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Autoclave tools for the recovery of pressurized samples from the deep sea

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Gas hydrates and free gas are widely distributed in marine sediments. However, the thermodynamic stability of gas hydrates restricts their accumulation to greater water depths usually below approx. 500 m and characterized by low temperature and high pressure. Thus, the recovery of gas- and gas hydrate bearing sediments under *in situ* conditions is a technical challenge and requires deployment of pressure sampling tools. Our autoclave sampling tools enable investigations of gas and hydrate distributions, quantifications, fabric and several other parameters. Here we present pressure sampling tools available at the MARUM to collect and preserve gas and gas hydrate-bearing sediments from deep sea sites under ambient pressure.

The Multiple Autoclave Corer (MAC) is similar in size and operation to standard multiple corers with max. four cores of 55 cm length each. The pressurized sample chambers were designed to enable computerized X-ray tomography for studies of gas hydrate distributions in shallow sediments.

The Dynamic Autoclave Piston Corer I (DAPC I) was assembled to recover, preserve and analyze pressurized sediment cores of up to 2.5 m length. The device in principle is similar to conventional piston corers and allows various analytical approaches, such as quantifications of gas released by incremental degassing, preparation of gas subsamples for chemical investigations and retrieval of pore water after degassing.

The Dynamic Autoclave Piston Corer II (DAPC II) consists of a tool system including an autoclave corer similar to the DAPC I and a set of individual pressure chambers and associated manipulators. It is designed to recover and cut sediment core segments,

which can be transferred into shorter, manageable pressure chambers while still under pressure. In contrast to the pressure chamber of the DAPC I, these shorter pressure chambers allow for visualization and quantification of gas volumes, gas hydrate and sediment distributions by computerized X-ray tomography prior to incremental degassing.

The Gas Bubble Sampler (GBS) was initially developed to collect free gas escaping from the sea floor within the gas hydrate stability zone, but enables sampling of gas hydrates generated in the water column and water samples, as well. Due to its handling by a remotely operated vehicle (ROV), samples may be taken very close to the sea floor, e.g. above discrete gas outlets. The GBS additionally allows for gas flux estimations by observation during ROV dives and by quantitative degassing upon its recovery.

An Autoclave Container was designed to collect solid samples from the sea floor by use of a ROV manipulator. The jar-like container fits into the porch of the ROV "QUEST 4000m" housed at the MARUM and can be filled with samples of up to 10x10x25 cm in size. After sampling the container’s lid is closed by the ROV’s manipulator and, upon ascent, investigations such as degassing of the sea floor sample may be performed.