The process of methane emanation at cold seeps and its correlation with sea-level changes throughout the last 210 thousand years

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Cold seep ecosystems are often characterized by microbial mediated carbonate precipitation processes, due to interaction between methane-rich fluid and biological activity. Carbonates from these ecosystems provide unique archives of focussed marine methane emanation by their geochemical, geobiological, mineralogical and structural inventory. Beside geological setting and tectonic activity as general driving forces, oceanographic parameter like water temperature and sea-level changes are potential controls on episodic fluid flow.

In this study carbonates, mainly from Hydrate Ridge (Cascadia Margin, Oregon) were investigated in order to decipher the geochemical archive of methane-related massive carbonate build-ups, supplied by a long lasting and focused venting system. Applied methods are MIC-ICP-MS (multi ion counting–inductively coupled–mass spectrometry) for U-Th age data and Laser Ablation (LA)–ICP-MS for high spatial resolution element ratios and concentration data.

The age data reflect an episodic reactivation of a fluid pathway over a time interval of at least 210 ky. The coincidence of massive carbonate build-up and glacial climatic intervals point to the possibility that the formation of the chemoherm carbonates and, hence, the activity of the cold seep vent sites are directly related to the height of sea level via the pressure difference between the height of the seawater column and the hydraulic head and buoyancy of the upward advecting fluids in the plumbing system of the sediments. Furthermore, the data set implies a dependancy from the speed of sea-level fall and not only from the reached low stand.

Sr and Ba LA-ICP-MS profiles identify high-frequency changes between high and low fluid flow precipitation phases. First results imply a breakthrough of deep seated fluids from below the bottom simulating reflector (BSR) between 55 and 42 ky after a phase of extensive gas hydrate destabilization.

In order to reflect the observed correlation of paleoactivity of cold vents and sea-level changes, methane-related carbonates from different regions are topic of our actual research. The important relation to the chronology of changes in atmospheric greenhouse-gas concentration will be discussed.