locations within the Titicaca Basin region were analyzed by neutron activation analysis and X-ray fluorescence. The new data were compared to the MURR database and artifacts were traced to known sources in Peru, Bolivia, and Argentina. Chemical abundance data is presented for several new obsidian source types. In addition, evidence is presented that the inhabitants of Tiwanaku used obsidian from a large number of sources, some of which were brought from very distant regions located outside of the Tiwanaku state sphere. Most samples analyzed were traced to the Chivay source in southern Peru, but a total of eleven other sources were present as well, mostly in non-elite areas. Here we compare obsidian access by elite, elated-related, and non-elite groups, as well as that present in two ceremonial structures, and we suggest that while the Tiwanaku elites obtained and distributed Chivay obsidian using themselves materials from this source exclusively, non-elite groups obtained materials from other sources through local networks.

Selection, Use and Distribution of Volcanic Glasses in Primorye, Far East Russia

Trudy Doelman[1], Robin Torrence[2], Vladimir Popov[3], Nikolai Kluyev[4], Irina Pantukhina[4], Igor Sleptsov[4]

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Obsidian artifacts sourced by INAA, PIXE-PIGME and X-ray fluorescence to the Paektusan volcano, located on the border between North Korea and China, are commonly recovered from archaeological sites in Primorye, Far East Russia. The long distance movement of obsidian into a region with abundant volcanic glass raises important questions about the nature of the cultural mechanisms responsible for the selection, use, and distribution of these seemingly competing raw materials. To address these issues, detailed field studies of the spatial distribution and physical properties of volcanic glass sources were integrated into a wider study based on characterization with PIXE-PIGME and relative density together with technological studies of the archaeological assemblages. By combining geological, geochemical, and archaeological approaches and findings, the research has provided insights into changes in the social and economic factors behind the exploitation of raw materials in Primorye, dating from the Late Paleolithic (c. 15 000 BP) through to the Bronze Age (c. 2500 BP).

Archaeological Obsidians Provenance of several Italian sites using non destructive XRF Method

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The provenance of 1.400 archaeological obsidian fragments was determined using the non-destructive XRF (X-ray Fluorescence) analytical method, based on the secondary X-ray intensity [1]. To test this methodology, a comparison with the classical XRF method on powders (major elements and selected trace elements concentration as Nb, Y, Zr, Rb and Sr), was preliminarily carried out on several obsidian samples representative of all the geological outcrops of Mediterranean Area, e.g. Lipari, Pantelleria, Sardinia, Palmarola, Hungary and the Greek islands of Melos and Giali [2]. The provenance of the entire archaeological obsidians is determined by comparing their composition with that of the quarry obsidians in the whole Mediterranean area. Just five chemical elements (the intensity ratios of Nb, Y, Zr, Rb and Sr) are sufficient to characterize the different places of origin because they are particularly indicative of the genetic processes which produced obsidian. With the non destructive XRF methodology has been analyzed about 1.400 archaeological obsidian fragments, coming numerous Italian Neolithic sites of the Tuscan archipelago, Tuscany, Abruzzo, Lazio, Campania and Marche region and also from Corsica island. The provenance of the 96% of the archaeological obsidians was successful and indubitably determined. Only for 4% of the analyzed obsidian, because of the small dimension of the fragments (few mm), was impossible to establish the origin. The obtained results show that the majority of archaeological obsidians come from Lipari, and represent 32% of the total, Palmarola obsidians about 30% and the remaining from Sardinia island. The obtained results demonstrate that the used non-destructive XRF method, due to its sensibility, low cost and high speed is surely an extremely valid instrument for the attribution of the provenance of the archaeological obsidian from the Neolithic sites.

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Network patterns in obsidian trade in the Pacific

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The extraction and distribution of obsidian has over a twenty thousand year history in the western Pacific. This paper will outline the history of obsidian extraction and distribution from the late Pleistocene onwards, and map the major changes over time, including the 6,000 kilometre distribution of obsidian from sources in West New Britain to Indonesia in the west and Fiji in the east, some 3,000 years ago. It will also provide a background to the obsidian sources from the western Pacific, and their elemental discrimination using various compositional techniques. The paper will also assess the nature of the social and economic interactions that have been modelled to account for the changing obsidian exchange networks.

A re-examination of volcanic glass hydration dating in Hawaii: a case study from Kahalu`u Habitation Cave, Hawai`i Island.

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Conventional hydration dating of Hawaiian volcanic glasses was attempted in the 1980s, but the method was abandoned because of problems measuring the thickness of hydrated surfaces on nearly opaque and relatively mafic glasses. Our attempt at potentially resurrecting hydration dating in Hawaii employs a two-stage process. First we used EDXRF to identify common source materials, and then we employed photoacoustic infrared spectroscopy (PAS) to quantitatively determine the concentrations of molecular (H_2O) and hydroxyl (OH) in glasses. Successful results of a blind study correlating absorption curves with stratigraphic contexts from Kahalu`u Habitation Cave are presented.