# A novel approach in utilising marine methane seep derived bivalve shells for developing local ΔR corrections in deep sea environments

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Shells and corals are commonly used as proxies for sea surface temperature reconstructions in paleoclimatology. These species utilise the dissolved inorganic carbon (DIC) in seawater making it suitable for analysing ocean circulation through the measurement of radiocarbon $^{14}C$. It is also possible to estimate the age of the shell through analysing the growth increments within the shells. Yet calibration models in deeper marine environment remains complicated due to the multiple variables that must be considered which include problems such as carbon sinks, ocean current flux and dead carbon effect from seafloor vents.
This study proposes a novel approach in $^{14}C$ dating shells found in a deeper marine environment (600m) located near methane vents off Tokai using a Single-Stage Accelerated Mass Spectrometer (AMS), to develop a suitable calibration model with a greater goal of observing local marine environmental changes in the deep sea. This method may allow bivalves living in deeper marine environments to be used as future tools for measuring samples located in complicated environments such as deep hydrothermal vents and cold seep vents, possibly leading to assessing local shallow fault movements occurrences in the past.
Sclerochronological analysis of the shells proved difficult since growth increments of deep sea shells are not determined according to simple changes in temperature such is the case with most surface marine shells which often reveal daily, fortnightly or annual bands during seasonal temperature extremes. The radiocarbon $^{14}C$ age of these bivalve shell measurements ranged between three age groups of 1396±36-1448±34, 1912±31-1938±35 and 5975±34. The $^{14}C$ age of shells that were alive upon collection and the dissolved inorganic carbon (DIC) in seawater show little difference (around 100 14C age) indicating that shells are not heavily affected by the dead carbon effect from cold seeps that is of biogenic or thermogenic origin, which can make the age of the shells to become considerably older than their actual age. The novel calibration model used was therefore based on the seawater DIC collected above the *Calyptogena* spp. colony site (1133±31), resulting in the dead shells to be clustered around 1900 Cal AD. This age group proves to be interesting as the Ansei-Tokai earthquake (M 8.4) in 1854 is extremely close to the bivalve colony site. Based on the theory that the bivalve shells formed sometime after the venting of methane fluids, it may support the validity for applying such novel calibrations methods in complicated deep sea environments. Using geological data obtained using visual analysis and sub-seafloor structural analysis that show multiple shallow faults and chaotic sediment structure below the colony site, the *Calyptogena* spp. shells have a strong connection to the coseismic faulting activity and could show potential for radiocarbon dating to be applied on marine samples providing the necessary calibration tools are available.

Keywords: Radiocarbon dating, Active fault, Cold seep, Bivalves, Methane

 