Investigation of benthic foraminiferal "non-traditional" stable isotopes to reconstruct methane fluxes in sedimentary environments

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Methane (CH_4) is an important greenhouse gas, with a global warming potential much higher than carbon dioxide (CO_2) on a short time scale. Even if the residence time of CH_4 in the atmosphere is relatively short (tens of years), one of the products of CH_4 oxidation is CO_2, a greenhouse gas with a much longer residence time in the atmosphere (tens to hundreds of years). CH_4 has been proposed as one of the trigger mechanisms for rapid global climate change today and in the geological past. With regards to the geological past, numerous studies proposed the benthic foraminiferal carbon isotope ratio ($\delta^{13}C$) as a tool to reconstruct the impact of marine CH_4 on rapid climate changes; however, the investigation of modern benthic foraminiferal $\delta^{13}C$ have produced inconclusive results.

CH_4 has a distinctive hydrogen isotope (δD) and $\delta^{13}C$ signature compared to seawater, and sulfate reduction, often coupled to CH_4 anaerobic oxidation in sediments, changes the sulfur isotope signature ($\delta^{34}S$) of the remaining sulfate in porewater. Therefore, we hypothesize that the δD and $\delta^{34}S$ signature of infaunal benthic foraminiferal species can provide a complementary approach to $\delta^{13}C$ to study CH_4 dynamics in sedimentary environments.

Here, we present the preliminary results obtained analyzing *Uvigerina peregrina* δD and $\delta^{34}S$ from three different locations at Hydrate Ridge, offshore Oregon. Unfortunately, the lack of chemical data related to the moment of foraminiferal calcification makes difficult to build a robust relationship among the *U. peregrina* stable isotopes and the CH_4 fluxes at the sampling sites. However, our results look very promising, as each site is characterized by a different δD and $\delta^{34}S$ signature. We emphasize that this study represents the first step in the development of new proxies (δD and $\delta^{34}S$), which may complement the more traditional benthic foraminiferal $\delta^{13}C$ values, to reconstruct marine CH_4 fluxes in the geological past.