



## **In situ measurement of seabed methane emission from Captain Arutyunov mud volcano (Gulf of Cadiz)**

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Mud volcanism represents an important pathway for methane from deeper reservoirs to the surface where it enters the benthic carbon cycle. A yet undetermined fraction is bypassing the benthic filter and is emitted into the hydrosphere. However, direct in situ measurements of the methane source strength of mud volcanoes and other cold seep environments are very scarce. So far methane emission rates from such systems are primarily derived from modelling of pore water gradients, ex situ methane turnover measurements and mass balance calculations. We determined the spatial variability of seabed methane emission at Captain Arutyunov mud volcano (CAMV) 1320 m deep in the Gulf of Cadiz using GEOMAR modular lander technology. Furthermore, methane injection into the water column was assessed by analysing water samples from CTD casts taken 5 m above the seafloor along a spatial grid atop CAMV and bottom water samples taken only a few centimetres above the sediment water interface. Methane anomalies of up to 38 nM have been found in the lower water column atop of NW CAMV. In this area the bottom water samples showed unexpectedly high methane concentrations with a maximum of 20,000 nM. Seabed methane emission was in the range of 0.001 to 0.950 mmol m<sup>-2</sup> d<sup>-1</sup>. Associated with the lowest methane release but high methane concentrations in the sediment, we found extremely high abundances of small siboglinid tube worms (tube diameter < 1mm) reaching 17,500 individuals m<sup>-2</sup>. Sulfate pore water profiles indicate that these organisms are strongly involved in the redistribution of solutes and gases. The posterior ends of the siboglinid tubes extend out from the sediment into the oxygenated bottom water forming dense “forests” of 3 - 4 cm height above the sediment surface in which enhanced oxygen uptake was measured. These tubes are densely covered with detritus and likely associated bacte-

ria. We assume that these “forests” create their own micro-climate which might further affect the flux of methane and other solutes across the sediment water interface.