HIGH RESOLUTION DELTA^{18}O AND DELTA^{13}C PROFILES IN BIVALVE SHELLS FROM EAST MEDITERRANEAN COLD SEEPS

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Abstract
Cold seeps ecosystems from deep sea environments are characterized by venting of methane-rich fluids. High resolution isotopic studies on bivalve shells from Mediterranean cold seeps provide informations on changes of environmental parameters as venting activity during the growth of the animals.
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Methane-rich fluids venting at cold seeps from deep sea environments fuel an intense biological activity where anaerobic oxidation of methane by *archaea* and *eubacteria* provide the energy necessary to sustain life of invertebrates. Methane contained in fluids is characterized by low delta ^{13}C values (-40 to -110 parts per mil V-PDB for biogenic methane and -35 to -60 parts per mil V-PDB for thermogenic methane) [1].
Previous studies on bivalve shells from hydrothermal vents and cold seeps [2,3] have shown that delta^{13}C and delta^{18}O values reflect environmental conditions experienced during their life (venting system variability, temperature, water composition, methaneflux...).
The aims of this study were to determine which signals are recorded by bivalve shells from Mediterranean cold seeps and what are their significance in terms of variability of environmental parameters as well as on the metabolism activity.
This study focuses on eight specimens of *Myrtea aff. amorpha*, bivalve *Lucinidae*. The shells were collected dead, by submersible dives during MEDINAUT cruise in November 1998 (Kazan Volcano at 1706 m) and during NAUTINIL cruise in September 2003 (Pockmarks area at 1600 m and Amon volcano at 1100 m), in Eastern Mediterranean. The carbonate mineralogy of Lucineshells is aragonite (96 %) and calcite (4 %).
The isotopic compositions of carbonate shells exhibit characteristic values depending on the site location: in Amon volcano: 2.1 <delta^{18}O parts per mil V-PDB <2.2 and 1.4 <delta^{13}C parts per mil V-PDB <2.1; Pockmarks area: 1.8 <delta^{18}O parts per mil V-PDB <2.5 and -1.8 <delta^{13}C parts per mil V-PDB <2.2; Kazan volcano 2.1 <delta^{18}O parts per mil V-PDB <3.4 and -10.2 <delta^{13}Cparts per mil V-PDB <1.9. Moreover, the stable isotope compositions display a large dispersion in shells from a same location: delta^{18}O vary by about 1.3 parts per mil V-PDB whereas delta^{13}C vary up to 12 parts per mil V-PDB.
High resolution delta^{18}O and delta^{13}C profiles of bivalve shells consist in doing successive micro-sampling ($\approx$ 100 μg) of calcium carbonate following the growth increment direction.
Isotopic profiles of the two shells from Amon volcano show similar delta^{18}O and delta^{13}C values. They both vary by about 1.5 parts per mil. Moreover, in these two shells, delta^{18}O and delta^{13}C values decrease with age. The two shells collected from the active pockmarks zone show two different delta^{13}C profiles. One shell records a variation of delta^{13}C values by about 9 parts per mil whereas the other shell displays moderate delta^{13}C variations by about 1.3 parts per mil. As shells were collected dead, it is possible that they didn't experience the same events.
The four shells collected from Kazan mud volcano also present different isotopic profiles. Three of them show small but significant variations 1 to 2 parts per mil for delta^{13}C and 1 parts per mil for delta^{18}O values. The fourth shell exhibits carbon isotopic profile with an important change of delta^{13}C values along his life (from -10 parts per mil to 0 parts per mil).
In conclusion, this is the first high resolution isotopic study carried out on bivalve shells of Mediterranean cold seeps. Bivalves shells from cold seeps are exposed to venting fluids containing methane with low delta^{13}C values which probably explains the pulses of delta^{13}C values recorded in shells. In addition, metabolism processes seem to influence delta^{13}C evolution with age. Variations of the oxygen isotopic compositions of bivalve shells might also be explained by metabolism processes, although local temperature variability could be due to higher heat flow.

References

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