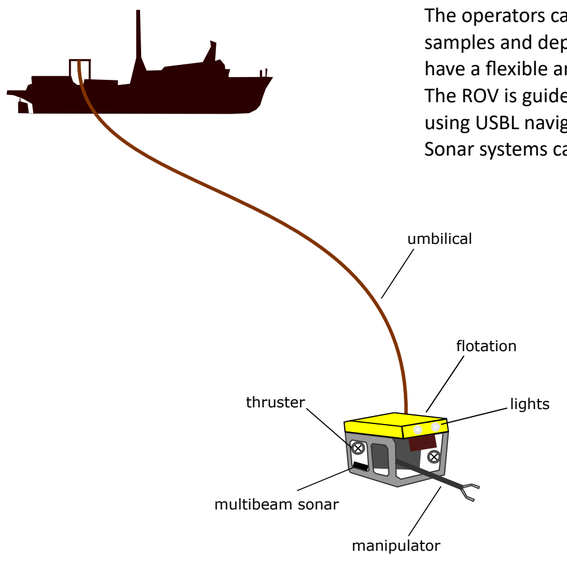
Seabed Minerals Authority
Runanga Takere Moana
COOK ISLANDS

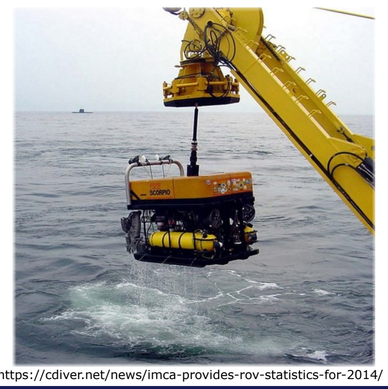
Exploration Techniques and Tools used for Baseline Environmental Research

ROV



Remotely operated vehicles allow for detailed examination of limited areas.
The operators can follow specific organisms, take specific samples and deploy sensors and sample tubes. They usually have a flexible and precise manipulator 'hand'.
The ROV is guided using thrusters and its location monitored using USBL navigation.
Sonar systems can also be mounted on an ROV.

recovery of an ROV to the expedition boat



https://cdiver.net/news/imca-provides-rov-statistics-for-2014/

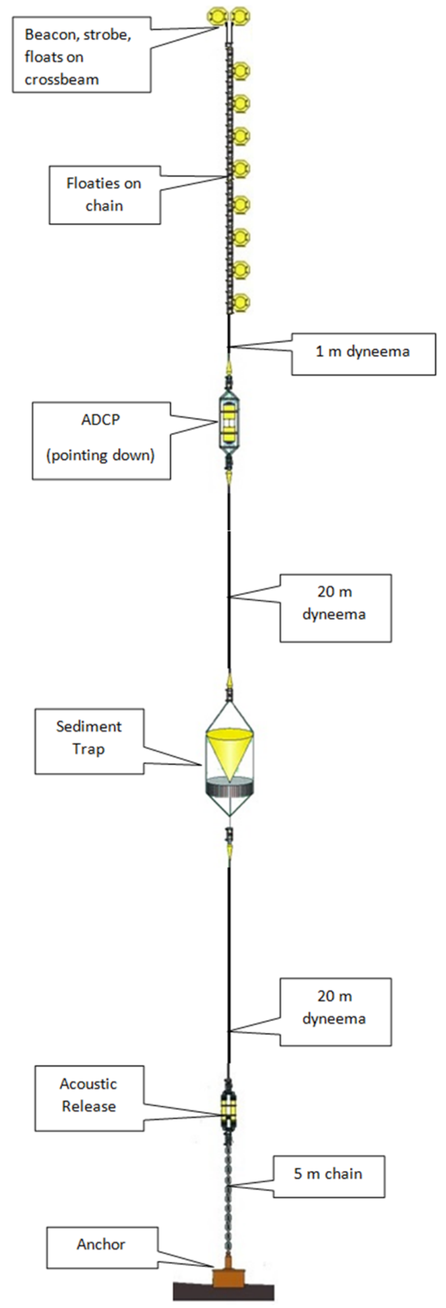
Environmental Mooring

Environmental moorings are left on the seabed to record changes in ocean chemistry, currents and sedimentation rates. They can be left for a few days (e.g. during a collector test) or for months or even years to capture baseline data over seasons and ENSO cycles. Limitations in terms of data storage and battery life may mean that a mooring is periodically recovered and then redeployed.

Moorings come in a very wide range of lengths and configurations. They range from a few tens of meters long to several kilometers long depending on what part of the water column they are focusing on.

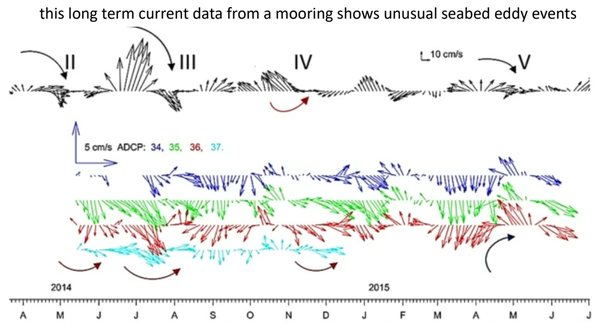
Deployment of moorings is usually complex and requires fair weather. Starting with the flotation each segment is deployed from a slowly moving expedition vessel to avoid tangles.
The final component is the ballast weight which pulls the system to the seabed. An acoustic release connects the ballast to the rest of the mooring and when sent a special code it releases the mooring string which is collected when back at surface, with the aid of a GPS beacon.

Moorings typically include ADCPs (see below) to measure ocean currents and sediment traps that collect downward migrating particles (marine snow).



deployment of an environmental mooring

this long term current data from a mooring shows unusual seabed eddy events



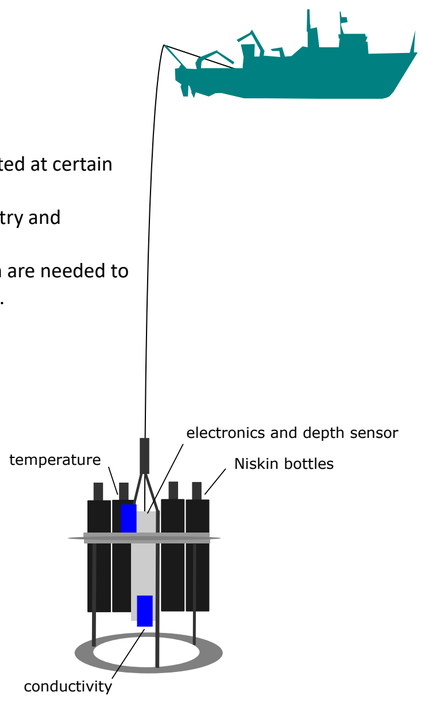
https://www.nature.com/articles/s41598-017-16912-2

CTD and Niskin Bottles

Conductivity-Temperature-Depth sensors are often mounted with carousels of Niskin bottles.
These are lowered to just above the seabed with water samples collected at certain depths in the bottles for chemical analysis.
These systems are used to provide baseline information on the chemistry and conditions of the water column.
CTD profiles can be used to define SVPs (sound-velocity profiles) which are needed to calibrate multibeam echosounder and ultra-short baseline survey data.

deployment of a large CTD-Niskin carousel

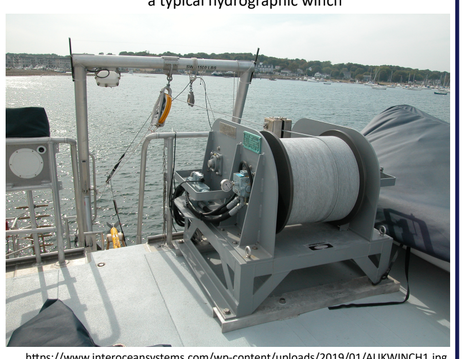
https://3.bp.blogspot.com/-NAnnVf4WhsY/T4aXHjey8yI/AAAAAAAAAjg/Z8qKsLpdUv8/s1600/CTD.jpg



a typical hydrographic winch

Winch/Umbilical

Winches hold and deploy/recover the longest piece of equipment - the umbilical line.
These need to raised and lowered several times a day for months at a time - clearly reliability is critical, and most expedition boats carry a backup system.
The lines include steel and special fibre ropes (kevlar or HMPE), as well as steel armoured or soft umbilicals which contain conductive wires and fibreoptic filaments.



https://www.interoceansystems.com/wp-content/uploads/2019/01/AUKWINCH1.jpg

ADCP

Acoustic doppler current profilers are instruments that use sound waves to measure ocean currents. The Doppler effect means that a sound wave has a higher frequency, or pitch, when it moves to you than when it moves away (e.g. like a passing car).

Complex coding and timing of sound pings and their echos off particles in the sea water means that the currents in different depth cells can be measured separately.

The frequency of sound pings from an ADCP can usually be adjusted to give greater range or greater precision in the measurements.

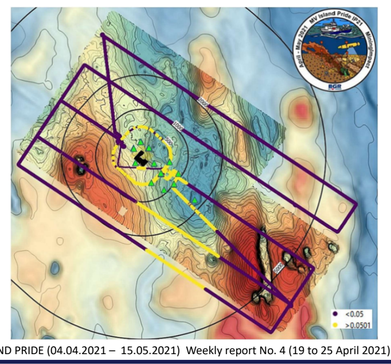
deployment of an ADCP

https://www.mbari.org/wp-content/uploads/2019/03/MBCCE_MS4_ADCP300_deployment_20151007-e1553889570728-852x1030.jpg

AUV monitoring of a nodule collector test in the central Pacific

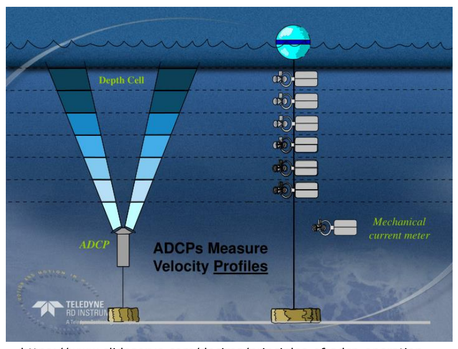
Eh/Ph and other sensors

Seawater only allows light transmission for several tens of metres, so a variety of other senors are often used.
Eh/Ph and nephelometer sensors aim to search for particulate matter in what is often very clear water.
These are important in tracking natural variations in turbidity and man made plumes from seabed activities.
These sensors can be mounted on any type of sub-sea device including AUVs as shown in the survey at right.



Expedition MANGAN 2021 with MV ISLAND PRIDE (04.04.2021 – 15.05.2021) Weekly report No. 4 (19 to 25 April 2021)

depth or distance cells from a moored ADCP



https://www.slideserve.com/decima/principles-of-adcp-operation

Photo-profile

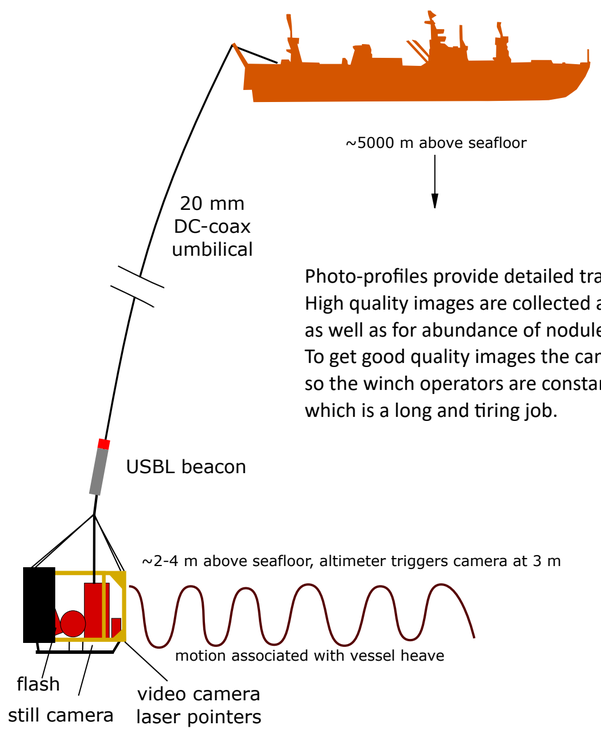
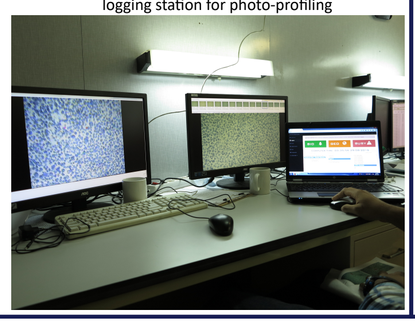
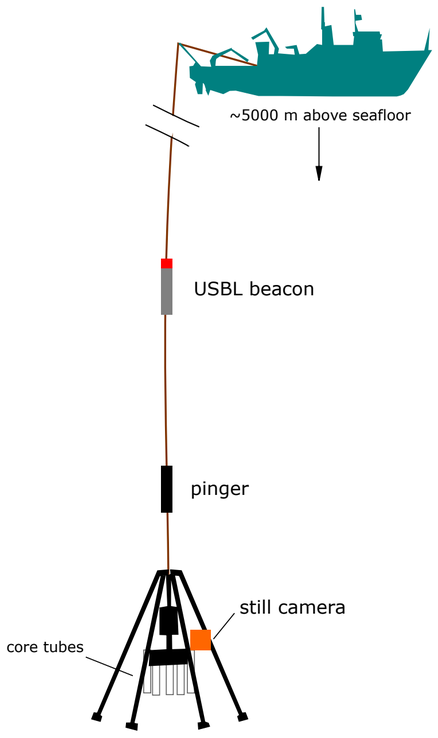


Photo-profiles provide detailed transects for biology and geology.
High quality images are collected and logged for mega-fauna (animals >2 cm across) as well as for abundance of nodules.
To get good quality images the camera needs to be close to the seafloor, so the winch operators are constantly trimming the camera using video feed, which is a long and tiring job.

logging station for photo-profiling





Multicorer and landers

Multicorers provide duplicate samples that help scientists study the smaller organisms that comprise most of the biomass at the seabed.
The cores in each tube are handled with specific protocols on the expedition boat.
Some are sieved to different fractions, while others are preserved using different chemicals.
The samples are then studied at labs using optical and DNA sequencing methods.
Other types of landers are used to measure sediment biochemistry and even to attract larger animals for study.

multicorer landing at the seabed

https://schmidtocean.org/wp-content/uploads/2012-11-20-lr-mucuw.jpg