

Stable carbon isotopes of benthic foraminifers from IODP Expedition 311 as possible indicators of episodic methane seep events in a gas hydrate geosystem

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Keywords: benthic foraminifer, carbon isotopic excursion, episodic methane release, Cascadia Margin, gas hydrate dynamic system

ABSTRACT

Integrated Ocean Drilling Program (IODP) Expedition 311 at the Cascadia Margin, northeastern Pacific, provides an excellent opportunity to study the response of carbon isotopic compositions of benthic foraminifers to episodic methane seep events in a gas hydrate geosystem. The shallow infauna benthic foraminifer species *Uvigerina peregrina* and *Bulimina mexicana* collected from five sites (U1325, U1326, U1327, U1328, and U1329) exhibit dramatic negative carbon isotopic excursions (−0.75‰ to −2.74‰, −1.11‰ to −2.62‰, −0.51‰ to −2.75‰, −0.58‰ to −2.71‰, and −0.22‰ to −3.32‰ respectively) and positive oxygen isotopic anomalies (3.27‰ to 4.91‰, 3.16‰ to 4.78‰, 3.37‰ to 4.88‰, 3.45‰ to 4.88‰, and 3.4‰ to 4.88‰ respectively). Results indicate that gas hydrate dissociation influenced the dissolved inorganic carbon of the pore water via anaerobic oxidation of methane. SEM analysis of foraminifer tests and the comparative carbon isotopic analysis of previous works on this subject indicate minimal alteration caused by diagenesis and authigenic carbonate precipitation. Carbon and oxygen isotopic values of these two species at Site U1327, U1328, and U1329 show episodic stratigraphic fluctuations, suggesting episodic gas hydrate dissociation and methane release possibly related to 100 ka sea-level fluctuations. $\delta^{13}\text{C}$ of these two species at Site U1325 and U1326 at the stage of gas hydrate formation show one and two events of methane release respectively, indicating methane seeps occurred in the recent millennium probably because of the lowered sea level. The negative $\delta^{13}\text{C}$ excursions and positive $\delta^{18}\text{O}$ anomalies of benthic foraminifers could be indicators of episodic methane seep events associated with gas hydrate dissociation in marine gas hydrate geosystems.