

Use of Scientific Methods in Archaeology

Garima Bharti

Research Scholar, Department of Ancient Indian History and Archaeology,
University of Lucknow, Uttar Pradesh, India

Abstract: *Historical past is depends upon Archaeological evidences and hence these evidences are the mirror of historical past. Using these evidences we compose the history of any particular. But the authenticity of these evidences is only when they are researched in methodical, hallmark and scientific way. In present scenario necessity of science is everywhere and archaeology is one of the important branches of science. To survey and perusal of archaeological evidences, so many scientific methods are sustenance by we can get perfect, chronological and appropriate evidences.*

Keywords: Scientific methods like Carbon14 dating, Archaeobotany field, Remote sensing, Thermo luminescence dating

1. Introduction

Since ages, science is the main part of human life. It's directly or indirectly effects men and environment. Archaeology is directly related to human past, in it the use of scientific methods makes it more meaningful and standard. It is very true that archaeology is a science by which the remains of ancient man can be methodically and systematically studied to obtain a complete picture of his ancient culture and society to a possible extent. In present time we identify and analyzed the evidence by the help of science. So here I would like to produce some aspect of scientific methods which are used in analysis of historical past.

2. Dating of Archaeological Evidence by Scientific Methods

One of the most important changes in the field of archaeology is analysis of archaeological evidence by scientific methods, which are developing day by day with new advanced scientific technology. There are lots of scientific methods which are used in the field of archaeology for dating the past, like Carbon-14, Potassium argon, Thermo luminescence, Fission Track, Pollen Analysis, Dendrochronology, Archaeomagnetism, Obsidian Hydration, Soil Analysis, and Magneto Meter. Here, I would like to describe, all of these scientific methods which are being used in archaeology and also how they are effective in dating methods.

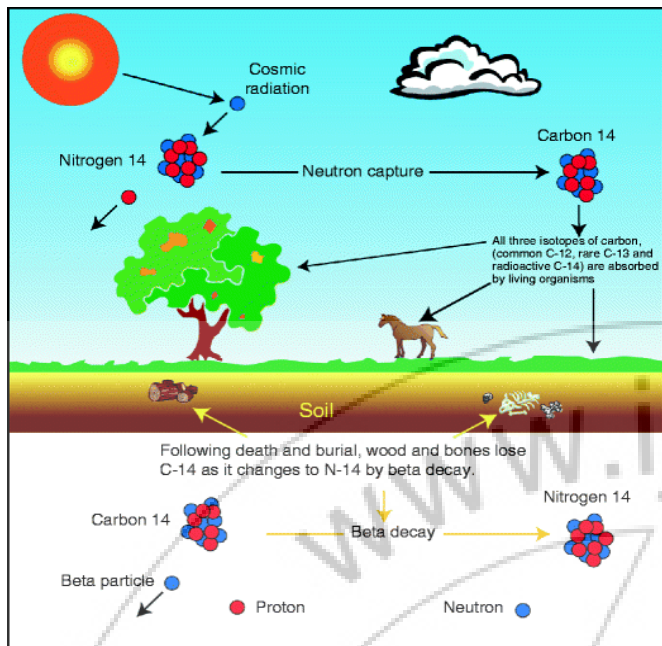
2.1. Carbon-14 Technique

The radio carbon dating technique is the most prominent method of dating analysis, which has changed the face of archaeological research. It has given revolutionary effect in the field of archaeology and history as well. Carbon 14 dating first time has been introduced by Willard F. Libby in 1948 as spin of atomic research. Since then this technique has been used in archaeology and with the help of this technique, we can get the data up to 75000 years old.

This technique is totally based on scientific system. The nature of an atom is determined by the number of protons and neutron present in its nucleus and the corresponding

number of electrons present outside its nuclear. When cosmic rays entered into atmosphere they produce shower of neutrons. They are unchanged but when neutron from the neutron shower collides with nucleus of a nitrogen atom, it lodges (neutron) in the nucleus by knocking out one proton. When it entered into earth atmosphere its do reaction with nitrogen 14 and because of this reaction the atom with 14 numbers (c14) is considered as the isotope of carbon. This is also called radio carbon. This radio carbon 14 is similar to stable carbon12 in all aspects except that it has extra neutrons in its nucleus, which makes it usable. This radio carbon gives out of parts through radiation (beta ray). It is very specific that when radiocarbon (c14) combine with oxygen in the same way as normal carbon (c12) to form carbon dioxide (co2). Though photosynthesis, carbon dioxide enters the chemistry of plants, which are in turn eaten by animals, man consumes both plants and animals. This way both radiocarbon and normal carbon enters all the living beings constantly throughout their lifetime.

Once the organisms or materials lost their life the amount of c14 present in the organism undergoes its normal decrees through the process of radioactive decay (means moving back of c14 to n14). Thus, after a time back when we measure the amount of c14 presents in the plants, animals and human remains we got to determine how much the time have been passed since the death of organism. So by calculating the difference between amount of originally present carbon content and lost carbon content in that organism, it may help in comparing the difference between dates passed from present date with the known rate of decay. By this, we can calculate the time passes in years. The radio carbon c14 decays by 1% every 83 years which means that 5730 year a given amount will be reduced to a half; the radio carbon decay rate is expressed in a half of about 5730 Years.



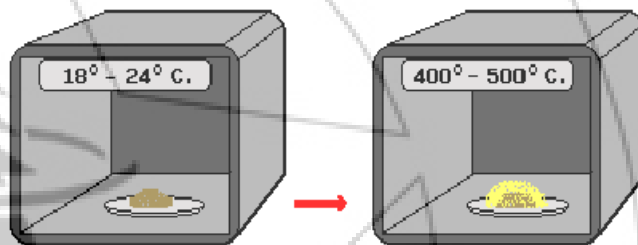
2.3 Thermoluminescence

Thermo luminescence dating (TL dating) is method is very useful in dating soil or soil material like pottery, soil bangles, terracotta, and clay materials. It is based on the fact that all material particularly crystalline material such as ceramic traps electrons released by natural radiation present in that material. The original heating of the energy (firing process in the case of ceramic and brick) would release all previously stored TL energy in the clay, thereby setting the clock at zero. Once the firing is over the process of trapping the new TL energy starts fresh. These trapped electrons accumulate through time. When a sample is heated above a critical temperature (400-500 c for ceramic) the accumulated or trapped electrons will be released as light energy (thermo luminescence). Thus, one can determine the time elapsed by calculating the accumulated light energy.

Now it is being relished that any heated material made of soil like pottery, fired clay, terracotta, brick, kilns, furnace, and hearth can be used for dating purpose.

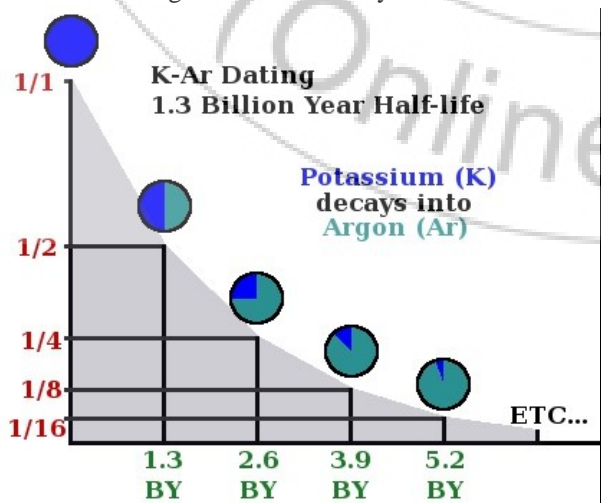
2.2 Potassium Argon

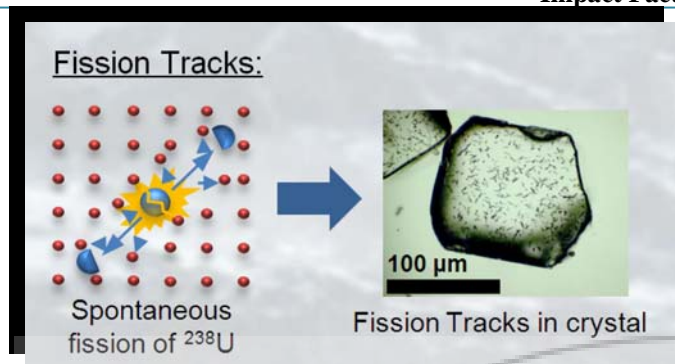
Potassium argon dating method, first time introduced by the scientists at the university of California in 1950, is based on the process whereby radioactive of rare isotopes of potassium (K^{40}) decays into argon (Ar^{40}) gas. This decay take place at known rate. This method is very helpful in dating the rocks or content of rock materials. The half life of K^{40} is 1.31 billion years. This method is based on this system that rock contained no argon gas when they get formed and how much time they lead in environment they adopt argon content, so by calculating argon we can easily identify the actual date of rock. This method is helpful without scientific analysis. This marks the scientists to choose the volcanic formation. When the rock is super heated like volcano, all the accumulated gases would be released into atmosphere. This sets the atomic clock to zero. When the rock solidifies again, radioactive potassium proceeds to decay into argon. The argon build up takes place in the rock at a fixed rate. So, the samples collected from volcanic flow are heated at a high temperature and the accumulated argon that is being released is measured. The date is determined based on the amount of argon gas that had accumulated through radioactive decay.



2.4 Fission Track

The natural fission of uranium 238 atoms present in obsidian and other glassy volcanic minerals leaves traces called fission track. These fission tracks are erased once the mineral is heated above a critical temperature. During volcanic eruption, all fission tracks present in the minerals are removed. This set the clock to zero. However, the fission track again started appearing once the material cooled down. The density of uranium 238 fission track is proportional to the time elapsed since the sample was last heated. So, the date determined by the calculating the fission track. These tracks can be detected by the treating a prepared rock sample with hydrofluoric acid and then observing its surface under magnification. To assign an actual date, one should aware of the uranium 238 content of the mineral. This achieved by bombarding the sample with known dose of U^{238} radiation. Once the uranium 238 content are known and the determined, the scientist correlates the samples fission tracks density with its estimated u^{238} fission rate assess its age.





2.5 Obsidian Hydration

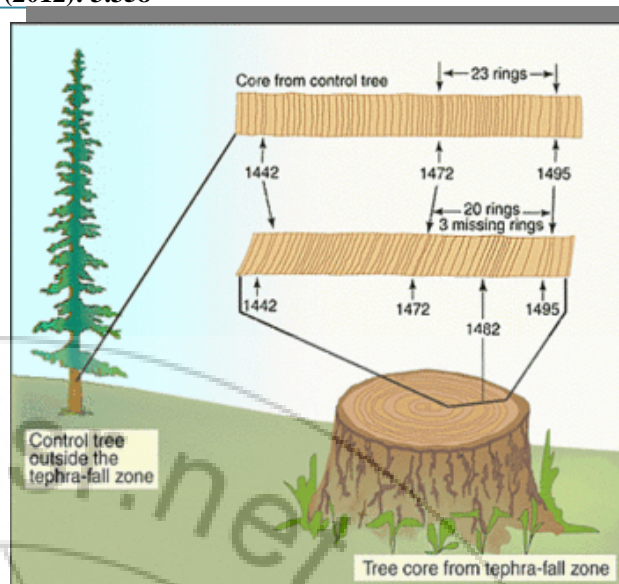
It has been observed that the surface of many geological material undergo chemical alteration through time. These weathering reactions create a visibly distinct surface layer or patina. When obsidian (a volcanic glass) artifacts are buried, they start absorbing water and form a layer called hydration layer. The thickness of the layer depends on how long the article has been buried, the surrounding temperature condition, long term change in the soil humidity and the petro graphic nature of the sample. By keeping these factors in mind, the sample is dated by measuring the thickness of the hydration layer.

2.6 Archaeomagnetism

Archaeo-magnetism dating based on the earth's magnetic field varies through time. Therefore, the location of the magnetic north pole changes its position both horizontally as well as vertically. Certain mineral compounds, such as clay, contain iron particles, which are aligned in magnetic north. When the clay is heated to a critical temperature (above 670c), the iron particles present in the clay align to the present magnetic north by losing their previous magnetic orientation. This method is widely used now.

2.7 Dendrochronology

Dendrochronology is an approach based on counting the annual growth rings observable in the cross sections of cut trees. It is developed by A.E.Douglass in 1913 and the method completely outlined in 1929. Douglass in his pioneering work developed a master sequence beginning with modern trees and extended it back in time as far as back to 2000 years and now the record spans more than 8000 years. This type of tree ring found in archaeological digging is compared with the master sequence and dated.



3. Conclusion

So at the end, if one says that History is made by scientific analysis of archaeological evidences, would not be wrong. In present scenario the trend to analyze the archaeological evidences are totally advanced and this happened only because of scientific methods. Archaeology is incomplete without science.

Reference

- [1] Binford, L.R., 1968, *New Perspective in Archaeology*, Aldine, Chicago.
- [2] Childe, V. Gordon, 1956, *Piecing Together the Past*, Routledge and Kegan Paul, London.
- [3] Aitken, MJ 1961, *Physics and Archaeology*, Interscience, New York.
- [4] Dillon, B.D. (e.d.), 1989, *Practical Archaeology, Field And Laboratory Techniques and Archaeological Logistics*, Hedrew Union College, New York.
- [5] Barker, Philip, 1977, *The Technique of Archaeological Excavation*, Batsford, London