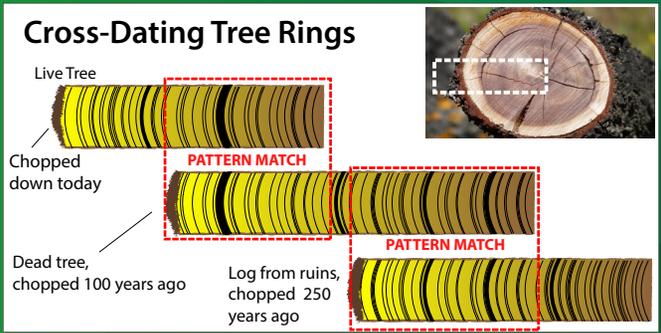


INDEPENDENT LINES OF EVIDENCE!

Radiocarbon dating is one of the best-known tools that geochemists use to obtain an age of ancient materials such as wood, bones, charcoal, and coral reef limestone. The method is suitable for samples less than 50,000 years old. It is applied to geology, paleontology, Biblical archaeology, anthropology, etc. Famous artifacts dated with carbon-14 include the Dead Sea Scrolls, Hezekiah's Tunnel, and the Shroud of Turin. Here I will describe how three *independent* processes are integrated to give confidence in the carbon-14 method: the growth of tree rings (biology), radioactive decay of carbon-14 (physics and chemistry), and annual layers of sedimentation (geology). It doesn't get any better than that!

The first process (biology) is the growth of tree rings, a pattern of light and dark bands formed annually. Rapid growth in the spring results in a light-coloured layer, followed in autumn/winter by a darker layer – yielding a method to count years into the past. Counting beyond the age of living trees is done by “cross-dating.” Tree-ring patterns can be overlapped on one another (because of unique patterns due to variations from year to year) to get a record extending much further into the past than the lifetime of any one tree. Using this method, scientists in Europe have produced an uninterrupted, overlapping, and cross-dated record back to 14,000 years.

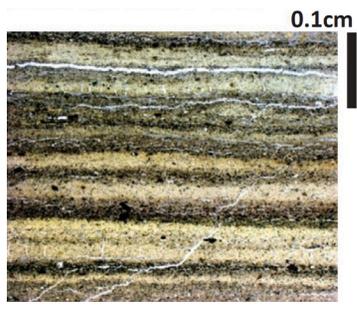


The second process (physics and chemistry) is the radioactive decay of carbon-14. These atoms are produced in the upper atmosphere by collisions of cosmic rays with nitrogen atoms. The resulting carbon-14 combines with oxygen, forming carbon dioxide that is absorbed into leaves and wood by growing plants. When the plant dies, the resupply of carbon-14 is cut off; the concentration

declines as the carbon-14 decays into nitrogen. Animals that eat the plants ingest the carbon-14 into their tissues until they die, and then the carbon-14 declines at the predictable rate based on its known half-life of 5,730 years.

Notice that the red line of carbon-14 data is a *squiggly* line. This result is expected because the cosmic rays bombarding the earth vary with time. Therefore, to obtain a calendar age in years, the amount of carbon-14 remaining in a tree ring is measured in the lab and plotted on a graph versus tree-ring count. So the calendar age of a wood sample of unknown age is determined from the graph linked back to the tree-ring count.

LAKE SUIGETSU VARVES

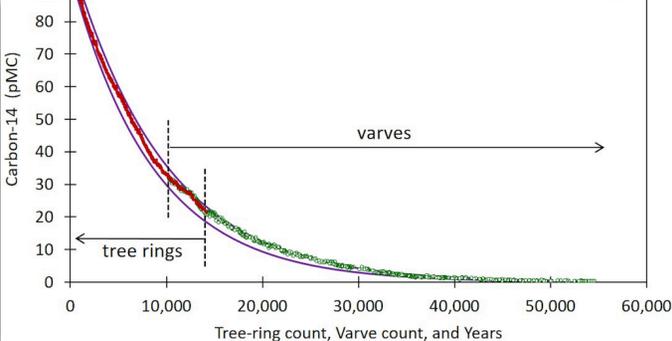


The third process (geology) is the sedimentation of annual layers called *varves*. Lake Suigetsu is part of a multi-lake system on the west coast of Japan that is unique for the study of climate history – so

unique it's nicknamed a “miracle lake.” River flow of water and sediment into adjacent Lake Mikata serves to trap the coarse-grained sediment that settles out before the fine-grained sediment passes into Lake Suigetsu. Each spring, algal blooms grow, producing tiny shells that rain out on the lake floor. For long periods of time, the bottom waters of Lake Suigetsu were anoxic (no oxygen), preventing burrowing organisms from disrupting the sediments, thus allowing preservation of annual couplets, called *varves*, of alternating darker sediment and lighter shells.

Like tree rings, age can be determined from counting the annual varves. One interval at Suigetsu does not have varves from a time when bottom waters were oxygenated, but fortunately, the varve record overlaps the tree-ring record, allowing varves and tree rings with the same carbon-14 content to be lined up. The majority of samples measured for carbon-14 were leaves and twigs found between the varves. The results shown are the (tiny) green circles identified as varves in the graph, tied to the data

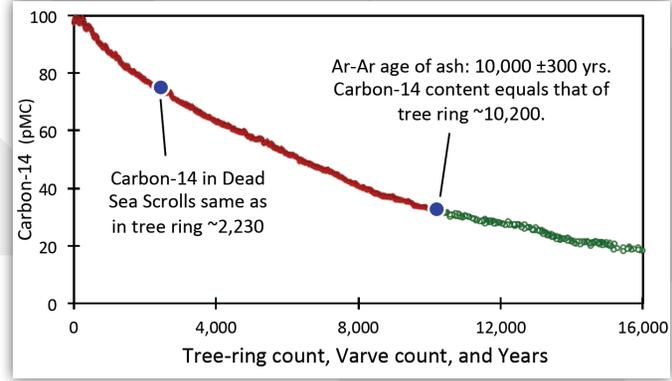
from tree rings in red. You can see that there are about 4,000 years of overlap between the tree rings and the varves. This provides a superb opportunity to verify that the sedimentary couplets in Lake Suigetsu are indeed varves – that is, the light and dark layering is annual. Together, the tree ring and varve count traces a history of nearly 50,000 years.



Still another confirmation of the tree-ring count and radiocarbon age comes from a volcanic ash layer in the lake, linked chemically to a specific eruption 10,000 years ago (Ar-Ar dating). The ash is next to leaves in the varves that have the same amount of carbon-14 as a 10,000 year old tree ring!

BIBLICAL ARCHAEOLOGY

One of our favorite Biblical applications is the Dead Sea Scrolls, related to Isaiah 53. The “suffering servant” seems so clearly a reference to Jesus, that critics have long argued that it was written after the time of Christ. But the carbon-14 content is the same as tree rings counted back to 107 to 335 BC, hence confirming that Isaiah 53 pre-dates the sufferings of Christ.



Wow, we have the intersection of three completely independent methods tied together for one coherent result: tree rings, carbon-14 decay, and annual layering of varves. God has given us some very neat tools to understand the past – real tree rings, real varves, real radioactive decay of atoms, representing real passage of time. 🌳

FIND OUT MORE

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