Complex burrow system of the mud shrimp *Laomedia astacina* and nutrient fluxes through its burrow

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Abstract

Laomedia astacina had large and unique burrow systems (Fig. 1), and its extensive burrows increased the total area of the sediment-water interface by roughly 1,044%, the highest value among reported data on marine invertebrates. Oxygen concentrations in a *Laomedia* burrow showed large fluctuations with respect to tidal variation, and the burrow was flushed by active irrigation, which caused a more than 100 times increase in oxygen supply to the burrow when compared to passive irrigation. The range of oxygen concentrations was different depending on the location of the burrow. It seemed to be determined by the activity of the shrimp and by the burrow structure. Burrow water mainly out-flowed through the mound lumen (about 90% of total water flow) and in-flowed only through the funnel lumen. The average burrow irrigation rate during flooding of about four hours duration was 24.7 ℓh^{-1} in the mound and 2.9 ℓh^{-1} in the funnel. At this irrigation rate, the inhabitants would flush their burrow water a maximum of 9.4 times during a flooding event. Nutrient flux through *Laomedia* burrows ranged from 23~224% of that on tidal flats, which included the flux through both macrofaunal burrows and the sediment surface, indicating that large and actively-irrigated burrows are important in material exchange between sediments and overlying water. These results suggested that nutrient flux may not be correctly determined unless tidal variation, daily variation, and deep burrows are taken into consideration.

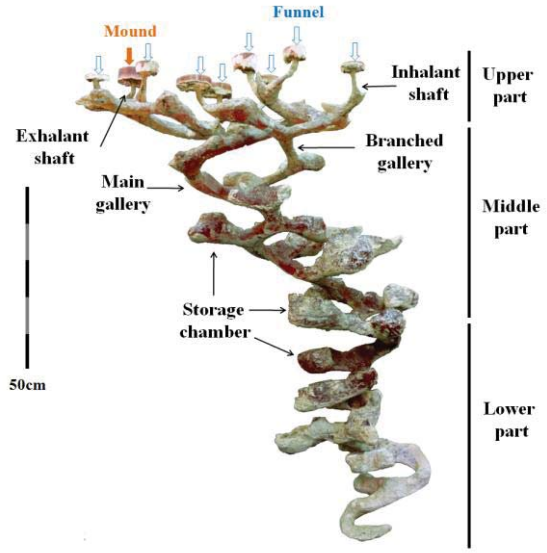

Figure 1: The complex burrow system of the mud shrimp *Laomedia astacina* recovered from Korean tidal flat.

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Use of 10^{12} and 10^{13} Ohm resistors in TIMS analysis of Sr and Nd isotopes in sub-nanogram geological and environmental samples

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Analysis of isotope ratios in small geological and environmental samples such as inclusions in diamonds or individual human hairs is ultimately limited by the detection system of the mass spectrometer. Here we report a technique using a TRITON Thermal Ionisation Mass-Spectrometer (TIMS) equipped with nine Faraday cups to measure sample sizes up to 10 times smaller than currently feasible. Use of current amplifiers with 10^{12} Ohm and 10^{13} Ohm resistors instead of the standard 10^{11} Ohm resistors promises a 3-fold and 4-5 fold improvement in signal to noise ratios, respectively. This improvement results in higher precision on analyses of small ion beams.

The precision of measurements of 100 pg Nd and Sr standards is found to be a factor of ~2 better for the 10^{12} ohm resistors compared 10^{11} Ohm resistors (i.e., 2RSE of 64 ppm instead of 110 ppm for a Nd analysis). The reproducibility of the $^{143}Nd/^{144}Nd$ and $^{87}Sr/^{86}Sr$ ratios for 100 pg standards using 10^{12} Ohm resisitors is 235 ppm for Nd (2RSD, n=20) and 133 ppm for Sr (2RSD, n=10). Thus, variability in Nd and Sr isotope ratios in the 4th decimal place, e.g. $^{143}Nd/^{144}Nd$ 0.5110 – 0.5119 or $^{87}Sr/^{86}Sr$ 0.7100-0.7109, can be resolved in such small samples, provided that the procedural blanks and chemical separation are optimal.

Preliminary data using current amplifiers with 10^{13} Ohm resistors indicate that the precision (2SE) on Nd isotope ratios for beam sizes of 40 μV (~2500 cps) is 1%. The high gain amplifiers can thus be used instead of multi ion counting and/or in the range between ion counting and Faraday cups, equipped with the standard 10^{11} Ohm resistors. Use of the 10^{13} Ohm resistors is prefered over multiple ion counting systems as potential problems with non-linearity, instability, or the limited dynamic range of the ion counters are avoided. This new methodology thus potentially opens up new applications in a range of studies on small sample sizes.