第 126 回汽水域懇談会

「海洋–陸域の範囲を越える古環境：貝殻の１年未満の安定同位体記録を用いて」

デヴィッド・デットマン博士（アリゾナ大学）

日時 ： 2017 年 7 月 28 日（金）16：30～18：00
場所 ： 島根大学 研究・学術情報機構 エスチュアリー研究センター2 階セミナー室（201 号室）

126th Estuaries Open Seminar

Title: Ancient environments across the marine – terrestrial spectrum: Using sub-annual stable isotope records from mollusk shells.
Speaker: Dr. David L. Dettman
Environmental Isotope Laboratory, Geosciences Department, University of Arizona
Date: 28 July 2017 (Fri) 16:30–18:00
Room: Seminar room (Room nr 201) on the 2nd floor of Estuary Research Center, Shimane University

The use of oxygen and carbon stable isotope records from mollusk shells can be a powerful tool in paleo-environmental analysis. Paleotemperature calculation based on stable isotope ratios in the terrestrial and estuarine realm is highly problematic due to the uncertain oxygen isotope ratio of surface waters. But, by turning the question upside down we can discover a great deal about ancient surface environments. The ability to investigate seasonal changes in isotope ratios at high resolution presented by shell-based isotope analysis can yield important insights into local evaporation, monsoon dynamics, river stability, estuary mixing, and saline lake systems. Four example studies will be presented that touch on these themes and techniques. In each of these studies, the variation in oxygen isotope ratio at one location across an annual cycle can identify the climate system, river class, or salinity regime present at that location.

In the first study, live-collected land snails from across Africa were analyzed for stable isotope variation in the accretionary shell growth. Large land snails, who commonly travel moderate distances from sources of permanent water can show large d18O cycles in the shell during an annual cycle in response to seasonal aridity. The isotope data therefore can be used to identify monsoon climates and monsoon intensity. In addition, there are characteristic isotope cycles for animals living in savanna, cool desert, and Mediterranean climates. The power of this system is strengthened if land snail data can be compared to aquatic mollusk shell of the same time and location. Another study looks at high resolution variability in large freshwater bivalve shells from archaeological settings in comparison to modern shells from the same river system. The differences in the isotope patterns (of O, C, and N isotope ratios) can be used to infer how the river system has been modified by human activity, water usage, agricultural pollution, and eutrophication. Groundwater supported river systems have characteristic oxygen isotope cycles, as do rivers that have distant high-elevation catchments.

Mollusk shell in estuarine systems can have a wide range of isotope ratios because of the high seasonal variation in local salinity and the mixing of freshwater and seawater. While there are some examples where bulk shell analysis may yield interpretable results, the use of sub-annual isotope cycles can be very informative. In the Colorado River delta, northern Gulf of California, oxygen isotope records were combined with tidal sclerochronology to identify the oxygen isotope ratio offset between “no flow” years and years when the Colorado River delivered significant amounts of water. Assuming that the same fortnight in any year (for example, the tenth fortnight in an annual band) has similar water temperatures, the difference in shell d18O can be used to infer the amount of freshwater entering the estuary back through time. Using this approach, paleo-salinity and ancient river runoff can be calculated. Finally, a study is presented that re-examines the distinction between brackish lacustrine systems and brackish estuarine systems. Some ancient saline lakes have both marine and terrestrial taxa in their fossil fauna and disagreement can arise over the marine or evaporative origin of the saline body of water. If the body of water was an estuary or lagoonal lake, there will be a predictable gradient of both isotope ratios and faunal turnover moving inland. But in saline lake systems never connected to the ocean, the spatial gradient will be missing. Both isotopic and faunal patterns can be used to make the distinction between ancient ‘lacustrine-brackish’ and ‘estuarine-brackish’ water bodies.