Developing technological synergies between deep-sea and space research

During the ROBEX Project (Wedler et al., 2017) deep-sea and space research have cooperatively enhanced autonomous functionalities, using advanced perception and navigation technologies to increase autonomy of robots in extreme environments. During two demonstration missions, one including GEOMAR's VIATOR Crawler and MANSIO Lander, the autonomous homing functionality could be demonstrated based on localization of active markers. During the space analog mission 2017 on Mt. Etna, the autonomous navigation (Schuster et al., 2020) and seismic instrument placement (Witte et al., 2020) has been demonstrated, as well as long travers navigation using SLAM techniques (Vayugundla et al., 2018). The mission autonomy was based on complex state machines (Brunner et al., 2018; Lehner et al., 2018), using the open source state flow visualization tool RAFCON (Rafcon-Team, 2021). The continuation of this deep-sea and space research to enhance autonomy for cooperative robotic teams is performed in the currently running ARCHES project (Wedler et al., 2021).

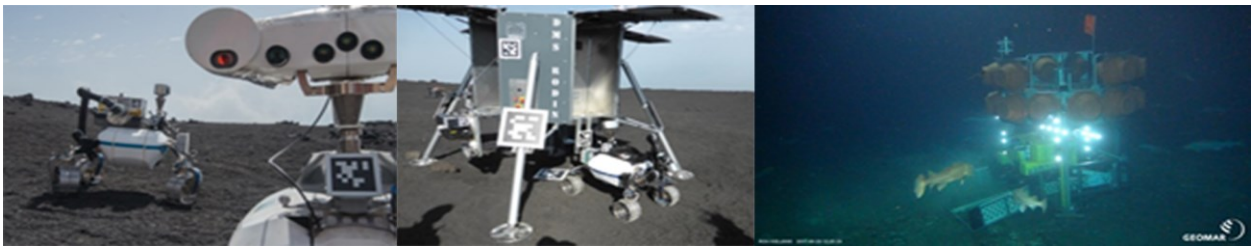

Figure S1. Space rovers and seafloor crawler during two ROBEX demo missions. Left: LRUs (Light weight Rover Units) at the ROBEX demo mission in Mt. Etna. LRU 1, equipped with a scientific imager, and LRU 2 equipped with a robotic arm. Middle: LRU 2 docking at the RODIN lander. Right: Crawler VIATOR during the demo mission in German East Sea, returning to the lander MANSIO.

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