PREFACE—RADIOCARBON AND DIET: AQUATIC FOOD RESOURCES AND RESERVOIR EFFECTS

Ricardo Fernandes[1,2,3] • John Meadows[2,4] • Alexander Dreves[2]

1. Institute for Ecosystem Research, University of Kiel, Kiel, Germany.
2. Leibniz-Laboratory for Radiometric Dating and Isotope Research, University of Kiel, Kiel, Germany.
3. McDonald Institute for Archaeological Research, University of Cambridge, Cambridge, United Kingdom.
4. Centre for Baltic and Scandinavian Archaeology, Schloss Gottorf, Schleswig, Germany.

One of the most exciting fields in current radiocarbon research is the study of aquatic radiocarbon reservoir effects (RREs). Potential RREs pose a challenge when chronologies are based on ^{14}C dating of food or human remains, providing an impetus for new and improved efforts to detect and quantify RREs in archaeological materials. Examples of such developments include compound-specific isotopic and ^{14}C analysis, and novel statistical methods to reconstruct ancient diets. Awareness of RREs has also created new research opportunities; in particular, radiocarbon is increasingly being employed as an environmental and dietary tracer in ecological and archaeological studies, requiring a better understanding of the spatial and temporal variability of aquatic RREs.

Thus, an interdisciplinary approach is required to fully explore the problems and opportunities introduced by aquatic RREs. This was the aim of the first international conference "Radiocarbon and Diet: Aquatic Food Resources and Reservoir Effects," held in Kiel (Germany) in September 2014. The conference was attended by nearly 90 participants from five continents, and 41 oral and 20 poster presentations were given. The conference's opening keynote was delivered by Jan Heinemeier, providing an overview on aquatic RRE corrections. Session keynotes were also given by Philippa Ascough, Carl Heron, Clive Bonsall, Paula Reimer, and Kerstin Lidén.

The interdisciplinary spirit of the conference is well reflected in the variety of topics and case studies presented in the proceedings. Lovis and Hart (pp. 557–570) collected environmental, archaeological, and ethnographic evidence to assess the potential for freshwater RREs in organic residues from archaeological pottery in northeastern North America. The authors concluded that the probability of pottery RREs in this region is low, but they emphasized the need to employ different analytical techniques to screen pottery samples prior to ^{14}C dating. In this respect, Heron and Craig (pp. 707–719) review the scientific techniques available to detect aquatic resources in pottery food-crusts, discussing the advantages and limitations of employing bulk carbon and nitrogen isotope measurements, lipid biomarker analysis, and compound-specific isotopic analysis. Such a multiproxy approach was adopted by Horiuchi et al. (pp. 721–736), in their study of aquatic contributions to organic residues in Jomon pottery from coastal and inland locations in Aomori Prefecture (Japan). Their results show that at coastal Jomon sites cooked foodstuffs consisted primarily of marine products, whereas predominantly terrestrial plants and animal foodstuffs were cooked at an inland site. Likewise, Piličiauskas and Heron (pp. 539–556) assess potential freshwater and marine RREs across archaeological cultures in the southeastern Baltic. This wide-ranging study includes ^{14}C and stable isotope measurements of modern fish remains, ceramic food-crusts, and associated samples, and coeval human and ungulate bone samples. Kulkova et al. (pp. 611–623) estimate freshwater RREs in different archaeological materials from the underwater site of Serteya II (Dvina-Lovat' basin, western Russia). Comparative ^{14}C dating of wooden piles, food-crusts, fish and animal bones show that RREs in Late Neolithic pottery food-crusts at this site are generally negligible.

Understanding spatial, temporal, and ecological variability in marine and freshwater RREs is fundamental to the interpretation of ^{14}C ages of archaeological materials. Faivre et al. (pp. 527–538)

demonstrate ecological variability by comparing RREs in pre-bomb Adriatic mollusk shells and algae. Significant differences in RREs between sample types are attributed to the contributions of geological carbonates during mollusk shell formation. Alves et al. (pp. 517–525) use charcoal, mollusk shells, and fish otoliths from the mid-Holocene Saquarema shell-midden site in southeastern Brazil to determine the local marine surface RRE. The negative ΔR obtained is interpreted as reflecting the possible influence of the many lagoonal systems in the region. Burr et al. (pp. 507–515) investigate variability in surface marine RREs at Espiritu Santo Island (Vanuatu) through paired U/Th and ^{14}C measurements of coral. This study identifies phases of higher variability in local RREs due to changes in oceanic mixing and circulation patterns. Motuzaite-Matuzeviciute et al. (pp. 657–664) use coeval aquatic and terrestrial samples from Neolithic sites in eastern Ukraine to demonstrate that large local freshwater RREs may be expected. Their results have important implications for the established local prehistoric chronology, which is often based on ^{14}C dating of human remains, freshwater mollusk shells, or pottery organic residues having aquatic contributions.

The primary method used to correct human ^{14}C ages for dietary RREs is diet reconstruction, based on stable isotope data. However, the interpretation of isotopic results is not always straightforward, and different models have been proposed. Bonsall et al. (pp. 689–699, 705–706) and Nehlich and Borić (pp. 701–703) propose contrasting dietary interpretations of available archaeological and isotopic data for Mesolithic humans from the Iron Gates region of the Lower Danube. Kuzmin (pp. 571–580) reviews human dietary preferences in the Russian Far East in different time periods, relying on stable isotope data. This review shows significant and variable contributions to human diets from marine foods, and highlights the potential for human dietary RREs. Schulting et al. (pp. 581–593) compare ^{14}C dates from coeval human and faunal bone samples from Mesolithic, Neolithic, and Bronze Age graves in the Upper Lena basin of southeastern Siberia. The observed human dietary RREs are highly variable and are not correlated with stable isotope values. Svyatko et al. (pp. 625–644) use isotope data to reconstruct the diets of Bronze Age humans from northeastern Kazakhstan, and estimate their consumption of freshwater foods. Variability of local freshwater RREs is investigated through ^{14}C dating of coeval herbivore and fish bone remains. Marchenko et al. (pp. 595–610) reconstruct the diets of humans buried at the Preobrazhenka 6 Bronze Age cemetery in western Siberia, using stable isotope results and dental pathology analyses, which show that plant carbohydrates were the main source of dietary energy, but there were also significant protein contributions from freshwater fish. Tõrv and Meadows (pp. 645–656) date inhumations at Kivisaare and Riigiküla I (Estonia) to the Early Bronze Age. By using the Bayesian mixing model FRUITS to interpret isotopic data, they estimate significant dietary contributions from freshwater foods. Andrade et al. (pp. 679–688) also employ FRUITS to reconstruct the dietary habits of interfluvial coastal individuals from northern Chile and to correct their ^{14}C ages. The results indicate continuity in the exploitation of marine resources during the 2nd millennium BC, in spite of increased contacts with agropastoral populations from the Andes highlands. A higher temporal resolution in the dietary histories of medieval individuals is reported by van der Sluis et al. (pp. 665–677), who sampled growth increments in dentine with an approximately annual resolution. The stable isotope and ^{14}C results show significant dietary shifts during the early lifetimes of the individuals analyzed.

The second international conference "Radiocarbon and Diet: Aquatic Food Resources and Reservoir Effects" will be organized in 2017 in Aarhus (Denmark). Given the growing number of case studies investigating RREs in archaeological materials, and exciting methodological developments, this forthcoming conference is eagerly anticipated.

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Group photo with part of the conference's participants