

# ABSOLUTE DATING TECHNIQUES

**Radiometric Dating** - considered the most important method of obtaining absolute dates. Modern methods, such as isochron dating, have increased the validity and accuracy of radiometric techniques.

**Paleomagnetism** – including both polar wandering and magnetic reversal studies, allows the correlation, and therefore verification, of radiometric dates.

**Optical Dating** - (optically stimulated luminescence dating (OSL dating) and photoluminescence dating (PL dating) – can determine how long ago sand and silt-size quartz and feldspar grains were last exposed to daylight.

## Incremental Dating Techniques

**Incremental dating** techniques allow the construction of year-by-year annual chronologies, which can be fixed to present day calendar time.

**Ice Cores** – are core samples from the accumulation of snow and ice over many years that have recrystallized and trapped air bubbles. The hydrogen and oxygen isotopes provide a picture of the climate at the time. Also, the air bubbles contain atmospheric concentrations of trace gases, including greenhouse gases carbon dioxide, methane, and nitrous oxide, and aerosols, which are produced in great concentrations during volcanic eruptions. The variety of climate data recorded in ice cores is greater than in any other natural recorder of climate, and includes temperature, ocean volume, precipitation, chemistry and gas composition of the lower atmosphere, volcanic eruptions, solar variability, sea-surface productivity, desert extent and forest fires. Ice core data currently goes back about one million years.

**Varves** are annual layers of sediment or sedimentary rock. Varves are amongst the smallest-scale events recognised in stratigraphy, and are very important in paleoclimate study.

**Speleothems** are mineral deposits formed in caves. Samples can be taken from speleothems to be used like ice cores as a proxy record of past climate changes. They are particularly useful for accurately dating the late Quaternary period. Stalagmites contain several different climate records, such as oxygen and carbon isotopes and trace cations. These can provide clues to past precipitation, temperature, and vegetation changes over the last ~ 500,000 years.

**Coral Density Bands** – can be studied to determine annual changes in sea level, ocean temperature, H and O isotopes, and carbon dioxide, and are now being correlated with sediment and ice core data using C<sup>14</sup>.

**Dendrochronology** or tree-ring dating is based on the analysis of tree-ring growth patterns. The technique can date wood to exact calendar years. This technique has been used to reconstruct climate data for North America going back about 9,000 years, and will soon extend to 10,000 ybp.

**Lichenometry** is the study of dating a surface using lichens as age markers. Measuring the diameter of the largest lichen on a rock surface can be used to determine the time the rock has been exposed. Lichen can be preserved on rock for up to 10,000 years, and can provide dates for glacial deposits, lake level changes, rockfalls, talus, extent of permafrost and snow cover.

**Tephrochronology** is a geochronological technique that uses layers of tephra - volcanic ash from a single eruption - to create a chronological framework in which palaeoenvironmental or archaeological records can be correlated. Each volcanic event has a unique chemical 'fingerprint' that provides a stratigraphic time horizon.

**Archaeomagnetism** is the science of how to interpret signatures of the Earth's magnetic field at past times that are recorded in archaeological materials. These paleomagnetic signatures can be recorded when materials were heated by ancient fires. The basis of the dating is Thermal Remnant Magnetism (TRM). When an ancient pot was fired, the direction and intensity of the magnetic field of the Earth may be recorded by iron-bearing minerals such as magnetite contained in baked ceramic material. The ceramic material must be locked into position in the earth, such as in a hearth pit or fire-hardened surface. As time passes, the magnetic field direction of the local environment varies from the direction locked into the ceramic material.

**The Vole Clock** is a method used by archaeologists at sites across Europe. Vole clocks provide a detailed framework of how different vole species evolved over the last million years, and where and when specific species became extinct. For many sites it is considered the most accurate way of dating, and also provides information on the climate and local environment.