A Comparative Investigation of Preparation Methods for Stable Carbon Isotope Analysis of Tree Rings

The most widely used method for preparing tree ring samples prior to stable isotope analysis involves digesting wood samples to α-cellulose in a multi-step process using many harsh chemicals. This is an essential step for sample preparation in the analysis of both stable oxygen and hydrogen isotopes because hydrogen and oxygen in dead wood readily exchange with their surroundings, an undesirable trait when measuring isotope ratios to reconstruct environmental variables such as temperature and precipitation. To avoid this, wood samples are purified to cellulose, a compound where the oxygen and hydrogen atoms are fixed during photosynthesis.

Although it is widely recognized that carbon compounds in dead wood do not exchange isotopically with the surrounding atmosphere, complex cellulose extraction methods are still often used in sample preparation for stable carbon isotope analysis. In this study, we compare different pre-treatment methods using tree-ring chronologies from four different tree species. Each set of tree-ring samples undergoes: 1) no treatment at all, 2) treatment with nitric and acetic acids, and 3) treatment with nitric and acetic acids followed by sodium hydroxide digestion. After preparation, all samples are processed using gas extraction tubes, a VG SIRA series II stable isotope ratio mass spectrometer located in the Environmental Stable Isotope Laboratory at The University of Vermont. Results will show whether the use of whole wood samples for isotope analysis yield similar values and temporal trends as samples processed to α-cellulose. Eliminating the digestion steps would save dendroclimatologists time, money, and exposure to harsh chemicals.