Forensics interest in stable isotope ratios of different compounds

James Ehleringer, Thure Cerling, Lesley Chesson, John Howa, Michael Lott, Shannon O'Grady, Brett Tipple, Luciano Valenzuela

University of Utah, USA

Stable isotope analyses are a valuable measurement that complements other analytical techniques used in forensic science. One class of applications is comparative, providing information on the relatedness of two or more pieces of evidence beyond traditional chemical identification approaches. A second class of applications is based on mechanistic or semi-mechanistic models. Here advances in our understanding of chemical processes or interacting factors are sufficient to develop predictions of expected isotope ratios in biological and non-biological materials across temporal or spatial scales. A third class of applications relates to product alteration, often referred to as adulteration or fraud. In this evening talk, we start with a most obvious application and consider a range of recent food adulteration applications, some of which might relate to the fine meal we enjoyed tonight. We then discuss carbon and nitrogen isotope ratio forensic applications of synthetic interest, including manufactured drugs, paper products, packaging materials, and both homemade and military-grade explosives. We then present a theoretical basis for expecting geographic patterns in stable isotopes and then show the magnitude of hydrogen and oxygen isotope ratio variations in humans and show applications to law enforcement cases involving unidentified murder victims. Getting back to the fine meal of the evening, we explore the ecological footprint of the food you eat, including meats, dairy products, breads, wines, bottled waters, and oils. “Isoscapes” of these food items can be constructed for forensic and commerce-related interests, depicting the predicted variations in stable isotope ratios of a food item across the USA and Europe. The precision of the stable isotope ratio approach using hydrogen and oxygen isotopes is shown to be regional, allowing one to define zone or bands of locations from which a food could have originated and to as easily show where a food item is likely not have originated from. We complete this presentation with a discussion of two of the many possible applications of stable isotope ratios to food-security interest.