## H56 Introduction to the Use and Limits of Elemental and Isotopic Analysis for the Forensic Provenancing of Unidentified Human Remains

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The presentation is focused on familiarizing forensic anthropologists with elemental and isotopic analysis of human remains as part of the special session "new technologies in forensic anthropology."

This presentation will impact the forensic science community by providing a basic understanding of what information elemental and isotopic profiling can and cannot provide. In this presentation, attention will be giving to sampling techniques, test design, calibration and validation of the instru- mental techniques, risk factors, and methods for interpretation. A quick overview of the state of the art and the directions for future research will be included.

The ultimate goal in the investigation of unidentified human remains is establishing the identity of the individuals. DNA analysis and odontology are the only truly confirmative techniques but the identification requires reference samples and/or ante-mortem data. In cases where (initially) reference samples and/or ante-mortem data are not available geographical provenancing with environmental markers can provide the investigators with possibilities for more effective searching by excluding options.

Of the environmental markers with a systematic and documented geographical distribution, pollen and the bio-available elemental and isotopic markers from water, soil, plants and livestock are the most promising for forensic investigations.

Large scale systematic, roughly latitudal, spatial differences in the hydrogen and oxygen isotopic composition of rainwater and subsequently drinking water are transferred to humans and can be used for large scale geographical provenancing. Regional differences in bedrock geology, soil mineralogy and reflect themselves in the elemental and isotopic composition of regional food supplies which again are transferred to humans. In pre-modern populations with limited traveling and often local sourcing of food strong geo-chemical links can be observed with the regional elemental and isotopic profiles in the environment. In modern populations inter-regional travel and intercontinental sourcing of food can confound the theoretical characteristic regional fingerprints.

Although contamination of the remains during environmental exposure or burial can confound the interpretation of the results the same analysis can often also indicate if such contamination has actually taken place.

Consideration should be given to which parts of the remains will be sampled for analysis as different parts of the skeleton have different turnover rates and thus the analysis will give different results for different parts. Although the teeth are best preserved they will probably not be the best indi- cation of the latest regional environmental background shortly before death.

Nutritional status, disease and sex may affect both the elemental and isotopic profiles, e.g., heamochromatosis affecting iron status and the natural iron isotopic composition.

Especially for the isotopic analysis it is useful to compare results to databases or spatial models and maps. However the test design and the analytical accuracy between different laboratories needs to addressed first and the effects on the interpretation needs to be assessed. A proper test design and investigation need also to deliver statements about the (spatial) uncer- tainty or likelihood of the results.

Examples will be given of this research in which we investigate how to bring together all relevant case information, e.g., DNA profiles, physical anthropological traits, elemental and isotopic information, palynology and other environmental markers in one regional Geo-graphical Information System which will allow a new level of complexity and thus also a new level of querying and ultimately interpretation and provenancing of unidentified human remains.

**Forensic Anthropology, Human Provenancing, Geochemistry**

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