

Laboratorial Based Archaeometrical Studies in Turkey

Ali Akin AKYOL

Gazi University, Faculty of Fine Arts, Department of Conservation and Restoration of Cultural Properties,
Ankara, Turkey

Abstract: Archaeometry is the term that was used for the application of the methods of natural and fundamental sciences on archaeological finds to define and characterize. The main areas of archaeometry are dating, artifact studies, study of the man and his environment, mathematical methods, remote sensing, prospection and conservation & restoration.

Although the archaeometrical techniques have been used extensively in the world since 1880's, systematical applications are very new in Turkey. In the last three decades, departments of archaeometry in different universities were started to education and new laboratories were established and equipped for that purpose. Then, the project base researches on all of the archaeological artifacts have been started by well-organized limited groups mostly localised in different universities and in some institutions. Many scientists have been graduated from related fields and they started to produce archaeometrical data on defining for Anatolian cultural heritage.

The aim of this article is to define the scope of archaeometry and its interdisciplinary methodology related with the institutions on archaeological base in Turkey from the beginning.

Keywords: Archaeometry, history of archaeometry in Turkey, archaeometry laboratories in Turkey

Introduction

Archaeology is partly the discovery of the treasures of the past, partly the precise work of the scientific analysis, and partly the exercise of creative imagination. Archaeology is both a physical activity out in the field and an intellectual pursuit in the study or laboratory. Archaeology relates to many other disciplines such as anthropology and history that are also concerned with the human story. Culture includes knowledge, belief, art, morals, law, custom and any other capabilities and habits acquired by man as a member of society (RENFREW, BAHN 1993).

For the generalization in all scientific researches, whether observational or experimental, it is apparent that a continuum is involved that has the laboratory sciences at one end, and the social sciences at the other.

Archaeology is located at the center of the line which means it is both related with experimental and observational sciences (BLALOCK 1979).

The beginning of archaeological studies dates back to very old times. However, the use and applications of disciplines such as physics, chemistry, geology, biology, material sciences, mathematics, statistics and computer science in the evaluation of archaeological findings increased more and more during the last 50 years or more. These studies have contributed to the development of an interdisciplinary cooperation and brought about a new concept called "Archaeometry".

Archaeometry is certainly older than its name. The term “Archaeometry” was first used in 1958 when a journal in Oxford University was published with this name. In fact, the application of physical methods goes back to the nineteenth century, and chemistry was employed even earlier still. Chemical analysis started around 1800 on glass, pigments and metal alloys used for weapons and coins. The famous English chemist Davy, for example, investigated in 1815 a pot with rests of colors originally belonging to a painter in Rome of the Emperors. This study is assumed to be the first important archaeometric study (AKYOL 2012; 2013; ESIN 1986; LEUTE 1990; OZDOGAN 2011; TITE 1991; YALCIN 2012).

The need for such quantitative treatment of archaeological artifacts is obvious if one imagines the questions asked by those archaeologists who have to appraise the material remnants of the past. What is it? How old is it? And in the case of artifacts how has it been made? Was it made locally or from where did it come to the site and by which trade routes? And, how is it affected by geographical and ecological changes? These studies in archaeometry provide the universal chronology, information on where artifacts were made, on how they were made and on what were used for, information on past landscapes, climates, tectonic processes, flora, and fauna as well as on man himself, information about the location both of archaeological sites themselves and of buried features within these sites, information for full site evaluation prior to any planning application, information for decay processes and development of new methods of conservation (RENFREW, BAHN 1993).

Archaeometry is also connected to earth sciences. Geological and geotechnical considerations make part of special cases brought during excavations in archaeological sites. Moreover, observations made these sites and / or ruins of structural components let unearthed to imagine parts of the area related to seismic earth deformations and structural distorsious signs of some unknown earthquakes of the past are ever depicted via these observations.

Archaeometric Applications

Interrelation between archaeometry and archaeology or history of art can be clearly observed in excavations. It may be said that archaeology, which is in close relation with many other disciplines, has various dimensions such as scientific, social, economical, technical, cultural etc. Scientific dimension of archaeometry itself has its own areas that are:

Composition

Knowledge of the compositions of the artifacts or other materials associated with ancient peoples can provide a great amount of information. Analysis of the composition of metal, stone or pottery can lead to location of the source of the raw materials used in their manufacture. Knowledge of trace or minor element composition can indicate the cause of physical properties such as colors of glass ,or ,the malleability of metal. Composition also can lead inferences concerning ancient technology, for example, how melting points were lowered to achieve the liquid state in metallurgy or glass manufacture, or, whether pottery was fired under an oxidizing or reducing atmosphere. Authenticity can sometimes be obtained directly by artifact composition. The presence in an artifact of a pigment or alloy that was unknown at the time the object was supposed to have been made is good evidence for forgery. Similarly, Chronology can sometimes be

established by knowledge of the development of metal or glass composition through history. Even information on ancient diet can be obtained through the analysis of the composition of bone.

Dating

The availability of relative or absolute dates of a site (excavation site) a fossil or an artifact provides data on authenticity or chronology. Methods used are radioactive methods and non-radioactive methods.

Radioactive methods are composed of ¹⁴C and K/Ar methods. Non-radioactive methods are composed of amino acid racemization, elemental content (F, U, N) and extent of hydration etc.

Prospection

Location of the sites or of features within sites relies mainly on geophysical methods, such as Ground Penetrating Radar, and the chemical analysis as phosphate analysis of soils are also useful in the various techniques of archaeometry.

Conservation

Restoration and conservation of artifacts involve the extensive use of chemical techniques. Wood, paper or textile artifacts require organic technology for stabilization of the material, whereas metals or pigments may require inorganic chemistry in that area.

Archaeological and Archaeometrical Backgrounds of Turkey

It is possible descend the beginning date of archaeology in Turkey to Seljuks Period. The Seljuks surrounded the Konya Huyuk with a city wall and decorated it with various engraved stones from different periods; in other words they applied concepts of museology. Léon de Laborde (1807-1869) gave some engravings of the Konya city wall and gates which were decorated with reliefs in his book "Voyages en Asie Mineure et Syrie" which was published in 1837. However the city wall of Konya is not a unique example. There are many other architectural monuments made by the Turks whose façades in an attention drawing way. By this way, these pieces were not only displayed but also prevented to be annihilated (EYICE 1990). During the reign of Sultan Abdulmecid (1839-1861), Fethi Ahmed Pasha (1801-1858) who was the Pahsa of Imperial Arsenal of Ardonance and Artillery, pioneered for the establishment of two small museums in 1848; one for the old weapons and another for the antiquities was laid in the two halls of the Atrium in the Hagia Eirene Church. These museums were the first archaeological museums in Turkey. Foreign authors such as Maxime du Camp (1850), Gustave Flaubert (late 1850) and Th. Gautier (1852) visited this museum and mentioned in their books. The catalogue of this small museum was published in the 1868 volume of *Révue Arcéologique* by A. Dumont.

In the real sense, Turkish museology and archaeology were started by Osman Hamdi Bey (1842-1910). In 1881, the first law of historical monuments was proposed by Osman Hamdi Bey who was the first Turkish museologist and one of the most famous painters.

In the Turkish Republic's Period, Department of Antiquities within the Ministry of National Education was founded in 1920. An official circular was sent to all provinces entitled "Instructions Concerning Museums and

Antiquities". This circular was of vital importance for the future of Turkish Museology and Turkish Archaeology. In 1923, a scientific research committee was founded by Ataturk who is the founder of Turkish Republic. This committee drew up a program for the establishment of national museum and an associated ethnographic museum and redrafted the antiquities law. During this time, the government announced a program which broadened the brief the enumeration of standing monuments, the collection and examination of ancient items and the establishment of museums in appropriate centers (ONDER 1990).

The 1930's were the years in which Ataturk was most concerned with the subjects of culture, history and language. Students were sent to Europe to study archaeology. In 1936, The Language and History - Geography Faculty was opened. The new Department of Antiquities and Museums was established under the supervision of the Ministry of National Education.

The Turkish Historical Research Association, later The Turkish Historical Society was founded in April 1930 aiming study the history of Turkey and the Turks and to publish the results of these studies. The first Historical Congress was held in Ankara in 1932.

The first Turkish excavation began at Ahlatlıbel in Ankara under the patronage of Ataturk. Turkish archaeologist took courage from the success of this project and in 1935, their first large scale excavation was began at Bronze Aged Alacahoyuk. The archaeological artifacts unearthed from the excavation were carried to Ankara gathered in Hittite Museum which is 15th Century Mahmut Pahsa Bedestan and Kurusunlu Caravanserai. The name of the museum was changed into Anatolian Civilization Museum in 1969.

Ministry of Culture and Tourism was founded and all departments were separated from the Ministry of National Education in 1974. Two departments, General Directorate of Cultural Heritages and Museums and General Directorate of Waqfs, under the ministril structure is generally responsible for not maintenance alone also restoration and conservation of the historical monuments in Turkey.

About 96953 archaeological points, 12937 archaeological and 448 archaeological & natural sites has registered officially in Turkey. In 2014, 200 excavations including 3 underwater excavations were performed by national and international teams (44 excavations directed by foreign teams; 13 German, 8 American, 7 Italian, 6 British, 2 Austrian, 2 French, 2 Belgian, 1 Swedish, 1 Japanese, 1 Canadian and 1 Dutch teams). In addition, 109 archaeological surveys (27 directed by international teams), 175 salvage excavations (including highway and dam projects) were carried out by museums and archaeological teams. The finds and related archaeological and ethnographical items (3175267 items in 2014) are preserved in 326 state (including 136 open air museum at sites) and 206 private museums in Turkey and more than 20 million tourists were indexed as cultural tourism data in that field in 2014 (TMC 2015).

Turkey has signed the World Heritage Convention in 1983 lastly after another international conservation contract and through the work carried out under the responsibility of the General Directorate for Cultural Heritage and Museums, 11 properties were inscribed on the World Heritage List (with other 52 archaeological area in the tentative country list). Among these properties, historical areas of Istanbul (1985), city of Safranbolu (1994), Hattusha (Bogazkoy, 1986) Hittite capital site, Nemrut Mountain (1987), Xanthos and Letoon archaeological sites (1988), ancient Troy (1998) and neolithic site Çatalhöyük (2012), Seljuks Great Mosque and Hospital of Divrigi (1985), Ottoman Selimiye Mosque and Complex (2011), Pergamum Multilayered Landscape Area (2014) and Ottoman Bursa and Cumalikazik Area (2014) were listed as cultural,

while Pamukkale-Hierapolis (1988) and Göreme National Park-Rock Sites of Cappadocia (1985) were listed both as cultural and natural heritage.

Archaeometrical Background: Universities and Archaeometry Groups in Turkey

For the archaeological material studies, knowing the archaeological or antropological science as a term, archaeometry was mostly accepted in Turkey. Archaeometrical studies were not started at the same time with Europe but multidisciplinary character of the archaeometry were accepted easily not only for necessity but also the technical improvements and educated skeleton of the Turkish archaeology was also ready to act (AKYOL 2012; 2013).

The archaeometrical interest, which already existed independently in the departments of basic sciences (physics, chemistry etc.) and archaeology at the different universities, flourished with the Keban Dam Rescue Project (1968-1974). The Keban and Lower Euphrates Projects began in 1975 and one of the biggest rescue projects in the world at that time were realised by salvage excavations. These acts, as an archaeological field laboratory, enable the well-educated new generations of the republic to learn the practise of field archaeology. So It opened new perspectives for the archaeologist and Turkish archaeology has found the oppurtunity to use modern archaeological tools and worked with foreign archaeologist cooperatively. In the 1970's, the govermental departments (Ministry of Culture) or institutions in the universities on the conservation of cultural heritage were were grew up. One of the first institution, Center for the Investigation and Salvage of Historical Remains, TEK DAM (later TAÇDAM) at Middle East Technical University (METU) which had a very efficient role of coordination of big-skaled regional projects, The Keban and Lower Euphrates, were come out.

The scientists who have carried out individual studies in Turkey since 1960's have been cooperating with archaeologists. In the 1970's, an application was filed to TUBITAK (The Scientific and Technological Research Council of Turkey) for the establishment of a Unit of Archaeometry attached to it and eventually the Unit of Archaeometry was established in 1980. The pioneer scientists are Halet Çambel, late Ufuk Esin (accepted the first archaeometrist in Turkey, ESİN 1969), late Bahadır Alkım, late Handan Alkım (Istanbul University), Yeter Göksu (Çukurova University) and late Olcay Birgül (METU). Olcay Birgül was also the first chairperson of the Archaeometry Unit. Scientists from METU (Ay Melek Ozer, Sahinde Demirci, Sevim Buluç, Emine Caner, Gülay Dereli, Mustafa Ozbakan and Naif Turetken), Hacettepe (Mehmet Ergin), İstanbul Technical (Muzaffer Sanver), Çukurova (Zehra Yegingil and Seref Kunç), Bogaziçi and Fırat Universities and archaeologist and bureaucrats from museums (Raci Temizer from Anatolian Civilization Museum, Ergun Kaptan from General Directorate of Mineral Research and Exploration and Volkan Ediger (Turkish Petroleum Association) have participated in this Unit. Unit had continued to do researches under the name of AKSAY which stands for the "Investigation of Archaeological Findings by Spectroscopic and Analytical Methods" in Turkish. This Unit functioned until 1992 (AKYOL 2012; 2013; OZER et.al 2008). Alongside the work of the AKSAY Unit, there was a need to educate students who would carry out archaeometric studies in the museums and at other research laboratories. As a result of this, METU initiated a M.Sc. Program in Archaeometry as part of the Graduate School of Natural and Applied Sciences in 1990 with thesis and non-thesis version in 2003 and Ph.D. in 2004. Then, another M.Sc. program at Çukurova

University was followed. The main purpose of the programs is to qualify the graduates toward bringing solutions to the archaeological problems by the application of scientific methods of natural and applied sciences. The study and understanding of history have acquired a new dimension through the collaboration between pure scientists and archaeologists. Thus, the analysis, identification and dating of archaeological remains and materials have become complete. The programs educate bachelor's degree holders in all fields. More than 30 archaeometrists have graduated since 1994.

The archaeometry was the main sub section of International Symposium of Excavation Survey and Archaeometry in 1985 held annually by Ministry of Culture and Tourism and 31th was in 2009. In addition the 29th International Symposium on Archaeometry (9-14 May, 1994) was also held by the METU Department of Archaeometry in Ankara (DEMIRCI et.al 1996). Same group was also organised the first thematic workshop on archaeometry of ceramics in 2009, than the workshops on glass (2011), metal (2013) and rock (2015) were organised regularly.

So many international research institutes having valuable documents on archaeology and libraries that are American, British, German, Netherland, French and Italian etc. have been studying on Anatolian archaeology and getting study on archaeometry since 1920's.

On the other hand, in 2006, the protocol was signed for the purpose of using high technology for the examination on cultural heritages between Turkish National Agency of Nuclear Energy and Ministry of Culture and Tourism. In the first step, the collections of Anatolian Civilizations Museum in Ankara were scanned by portable devices. These studies are still going on.

Application of New Technologies in Turkey

Classical analytical techniques on archaeology have applied since 1970's in Turkey. Not only the changing of the philosophy of the archaeology, but also high-tech based studies have a great part of the research projects with the increasing the engineering facility in this field. Especially last decades, new technologies have become available to researchers allowing them to undertake more sophisticated analysis. These technologies include mostly digital surveying equipment which records each artifact in three dimensional (3D) space, digital scanners which can record photographically archaeological areas in 3D and portable spectroscopic devices.

In addition, dating of the artifacts, geophysical prospection, provenance studies for different materials, geoarchaeological and genetic studies of man and his environment are more very popular topics in contemporary archaeology now. The other scientific branches as conservation and restoration of cultural heritage are also getting important in the national agenda. By the way, in the last five years, three projects for conservation of cultural heritage were awarded by Europa Nostra.

As a result of these, both governmental and foundation universities investments including big budget long term research projects introduced the new technologies to Anatolian archaeology. New research centers and institutions have been established. These are followings:

Turkish Atomic Energy Authority (TAEK) Saraykoy Nuclear Research and Training Center (SANAEM, Ankara, Turkey)

SANAEM works under TAEK (Turkish Atomic Energy Authority) has considerable expertise in the applications of nuclear techniques in many area for peaceful purposes. The electron accelerator is the only one in the country. It has 500 keV energy and 20 mA current. The center consists of a wide range of laboratories that are the biggest capacity in Turkey: Alpha/beta particle spectroscopy laboratory, liquid scintillation spectrometry laboratory, alpha particle spectrometry laboratory, gamma particle spectrometry laboratory, C14 dating laboratory, Radon screening laboratory, analytical measurement and analysis laboratories, chemical elements and stable isotopes analysis laboratory, chromatography laboratory, spectroscopy laboratory, nuclear electronics laboratory, film dosimetry laboratory, thermoluminescent dosimetry laboratory finger ring dosimetry laboratory, environmental radiological monitoring activity, medical physics applications laboratory, radiation source quality control test laboratory, molecular genetics laboratory, stable isotopes laboratory, differential scanning calorimetry and thermogravimetric analysis in material characterization laboratory, microscopy laboratory, nuclear fusion laboratory, plasma physics laboratory, nuclear fission laboratory, radiation microbiology laboratory, food microbiology laboratory, food irradiation determination laboratory and three gamma radiation units are in service for sterilization.

(<http://www.taek.gov.tr/kurumsal/birimler/bagli-kuruluslar/sanaem.html>)

Anatolian Civilization Museum Laboratory For Restoration & Conservation (Ankara, Turkey)

Anatolian Civilization Museum is one of the leading museums of the world with its unique collection of materials that currently consists more than 190.000 archaeological objects. The museum laboratory is located in the Museum of Anatolian Civilizations held its first effective conservation efforts in 1968. Laboratory has developed its own manifesto on conservation as first laboratory unit and first staff trained in restoration and conservation in Turkey were employed in this laboratory. The first archive related to the protection was created by this laboratory. It gives conservation and restoration service not only for the Anatolian Civilizations Museum collection but also all over the museums and excavation sites in Turkey. The laboratory has capacity to give routinely restoration and documentation services for 1500-2000 movable cultural objects in a year by using suitable cleaning, stabilizing and consolidating conservational methods.

(<http://www.kulturvarliklari.gov.tr/TR,62800/ankara-restorasyon-ve-konservasyon-laboratuari-bolge-mu-.html>)

Ministry of Culture & Tourism Central Restoration Laboratory (Central Lab, İstanbul, Turkey)

The establishment of laboratories of equipped with modern technology for restoration and conservation in museums are ongoing since the 1980s. For this purpose, the first laboratory, İstanbul Central Laboratory of Restoration and Conservation was established in 1985. In İstanbul Central Lab, the restoration workshops of metal, ceramic, glass, stone, mosaic, paper and sculpture are available. In addition, other workshops for the composite artifacts, wood, textiles, oil painting, underwater artifacts, the film-microfilm-digital data conservation are ongoing project. In the year 2012, Under the Ministry of Culture and Tourism, the General Directorate of Cultural Heritage and Museums, regional restoration and conservation laboratories (in Adana,

Ankara, Antalya, Bursa, Çorum, Diyarbakır, Erzurum, Gaziantep, İzmir, Kayseri, Konya, Mardin, Muğla, Trabzon and Van Restoration and Conservation Laboratories) were also established.

(<http://www.kulturvarliklari.gov.tr/TR,108525/istanbul-restorasyon-ve-konservasyon-merkez-ve-bolge-la-.html>)

Koç University Surface Science & Technology Center (KUYTAM, Istanbul, Turkey)

Although there are quite a number of academic research centers in Turkey devoted to materials science and related technologies such as; nanotechnology, polymer science, ceramics, composites, biomaterials, microelectronics and device manufacturing, Koç University Surface Science and Technology Center (KUYTAM, 2010) is the first multidisciplinary effort to investigate the surface science and related technologies. (<http://kuytam.ku.edu.tr/>)

Bosphorous University Archaeometry Application & Research Center (Istanbul, Turkey)

Archaeometry Application & Research Center was established in 1991. This is the first archaeometric research center in Turkey. Center support the research projects on history of human their environment and artifacts. The main purpose of the center are to improve and apply the methods to the problems of environmental and historical materials, to develop joint research concepts for national and international institutions, to provide the services of easily accessible databases and educational products to the institutions and organizations and to organize the various cultural and educational events in order to emphasize the importance of our cultural heritage and human environment. The center is also producing materials and offers courses in related areas with archaeometry.

(http://www.arastirma.boun.edu.tr/arastirma.php?a_l=tr&p=102)

Izmir High Technology Institute Material Conservation Laboratory (Izmir, Turkey)

The Materials Conservation Laboratory was established at the Department of Architectural Restoration in 2001. It deals primarily with deterioration and conservation problems of historic building materials through the research projects, courses and thesis studies. The studies carried out in the laboratory are the characterization of the physical, mechanical, mineralogical and chemical properties of the building materials, understanding of the deterioration mechanism, studies on the efficiency of the conservation treatments and selection of the compatible materials for the repairs. A large number of tests have been carried out by the laboratory equipment that are determination of physical properties of materials, durability tests, mechanical strength measurements, mineralogical, petrographical and chemical analyses.

(<http://web.iyte.edu.tr/arch/restoration/index.htm>)

Cultural Heritage Preservation and Natural Dyes Laboratory (DATU, Istanbul, Turkey)

DATU was founded in 2010 in Istanbul by the Turkish Cultural Foundation with support from the Armaggan brand. DATU conducts research, analysis and provides know-how and technical support for the conservation and reproduction of historical Ottoman textiles. Since its establishment DATU has developed into one of the

world's most advanced laboratories on natural dyes and is making significant contributions to preservation and documentation of Turkey's cultural heritage. With its constantly expanding collection of natural dye Plants, natural organic lake pigments and dye insects, currently at 612, DATU is the world's richest depository of natural dyestuff resources. DATU support the preservation of Turkey's cultural heritage by using state-of the art technology and its natural dyes collection to conduct analytical Research on historical and archaeological artifacts. In collaboration with Armaggan, DATU provides scientific assistance to reproduce the outstanding textiles of the Seljuk and Ottoman Civilizations.

(<http://www.tcfdatu.org/tr/anasayfa/>)

Middle East Technical University (METU) Materials Conservation Laboratory (MCL, Ankara, Turkey)

The Materials Conservation Laboratory (MCL) of the Department of Architecture, METU, was established in 1967, as an educational and research laboratory in the newly established "Department of Restoration", a graduate program for the architects for the conservation of the architectural heritage. The laboratory has served as a teaching and research unit in charge of materials studies for the conservation of cultural heritage. It is the most important center in Turkey for the development of scientific conservation studies and improvement of conservation practice. MCL aims at diagnostic analyses of historic structures and materials for the active decay factors and their sources, development of conservation treatments, selection and preparation of compatible repair materials, and the establishment of maintenance and monitoring programs.

(<http://archweb.metu.edu.tr/research-projects/laboratories>)

Middle East Technical University Ancient DNA Laboratory (TOGAN Lab, Ankara, Turkey):

TOGAN Lab was built in 2012 in the MODSIMMER Building, within the METU Campus. The lab is fully equipped with flow-hoods, PCR cabinet with UV crosslinker, dedicated centrifuges, PCR machines, gel electrophoresis tanks, and gel monitoring systems. Laboratory works on population genetics of diverse species including humans, Anatolian sheep, cattle and dog (Kangal and Akbas) breeds, brown trout, and anchovy. The main study area of the laboratory is DNA diversity in extant populations and ancient DNA. The group is currently working on human, sheep and fish aDNA using mtDNA markers and whole-genome sequencing. (<http://www.metu.edu.tr/~togan/>)

Ankara University Earth Science Application & Research Center (YEBİM, Ankara, Turkey)

YEBİM was established at Ankara University in 2009. The goal of YEBİM are to make scientific research and studies in the related fields of earth sciences as geology, geophysics, soil, archaeometry, mining and environment, to produce a joint project, to present solutions to existing problems and storing all kinds of information and data to present and disseminate the service for the beneficiaries. The activities are mainly on rock and soil composition, formation, economic evaluation, origin and use the energy of the natural resources, potential of the sites today and past.

(<http://www.yebim.com/>)

Gazi University Material Conservation and Research Laboratory (MAKLAB, Ankara, Turkey)

MAKLAB was established in 2004. The laboratorial studies are mostly on historical constructive material (as stone, brick, mortar, plaster etc.) characterisation. Laboratory has one of the biggest historical material archive in that field from many projects of restoration in Turkey.

(<http://gsf-kob.gazi.edu.tr/posts/view/title/malzeme-arastirma-ve-koruma-laboratuvari-%28maklab%29-121136?siteUri=gsf-kob>)

Conclusions

Archaeological and museological backgrounds of Turkey goes to the date of Late Ottoman Period in 1880's. So many first on Anatolian archaeology come along that are the first systematic excavations (in Troy by Schliemann and Sidon by Osman Hamdi Bey) and the first laws on cultural heritages. After a long war period, the effective transition periods between from 1920 to 1940 passed and institutional and academic organisations to the conservation of cultural heritages formed at about same period with western country. Although archaeometrical studies in Europe started in 1950's with the new dating and analysing techniques, the first archaeometrical systematic studies with similar acceleration were unfortunately seen in 1980's in Turkey. Since then, number of groups in different universities of Turkey started to analysed the archaeological material for both identification and mostly conservational purposes. This experience of groupbase studying on archaeometry has changed in the last decades and there is an interventions that large scaled university laboratories reorganised and are interested in archaeological artefact studies increasingly. Many basic and environmental scientists are graduated from related fields and they are producing archaeometrical data. The national and international multidisciplinary scientific and research projects are going on the subjects of documentation, cultural heritage assessment and conservational purposes. These are supported by national and international resources and thus, the studies has published periodically never seen as before.

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Figures

Institutions

SANAEM (Sarayköy Nuclear Research and Training Center), works under TAEK (Turkish Atomic Energy Authority), has considerable expertise in the applications of nuclear techniques in many area for peaceful purposes.



Fig. 1a– Turkish Atomic Energy Authority Saraykoy Nuclear Research and Training Center (SANAEM)

LABORATORY FOR RESTORATION AND CONSERVATION OF MAC



Examination	Remedial Conservation	Preventive Conservation	Other
<ul style="list-style-type: none"> X-Ray Inspection System p-XRF Spectrometer 	<ul style="list-style-type: none"> Cleaning, Restoration, Stabilization Consolidation Conservation and Preservation 	<p>the protection of cultural property through activities that minimize chemical and physical deterioration and damage and that prevent loss of informational content in order to prolong the existence of cultural property</p>	<ul style="list-style-type: none"> Casting and Molding Preparing the objects to Display/Storage Environmental Monitoring Educational Programs

Fig. 2b – Anatolian Civilization Museum Laboratory For Restoration & Conservation

Ministry of Culture and Tourism Central Restoration Laboratory

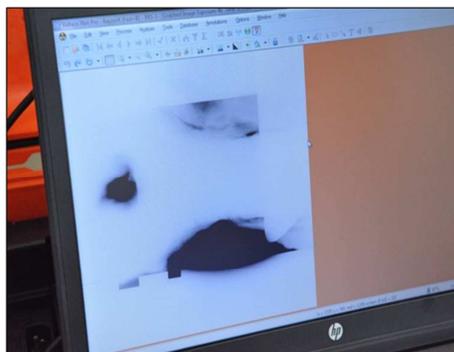
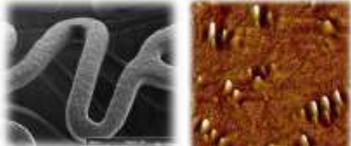


Fig. 1c – Ministry of Culture & Tourism Central Restoration Laboratory (Central Lab)



Ongoing Research Projects

- Superhydrophobic/superhydrophilic surfaces
- Self-cleaning surfaces
- Anti-icing surfaces
- Ceramic surfaces
- Polymer nanocomposites
- Surface modifications by plasma
- Corrosion resistant coatings
- Coated nanoparticles
- Surface modifications with laser
- Sensors and microelectronic devices
- Biomaterials, blood compatible and antibacterial surfaces

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- AlviMedica, Arçelik, Aselsan, Bosch, Dow-Aksa, General Electric, MEMFIS-FP7, Microvision, Şişecam, TAI, V.K.V Amerikan Hastanesi, Yünsa
- German Archaeological Inst., Baghdad Technology Univ., Bilkent Univ., Dokuz Eylül Univ., EPFL, İstanbul Univ., İstanbul Technical Univ., Sabancı Univ., TÜBİTAK Marmara Research Center, Virginia Commonwealth Univ., Yıldız Technical Univ.

KUYTAM
KOÇ UNIVERSITY
SURFACE SCIENCE
AND TECHNOLOGY CENTER



KOÇ UNIVERSITY
Rumeli Feneri Yolu
Sarıyer, 34450 İstanbul-TURKEY
Phone: +90 212 338 1056
e-mail: kuytam@ku.edu.tr
web: <http://kuytam.ku.edu.tr/>



Fig. 1d – Koç University Surface Science & Technology Center (KUYTAM)

ARKEOMETRİ UYGULAMA VE ARAŞTIRMA MERKEZİ (1991)



Merkez Müdürü Prof.Dr. Neylan Dirilgen

İletişim Bilgileri Boğaziçi Üniversitesi
Arkeometri Uygulama ve Araştırma
Merkezi,
Bebek 34342 Beşiktaş,
İstanbul, Türkiye

Eposta dirilgen@boun.edu.tr

Telefon +90 212 359 68 16

Faks +90 212 287 24 76

- [Merkez Yönetmeliği](#)
- **Merkez Faaliyet Raporu**
 - [2013](#)
 - [2012](#)
 - [2011](#)
 - [2010](#)

Fig. 1e – Bosphorous University Archaeometry Application & Research Center



MATERIAL CONSERVATION LABORATORY

The Materials Conservation Laboratory has been established in the Department of Architectural Restoration. It deals primarily with **deterioration and conservation problems of historic building materials** through the research projects, courses and thesis studies.

The studies carried out in the laboratory are;

- Characterization of the physical, mechanical, mineralogical and chemical properties of the building materials
- Understanding of the deterioration mechanism
- Studies on the efficiency of the conservation treatments
- Selection of the compatible materials for the repairs

A large number of tests will be carried out by the laboratory equipment. They are;

- Determination of physical properties of materials
- Durability tests
- Mechanical strength measurements
- Mineralogical and petrographical analyses
- Chemical analyses

Fig. 1f – Bosphorous University Archaeometry Application & Research Center

DATU - CULTURAL HERITAGE PRESERVATION AND NATURAL DYES LABORATORY (2010)



Fig. 1g – Cultural Heritage Preservation and Natural Dyes Laboratory (DATU)



Research & Projects Publications People Events Documents

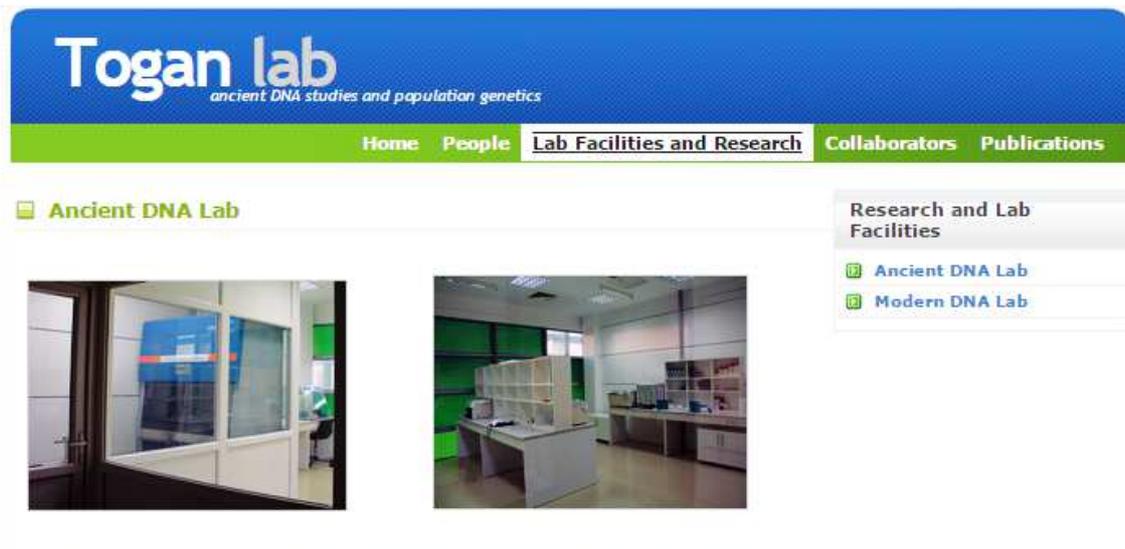


Materials Conservation Laboratory

The Materials Conservation Laboratory (MCL) of the Department of Architecture, Middle East Technical University, was established in 1967, as an educational and research laboratory in the newly established “Department of Restoration”, a graduate program for the architects for the preservation of the architectural heritage. The laboratory has served as a teaching and research unit in charge of materials studies for the conservation of cultural heritage. It is the most important center in Turkey for the development of scientific conservation studies and improvement of conservation practice. MCL aims at diagnostic analyses of historic structures and materials for the active decay factors and sources, development of conservation treatments, selection and preparation of compatible repair materials, and the establishment of maintenance and monitoring programs for historic structures. MCL has more than thirty years of experience on site and laboratory investigations of historic structures in Turkey. It has been the task of the laboratory to study technological properties of historic building materials and their problems for the purpose of their conservation.

In autumn 2003, the “Graduate Program in Restoration” started to accept science and engineering students to Ph D. program. Starting from 2007-2008 Fall Semester, The Graduate Program in Restoration accepts graduates of four year bachelor's degree programs in all disciplines. At present, four PhD theses research and five master's theses research are going on in MCL.

Fig. 1h – Middle East Technical University Materials Conservation Laboratory



This laboratory was built in 2012 in the MODSIMMER Building, within the METU Campus. The lab is fully equipped with flow-hoods, PCR cabinet with UV crosslinker, dedicated centrifuges, PCR machines, gel electrophoresis tanks, and gel monitoring systems. We are currently working on human, sheep and fish aDNA using mtDNA markers and whole-genome sequencing.

Fig. 1i – Middle East Technical University Ancient DNA Laboratory (TOGAN Lab)



YEBİM Research Laboratories



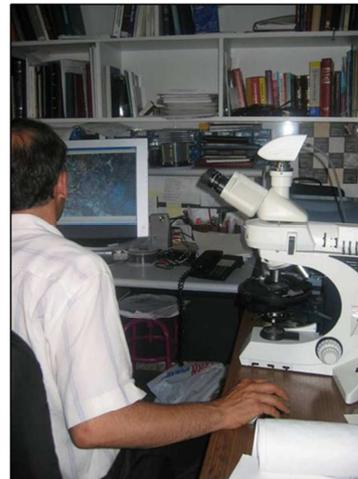
Ankara University Earth Sciences Application & Research Center - 2009



Raman Confocal Spectrophotometer



Micro-XRF



Thin-Section Polarized Optical Microscope

Fig. 1j – Ankara University Earth Science Application & Research Center (YEBİM)

Gazi University Research Laboratory - MAKLAB

Gazi University, Faculty of Fine Arts, Department of Conservation & Restoration of Cultural Properties, Material Research & Conservation Laboratory (MAKLAB; 2004)



Fig. 1k – Gazi University Material Conservation and Research Laboratory (MAKLAB)

Imprint:

Proceedings of the 19th International Conference on Cultural Heritage and New Technologies 2014 (CHNT 19, 2014)

Vienna 2015

<http://www.chnt.at/proceedings-chnt-19/>

ISBN 978-3-200-04167-7

Editor/Publisher: Museen der Stadt Wien – Stadtarchäologie

Editorial Team: Wolfgang Börner, Susanne Uhlirz

The editor's office is not responsible for the linguistic correctness of the manuscripts.

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