

Annotating NOAA Ocean Exploration Video

March 2023

Introduction

NOAA Ocean Exploration produced this document to standardize the annotation of video collected during remotely operated vehicle (ROV) dives on NOAA Ship *Okeanos Explorer*. It briefly describes the platform used by NOAA Ocean Exploration for ROV video annotation and then explains the standardization of data fields and vocabularies and what it means for an individual dive's set of annotations to be "complete" (as of summer 2022).

The primary audience for this document is scientists who participate in NOAA Ocean Exploration dive operations and/or otherwise contribute to video annotations both during and after an expedition.

Annotation Platform

Ocean Networks Canada (ONC) created and maintains [SeaTube](#), a cloud-based annotation platform that uses a web browser-based graphical user interface. NOAA Ocean Exploration has a contract with ONC to use SeaTube for annotation of video collected during ROV dive operations on NOAA Ship *Okeanos Explorer*.

SeaTube has two modes of annotation: live annotation and post-dive annotation. Scientists viewing a dive's low-latency video in real time can make live annotations. All dive video is stored in SeaTube for later viewing, so scientists can also review a dive's recorded video in SeaTube after a dive and make post-dive annotations. Time stamps link a dive's recorded video to its live and post-dive annotations as well as ROV sensor data and dive chat logs.

See the [Science Annotations web page](#) on NOAA Ocean Exploration's website to learn more about using SeaTube to annotate ROV dive video from expeditions on *Okeanos Explorer*.

Annotation Standardization

Data Fields

Appendix A contains a list of all the data fields available in SeaTube for the annotation of dive videos from expeditions on *Okeanos Explorer*. Each annotation includes ship and ROV sensor information collected from the ship and ROV at the time a subject is seen, full taxonomic

information for biological subjects, select fields for other types of subjects (e.g., geological, archaeological), and comments.

Vocabularies

NOAA Ocean Exploration relies on recognized and standard vocabularies for uniform and interoperable annotations. Specifically, NOAA Ocean Exploration uses the [World Register of Marine Species \(WoRMS\)](#) for taxonomy and the [Coastal and Marine Ecological Classification Standard \(CMECS\)](#) for geology and substrates. As there are no authorized or standard vocabularies for archaeology, education, and video quality, NOAA Ocean Exploration has established its own standard vocabularies for these related data-fields (see **Appendix B**).

The vocabularies are built into SeaTube for easy population of data fields.

Complete Set of Dive Annotations

Every dive should be annotated to a point at which it can be considered complete. Dives on *Okeanos Explorer* typically fall into one of two categories: benthic and water column. Besides operational annotations, which are included for every dive, the two categories have their own definition of “complete” due to inherent differences in the two environments (see below). Education and maritime heritage annotations are not required for a dive to be considered complete.

Annotation Uncertainty

When an annotating scientist is unable to make or unsure of an identification, they can flag an annotation as “To Be Reviewed.” A dive is not complete until all flagged annotations are resolved.

To enable a dive to be marked complete as soon as possible (without waiting for expertise that may not be available), NOAA Ocean Exploration recommends taking a conservative approach to annotation. For a biological subject, this entails using WoRMS to identify it at a higher taxonomic level and noting possible names in the comment field. For example, an annotator unsure of a genus of Primnoidae can enter the family (Primnoidae) in the appropriate data field and a suspected genus in the comment field: “possible *Calyptrophora*.” This ensures that all subjects are annotated to some degree, and more specific information can be added later.

To share an annotation with other experts for review and/or further annotation, users can share a direct link to the annotation in question (select the annotation and then click the three dots at the top right of the Annotation List panel). Alternatively, users can take and download a

screenshot of the recorded video in SeaTube (click on the gear icon on the video player and then Take Snapshots).

Operational Annotations

Each dive's set of annotations include operational annotations entered in real time by the team aboard *Okeanos Explorer* during a dive. These annotations include:

- ROV in/out of water
- ROV on/off bottom
- Transect start/end and depth
- Start and end of sampling operations (including failed attempts with sample number and preliminary identification)

Benthic Dive Annotations

A complete set of annotations for a benthic dive will include annotations for all biological, geological, and maritime heritage (if applicable) subjects as described below.

Biological Subjects

Biological subjects (organisms) should be annotated using accepted taxonomic names in WoRMS. All organisms that are larger than 3 cm in size and in focus should be annotated to the lowest taxonomic level possible. Those smaller than 3 cm can be annotated at the discretion of the annotator. There should not be multiple annotations for a single sighting of an individual organism. Duplicate annotations will be removed during quality control.

When to annotate a benthic organism:

- If an organism is not zoomed in on: Annotate it when it's first seen.
- If an organism is zoomed in on: Annotate it at the time when it's first in focus enough to make an identification.

How to annotate multiples of a benthic organism:

- If there are multiple individuals of the same organism seen in a single frame: Combine them into one annotation, including the number observed under the Count attribute and the note "multiple observed" in the comment field.
- If there are multiple individuals of the same organism seen across multiple continuous frames: Annotate them every five minutes (maximum) counting all of the organisms seen during the interval and including the number under the Count attribute and noting "multiple observed" in the comment field.

Geological Subjects

Geological subjects should be annotated using the terminology established in CMECS. Two types of geological annotations should be made during each benthic dive:

- **Geoform:** A single annotation of the dive’s geoform(s) should be made by the expedition coordinator when setting up the dive in SeaTube the night before the dive. Level 1 geoforms are larger scale geological features that should be captured in the record (e.g., submarine canyon or seamount). These large geoforms should be evident based on the bathymetry data compiled for the dive. The largest geoform feature should be noted first, followed by the smaller feature(s) along the planned dive transect (e.g., “seamount/slope/ridge”). The CMECS geoform is also noted on the dive summary form for each dive and should match the terminology entered into SeaTube for that dive.
- **Substrate:** Substrate annotations should be made every five minutes or when there is a major change in substrate type (e.g., rock, sand, rubble). This allows for a continuous record of the substrate traversed. Substrate annotations should follow CMECS terminology and definitions (using either the CMECS or Simplified CMECS taxonomy). The full CMECS substrate terminology is in the CMECS taxonomy in SeaTube. The user-defined Simplified CMECS taxonomy was developed by NOAA’s National Centers for Coastal Ocean Science’s deep-sea coral ecology lab to ease real-time substrate annotation during dives and is in **Appendix C**.

Maritime Heritage Subjects

Maritime heritage subjects should be annotated using the vocabularies in **Appendix B** (note the separate vocabularies for aircraft and shipwreck features). Annotations for specific features associated with a maritime heritage subject should be made at the point in the video where the feature is most clearly seen. If a feature is not included in the vocabularies or is unknown, it can be noted in the comments.

Water Column Dive Annotations

Water column dives occur in the pelagic areas of the ocean. Since there are no visual reference points, readings from the ultra-short baseline acoustic positioning system (USBL) used for navigation, the conductivity, temperature, and depth system (CTD), and split-beam sonars used to detect water column aggregations) are important guides to the exploration. Water column exploration entails a series of timed transects at a variety of depths to identify the types and quantities of organisms that live there.

A complete set of annotations for a water column dive will include annotations for all biological subjects and water column features as described below.

Biological Subjects

Biological subjects (organisms) should be annotated using accepted names in WoRMS. All organisms visible on screen during a transect, including those that are not zoomed in on or that are out of focus, should be annotated to the lowest taxonomic level possible.

When to annotate a water column organism:

Annotate an organism when it's first seen. Do not wait for the zoom. This should result in the most accurate depth and location of the observation.

How to annotate transects and transits:

Denote the start and end of each transect in the comment field as “start/end transect XXX m” (“XXX m” indicates transect depth). Focus annotating efforts on transects. Limit annotations between transects to larger organisms that the camera can detect without zooming.

Water Column Features

Water column features like the deep scattering layer should be annotated by noting their presence in a comment field.

Inner Space Center Annotations

The University of Rhode Island's Inner Space Center (ISC) provides education and video quality annotation support for expeditions on *Okeanos Explorer*. The associated vocabularies are in **Appendix B**.

Education

Watchstanders from the University of Rhode Island's Graduate School of Oceanography provide annotations for subjects of interest/learning moments identified by the NOAA Ocean Exploration Education Team (e.g., interesting phenomena, organisms, geological features; good discussions, descriptions, explanations) that can be used to support NOAA Ocean Exploration educational efforts. Staff at the ISC conduct quality control on these annotations.

Video Quality

The ISC watchstanders are also responsible for annotating issues with the video streams experienced on shore. The ISC and Global Foundation for Ocean Exploration use these annotations to assess video workflow and troubleshoot problems.

Appendix A: Data Fields

Note: Any text within parenthesis is for descriptive purposes and not part of the field names.

Fields Populated by Expedition Coordinator Per Dive

These fields are updated by the NOAA Ocean Exploration expedition coordinator for each dive. Input data are used for defining unique attributes of a specific dive and to define metadata.

- Dive Name
- Cruise Name
- Geoform
- Start Date (and UTC time)
- End Date (and UTC time)
- To Be Reviewed
- Comment

Fields Generated by SeaTube

These fields are automatically generated by SeaTube for data management, as well as data version control and tracking.

- Dive ID
- Resource ID
- Creator First Name
- Creator Last Name
- Creator Email
- Modifier First Name
- Modifier Last Name
- Modifier Email
- Modified Date
- Annotation ID
- Annotation Source
- Resource Type ID

Fields Populated Automatically From Ship and Vehicle Data

These fields are automatically populated with data from remotely operated vehicle *Deep Discoverer* and are associated with every annotation, with the exception of annotations of maritime heritage sites.

- TEMPPROBEDEEPDISCOVERERROV_23974_Temperature
- TEMPPROBEDEEPDISCOVERERROV_23974_Temperature Time
- DEEPDISCOVERERNAV01_23975_Latitude
- DEEPDISCOVERERNAV01_23975_Latitude Time
- DEEPDISCOVERERNAV01_23975_Pitch
- DEEPDISCOVERERNAV01_23975_Pitch Time
- DEEPDISCOVERERNAV01_23975_Longitude
- DEEPDISCOVERERNAV01_23975_Longitude Time
- DEEPDISCOVERERNAV01_23975_Roll
- DEEPDISCOVERERNAV01_23975_Roll Time
- DEEPDISCOVERERNAV01_23975_Altitude
- DEEPDISCOVERERNAV01_23975_Altitude Time
- DEEPDISCOVERERNAV01_23975_Heading
- DEEPDISCOVERERNAV01_23975_Heading Time
- SBECTD9PLUSDEEPDISCOVERER_23978_Oxygen Concentration
- SBECTD9PLUSDEEPDISCOVERER_23978_Oxygen Concentration Time
- SBECTD9PLUSDEEPDISCOVERER_23978_Temperature
- SBECTD9PLUSDEEPDISCOVERER_23978_Temperature Time
- SBECTD9PLUSDEEPDISCOVERER_23978_Depth
- SBECTD9PLUSDEEPDISCOVERER_23978_Depth Time
- SBECTD9PLUSDEEPDISCOVERER_23978_Practical Salinity
- SBECTD9PLUSDEEPDISCOVERER_23978_Practical Salinity Time
- SEIROSROVNAV01_23977_Latitude
- SEIROSROVNAV01_23977_Latitude Time
- SEIROSROVNAV01_23977_Pitch
- SEIROSROVNAV01_23977_Pitch Time
- SEIROSROVNAV01_23977_Longitude
- SEIROSROVNAV01_23977_Longitude Time
- SEIROSROVNAV01_23977_Roll
- SEIROSROVNAV01_23977_Roll Time
- SEIROSROVNAV01_23977_Altitude
- SEIROSROVNAV01_23977_Altitude Time
- SEIROSROVNAV01_23977_Heading

- SEIROSROVNAV01_23977_Heading Time
- SBECTD9PLUS-SEIROS_23979_Oxygen Concentration
- SBECTD9PLUS-SEIROS_23979_Oxygen Concentration Time
- SBECTD9PLUS-SEIROS_23979_Temperature
- SBECTD9PLUS-SEIROS_23979_Temperature Time
- SBECTD9PLUS-SEIROS_23979_Depth
- SBECTD9PLUS-SEIROS_23979_Depth Time
- SBECTD9PLUS-SEIROS_23979_Practical Salinity
- SBECTD9PLUS-SEIROS_23979_Practical Salinity Time
- OKEANOSEXPLORERMETSTATION01_22882_Air Temperature
- OKEANOSEXPLORERMETSTATION01_22882_Air Temperature Time
- OKEANOSEXPLORERMETSTATION01_22882_Relative Humidity
- OKEANOSEXPLORERMETSTATION01_22882_Relative Humidity Time
- OKEANOSEXPLORERNAV01_23973_Heave
- OKEANOSEXPLORERNAV01_23973_Heave Time
- OKEANOSEXPLORERNAV01_23973_Latitude
- OKEANOSEXPLORERNAV01_23973_Latitude Time
- OKEANOSEXPLORERNAV01_23973_Longitude
- OKEANOSEXPLORERNAV01_23973_Longitude Time
- OKEANOSEXPLORERNAV01_23973_Heading
- OKEANOSEXPLORERNAV01_23973_Heading Time
- OKEANOSEXPLORERNAV01_23973_Pitch
- OKEANOSEXPLORERNAV01_23973_Pitch Time
- OKEANOSEXPLORERNAV01_23973_Roll
- OKEANOSEXPLORERNAV01_23973_Roll Time
- SOUNDVELOCITYPROFILEROKEANOSEXPLORER_23981_Sound Speed
- SOUNDVELOCITYPROFILEROKEANOSEXPLORER_23981_Sound Speed Time
- SBETSG45OKEANOSEXPLORER_23982_Temperature
- SBETSG45OKEANOSEXPLORER_23982_Temperature Time
- SBETSG45OKEANOSEXPLORER_23982_Practical Salinity
- SBETSG45OKEANOSEXPLORER_23982_Practical Salinity Time

Fields Populated by Individual Annotators

These fields are populated by individual annotators (users) and are ideally done so in accordance with the timeline described in the “Completed Dive” section. Biological annotations are connected to the [World Register of Marine Species \(WoRMS\)](#) database. Geological

annotations are connected to the simplified [Coastal and Marine Ecological Classification Standard \(CMECS\)](#) (see **Appendix C**).

- To Be Reviewed
- Comment
- Taxonomy
- Taxon
- Taxon Common Names
- Taxon Path
- Taxonomy Attributes
- Biota
- Kingdom
- Subkingdom
- Infrakingdom
- Phylum
- Subphylum
- Infraphylum
- Parvphylum
- Division
- Subdivision
- Infradivision
- Parvdivision
- Gigaclass
- Megaclass
- Superclass
- Class
- Subclass
- Infraclass
- Subterclass
- Superorder
- Order
- Suborder
- Infraorder
- Parvorder
- Section
- Subsection
- Superfamily
- Epifamily

- Family
- Subfamily
- Supertribe
- Tribe
- Subtribe
- Genus
- Subgenus
- Species
- Subspecies
- Natio
- Variety
- Subvariety
- Forma
- Subforma
- Mutatio
- Component
- Subcomponent
- Water Column Layer
- Hydroform Class
- Hydroform
- Hydroform Type
- Salinity
- Temperature
- Biogeochemical Feature
- Substrate Origin
- Substrate Class
- Substrate Subclass
- Substrate Group
- Substrate Subgroup
- Unclassified
- Physiographic Setting
- Tectonic Setting
- Geoform Origin
- Geoform
- Geoform Type

Appendix B: Vocabularies

Since there are no standard or authorized vocabularies for archaeology, education, and video quality, NOAA Ocean Exploration established the vocabularies below.

NOAA Ocean Exploration uses the [World Register of Marine Species \(WoRMS\)](#) for taxonomy and the [Coastal and Marine Ecological Classification Standard \(CMECS\)](#) for geology and substrates (see their websites for more information about their vocabularies).

Maritime Heritage

Aircraft-Specific Features

- Fuselage
- Wing
- Vertical Stabilizer
- Horizontal Stabilizer
- Rudder
- Flaps
- Aileron
- Engine
- Nacelle
- Propeller
- Landing Gear
- Ordinance
- Armament
- Small Material Culture

Shipwreck-Specific Features

- Bow
- Stern
- Anchor
- Windlass
- Winch
- Chain
- Propeller
- Transom
- Midships
- Bridge

Conning Tower
Armament
Battery
Ordinance
Boiler
Engine
Hull Planking
Ceiling Planking
Frame
Fastener
Knee
Deck Beam
Davit
Lifeboat
Rigging
Keel
Rudder
Foremast
Mainmast
Mizzen Mast
Bowsprit
Sail
Smokestack
Snorkel
Foredeck
Aft Deck
Hatch
Gangway
Hallway
Staircase
Ladder
Name/Hull Number
Running Lights
Navigation Equipment
Communications Equipment
Helm
Wheel
Cargo

Small Material Culture

Chain Plate

Bottle

Plate

Cup

Brick

Stove

Sheathing

Copper Sheathing

Hawse Pipe

Site Condition

Wrecking Event

- Salvage Damage
- Collision Damage
- War Damage
- Fire Damage
- Scuttle

Natural Transforms

- Seabed Scour
- Substrate Type (from CMECS)
 - Sand
 - Silt
 - Clay
 - Mud
 - Gravel
 - Pebble
 - Cobble
 - Boulder
- Seabed Embedding

Post-Sinking Anthropogenic Features

Marine Debris

Fishing Gear/Line

Trawl/Dredge

Buoys/Floats With Line

Education

Biology

Adaptation
Bacterial Mats
Biodiversity
Bioluminescence
Brine Pool
Camouflage
Chemosynthesis
Cold Seep
Corals
Fisheries (Commercially Valuable)
Organism
Predation (Food Chain)
Succession
Symbiosis

Engineering/Technology

ROV Feature (Engineering Feature)
Sampling Interesting Feature or Organism
Seafloor Mapping

Geology

Hotspot (Archipelago)
Hydrothermal Vent
Lava Flow
Manganese Nodules
Minerals
Mud Volcano
Seamount

Human Impacts/Conservation

CO₂ (Climate Change)
Damage
Marine Debris

Maritime History

Shipwreck

People

Physical/Chemical

Currents

Methane Hydrate

Methane Seep

Plume

Precipitates

Video Quality

Audio

Video Down

Video Pixelated

Video Wrong Route

Appendix C: Simplified CMECS Taxonomy

The table below contains the simplified [Coastal and Marine Ecological Classification Standard \(CMECS\)](#) taxonomy for geology and substrates developed by NOAA’s National Centers for Coastal Ocean Science’s deep-sea coral ecology lab to ease real-time substrate annotation during dives. The full CMECS document has detailed descriptions and references and figures (some noted in the table) for the terms listed below, when applicable. It is accessible through the NOAA Institutional Repository along with a searchable database.

CMECS Geoform	Definition
Authigenic Carbonate Outcrops	These outcrops result from the slow seepage of fluid containing dissolved carbon. They form pavements, chimneys, and rings, donuts, or slabs (Stakes et al. 1999).
Basin	General term for an area of the seafloor or land surface that lies below the surrounding bottom or terrain elevation. They are normally areas of low relief.
Boulder Field	An area dominated by large, boulder-sized (256-4,096 mm) stones or pieces of rock. These can occur below cliffs or at the foot of steep slopes or canyons, where they are the result of depositional processes. These fields can also occur as the result of currents that have removed the finer sediments.
Flat	A general term for a level (or nearly level) surface or area of land marked by little or no relief; flats are often composed of unconsolidated sediments (such as mud or sand). These forms are more commonly encountered in the intertidal or in the shallow subtidal zones (see Figure 6.2).
Hole/Pit	A generally more steep-sided indentation or depression that is lower than the surrounding surface formed through a variety of processes.
Ledge	Bedding planes that are exposed (either on the surface or at depth) often form ledges that have a high-habitat value and support colonizing plants and animals. Ledges often provide a more level surface than the bounding slopes. Ledges in the intertidal zone can form shelves or projections of rock (that are much longer than they are wide) on a rock wall or cliff face. They are formed along a coast by differential wave action on softer rocks and may be eroded by biological and chemical weathering.
Megaclast	Substrate where individual rocks—with particle sizes greater than or equal to 4.0 m (4,096 mm) in any dimension—cover 50% or more of the geologic substrate surface. (Note: Technically a substrate subclass rather than a geoform, but so large that it’s used here as a geoform level 2.
Megaripples	Large, sand waves or ripple-like features having wavelengths greater than 1 m or a ripple height greater than 10 cm; Megaripples are formed in a subaqueous environment, and they are also known as subaqueous dunes. They may be superimposed with smaller bedforms (Bates and Jackson 1984).

CMECS Geoform	Definition
Mound	A low, rounded, natural hill of unspecified origin, which is generally less than 3 m high and composed of earthy material.
Mud Volcano	An accumulation (usually conical in shape) of mud and rock formed by volcanic gases; may also refer to a similar accumulation formed by escaping petroliferous gases (Bates and Jackson 1984) (see Figure 6.3).
Outcrop/Rock Outcrop	An area where bedrock is exposed at the earth's surface.
Pinnacle	A steep-sided, often isolated peak that can occur at depth or reach close to the surface. They are often important aggregation points for fish and other marine life.
Plateau	A mound-like or ridge-like elevated area on the seafloor; it may have a modest-to-substantial extent. Although submerged, this feature can reach close to sea level (e.g., Bahama Banks).
Ridge	A long, narrow elevation, usually sharp crested with steep sides. Larger ridges can form an extended upland between valleys.
Scarp/Wall	A relatively straight, cliff-like face or slope of considerable linear extent, which breaks up the general continuity of the land by separating surfaces lying at different levels (as along the margin of a plateau or mesa). The term wall can be applied to steep or vertical areas on the seaward or exposed side of a reef. Although hard corals may be present, walls in this setting are formed by geologic processes and are not the result of reef-building activities by corals. A wall may be vertical or terraced, and is often referred to as the "drop-off."
Seamount	An elevation of the seafloor, which is 1,000 m or higher. Seamounts may be discrete, arranged in a linear or random grouping, or connected at their bases and aligned along a ridge or rise.
Shelf Valley	A valley crossing the continental shelf, often forming an extension of an existing terrestrial river and terminating in a canyon as the valley reaches the shelf break. Shelf valleys were formed during periods of lower sea level, and continental, glacial melt water contributed to their genesis.
Slope	An inclined area of ground or substrate with a change in depth or elevation between its upper and lower limits. Slopes occur at all scales and can refer to broad areas of inclined topography to the flanks of small mounds or depressions in the earth's surface.
Submarine Bank	An elevated area above the surrounding seafloor that rises near the surface. Banks generally are low-relief features, of modest-to-substantial extent, that normally remain submerged. They may have a variety of shapes and may show signs of erosion resulting from exposure during periods of lower sea level. Banks tend to occur on the continental shelf. Banks differ from shoals in having greater size and temporal persistence. The geoform bank differs from the coral reef zone modifier bank based on its geologic origin.
Submarine Canyon	A general term for all linear, steep-sided valleys on the seafloor. These canyons can be associated with terrestrial or nearshore river inputs, such as in the Hudson or Mississippi canyons.

CMECS Geoform	Definition
Submarine Slide Deposit	This form includes a wide variety of mass-movement landforms and processes involving the down-slope transport (under gravitational influence) of soil and rock material en masse. Rubble field is a geoforms that could occur within (or as a result of) landslides.
Terrace	Any long, narrow, relatively level or gently inclined surface, generally less broad than a plain, but broader than a ledge and bounded along one edge by a steeper descending slope and along the other by a steeper ascending slope. Terraces may border a valley floor or shoreline, and they can represent the former position of a flood plain, lake, or sea shore. Terraces may be created by erosion, wave action, uplift, currents, or any other process.
Wreck	Any of a variety of man-made structures (such as sunken ships or collapsed drilling rigs) that have fallen to the seafloor. They may be either completely or partially submerged. Wrecks often provide valuable habitat for attaching organisms or fish, but they may also leach contaminants into the environment.