

## A Holocene strontium isotope record of palaeosalinity for the Littorina Sea stage of the Baltic Sea

A. WIDERLUND<sup>1</sup> AND P. S. ANDERSSON<sup>2</sup>

<sup>1</sup>Division of Applied Geology, Luleå University of Technology, SE-971 87 Luleå, Sweden  
(Anders.Widerlund@ltu.se)

<sup>2</sup>Laboratory for Isotope Geology, Swedish Museum of Natural History, Box 50007, SE-104 05, Stockholm, Sweden  
(Per.Andersson@nrm.se)

The Holocene history of the Baltic Sea is characterized by a complex interplay between deglaciation dynamics and isostatic/eustatic relative sea-level changes. The resulting salinity variations experienced during the development of the Baltic Sea have been discussed extensively since the late 19<sup>th</sup> century, but are still incompletely understood. Here we present a study of Baltic palaeosalinity variations based on the <sup>87</sup>Sr/<sup>86</sup>Sr isotope record of <sup>14</sup>C-dated sub-fossil shells of blue mussels (*Mytilus edulis*) found in raised-beach sediments from the Littorina Sea stage of the Baltic Sea (~8000–3000 cal BP). Scanning electron microscope images of the shells show no signs of secondary calcite overgrowths. This suggests that the sub-fossil shells are well-preserved, and that the <sup>87</sup>Sr/<sup>86</sup>Sr ratio in the carbonate shells should reflect the isotopic composition of dissolved Sr in Baltic Sea water at the time of mussel growth. The distribution of dissolved Sr in the Baltic Sea is controlled by conservative mixing between seawater and river water, and proxy salinities are calculated using a mixing model where the concentration and isotopic composition of dissolved Sr in present-day seawater and river water are known.

The Sr isotopic composition in shell carbonate and present-day seawater was determined using a Thermo–Finnigan® Triton multiple collector mass spectrometer (TIMS). Replicate determinations of <sup>87</sup>Sr/<sup>86</sup>Sr isotope ratios in modern shells, and comparison with measured present-day salinities indicate a relative precision and accuracy of better than ± 5 % for the proxy salinities. With this precision and accuracy, the present-day salinity differences between the major Baltic sub-basins can be detected. During the time interval 6800–3100 cal BP, the surface-water salinity in the Bothnian Bay increased from 7 to 9, while that in the Bothnian Sea increased from 7 to 13. These palaeosalinities are considerably higher than the present-day surface-water salinities in these two sub-basins of the Baltic Sea (2–3 and 5–6, respectively), and suggest that the Littorina Sea stage palaeosalinity of the Bothnian Bay was similar to that of the present-day Baltic Proper (6–8). The observed difference in palaeosalinity between the Bothnian Bay and the Bothnian Sea (7–9 vs. 7–13) suggests that deep-water-exchange between these two basins was restricted by a sill also during the Littorina Sea stage, despite the 30–90 m larger water depth at that time.

## Isotopic tracers of lithospheric recycling

E. WIDOM

Department of Geology, Miami University, Oxford, Ohio, 45056, USA (widome@muohio.edu)

Recycling between the Earth's crustal and mantle reservoirs is a fundamental consequence of plate tectonics, and there is compelling evidence for recent recycling of oceanic crust and sediment at subduction zones from both geochemical and seismic data. The chemical and isotopic signatures of oceanic basalts provide a window into the spatial and temporal variations of the composition of the Earth's mantle that have resulted from past recycling. Radiogenic Pb and Os isotopic compositions of ocean island basalts have long been held as evidence for significant fractions of ancient recycled oceanic crust in OIB mantle sources, and radiogenic Sr signatures have generally been attributed to recycled sediment. However, despite decades of investigations and an arsenal of radiogenic isotope systems, unambiguously identifying the nature of potential recycled components and uniquely distinguishing crustal recycling from alternative mantle enrichment processes has proven difficult. Recycled crustal materials will, after subduction and aging in the mantle, bear only limited resemblance to the original crustal "inputs" in their radiogenic isotope signatures due to changes in parent:daughter element ratios during subduction zone dewatering and variable durations of post-subduction aging.

Recent studies, though, have shown that light stable isotope systems such as O and Li may have great potential as diagnostic tracers of recycled crustal material in oceanic mantle sources. Strong fractionations of light isotopes occur only in low-temperature (near-surface) conditions, with minimal fractionation at magmatic temperatures and no time dependence. Isotopic variations of O and Li in OIB outside of the relatively restricted MORB mantle range can provide strong support for a role of recycled lithospheric material in OIB mantle sources, as long as the influence of shallow magmatic processes can be ruled out. Low O isotope signatures in many OIB, including some with highly radiogenic Sr, appear to preclude a significant role of recycled sediment but are consistent with recycling of lower oceanic crust or serpentinized mantle lithosphere. Surprisingly, though, there is a growing database of heavy Li isotope signatures in OIB that, based on our current understanding of Li behavior, is not easily explained by recycled oceanic crust in OIB mantle sources. Instead, incorporation of subduction modified mantle wedge or serpentinized lithospheric mantle could be important components of some OIB sources. The ages of such mantle can potentially be constrained based on Re-Os and Lu-Hf isotope systematics, both of which are relatively resistant to overprinting by metasomatic fluids and can serve tracers of aged melt-depleted mantle.