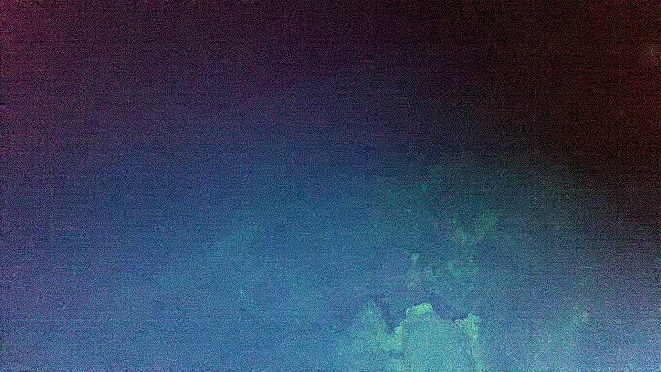
# **Supplementary information 2**

## ***Recommendations on the acquisition of optical data for 3D reconstruction***

General recommendations on the acquisition of high-quality optical data for photogrammetric purposes are detailed in Agisoft Metashape user’s manual (*Agisoft Metashape*, 2023). Here we highlight some of the issues encountered during the reconstruction process using the opportunistic data from this study. These can be used as recommendations for future ROV dives aiming to apply structure-from-motion techniques to the acquired optical data.

1. Seafloor visibility. Although seafloor might appear visible at a human eye, we encountered issues during the alignment process with images taken at an altitude between 3-4 m above seafloor. These numbers might vary based on lighting conditions and camera resolution. Below examples of images where alignment failed.

1. When flying an ROV at such low altitudes, sediment can easily be lifted by the vehicle’s propellers. Although avoiding the problem altogether might be challenging, the trajectory of the ROV can be studied so that sediment will only be lifted at the rear end of the vehicle, or at least behind the cameras recording the scenery. Below two examples of lifted sediment which disrupted the camera alignment process (left) and sediment which appeared in the textured 3D model (right).

1. The quality of the images will depend on the vehicle’s speed and the camera’s parameters. In particular, when working with still images recorded at a constant time rate (e.g., two images every second), a constant vehicle’s speed is crucial to ensure enough overlap between images. On the other hand, when extracting frames from video recordings, both the frame rate and the shutter speed play an import role in motion blur. Images below are taken 3 sec apart while the vehicle is stationary (left) and while turning (right). This shows a difference in sharpness affecting the alignment process during 3D reconstruction.  
    
2. Color correction of underwater imagery. This is an ongoing field of study. The colors of images are affected by the light source and the distance of the object from it. In order to obtain a uniform texture in the 3D reconstruction, such parameters should be kept as constant as possible. A sudden change in light source or a change in vehicle’s altitude creates a patched-like textured model like seen below. This effect could be limited by manually changing the images’ red, blue and green pixel values as well as adjusting for brightness and contrast.



1. An accurate navigation data allows the georeferencing of the images, which is crucial for an accurate scale of the model when laser points are not available.   
   In addition to the navigation data, the offsets between the reference point and physical placement of the cameras on the vehicle should be specified. This includes both location (x, y, z) and orientation (yaw, pitch, roll) data.  
   Poor navigation and offsets data might result in off-scale and rotated models (e.g., 50m-high hydrothermal vents, growing horizontally).