Developing isotopic tools (databases and models) for human traceability and provenance in Argentina: updates.

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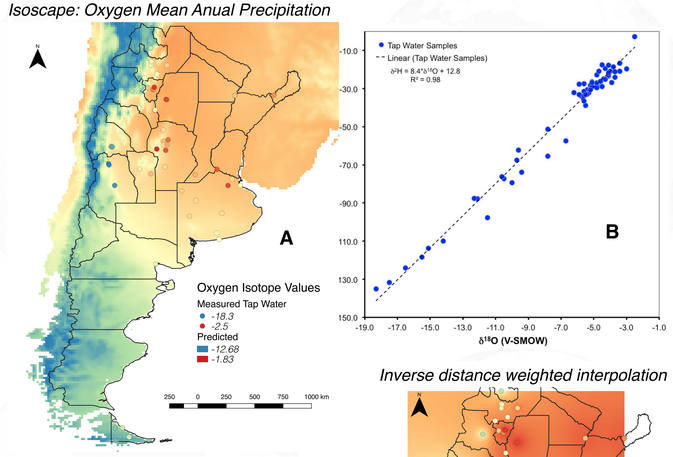
Background and Objectives

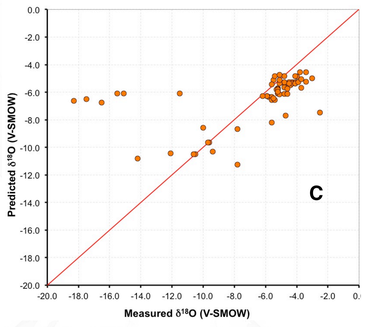
- Determining the region and/or population of origin of victims of murder, migrants, or tragedy is very useful in aiding the person's identification, as well as adding information to forensic investigations.
- In Argentina there are many instances were biogeochemical markers could aid in identifying a person. For example the EAAF still has more than 600 skeletons without identification, and also in the last 35 years more than 5000 people have been buried as NN in cemeteries across the country (Report from Procuraduría de Trata y Explotación de Personas, 2016).
- The main objective of this HHRRC-AAFS funded project is to generate predictive maps of the geographic distribution of stable isotopes of human tissues useful in accurate and precise region of origin assignment of unidentified remains (human provenancing) in Argentina.
- To achieve this goal, we will analyze the spatial and temporal variation of the stable isotopes of water available for human consumption, alongside human hair and teeth, testing geographic assignment models on samples from known origin.
- We present updates on this project showing, a first **preliminary analysis of tap water** samples and a **region-of-origin assignment** of 4 individuals using $\delta^{18}O$ and $\delta^{13}C$ values. We also describe the development of a sampling project during the COVID-19 to create a **"reduced mobility" isotopic database** of human hair.

a) Preliminary Tap Water Analyses

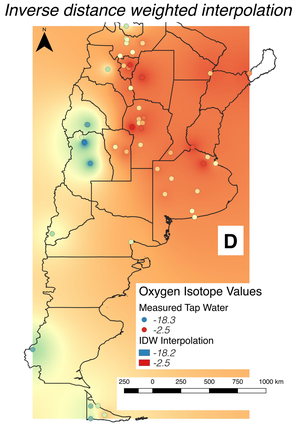
Sixty eight (n=68) tap water samples were analyzed for δ18O and δ2H values (48 different locations).

Isoscape: Oxygen Mean Anual Precipitation





Inverse distance weighted interpolation



- Predicted ranges are much smaller than those measured (Figs. A and B).
- Existing models for precipitation overestimate values for samples taken in regions near the Andes Mountains (Figs. A and C).
- A first interpolation of tap water values shows several areas were sample density is too low for accurate prediction (Fig. D).
- There are still 70 tap water samples collected in 2020 to be sent for analyses.
- Further collection will take place in 2021 alongside hair samples.

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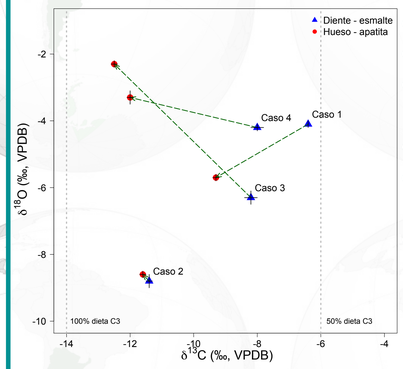
b) Region-of-origin analyses four cases from EAAF. These cases exhumed in 2009 are not under forensic investigation.

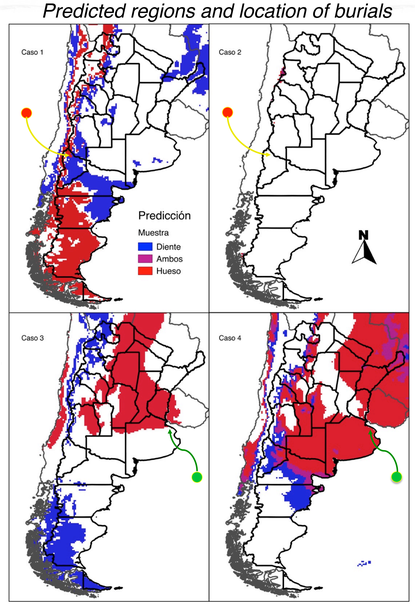
Cases 1 and 2 belong to historic samples (burial late 1800s) from the same site.
Cases 3 and 4 correspond to inhumations from 1977 and both in the same cemetery.

	Samples		*Teeth-enamel*		*Bone-apatite*		*Water Prediction*	
Cases	Teeth	Bones	$\delta^{13}Ce$	$\delta^{18}Oe$	$\delta^{13}Ca$	$\delta^{18}Oa$	$\delta^{18}Ow$-e	$\delta^{18}Ow$-a
1	2MSD	5th Right Rib	-6.36 ± 0.05	-4.11 ± 0.08	-9.32 ± 0.13	-5.72 ± 0.14	-6.6	-9.1
2	2MID	7th Right Rib	-11.35 ± 0.12	-8.79 ± 0.18	-11.61 ± 0.09	-8.55 ± 0.08	-13.8	-13.5
3	2PMII	Undetermined Rib Fragment	-8.21 ± 0.18	-6.32 ± 0.17	-12.48 ± 0.08	-2.27 ± 0.08	-10.0	-3.7
4	2MII	9th Right Rib	-7.97 ± 0.15	-4.22 ± 0.09	-12.04 ± 0.1	-3.34 ± 0.16	-6.7	-5.4



- Large isotopic ranges
- Different origins.
- Changes in residency and diet for three cases (1, 3, 4).
- Case 1 "moving" towards case 2?
- Cases 3 and 4 "moving" to a similar region?
- Have they reached isotopic equilibrium?

Predicted regions and location of burials



With the available models and the small isotope database described here it is still very difficult to generate accurate regions of origin.

c) "Reduced Mobility Database" - Beard samples

- During the COVID-19 pandemic the Argentinian government set up a strict quarantine starting in mid-March 2020.
- This quarantine reduced dramatically the mobility of people across the country, even within larger cities, providing us with an unexpected experiment to capture the *true local* isotopic signal in human hair.
- Beard was chosen because we could be sure it was grown during the quarantine and it can be sampled very easily (after normal shaving).
- We received more than 150 entries to an online questionnaire and so far we have received near 50 samples.

The questionnaire gathered donors' information on previous travels, dietary choices and health, among other information. We requested that the volunteers filled the questionnaire, and then shave and send the samples via postal mail. Some examples of the information gathered:

These samples will be analyzed and incorporated into a new database to represent the isotopic variability of local people across Argentina.

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