Seabed video and still images from the northern Weddell Sea and the western flanks of the Powell Basin

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Abstract. Research vessels equipped with fibreoptic and copper cored coaxial cables support the live onboard inspection of high-bandwidth marine data in real-time. This allows towed still image and video sleds to be equipped with latest generation higher resolution digital camera systems and additional sensors. During RV *Polarstern* expedition PS118 in February-April 2019, the recently developed Ocean Floor Observation and Bathymetry System (OFOBS) of the Alfred Wegener Institute was used to collect still and video image data from the seafloor at a total of 11 ice covered locations in the northern Weddell Sea and Powell Basin. Still images of 26 megapixel resolution and HD quality video data were recorded throughout each deployment. In addition to downward facing video and still image cameras, OFOBS also mounted sidescan and forward-facing acoustic systems, which facilitated safe deployment in areas of high topographic complexity, such as above the steep flanks of the Powell Basin and the rapidly shallowing, iceberg scoured Nachtigaller Shoal. To localise collected data, the OFOBS system was equipped with a POSIDONIA transponder for Ultra Short Baseline triangulation of OFOBS positions. All images are available from: https://doi.org/10.1594/PANGAEA.911904 (Purser et al., 2020).

1 Introduction

Recent studies indicate that climate change processes in the maritime Antarctic are accelerating, leading to the increasing retreat of the ice sheets of the eastern coast of the Antarctic Peninsula and the near disintegration of the ice shelves Larsen A in 1995 and Larsen B in 2002 (Rott et al., 1996; Scambos et al., 2013; Shepherd et al., 2003), as well as the break-off of giant icebergs from Larsen C (Han et al., 2019; Shepherd et al., 2003; Skvarca, 1993). This change in ice coverage have resulted in spatially extensive habitat change both above and below water, with many processes from light penetration, ocean stratification, surface productivity and food transportation pathways affected (Barnes and Tarling, 2017; Chaabani et al.,

2019; Fillinger et al., 2013; Griffiths et al., 2017; Gutt et al., 2019). By assessing the seafloor habitats and associated benthic fauna communities in these areas recently free of permanent ice cover with the Ocean Floor Observation and Bathymetry

35   System (OFOBS) of the Alfred Wegener Institute (AWI), Helmholtz Centre for Polar and Marine Research Bremerhaven (Germany) (**Figure 1**), the ecological effects of climate-driven ice shelf loss can be studied. OFOBS is a towed platform capable of deployment in moderate ice-cover conditions and capable of concurrently collecting acoustic, video and still image data from the seafloor (Purser et al., 2018).

40   During RV *Polarstern* expedition PS118 (February 9th – April 10th 2019) (Dorschel, 2019b) OFOBS was deployed 11 times, conducting concurrent high-resolution still image, video and acoustic surveys across diverse and contrasting regions of the Antarctic seafloor (**Figure 2**). Ice conditions during the cruise were harsh, though a north-south transect from the Weddell Sea continental shelf to the northwest continental shelf edge of the Powell Basin was completed, with stations on the Weddell Sea plateau, Nachtigaller Shoal (Dorschel et al., 2014) and the flanks and rim of the Powell Basin investigated

45   (**Table 1**).

The PS118 OFOBS data was collected with the same cameras, illumination regime and deployment protocols as mounted on the previous AWI towed camera sled system, (Ocean Floor Observation System (OFOS)), used to survey the Antarctic seafloor during previous recent RV *Polarstern* expeditions (Piepenburg et al., 2017), such as PS81, also to the western

50   Weddell Sea area in 2013 (Gutt, 2013; Gutt et al., 2016) and PS96, to the southeastern Weddell Sea in 2015/16 (Schröder et al., 2016). By continuing to mount the same camera systems, observations made during PS118 can be most readily compared with those made during the previous expeditions, uncomplicated by methodological problems relating to variabilities in camera performance, flight height or illumination (Schoening et al., 2020).

55   The OFOBS data collected during PS118 and presented here is of use for a range of scientific studies, such as:
1) Assessment of epibenthic megafauna communities observed at several sites along a South-North transect from the Weddell Sea Antarctic Peninsula continental shelf to the Powell Basin.
2) For spatial comparison of these observed shelf and basin megafauna communities with those observed with the very similar OFOS towed device sled during recent cruises.
60   3) A temporal picture of seafloor communities occupying these seafloor regions in 2019, for comparison with future studies following continued ice loss.
4) An extensive set of seafloor images from several locations on the Powell Basin flank, a region of southern seafloor sparsely surveyed to date.

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2 Materials and methods

2.1 Ocean Floor Observation and Bathymetry System (OFOBS)

The OFOBS is a state-of-the-art towed camera and acoustic survey sled recently developed by the Deep Sea Ecology and Technology group of AWI for benthic polar research in ice-covered environments (Purser et al., 2018). The device was deployed during PS118 as described in Purser et al. (2018), taking images under comparable illumination conditions, flight heights and with the same camera systems as were mounted on the OFOS sled during the PS86 and PS96 cruises in 2013 and 2015/16, respectively (Piepenburg et al., 2017). OFOBS positioning during deployments was carried out with the iXBlue POSIDONIA Ultra-Short Base Line (USBL) system used by RV *Polarstern*, localising the relative position of the OFOBS to the vessel (itself deriving its position from a satellite based Global Navigation Satellite System (GNSS). Every few seconds (depending on deployment depth) the OFOBS received a new position fix, which was used to position stamp each collected image against a UTC timestamp. Images were taken with an automated timer (for the majority of images, these were taken with a frequency of ~1 image every 20 seconds), with additional images taken at the discretion of the operator. These two image categories are distinguished in the data set as 'HOTKEY' and 'TIMER' images – designations automatically incorporated into the timestamped filenames. 'HOTKEY' images were commonly taken on the first observation of a particular fauna species or to record a feature of interest, such as a whale fall or interesting geological structure.

The OFOBS system has three parallel lasers mounted in an isometric triangular arrangement with 50 cm spacing. These lasers assure that all collected images include three red laser points, which allow both the scaling of the seafloor image as a whole, as well as the facility to size all fauna and features observed on the seafloor.

Throughout all deployments, HD video data was recorded by the OFOBS for the duration of each dive.

2.2 Field sampling

2.2.1 Weddell Sea sampling

OFOBS surveys were carried out in a roughly south-north transect from the Weddell Sea continental shelf of the Antarctic Peninsula to the northern Powell Basin. In total, 7 OFOBS deployments were made between 65 and 62°S (**Table 1**, **Figure 2**). With the exception of an OFOBS deployment across the Nachtigaller Shoal (Dorschel et al., 2014) (station PS118/11-2), the seafloor in these regions was observed to be predominantly made up of soft material with occasional drop stones present (**Figure 3**).

2.2.2 Powell Basin sampling

Four successful OFOBS deployments were made on the flanks and rim of the Powell Basin (**Table1, figure 2**). Three of
100   these deployments, PS118/39-1, PS118/69-1 and PS118/81-1, benefitted from the equipping of the OFOBS sled with a
forward looking sonar (Purser et al., 2018). This sensor allowed OFOBS to be used over very steep terrain with minimum
risk, by giving advance warning of any hard structures ~30 m ahead of the sled. The majority of towed sleds, such as OFOS,
are less capable in high-relief regions, where snagging on tall structures such as cliffs or vent structures can occur. With
OFOBS, the ~30 m warning of approach is sufficient to allow the operators to commence winching of the system in good
105   time to minimise the risk of impact of the sled with the seafloor whilst still collecting usable image data. These data sets each
cover many 100s of meters of the Powell Basin flank walls, visually surveying these traditionally difficult to investigate
regions of seafloor (**Figure 4**).

3 Data availability

110   All seafloor images collected with the OFOBS system are available from the data publisher PANGAEA. These images are
provided with georeferenced positions for each image, as derived from the POSIDONIA system
(https://doi.org/10.1594/PANGAEA.911904; (Purser et al., 2020)). The full cruise track is also available via PANGAEA
(https://doi.org/10.1594/PANGAEA.901319; (Dorschel, 2019a)) with information on additional environmental and scientific
data collected during the cruise given in the PS118 cruise report (Dorschel, 2019b). Video data collected via the OFOBS
115   system is available from the authors on request.

Competing interests.

The authors declare that they have no conflict of interest.

Author contributions.

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AP applied for the secondary user time for the PS118 cruise, conceived of the investigation and ran the data collection
campaign. BD was chief scientist for the PS118 expedition. SD, LH, HS, HG and AN helped run the OFOBS platform. AP,
125   HG, KJ, DP, CR and BD determined sampling strategies for the OFOBS and aided in data collection. AP prepared the
manuscript with contributions from all co-authors.

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190 **FIGURES**
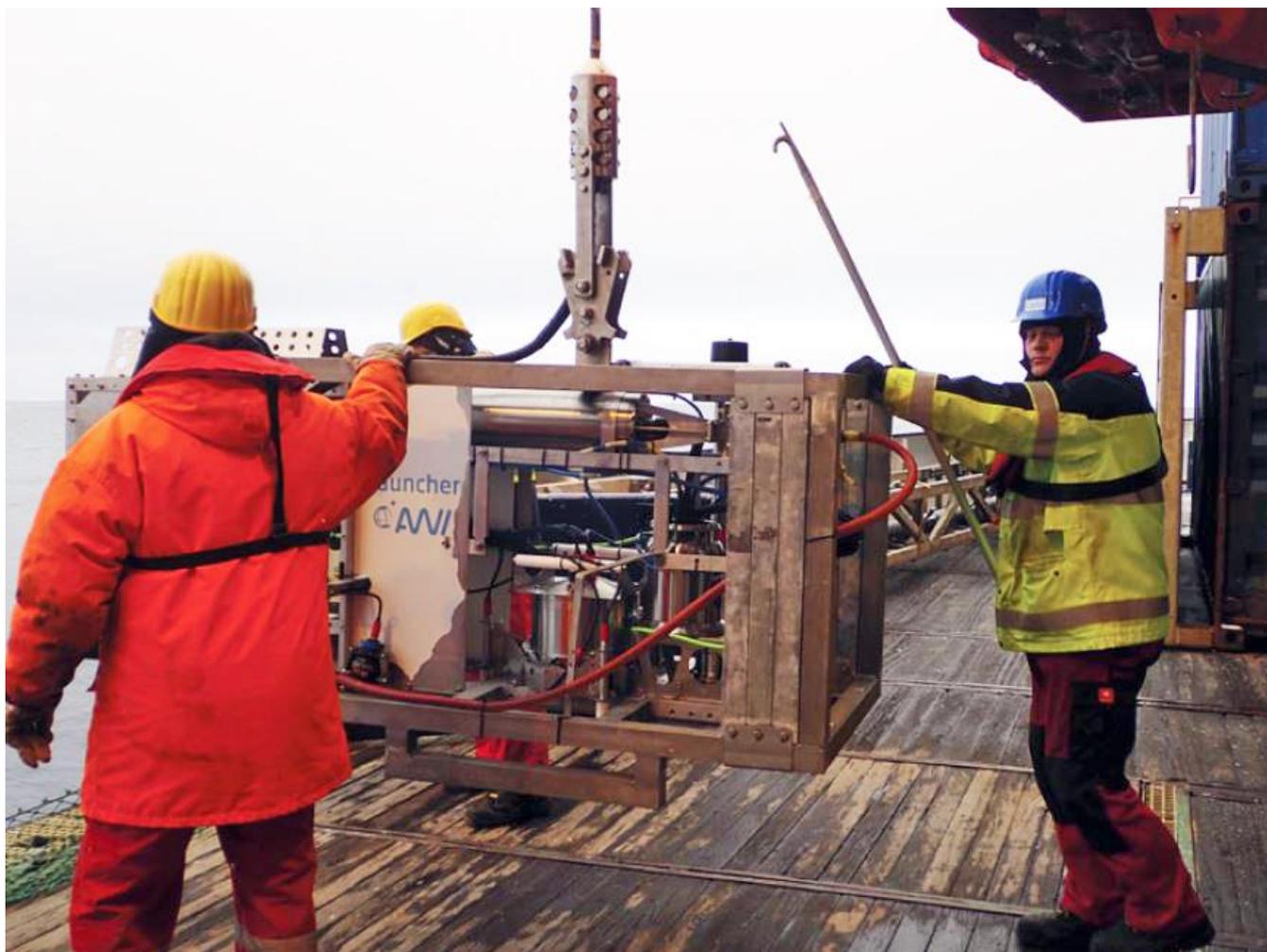
Figure 1: The Ocean Floor Observation and Bathymetry System (OFOBS) of the Alfred Wegener Institute (AWI),
Helmholtz Centre for Polar and Marine Research Bremerhaven, deployed from the RV *Polarstern* during cruise PS118 in the
waters east of the Antarctic Peninsula and on the flanks of the Powell Basin (Feb – April 2019)

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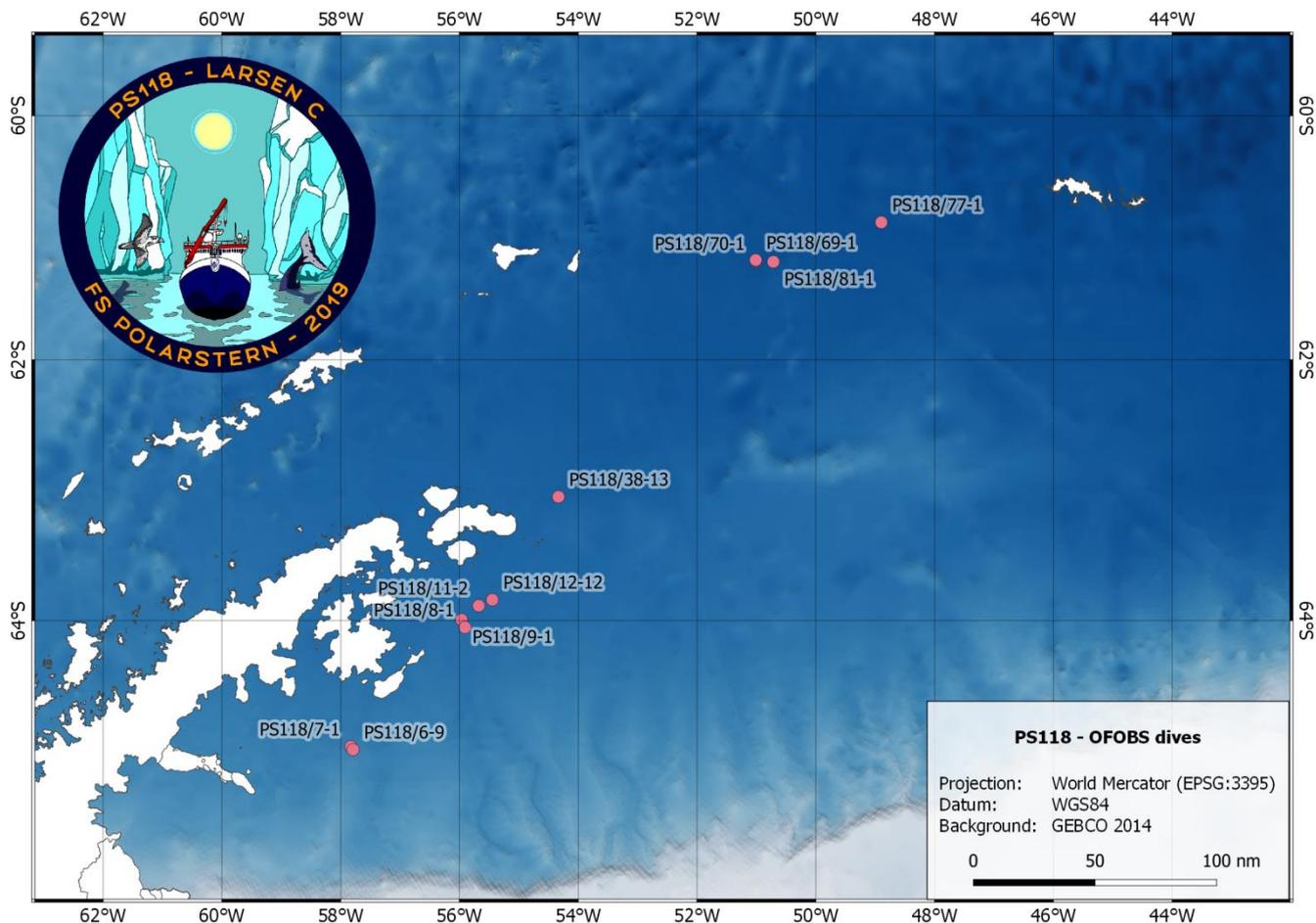
Figure 2: Regional map showing the positions of OFOBS deployments made during RV *Polarstern* cruise PS118.

200
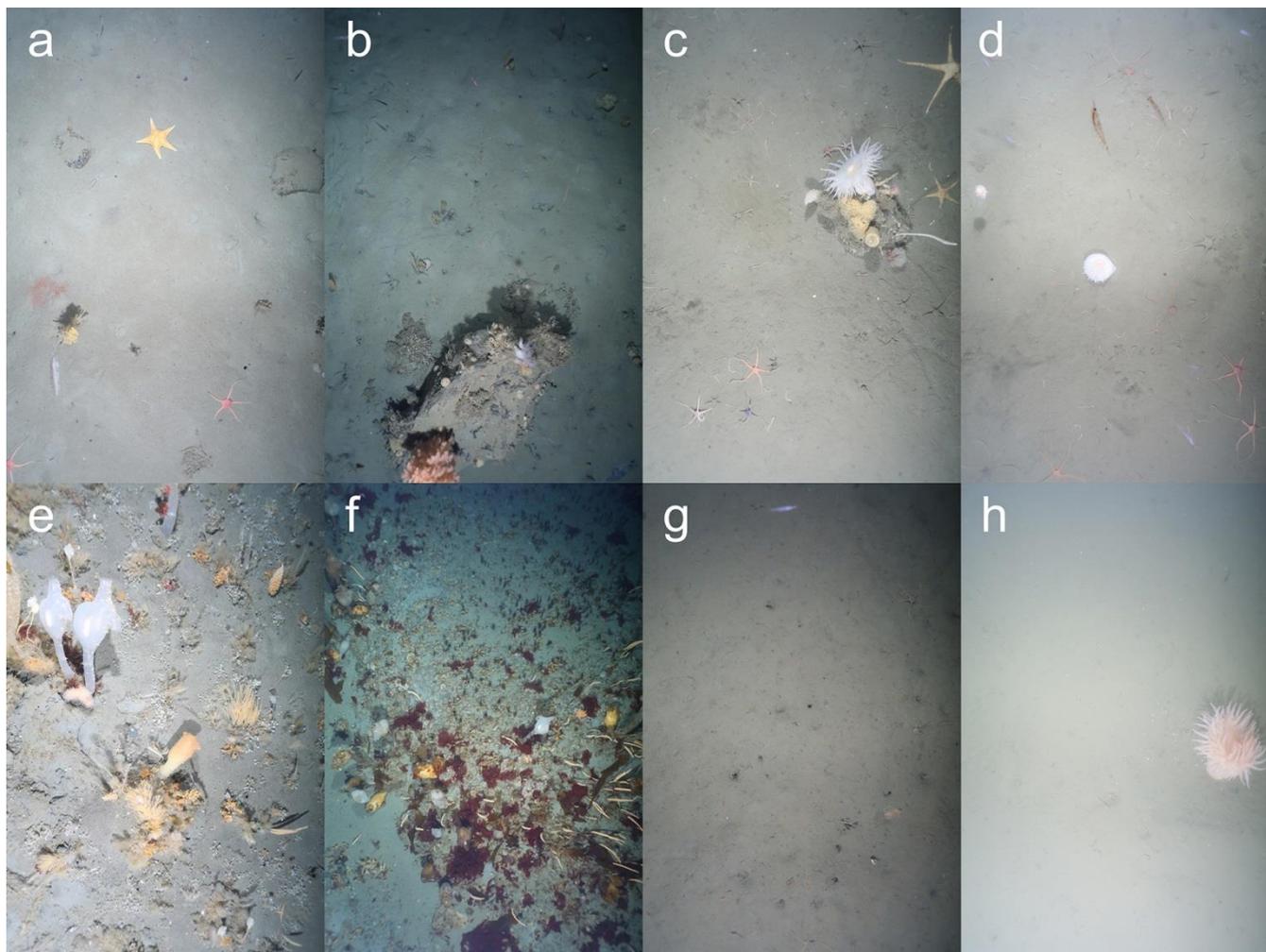
Figure 3: Typical seafloor images collected from each of the OFOBS surveys made of the Weddell Sea seafloor during RV *Polarstern* cruise PS118. a) Station PS118_6, hotkey_2019_03_06 at 05_07_31 b) Station PS118_7, hotkey_2019_03_06 at 19_36_28 c) Station PS118_8, hotkey_2019_03_11 at 14_33_24 d) Station PS118_9, timer_2019_03_12 at 06_01_06 e) Station PS118_11, timer_2019_03_13 at 20_14_04 f) Station PS118_11, timer_2019_03_13 at 22_18_47 g) Station PS118_12, timer_2019_03_15 at 01_29_36 h) Station PS118_38, hotkey_2019_03_23 at 06_27_00

205
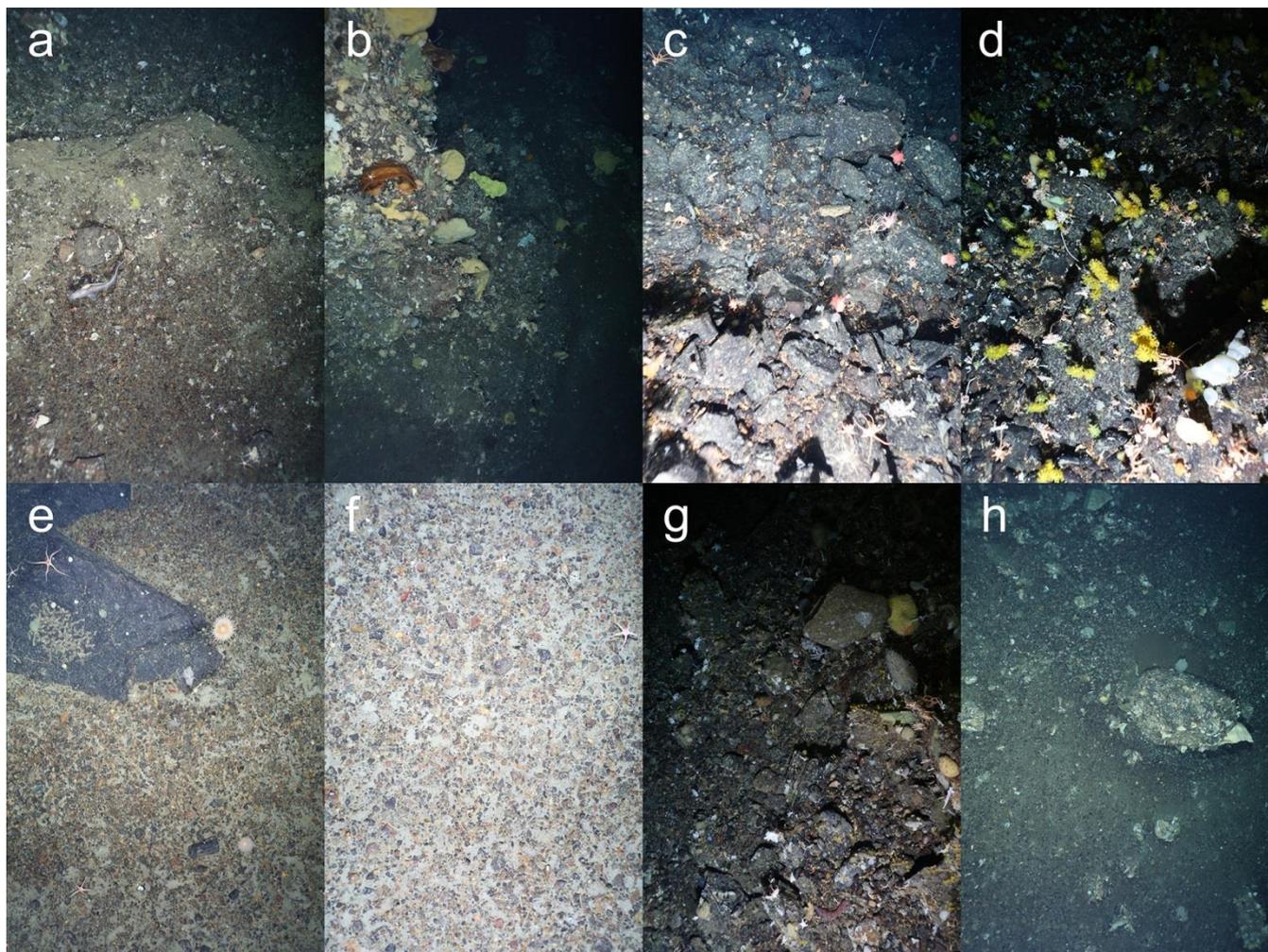
Figure 4: Typical seafloor and cliff escarpment images collected during OFOBS surveys of the Powell Basin flanks during RV *Polarstern* cruise PS118 . a) Station PS118_39, hotkey_2019_03_23 at 23_21_46 b) Station PS118_39, timer_2019_03_25 at 18_50_09 c) Station PS118_69, hotkey_2019_03_31 at 12_20_55 d) Station PS118_69, hotkey_2019_03_31 at 14_10_56   e) Station PS118_77, timer_2019_04_01 at 20_39_51   f) Station PS118_77, timer_2019_04_01 at 20_11_32 g) Station PS118_81, timer_2019_04_04 at 00_25_31 h) Station PS118_81, timer_2019_04_04 at 02_27_33

TABLES

Table 1: Locations of OFOBS deployments during PS118. Start and end position co-ordinates and times are given, in addition to the numbers of
220 'timer' and 'hotkey' images collected during each deployment.

Station Number	Region	Date	Start (UTC)	End (UTC)	Latitude Start	Longitude Start	Latitude End	Longitude End	Timer Images	Hotkey Images
PS118_6	Weddell Sea	06.03.2019	05:01	09:33	-64.939363	-57.791526	-64.929378	-57.818072	1314	90
PS118_7	Weddell Sea	06.03.2019	19:25	20:08	-64.918268	-57.824799	-64.914652	-57.826477	259	28
PS118_8	Weddell Sea	11.03.2019	12:02	15:45	-64.049462	-55.906690	-64.007332	-55.908186	891	73
PS118_9	Weddell Sea	12.03.2019	06:00	06:51	-63.991755	-55.965738	-63.993996	-55.968168	319	4
PS118_11	Nachtigaller	13.03.2019	20:14	22:25	-63.888204	-55.675914	-63.887744	-55.656926	690	7
PS118_12	Weddell Sea	15.03.2019	01:28	05:55	-63.844375	-55.447947	-63.844602	-55.446939	1547	5
PS118_38	Weddell Sea	23.03.2019	05:01	06:31	-63-066654	-54.334116	-63.073675	-54.319400	379	11
PS118_39	Powell Basin	23.03.2019	18:46	09:56	-61.914657	-53.323264	-61.865707	-53.324424	3667	140
PS118_69	Powell Basin	31.09.2019	01:52	16:00	-61.192316	-50.996506	-61.192854	-51.085361	2655	68
PS118_77	Powell Basin	01.04.2019	21:08	21:48	-60.888864	-48.896518	-60.887241	-48.905883	153	5
PS118_81	Powell Basin	03.04.2019	21:24	09:31	-61.213897	-50.716745	-61.186405	-50.672902	373	12