New internal biothermometer in biomass-PO_4 to study vent macrobiota at the seafloor

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Hydrothermal vent associated biological assemblages have advanced our knowledge of the thermal tolerance of organisms, however habitat temperatures are still widely debated. *Paralvinella sulfincola* and *Paralvinella palmiformis* are two such hydrothermal vent worm species for which the maximum thermal tolerance is uncertain. *In situ* measurements indicate average habitat temperatures of 68ºC [1], however the rapid mixing of hot vent fluids and cold seawater produces a dynamic thermal condition, making *in situ* measurements unreliable. In contrast, laboratory simulations of thermal gradients in hydrothermal systems show preferred growth temperatures of *P. sulfincola* between 40ºC-50ºC [2]. Our previous work has demonstrated that the O-isotope composition of PO_4 ($\delta^{18}O_p$) in soft-tissue biomass can record growth temperature for both bacteria and macrobiota. This new tool based on soft-tissue biomass PO_4 O-18 extends thermometry studies beyond only organisms possessing mineral hardparts (*e.g.*, shells, teeth, scales), and suggests that the $\delta^{18}O_p$ value of biomass-PO_4 could serve as an internal thermometer for organisms like vent worms that inhabit environments with sharp temperature gradients. Here we apply our new biomass-PO_4 thermometer to worm specimens collected from sulfide structures on the Explorer Ridge. Using a reported range of ambient water $\delta^{18}O$ of 0 to +2.5‰ [3,4], measured $\delta^{18}O_p$ values from bulk biomass of *P. sulfincola* and *P. palmiformis*, yield calculated *in situ* growth temperatures of 40.8 - 47.7ºC and 25.0 - 31.8ºC, respectively, which are consistent with the temperature range preferred by these worm species determined from laboratory simulation experiments [2]. Our findings show the potential of biomass-PO_4 O-isotope thermometry as an ideal tool to study *in situ* habitat temperatures of organisms of unknown origins (*e.g.,* snowblower erupted microbial biomass) as well as organisms inhabiting sharp and variable, or uncertain thermal gradients.

[1] Cary *et al*. (1998) *Nature* **391**, 545-546. [2] Girguis and Lee (2006) *Science* **312**, 231. [3] Shanks *et al*. (1995) *Seafloor Hydrothermal Systems: Physical, Chemical, Biological, and Geological Interactions*. [4] Jean-Baptiste *et al*. (1997) *GCA* **61**, 2669-2677.