Geophysical Research Abstracts
Vol. 13, EGU2011-3168, 2011
EGU General Assembly 2011

Development and validation of a spatial prediction 'Isoscape' model for the forensic geographical provenancing of human remains in the Middle East.

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The demand for validated isotopic maps (Isoscapes) is rapidly growing due to the wide range of disciplines that have started to use the information to answer spatially related questions in their research areas. Isoscapes have been applied to problems ranging from the modelling of bird migration patterns, understanding hydrological systems and the provenancing of controlled substances and other forensic samples. A number of studies have utilized a combination of stable and radiogenic isotopes as indicators of the geographical origin of human and/or their remains.

In the UK alone, over 1000 bodies that have been found during the last 50 years remain unidentified. Isotope analysis of human remains has the potential to provide authorities with geographical information about the provenance and migration of the individual which can improve the probability of successful identification. Meier-Augenstein and Fraser (2008) presented the first published case in which stable isotope intelligence was successfully used to help the police identify the origin of an unidentified body. However the application of isotope intelligence to human remains is in its infancy as there are no validated published Isoscapes for human tissue other than for hair (Ehleringer et al, 2008).

In the presented research we have focused on the Greater Middle East. This is a challenging region as very little isotopic information is available for the Middle East from the Global Network for Isotopes in Precipitation (GNIP) database maintained by the IAEA in Vienna. Additionally it has been suggested that due to the complex climatic conditions, the use of desalinated water, and the wide availability of imported foods, published spatial oxygen and hydrogen isotope models based on the GNIP database may be poor predictors for the actual isotopic composition of water and food and thus human tissue for this region. In a first attempt to develop a regionally validated model for the Middle East we use a combination of oxygen and strontium isotopic data collected from 66 modern human teeth originating from 5 countries in the Middle East (United Arab Emirates, n = 11, Oman, n = 11, Iraq, n = 10, Iran, n = 19 and Yemen, n = 15). The $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ isotope ratios of enamel extracted from the samples were determined by Multi Collector Inductively Coupled Plasma Mass Spectrometry (MC-ICPMS) and Isotope Ratio Mass Spectroscopy (IRMS) in our laboratories.

As expected the comparison of the measured data with published spatial models highlighted discrepancies suggesting that indeed a regional model is required. In the presentation we will discuss different modeling approaches, e.g. spatial versus climatic, incorporation of non-isotopic information and other options.

References

Ehleringer, J.R. et al, *Hydrogen and oxygen isotope ratios in human hair are related to geography*. Proc Natl Acad Sci USA, (2008), 105:2788-2793.

W. Meier-Augenstein, I. Fraser, *Forensic isotope analysis leads to identification of a mutilated murder victim*. Science and Justice 48, (2008), 153-159.