Abstract to Keynote Lecture

Use of ROVs and AUVs for observations, measurements and experiments in the deep-sea

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Unmanned underwater vehicles made their way into today's deep-sea research as well. Selected scientific ROV and AUV deployments at a deep-sea observatory and at submarine methane seeps are presented.

High quality field observations are the basis of the comprehension of interactions between biology, physics and geochemistry and the understanding of process in marine sciences, respectively. Complex underwater platforms such as remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs) are commonly deployed today in marine research.

Under the lead of the AWI several expeditions have been conducted to Håkon Mosby Mud Volcano (HMMV, western Barents Sea) where methane is released at the seafloor in gaseous as well as in dissolved form. Using Ifremer's ROV Victor 6000 the micro-topography of HMMV was mapped by high resolution multibeam echo sounders [1]. After a visual exploration of the different habitat types by the ROV [2] a systematic video mosaic was recorded with Victor 6000's downward-looking camera. The geo-referenced video mosaics were interpolated to a habitat map (Figure 1). Although the results were excellent, both, the hydro-acoustic as well as the video mapping could have been accomplished much faster using an AUV instead of a ROV (however, there was no operational AUV available at that time). However, as later efforts to use an AUV at this location to survey the dynamics of a methane plume discharged from HMMV showed impressively, ROV deployments might be more time consuming but may be at the same time more reliable in rough weather areas. For numerous other investigations with manipulation tasks and targeted sampling such as the quantification of bubble ebullition rates by image analysis and the determination fluid flow by an acoustic travel time current meter as well as for the deployment of an autonomous micro profiler module the full size ROV Victor 6000 was very well suited [2, 3].

At the deep-sea long term observatory HAUSGARTEN [4] different kinds of experiments were performed by means of the ROV in order to learn more about the survival strategies of benthic deep-sea organisms (saving energy by waiting for eventual food supply versus actively moving for seeking food): for this purpose e.g. fish bites were deployed and algae were distributed on the seafloor, respectively, and after a representative exposure time sampled by push cores for further analysis. Colonization experiments with plates from different materials were conducted at HAUSGARTEN and inspected one year later by the ROV.

In order to understand the effect of near bottom flow current meter measurements were performed by the ROV around hydrodynamic obstacles like rocks. Furthermore a flume was installed at 2500 m depth in the main current direction and visited for intensive sampling and measurements two years later by Victor 6000.

As a conclusion one can state that for a large variety of manipulation tasks in deep-sea research full size ROVs are indispensable tools. AUVs can in principle be deployed for touchless hydro-acoustic, visual and sensor surveys of larger areas. However, there is still room for improvement in respect to situation-specific mission changes. The development of hybride ROVs as well as advances in sensor systems, mission planning and autonomy will further increase the flexibility of underwater robots.

References

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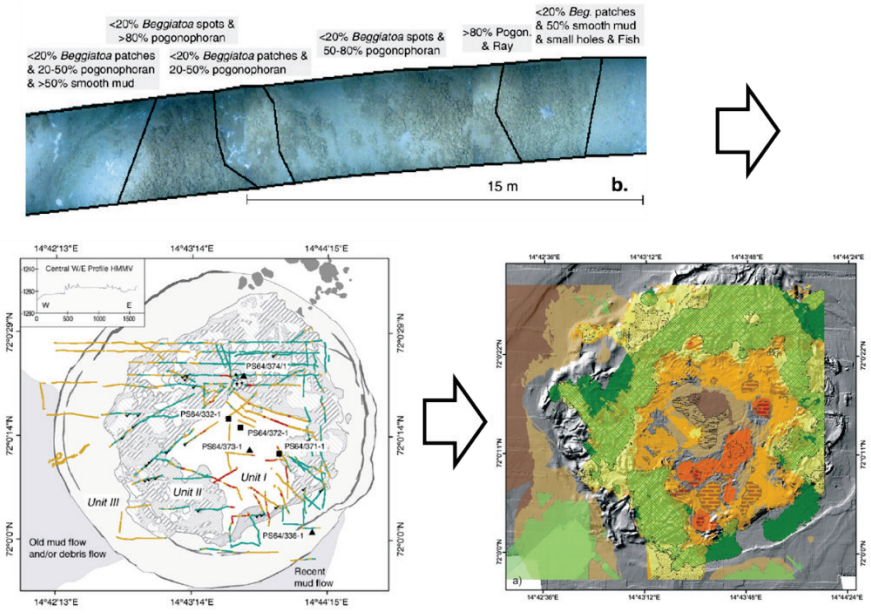

Figure 1: Video mosaics from the ROV's vertical camera are corrected and processed to a habitat map [1].

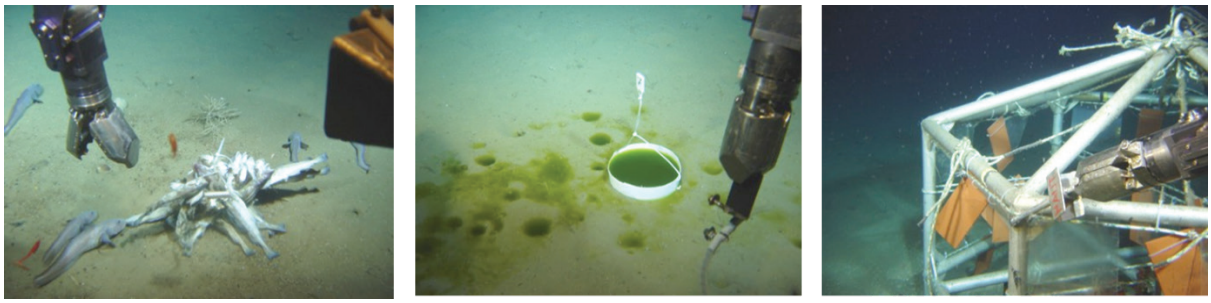

Figure 2: Examples of experiments performed by the ROV Victor 6000 at the HAUSGARTEN long term observatory at the seafloor at 2500 m depth: deployment of fish bites (left), chlorophyll irrigation experiment (middle), and surface colonization experiments (right).