The Reconstructed of Ancient Diets and Environments

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INTRODUCTION:

The purpose of the laboratory research is to reconstruct ancient diets and environments using stable carbon and oxygen isotopes in fossil teeth.

The ratios of the stable isotopes of carbon (distinguished only by their atomic mass, 12C and 13C), provide a natural tracer for the chemical and biochemical reactions of the carbon cycle. In our research, the fossil teeth are about 50,000 years old and were from a Late Pleistocene fossil cave (Baxian Cave) in Guangxi Province, South China. The study area is currently located within the subtropical evergreen forest zone which is dominated by plants using the C3-photosynthetic pathway – C3 plants, with only a minor amount of C4 plants using the C4 photosynthetic pathway (Fig 3). Some plant examples for C3 plants are trees, shrubs, forbs, and cool season grasses. The plant example for C4 plants are warm season grasses such as corn, amaranth, sugar cane, sorghum, and some of the millets. Because they use different photosynthetic pathways to fix carbon, these two groups of plants have very distinct 13C/12C ratios. Animals incorporate the plant carbon they eat into their tissues, which then directly reflect proportions of C3 and C4 plants eaten (Kohn et al., 2005). In order to adequately retrieve the isotope ratios of our enamel samples, a gas spectrometer must be used to separate each isotopic variation. The way this is done is by first positively ionizing the elements into ion beams that are run through the mass spectrometer. Then the spectrometer increases the speed of the ions so that each variation is at the same speed. The mass spectrometer then deflects the moving ions by magnetism. Ions with different isotopes are separated into categories based upon their mass and is then recorded electronically to determine the ratio of different isotopes (Clark, 2014).

EXPERIMENTAL PROCEDURES

1. Drill the serial sample teeth by taking weighing paper and folding it in half to collect the enamel powder, once cleared of debris found on the teeth (Fig 6a).
2. Once 24 samples have been collected, add 1 mL of 5% sodium hypochlorite solution to oxidize organic material in each sample, mix them, and let it sit to react overnight.
3. Rinse each sample with distilled water after pipetting the previous solution out by placing the samples in a centrifuge to separate the sample and the solution, and then adding the 1 mL of distilled water to each sample. Repeat this process 3 times.
4. Rinse each sample with acetic acid to extract any non-structural carbonates by adding 1 mL of the acid, shaking it, and centrifuging it to remove the reacted to acetic acid. Then an additional 1 mL of acetic acid is added to each sample for it to sit overnight (Fig 6b).
5. Repeat the process for rinsing each sample with distilled water to remove the solution in sample, as demonstrated in step 3.
6. Freeze-dry each sample by covering each sample with aluminum foil and poking a hole in it. Then place the samples in the freezer to sit overnight, so those frozen samples can be taken into the freeze dryer to remove any moisture (Fig 6c).
7. Weigh each sample and corresponding carbonate standards on a microbalance. This will provide a basis of comparison to the flushed samples in the future use of the mass spectrometer (Fig 6d).
8. Bake each sample overnight to remove any additional moisture.
9. Flush each sample and standard with Helium to remove air from each sample and any carbon dioxide that exists in the air.
10. Add 8-10 drops of 100% phosphoric acid to each sample and let it sit over night to be able to react with the structural carbonate when the mass spectrometer runs through the sample (Fig 6e).
11. Run each sample through the mass spectrometer to collect the isotopic variation data of oxygen and carbon (Fig 6f).

The data from the R. sinensis sample show that there is no significant intra-tooth carbon isotopic variations (Fig 7). This indicates that there is little or no seasonal variation in its diet. Based on the results from the Baxian Cave area located in the Guangxi Province in South China. A serial sample was taken from the enamel of the species to determine its isotopic variation of carbon and oxygen intake during development. The data confirmed that the species did consume C-3 plants and experienced a full seasonal cycle during its development which enables us to be informed of the migration, location and identification of this species. The range in δ13C values (−15.9‰ to −16.9‰) indicates that R. sinensis fed on solely C3 biomass, and lived in dense forest habitats, and not open country or savannas.

CONCLUSION

The R. sinensis was a species that existed during the Pleistocene Epoch in the Baxian Cave area located in the Guangxi Province in South China. A serial sample was taken from the enamel of the species to determine its isotopic variation of carbon and oxygen intake during development. The data confirmed that the species did consume C-3 plants and experienced a full seasonal cycle during its development which enables us to be informed of the migration, location and identification of this species. The range in δ13C values (−15.9‰ to −16.9‰) indicates that R. sinensis fed on solely C3 biomass, and lived in dense forest habitats, and not open country or savannas.

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REFERENCES:

