Geophysical Research Abstracts
Vol. 19, EGU2017-8409-1, 2017
EGU General Assembly 2017

Marine bivalve feeding strategy, radiocarbon ages and stable isotopes in Scottish coastal waters

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Marine bivalve molluscs have been widely used for palaeoenvironmental reconstructions as their carbonate provides a direct chronology of environmental change through radiocarbon dating, and their shell composition, particularly with regard to their oxygen and carbon stable isotopes, is likely to reflect ambient seawater conditions. However, stable isotope signatures of marine bivalve shells are difficult to interpret, as shell formation can be influenced by secondary factors such as metabolic processes and feeding strategies. In radiocarbon ages, uncertainty is introduced as bivalves inhabit a range of ecological niches which may be of significance in the case of deep borrowing and deposit feeding bivalves, as they could incorporate older carbon in their shells, resulting in apparent older ages than the true age of the dissolved inorganic carbon in the overlying seawater. To discriminate between the different factors influencing the composition of marine molluscs' shells, we measured radiocarbon ages, oxygen and carbon stable isotopes in nine species of marine bivalves having different known feeding strategies and inhabiting a number of ecological niches; all shells being live-collected (between 1923-1925) from six localities around the Scottish coast, a wider context than has been previously undertaken. Our results show that in situ variability (i.e.: replicate measurements of the same species at the same location) is generally low for both stable isotope analyses and radiocarbon dates, indicating good accuracy of the measurements. Intra-species (i.e.: same species - different location) and inter-species (i.e.: different species – same location) variability is significant in stable isotopes measurements, meaning that marine bivalve shells do record changes in the local environment and are sensitive to different feeding strategies and ecological settings. In contrast, radiocarbon ages do not change with location and are not sensitive to molluscs' diets or microhabitats, as all measured bivalve shells are the same age within the $\pm$ 2sigma error. Thus, the main conclusion that can be drawn from our results is that stable isotopes measured in marine bivalve shells can be a very useful source of palaeoenvironmental information in coastal and continental shelf waters, while radiocarbon dating of the same shells provides a reliable chronology of environmental change, regardless of vital effects and differences in microhabitats, feeding strategies and sample location.