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Determining an Alternative Skeletal Feature to be Utilized in 87Sr/86Sr Isotopic Analysis When Tooth Enamel is Unavailable

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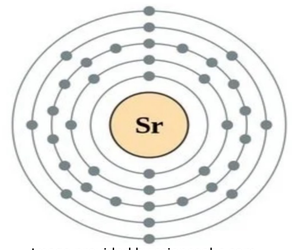


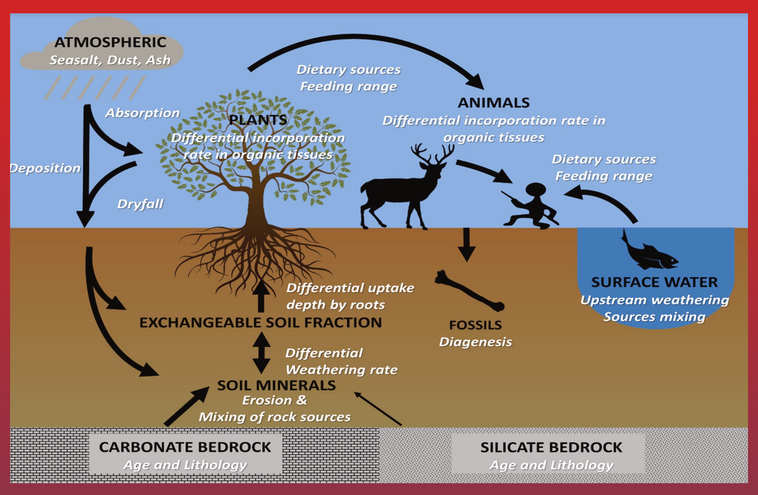
Image provided by scienceabc.com

Introduction

Strontium is an alkaline earth metal that enters the human body via consumption of food and water. A small level of these molecules integrate into human bone, replacing calcium. Due to the lack of fracturing, isotopic levels found in bone may be correlated to Isoscape maps or the level of strontium found in the fauna and soil in the region of interest.

Due to this correlation, strontium isotopes are currently being used in forensic cases to determine the region an individual resided, at or near their time of death. Bioarcheology applies this analysis to the study of migration in past populations. Previous research supports using enamel of the teeth for the most accurate reading of strontium levels for place of birth, and bone for where the individual spent the latter years of their life. In many cases, teeth are not recovered or may be too damaged or decayed to provide enough enamel. There is minimal research or standard in determining what bone to use for end-of-life residence.

This research explores alternative locations of the human skeleton to be used in these cases. There is currently minimal research that explores this alternative. For the field of forensics, as well as bioarcheology, this will increase the ability to utilize strontium when complete skeleton is not able to be recovered.



Schematic of strontium Isotope cycle from rocks to ecosystems (Bataille et al., 2020)

Research Questions

- Is the petrous portion of the temporal bone as reliable as tooth enamel in providing a strontium level to indicate an early life residence?
- Do the cortical bone samples give similar $^{87}Sr/^{86}Sr$ levels as the last known place of residence?
- Are the $^{87}Sr/^{86}Sr$ levels higher in cancellous bone samples than in cortical bone samples, demonstrating possible diagenesis?

Methodology

The University of Montana currently houses an individual that has been approved for destructive analysis. This individual's early life residence and end of life residence are known. This provided an appropriate sample for preliminary research.

Sample Collection and Preparation

- Wood samples were collected from both early and end of life residence. A water sample was also collected from the end-of-life residence to test for possible diagenesis.
- 12 bone samples were collected using a Dremel drill. 7 Samples were collected using a common method to prepare bone dust. 5 samples were collected using a diamond core bit, a new method to prepare a bone core

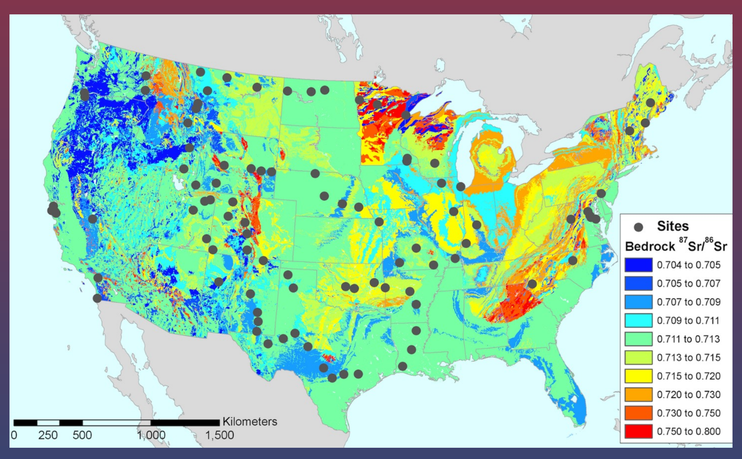
Sample Analysis

- Samples were submitted to a lab in the Department of Geology and Geophysics at the University of Utah
- Samples were analyzed using a Thermo-Fisher Scientific Neptune MC-ICP-MS to perform laser ablation and mass spectrometry
- Results are still pending

Results

Upon the return of sample analysis

- $^{87}Sr/^{86}Sr$ levels of all samples will be compared to an Isoscape map of the United States.
- Tooth enamel and the petrous bone will be compared to each other as well as the expected level of early life residence. All other bone samples will be analyzed for evidence of similar $^{87}Sr/^{86}Sr$ ranges
- All bone samples will be compared to the $^{87}Sr/^{86}Sr$ ranges found in the end-of-life residence
- All bone samples will be compared to the $^{87}Sr/^{86}Sr$ levels found in the wood and water samples, looking for evidence of diagenesis



$^{87}Sr/^{86}Sr$ Isoscape map of the United States (Chesson et al., 2012)

Further Research & Broader Impacts

The findings of this research has the potential to be applied to the overwhelming number of individuals that remain unidentified at the Pima County Office of Medical Examiners. Most of these individuals perished while crossing the United States Southern border. A predominant factor in these individuals remaining unidentified is not knowing the country or region of origin. The use of strontium isotope levels found in bone can help to narrow down where an individual resided prior to their death. This information can help direct a search when locating next of kin.

This research could also be applied to migration research when teeth have not been recovered, are too damaged for analysis, or have a high level of diagenesis.

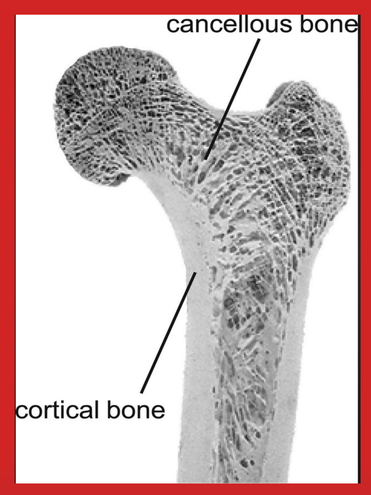


Image demonstrating the difference between cortical and cancellous bone ResearchGate.com

Acknowledgements

I would like to acknowledge my advisor Dr. Meradeth Snow for her countless hours of help and endless support; Keith Biddle for training me in proper procedure of drilling bone samples; Diego P. Fernandez at the University of Utah for processing my samples; lastly, I would like to acknowledge those individuals and their families who allow for necessary scientific research to be conducted after they have passed.

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"Figure 2 Cortical and Cancellous Bone in Human Femur." n.d. ResearchGate. Accessed February 27, 2022.