Forensic Radiocarbon Dating of Charcoal to Help Crime Scene Investigation

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Abstract- carbon-14 dating, also called radiocarbon dating, method of age determination that depends upon the decayto nitrogen of radiocarbon (carbon-14).Carbon-14 is continually formed in nature by the interaction of neutrons with nitrogen-14 in the Earth's atmosphere; the neutrons required for this reaction are produced by cosmic rays interacting with the atmosphere.Radiocarbon present in molecules of atmospheric carbon dioxide enters the biological carbon cycle: it is absorbed from the air by green plants and then passed on to animals through the food chain. Radiocarbon decays slowly in a living organism, and the amount lost is continually replenished as long as the organism takes in air or food. Once the organism dies, however, it ceases to absorbcarbon-14, so that the amount of the radiocarbon in its tissues steadily decreases. Carbon-14 has a half-life of 5,730 ± 40 years—i.e., half the amount of the radioisotope present at any given time will undergo spontaneous disintegration during the succeeding 5,730 years. Because carbon-14 decays at this constant rate, an estimate of the date at which an organism died can be made by measuring the amount of its residual radiocarbon ln the reference we can find accurate age of coal particle by acclerated mass spectroscopy.it is easy way to find out their age also this ĉontext this can help crime scene lnvestigation.

Indexed Terms- Forensic Radio carbon, charcoal, Accelerated mass spectroscopy Crime scene

I. INTRODUCTION

In forensic Science Radiocarbon dating most routine as powerful tool for specimen age Carbon dating method help to forensic scientist identify the trace amount of radioactive material are present in organic remains of 500- 50.000 years Radiocarbon (140) is produced naturally in atmosphere, by the interaction of cosmic rays nitrogen (14) Radio Carbon dating naturally decay with half life. 5730 years allows measuring the ratio of 146/as for back 50,000 years ago.[1] carbon dating is only technique. that as been useful for determination approximate age of carbon based materials In 1946 American physical chemist Willard Libby Propose innovative Radiocarbon dating. Radiocarbon dating works by Comparing the three different isotopes of carbon Isotopes of a protein element have the same number of Proton in their nucleus but different number of Neutron this means that although they are similar chemically they have different mass.[2] Over time 14 C decay to nitrogen most 14C is produced in the upperatmosphere where neutron, Which Produce Cosmic rays, react with 14 Neutron Every plant and animal In (1/2) In e 5700K= 5700 K will therefore have same amount of k = In 1/2/5700

0.000125 atmosphere the 14C and 12C ratio on archeological and palaenvorimental at context Charcoal generally refers to microscopic material resulting from incomplete Combustion of woody plant tissue Accelerator mass Spectroscopy (AMS) is a form of mass Spectroscopy that accelerated ions to extraordinary high kinetic energy before mass analysis this allows the separation of isotopes having neighbouring masses.[3]

Charcoal is a lightweight black carbon residue produced by strongly heating wood (or other animal and plant materials) in minimal oxygen to remove all water and volatile constituents. In the traditional version of this pyrolysis process, called charcoal burning,of ten by forming a charcoal kiln the heat is supplied by burning part of the starting material itself, with a limited supply of oxygen.The material can also be heated in a closed retort. Modern "charcoal"briquettes used for outdoor cooking may contain many other additives .

e.g. coal.This process happens naturally when combustion is incomplete and is sometimes used in radiocarbondating.It also happens inadvertently while burning wood, as ina fireplace or wood stove. The visible flame in these is due to combustion of the volatile gasesexuded as the wood turns into charcoal. Thesoot and smoke commonly given off by wood firesresult from incomplete combustion of those volatiles. Charcoal burns at a higher temperature than wood, with hardly a visible flame, and releases almost nothing except heatand carbondioxide(One kilogram of charcoal contains 680 to 820 grams of carbon, which when combinedwith oxygen from the atmosphere form 2.5 to 3 kg of carbon dioxide).[4]

- Common charcoal is made from peat, coal, wood, coconut shell, or petroleum.
- Sugar charcoal is obtained from the carbonization of sugar and is particularly pure. It is purified by boiling with acids to remove any mineral matter and is then burned for a long time in a current of chlorine to remove the last traces of hydrogen. It was used by HenriMoissanin his early attempt to createsyntheticdiamonds.
- Activated charcoalis similar to common charcoal but is manufactured especially for medical use. To produce activated charcoal, common charcoal is heated to about 900 °C (1,700 °F) in the presence of a gas (usually steam), causing the charcoal to develop many internal spaces, or "pores", which help the activated charcoal to trap chemicals. Impurities on the surface of the charcoal are also removed during this process, greatly increasing itsadsorptioncapacity.
- Lump charcoal is a traditional charcoal made directly from hardwood material. It usually produces far less ash than briquettes.[5]
- Japanese charcoal has had pyroligneous acidremoved during the charcoal making; it therefore produces almost no smell or smoke when burned. The traditional charcoal of Japan is classified into three types:
    - Whitecharcoalis very hard and produces a metallic sound when struck.
    - Blackcharcoal
    - Ogatanis a more recent type made from hardened sawdust.
- Pillow shapedbriquettesare made by compressing charcoal, typically made from sawdust and other wood by-products, with a binder and other additives. The binder is usually starch. Briquettes may also include brown coal (heat source), mineral carbon (heat source), borax,sodiumnitrate (ignition aid), limestone (ash-whitening agent), rawsawdust(ignition aid), and other additives.[6]
- Sawdust briquette charcoal is made by compressing sawdust without binders or additives. It is the preferred charcoal in Taiwan, Korea, Greece, and the Middle East. It has a round hole through the center, with a hexagonal intersection. It is used primarily for barbecue as it produces no odour, no smoke, little ash, high heat, and long burning hours (exceeding 4 hours).
- Extruded charcoal is made by extruding either raw ground wood or carbonized wood into logs without the use of a binder. The heat and pressure of the extruding process hold the charcoal together. If the extrusion is made from raw wood material, the extruded logs are subsequently carbonized.
    - Production and utilisation of charcoal, like any use of woody biomass as fuel, typically results in emissions and can contribute to deforestation.
    - The use of charcoal as a smeltingfuel has been experiencing a resurgence in SouthAmericaresulting in severe environmental, social and medical problems. Charcoal production at a sub-industrial level is one of the causes of deforestation. Charcoal production is now usually illegal and nearly always unregulated as in Brazilwhere charcoal production is a large illegal industry for makingpigiron.
    - Massive forest destruction has been documented in areas such as Virunga NationalPark in the Democratic Republic of Congo, where it is considered a primary threathe survival of the mountain gorillas. Similar threats are found in Zambia.
    - In Malawi, illegal charcoal trade employs 92,800 workers and is the main source of heat andon the surface of the charcoal are also

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  - Massive forest destruction has been documented in areas such as Virunga NationalPark in the Democratic Republic of Congo, where it is considered a primary threat to the survival of the mountain gorillas. Similar threats are found in Zambia. In Malawi, illegal charcoal trade employs 92,800 workers and is the main source of heat and
  - cooking fuel for 90 percent of the nation's population. Some experts, such as Duncan MacQueen, Principal Researcher–Forest Team, International Institute for Environment andDevelopment(IIED),argue that while illegal charcoal production causes deforestation, a regulated charcoal industry that required replanting and sustainable use of the forests "would give their people clean efficient energy – and their energy industries a strong competitive advantage".
- Recent assessments of charcoal imported to Europe have shown that many charcoal products are produced from tropical wood, often of undeclared origin. In an analysis of barbecue charcoal marketed in Germany, the World Wildlife Fundfinds that most products contain tropical wood. As a notable exception, reference is made to barbecue charcoal imports from Namibia, where charcoal is typically produced from surplus biomass resulting frombushencroachmentradiocarbon dating (also referred to as carbon dating or carbon-14 dating) is a method for determining the age of an object containing organicmaterial by using the properties ofradiocarbon,aradioactiveisotope ofcarbon.[8]
- The method was developed in the late 1940s at the University of Chicago by Willard

Libby. It is based on the fact that radiocarbon (^{14}C) is constantly being created in the Earth's atmosphere by the interaction of cosmic rays with atmospheric nitrogen. The resulting ^{14}C combines with atmospheric oxygen to form radioactive carbon dioxide, which is incorporated into plants by photosynthesis; animals then acquire ^{14}C by eating the plants. When the animal or plant dies, it stops exchanging carbon with its environment, and thereafter the amount of 14C it contains begins to decrease as the ^{14}C undergoes radioactive decay. Measuring the amount of ^{14}C in a sample from a dead plant or animal, such as a piece of wood or a fragment of bone, provides information that can be used to calculate when the animal or plant died.

sample is, the less ^{14}C there is to be detected, and because thehalf-lifeof ^{14}C (the period of time after which half of a given sample will have decayed) is about 5,730 years, the oldest dates that can be reliably measured by this process date to approximately 50,000 years ago, although special preparation methods occasionally make accurate analysis of older samples possible. Libby received the Nobel Prize in Chemistry for his work in 1960.

- Research has been ongoing since the 1960s to determine what the proportion of ^{14} C in the atmosphere has been over the past fifty thousand years. The resulting data, in the form of a calibration curve, is now used to convert a given measurement of radiocarbon in a sample into an estimate of the sample's calendar age. Other correctionsmust be made to account for the proportion of ^{14}C in different types of organisms (fractionation), and vary single velsof ^{14}C throughout thebiosphere(reservoir effects). Additional complications come from the burning of fossil fuels such as coal and oil, and from the above-ground nuclear tests done in the 1950s and 1960s. Because the timeit takes to convert biological materials to fossil fuels is substantially longer than the time it takes for its ^{14} C to decay below detectable levels, fossil fuels contain almost no ^{14}C. As a result, beginning in the late 19th century, there was a noticeable drop in the proportion of ^{14}C as the carbon dioxide generated from burning fossil fuels began to accumulate in thatmosphere.Conversely,nuclear testingincreased the amountof ^{14}C in the atmosphere, which reached a maximum in about 1965 of almost double the amount present in the atmosphere prior to nuclear testing. [9]
- Measurement of radiocarbon was originally done by beta-counting devices, which in the sample and not just the few that happen to decay during the measurements; it can therefore be used with much smaller samples (as small as individual plant seeds), and gives results much more quickly. The development of radiocarbon dating has had a profound impact on archaeology. In addition to permitting more accurate dating within archaeological sites than previous methods, it allows comparison of dates of events across great distances.Histories of archaeology often refer to its impact as the "radiocarbon revolution". Radiocarbon dating has allowed key transitions in prehistory to be dated, such as the end of the last ice age, and the beginning of theNeolithicand BronzeAgein different regions.
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Measurement of radiocarbon was originally done by beta-counting devices, which counted the amount of beta radiation emitted by decaying C atoms in a sample. C atoms in the sample and not just the few that happen to decay during the measurements; it can therefore be used with much smaller samples (as small as individual plant seeds), and gives results much more quickly.The development of radiocarbon dating has had a profound impact on archaeology.In addition to permittingmore accurate dating within archaeological sites than previous methods, it allows comparison of dates of events across great distances. Histories of archaeology often refer to its impact as the "radiocarbon revolution". Radiocarbon dating has allowed keytransitions in prehistory to be dated, such as the end of thelasticeage,and the beginningof theNeolithicandBronzeAgein different regions.

The phenomenon of Adsorption is a widely used as an effective physical method for elimination or lowering the concentration of wide range of dissolved pollutants (organic and inorganic) in an effluent. Activated carbon (AC) is the best adsorbent that can be used effectively for removal of broad spectrum of pollutants from air, soil and liquids. Activated carbon is prepared by carbonization and activation of a large number of raw materials of organic origin such as wood, coal, coconut shell and lignite (Zhonghuo, et al , 2001). Characteristics of the ACs depend on the physical and chemical properties of the raw materials as well as the methods of activation (Lua, et al, 2001). The carbonization process enriches the carbon content and introduces the porosity in the char while activation further develops the porosity and creates some ordering in the structure.[11]

Activated charcoal is an insoluble powder produced by pyrolysis of organic material. It is able to adsorb a wide variety of drugs and toxic agents onto its surface. The capacity of charcoal to bind chemicals has been recognised for centuries and the first systematic studies of charcoal as an antidote were performed in the early 1800s. During the following hundred years, several studies on activated charcoal were published, but in many countries and in many hospitals its use as an antidote has not been accepted until recently. One reason for this neglect has been the lack of suitable formulations, a situation which has prevented the use of activated charcoal in adequate amounts. Furthermore, until the 1980s there have been only a few experimental or clinical human studies on the antidotal effect of high doses of activated charcoal. The effect of high single and repeated doses of charcoal on the absorption and elimination of various drugs has been studied intensively during the last 10 years. Various aspects ofthe antidotal use of activated charcoal have been reviewed lately (Cooney 1980; Levy 1982; Neuvonen 1982;Olkkola 1985a; Park et al. 1986; Pond 1986; Spector et al. 1986). As a result, the initial management in particular of intoxicated patients has changed.[12]

Single-dose activated charcoal should not be administered routinely in the management of poisoned patients. Based on volunteer studies, the administration of activated charcoal may be considered if a patient has ingested a potentially toxic amount of a poison (which is known to be adsorbed to charcoal) up to one hour previously. Although volunteer studies demonstrate that the reduction of drug absorption decreases to values of questionable clinical importance when charcoal is administered at times greater than one hour, the potential for benefit after one hour cannot be excluded. There is no evidence that the administration of activated charcoal improves clinical outcome. Unless a patient has an intact or protected airway, the administration of charcoal is contraindicated. A review of the literature since the preparation of the 1997 Single-dose Activated Charcoal Position Statement revealed no new evidence that would require a revision of the conclusions of the Statement.

.Activated charcoal can be prepared from one of a variety of carbon-containing materials.6 Wood pulp with a low ash content, coal, lignite and rye starch are some examples of sources. Once the charcoal (nearly pure carbon) is obtained through chemical means, it is broken down into a fine granular form. To activate it, a further process of treating it with steam, oxygen, carbon dioxide, certain acids and other chemicals is undertaken. This activating process removes impurities and creates fine, small granules. As a result, currently used activated charcoal has a surface area of about 1,000 m2 per gram, while experimental activated charcoal with surface areas of up to 3,500 m2 per gram has been manufactured.7 Activated charcoal will adsorb most drugs and toxins,8'9 but not all compounds are well adsorbed [13]

Charcoal for medicinal use is created by the controlled pyrolytic decomposition of carbon-based compounds, such as coconut shells or peat . Thereafter, 'activation' with gases at high temperature removes previously adsorbed substances and further reduces particle size, resulting in an exceptionally porous final product Indeed, some 'superactivated' charcoal preparations have a surface area of up to 3500 m2 g–1 , or about 175 000 m2 per 50 g bottle (For perspective, the area of a large football pitch is about 10 000 m2 .) This allows the adsorption of drugs and toxins through weak intermolecular forces, with non-ionized, organic compounds binding more avidly than dissociated, inorganic ones

Activated carbon has been used in purification schemes for centuries because of its remarkable adsorption properties. While these properties are certainly related to the porous nature of the carbon, the detailed mechanism of adsorption remains rather speculative at the present time. In the caSe of non-electrolytes, physical or 'specific' adsorptionl takes place at the solid-liquid interface, whereas with electrolytes a chemical or 'non-specific' adsorption takes place in the electrical doublelayer surrounding each carbon surface.

II. CARBON EXCHANGE RESERVOIR

- Simplified version of the carbon exchange reservoir, showing proportions of carbon and relative activity of the ^{14}C in each reservoir
- Carbon is distributed throughout the atmosphere, the biosphere, and the oceans; these are referred to collectively as the carbon exchange reservoir, and each component is also referred to individually as a carbon exchange reservoir. The different elements of the carbon exchange reservoir vary in how much carbon they store, and in how long it takes for the ^{14}C generated by cosmic rays to fully mix with them. This affects the ratio of ^{14}C to ^{12}C in the different reservoirs, and hence the radiocarbon ages of samples that originated in each reservoir. The atmosphere, which is where ^{14}C is generated, contains about 1.9% of the total carbon in the reservoirs, and the ^{14}C it contains mixes in less than seven years.The ratio of ^{14} C to ^{12}C in the atmosphere is taken as the baseline for the other reservoirs: if another reservoir
- has a lower ratio of ^{14}C to ^{12}C, it indicates that the carbon is older and hence that either some of the ^{14}C has decayed, or the reservoir is receiving carbon that is not at the atmospheric baseline. [The ocean surface is an example: it contains 2.4% of the carbon in the exchange reservoir, but there is only about 95% as much ^{14}C as would be expected if the ratio were the same as in the atmosphere. The time it takes for carbon from the atmosphere to mix with the surface ocean is only a few years,but the surface waters also receive water from the deep ocean, which has more than 90% of the carbon in the reservoir.Water in the deep ocean takes about 1,000 years to circulate back through surface waters, and so the surface waters contain a combination of older water, with depleted ^{14}C, and water recently at the surface, with ^{14}C in equilibrium with the atmosphere. Creatures living at the ocean surface have the same ^{14}C ratiosas the water they live in, and as a result of the reduced $^{14}C/^{12}C$ ratio, the radiocarbon age of marine life is typically about 400 years.Organisms on land are in closer equilibrium with the atmosphere and have the same $^{14}C/^{12}C$ ratio as theatmosphere. These organisms contain about 1.3% of the carbon in the reservoir; sea organisms have a mass of less than 1% of those on land and are not shown in the diagram. Accumulated dead organic matter, of both plants and animals, exceeds the mass of the biosphere by a factor of nearly 3, and since this matter is no longer exchanging carbon with itsenvironment, it has a $^{14}C/^{12}C$ ratio lower than that of the biosphere.[14]

III. METHODOLOGY

- SAMPLES FOR CARBON DATING

A. Suitability of Materials
In order to be suitable for use in carbon dating, materials commonly derived from biological systems must contain Carbon that was initially able to exchange with theatmosphere. Samples collected for Carbon dating must be changed into suitable forms for measuring the 14C content:which means depending on the measurement technique to be used for dating, the sample is converted to gaseous, liquid, or solid forms accordingly. Before that,the sample must be treated to remove any contamination and any unwanted components.

charcoals are very much preferred for carbon dating because of their high carbon content which does not get replaced by other carbon Sources. However Soil buried charcoal can easily absorb considerable amounts of Soluble Soil humic substance mainly formed In-situ especially in seasonally wet soil rich in organic matter treating charcoal's exhaustively with a mixtape of M NO4P2O7 0.1M Noah helps Charcoals are very much preferred for carbon dating because of their high Carbon content which does not get replaced by other carbon sources. However, soil-buried

Charcoals. can easily adsorb considerable amounts of soluble soil humid substances, mainly formed in-situ especially in seasonally wet soil rich in organic matter. Treating charcoals exhaustively with a mixture of 0:1 MNa4P207 : 0:1 MNaOH helps to remove such contamination [15]

- Sampling charcoal for Radiocarbon Dating

sampling of macroscopic charcoal form archeological site and soil sedimentary sequence is relatives & bright and fragments can be handpicked from the sedimentary matrix wrapped in solvent-washed aluminum foil and Sealed in a labelled plastic bag.
Charcoal : to separate charcoal from sedimentmatix use tweezers for micro tweeze for large piece of charcoal that are not coursed in a lot of day you can use water Floatation Day Charcoal samples at temperature less 70° for 12-24 hours prior to shipping.. In AMS the sample is first changed to a solid graphite by conversion to co 2 followed by graphitization in the presence of a metal catalyst these samples placed. On a disc along with the reference which are then. . fixed on a target wheel and analyzed sequentially Ions are the fired at the target wheel using

Gram generally negatively changed carbon ions which are accelerated to the positive terminal Foam the tandem Accelerator After an AFTS. Out data collected is the number and quantity of various isotopes of carbon from the values concentration ratio of these isotopes can be determined to allow evaluation of the level of fractiotism. While collection of samples, the spot and region from where it is collected, and the relationship between the original sample and the event to be dated should be noted. Older samples collected are often put through thermal diffusion column to increase the amount of 14C present.

In it. But it is seldom done in practice as it is a time consuming process and it needs large sampling size. However, it extends the limit of maximum age that can be accurately calculated by giving precise measurement of the 14C/12C ratio in old samples collected. Once samples are decontaminated, depending on the measuring technology to be used, they must be transformed

Into a suitable forms accordingly. Carbon must be in liquid form (benzene) for Liquid Scintillation technique Solid Carbon (graphite) targets are the more typical for Accelerator Mass Spectrometry, although gaseousCO2 can also be used.

In the early 20th century, the most notable way to measure the activity of 14C decay was to measure the radioactivity that can be denned as \the number of decay events per unit mass per time period, of the sample."This method was called Beta counting as number of particles emitted from 14C was counted. In the late20th century, an alternative method called Acceleration mass spectrometry (AMS) was introduced which directly counted the number of atoms of both 14C and 12C presenting a given sample, hence formulating the ratio. Initially, _ counting was more accurate. However AM Snow has become more error-free with advancement of the apparatus. The sample size needed for AMS is smaller than needed for _ counting and it is much faster.

A Geiger counter is an instrument which detects ionizing radiation such as _ particles, _ particles, and rays using the ionization eject produced in a Geiger {M• ulcer tube Libby designed his own Geiger counter covering the inner surface of a cylinder with Carbon from his sample converted to soot. The placing of this cylinder into the counter was such that there was nothing between the counting wire and the sample- the wire being inside the sample. The tube brie conducted

Electrical charge when a particle or photon of incident radiation made the gas conductive by ionization and produced detectable pulse [16]

In this method, Carbon in the sample is converted intogaseous form (carbon dioxide, methane, or acetylene),which is then introduced into a proportional counter to measure _-particle emissionsTo exclude background cosmic radiations or other radioactive emissions, the counters are shielded by lead or steel. Additionally,anti-coincidence detectors which record events outside the counter, and all events recorded simultaneously inside and outside the counter are regardedas nonessential events and hence ignored.Liquid Scintillation Counting.

It is the measurement of radioactive activity of asample using the technique of mixing the active material with a liquid scintillate (exhibiting the property of luminescence - e.g. zinc slide), and counting the resultant photon emissions" Libby's anti-coincidence counter. The purpose is to allow more ancient counting duet the intimate contact of the activity withthe scintillate.

This method also uses anti-coincidence counters to shield from background radiation.
As we know the number of _ particles detected in given time period for Beta Counting in the given sample, we can convert it to a standard measure of \activity in units of either counts per minute per gram of carbon(cam/g C), or Becquerel’s per kg (By/kg C, in SI units)."We also needto measure the activity of a blank sample and a sample with a standard activity using the measuring device to subtract background radiation and compare results

Accelerator mass spectrometry (AMS) is form of mass spectrometry that accelerates ions To extraordinarily high kinetic energies before mass analysis." This allows the separation of isotopes having neighboring masses [17]

IV. OBSERVATIONS

AMS gives result in the form of ratio of isotopes of carbon that is 12C, 13C,14C ratio are used to calculate Fm the Fraction modern calibration carve Varieties of method and statistical approaches based on new improved values collected form tree rings were used to publish numerous calibration curve over the next few decades.

V. CALIBRATION CARVE

Varieties of method and statistical approaches based on new improved values collected form tree rings sings were used to publish numerous calibration curves over the next few decades.

Modern methods of calibration take the original normal distribution of radiocarbon age

Ranges and use it to develop a histogram showing the relative probabilities for calendar ages." Calibration curve cannot be formulated, thus it is done numerically. Programs like Ox Cal andCALIB perform these calculations and produce probabilisticoutput as a table as well as in graphical form. In the blue curves give tree ring measurements (_standard deviation) and alongthe y-axis the red curvegives the sample radiocarbon concentration. The greyhistogram represents all the possible ages for the sample.

Calculated age of a sample in \Radiocarbon years “along with an associated range of error of plus or minus one standard deviation (denoted by the symbol ±_), can be transformed into a range of the sample's calendar ages using calibration curves (See _gore 14 - \the solid line is the calibration curve, and the dotted lines on either side represent the range of standard error"). The calibration curve has an associated error term by itself. Thus the _nil error term can be calculated as:

CONCLUSION

Radiocarbon dating of charcoal for investigation purpose it is quite challenging. It is essential that carbon dating applied on carbon relevant object Reading this paper it tells importance of Forensic carbon dating and how we applied. On a charcoal, and most How useful in crime.

Scene investigation.

RESULT

This article on the motto behind the article was to know carbon dating charcoal which will help solve the cases we told to take simple method. For the analysis which will help crime scene investigation**.**

REFERENCES

[1] Akaranta O., Odozie T.O., (1986), Activated carbon from kernael shell. Nigeria Journal of Applied Science, 4(1), 85- 90.

[2] Aloko D. F., Adebayo G. A., Production and characterization of Activated Carbon from 2) Agricultural waste (Rice-Husk and Corn-cob). Journal of Engineering and Applied Sciences ,2(2), (2007) 440-444.

[3] (2021), "Radiocarbon dating lab, ams miami - beta analytic," https://www.radiocarbon.com/.

[4] Chem Libre Text contributors, (2019), "Radiocarbon dating: Using radioactivity to measure the age of fossils and other artifacts," https://chem.libretexts.org/@go/ page/161977.

[5] Coleman, David C, and Brian Fry, Eds. (1991), Carbon Isotope Techniques, 3 (Academic Press). Hajdas, Irka (2009), "Applications of radiocarbon dating method," Radiocarbon 51, 79–90.

[6] de Messi`eres, Nicole (2001), "Libby and the interdisciplinary aspect of radiocarbon dating," Radiocarbon 43 (2), 1–5.

[7] Barber, E. A. 1909. The Pottery and Porcelain of the United States. An Historical Review of American Ceramic Art from the Earliest Times to the Present Day. New York, NY: G.P. Putnam's Sons.

[8] Behrensmeyer, A. K. 1978. Taphonomic and ecologic information from bone weathering. Paleobiology. 4:150–162.

[9] Beta Analytic. 2013. Radiocarbon dating. http://radiocarbon.com/ Broeker, W. S., A. Schulert, and E. A. Olson. 1959. Bomb Carbon-14 in human beings. Science 130:331–332.

[10] Calcagnile, L., G. Quarta, C. Cattaneo, and M. D'Elia. 2013. Determining 14C content in different human tissues: Implications for application of 14C bomb-spike dating in forensic medicine.

[11] Radiocarbon. 55:1845–1849. Cardoso, H. F.V., K. Puentes, A. M. Soares, A. Santos, and T. Magalhaes. ˜ 2012. The value of radiocarbon analysis in determining the forensic interest of human skeletal remains found in unusual circumstances. Journal of Forensic and Legal Medicine. 19:97–100.

[12] Alon D, Mintz G, Cohen I, Weiner S, and Boaretto E (2002) The use of Raman spectroscopy to monitor the removal of humic substances from charcoal: Quality control for 14C dating of charcoal. Radiocarbon 44: 1–11.

[13] Arnold JR and Libby WF (1949) Age Determinations by radiocarbon content: Checks with samples of known age. Science 110: 678–680.

[14] Ascough PL, Bird MI, Francis SM, and Lebl T (2011a) Alkali extraction of archaeological and geological charcoal: Evidence for diagenetic degradation and formation of humic acids. Journal of Archaeological Science 38: 69–78. Ascough PL,

[15] Bird MI, Francis SM, et al. (2011b) Variability in oxidative degradation of charcoal: Influence of production conditions and environmental exposure. Geochimica et Cosmochimica Acta 75(9): 2361–2378.

[16] Bhardwaj R D, Curtis M A, Spalding K L, et al. (2006) Neocortical neurogenesis in humans is restricted to development. Proceedings of the

National Academy of Science 103 (33):12564-12568

[17] Cook G T, Dunbar E, Black S M, Xu S (2006) A preliminary assessment of Age at Death Determination using the nuclear weapons testing 14C of Dentine and Enamel. Radiocarbon 48(3):305-313.

[18] Jull A J T, Kalin R M, Burns K (1995) Bomb-derived 14C in Human Bones: AMS application to Forensic Science. American Chemical Society, 205th Annual Meeting, Anaheim, CA, April 1995.

[19] Levin I, Kromer B (2004) The tropospheric 14CO2 level in mid-latitudes of the Northern Hemisphere (1959-2003). Radiocarbon 46:1261-1272.

[20] Parr, J., Sullivan, L., Chen, B., Ye, G., and Zheng, W. (2010). Carbon biosequestration within the phytoliths of economic bamboo species. Global Change Biol. 16, 2661–2667. doi: 10.1111/j.1365-2486.2009.02118.

[21] Parr, J., and Sullivan, L. (2011). Phytolith occluded carbon and silica variability in wheat cultivars. Plant Soil 342, 165–171. doi: 10.1007/s11104-010-0680-z Parr, J. F., and Sullivan, L. A. (2014). Comparison of two methods for the isolation of phytolith occluded carbon from plant material. Plant Soil 374, 45–53. doi: 10.1007/s11104-013-1847-1

[22] Piperno, D. R. (2006). Phytoliths: a comprehensive guide for archaeologists and paleoecologists. Lanham MD: Altamira Press. Piperno, D. R. (2016a). Phytolith radiocarbon dating in archaeological and paleoecological research: a case study of phytoliths from modern neotropical plants and a review of the previous dating evidence.

[23] J. Archaeolog. Sci. 68, 54–61. doi: 10.1016/j.jas.2015.06.002 Piperno, D. R. (2016b). Standard evaluations of bomb curves and age calibrations along with consideration of environmental and biological variability show the rigor of phytolith dates on modern neotropical plants: review of comment by Santos, Alexandre, and Prior.

[24] J. Archaeolog. Sci. 71, 59–67. doi: 10.1016/j.jas.2016.01.013 Piperno, D. R., and Becker, P. (1996). Vegetational history of a site in the central Amazon basin derived from phytolith and charcoal records from natural soils. Quat. Res. 45, 202–209. doi: 10.1006/qres.1996.002

[25] HUA, Q. & BARBETTI, M. (2004): Review of tropospheric bomb C-14 data for carbon cycle modeling and age calibration purposes. – Radiocarbon 46: 1273-1298.

[26] HUGHEN, K., LEHMAN S., SOUTHON J., OVERPECK J., MARCHAL O., HERRING C. & TURNBULL J. (2004a): C-14 activity and global carbon cycle changes over the past 50,000 years. – Science 303: 202-207.

[27] HUGHEN, K.A., BAILLIE, M.G.L., BARD, E., BECK, J.W., BERTRAND, C.J.H., BLACKWELL, P.G., BUCK, C.E., BURR, G.S., CUTLER, K.B., DAMON, P.E., EDWARDS, R.L., FAIRBANKS, R.G., FRIEDRICH, M., GUILDERSON, T.P., KROMER, B., MCCORMAC, G., MANNING, S., RAMSEY, C.B., REIMER, P.J., REIMER, R.W., REMMELE, S., SOUTHON, J.R., STUIVER, M., TALAMO, S., TAYLOR, F.W., VAN DER PLICHT, J. & WEYHENMEYER, C.E. (2004b): Marine04 marine radiocarbon age calibration, 0-26 cal kyr BP. – Radiocarbon, 46: 1059-1086.

[28] HUGHEN, K., SOUTHON, J., LEHMAN, S., BERTRAND, C. & TURNBULL, J. (2006): Marine-derived C- 22 IRKA HAJDAS 14 calibration and activity record for the past 50,000 years updated from the Cariaco Basin. – Quaternary Science Reviews, 25: 3216-3227. HUMLUM O., ELBERLING B., HORMES A., FJORDHEIM K., HANSEN O. H. & HEINEMEIER J. (2005): Late-Holocene glacier growth in Svalbard, documented by subglacial relict vegetation and living soil microbes. – Holocene 15: 396-407. INGALLS,

[29] A.E., ANDERSON, R.F. & PEARSON, A. (2004): Radiocarbon dating of diatom-bound organic compounds.-Marine Chemistry, 92: 91-105. JULL, A.J.T. & BURR, G. S. (2006): Accelerator mass spectrometry: Is the future bigger or smaller? – Earth and Planetary Science Letters, 243: 305-325.

[30] Christensen AM, Passalacqua NV, Bartelink EJ. Forensic anthropology: current methods and practice. Oxford (UK); San Diego (CA): Academic Press; 2014.

[31] Latham KE, Bartelink EJ, Finnegan M, editors. New perspectives in forensic human skeletal identification. London (UK); San Diego (CA): Figure 5. Region-of-origin prediction map for Case Study 3, remains of an unidentified border crosser (OpID 0381), using the oxygen and strontium isotopic compositions of tooth enamel. (Water base layer data used for region-of-origin prediction . The darkest gray highlighted areas indicate locations where the individual may have obtained their drinking water (based on measured oxygen isotope ratios of tooth enamel).

[32] Mallett X, Blythe T, Berry R. Advances in forensic human identification. Boca Raton (FL): CRC Press; 2014.

[33] Morewitz SJ, Sturdy Colls C, editors. Handbook of missing persons. New York (NY): Springer, Cham; 2016.

[34] Thompson T, Black S, editors. Forensic human identification. Boca Raton (FL): CRC Press, Taylor & Francis Group; 2007. [6] Fry B. Stable isotope ecology. New York (NY): Springer; 2008.