

# **A Groundtruthing Method for Sea Floor Mapping**

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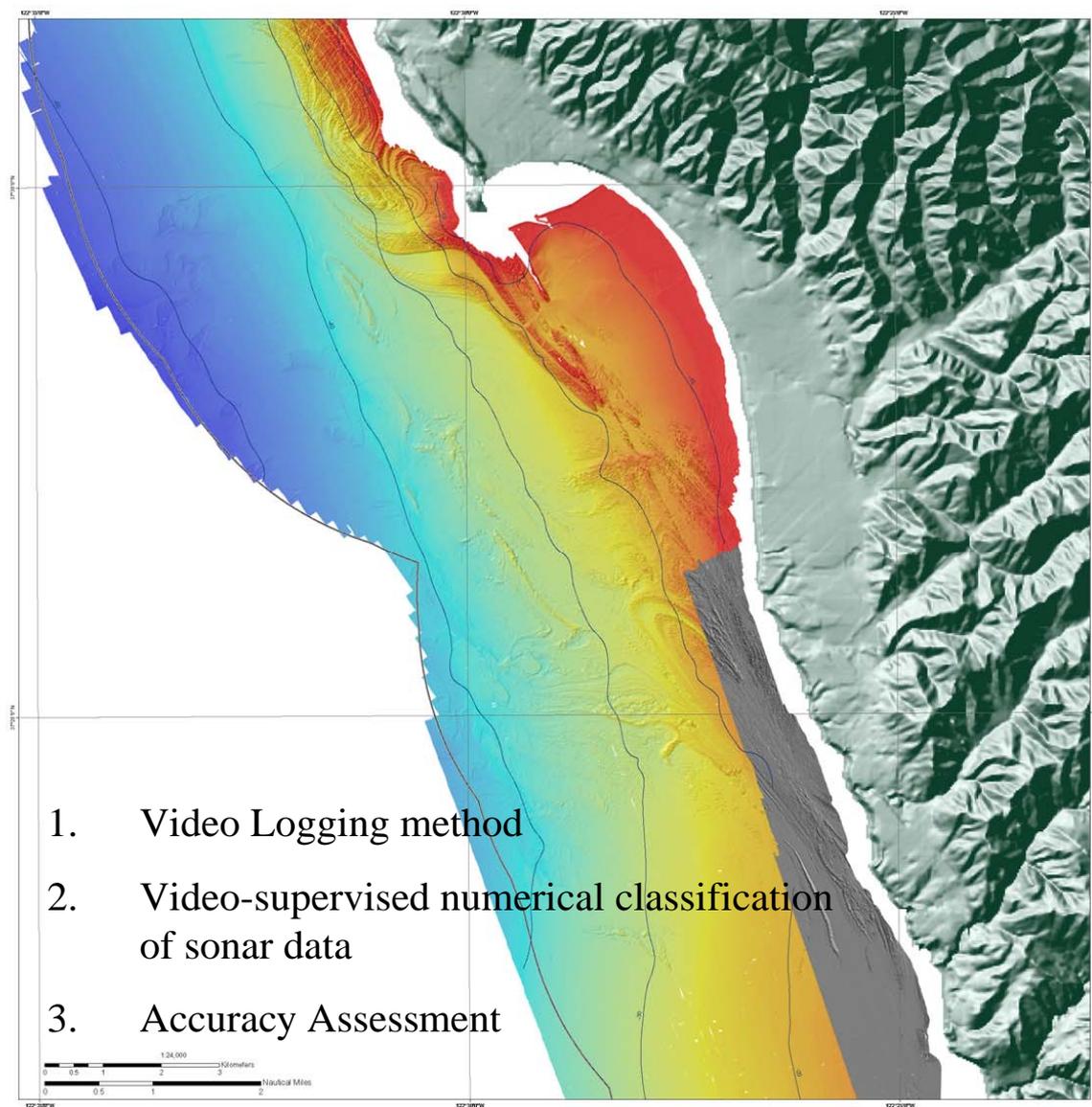
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1. Video Logging method
2. Video-supervised numerical classification of sonar data
3. Accuracy Assessment

Central California Mapping Project  
Half Moon Bay Sheet  
**DRAFT**



**Map Information**

Datum - WGS 1984  
 Projection - UTM Zone 10

3-mile limit  
 10 m depth contours (generalized)

**Depth (2m Digital Elevation Model)**

Minimum: 2 meters  
 Maximum: 55 meters

**Seafloor surface model colored by depth**

Fine-scale seafloor geomorphology is revealed in shaded relief and colored by depth in this digital elevation model (DEM) created from multibeam sonar bathymetry data gridded at 2 m horizontal resolution.

NOTE: Areas of the seafloor for which depth grids and backscatter images are available are shown with color-coded depth values. For the area with a gray-scale hillshaded usage, only contours are available.



## California MLPA Minimum Benthic Habitat Classes

### Seafloor Habitats

- Rocky reefs
- Intertidal zones
- Sandy or soft ocean bottoms
- Underwater pinnacles
- Submarine canyons

### Depth Zones

- Intertidal
- Intertidal to 30m
- 30 to 100m
- 100 to 200m
- 200m and deeper

## Video Observations

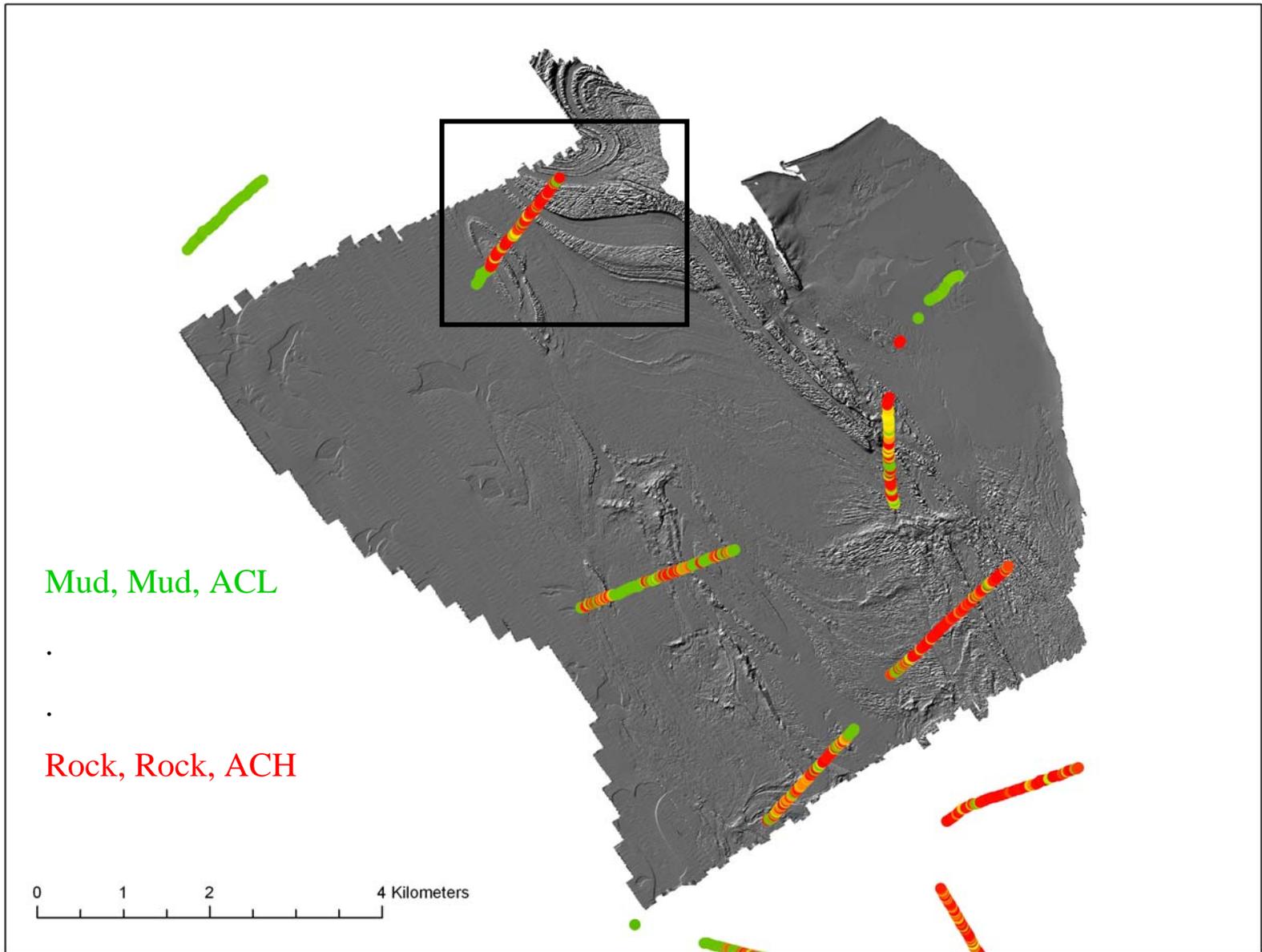


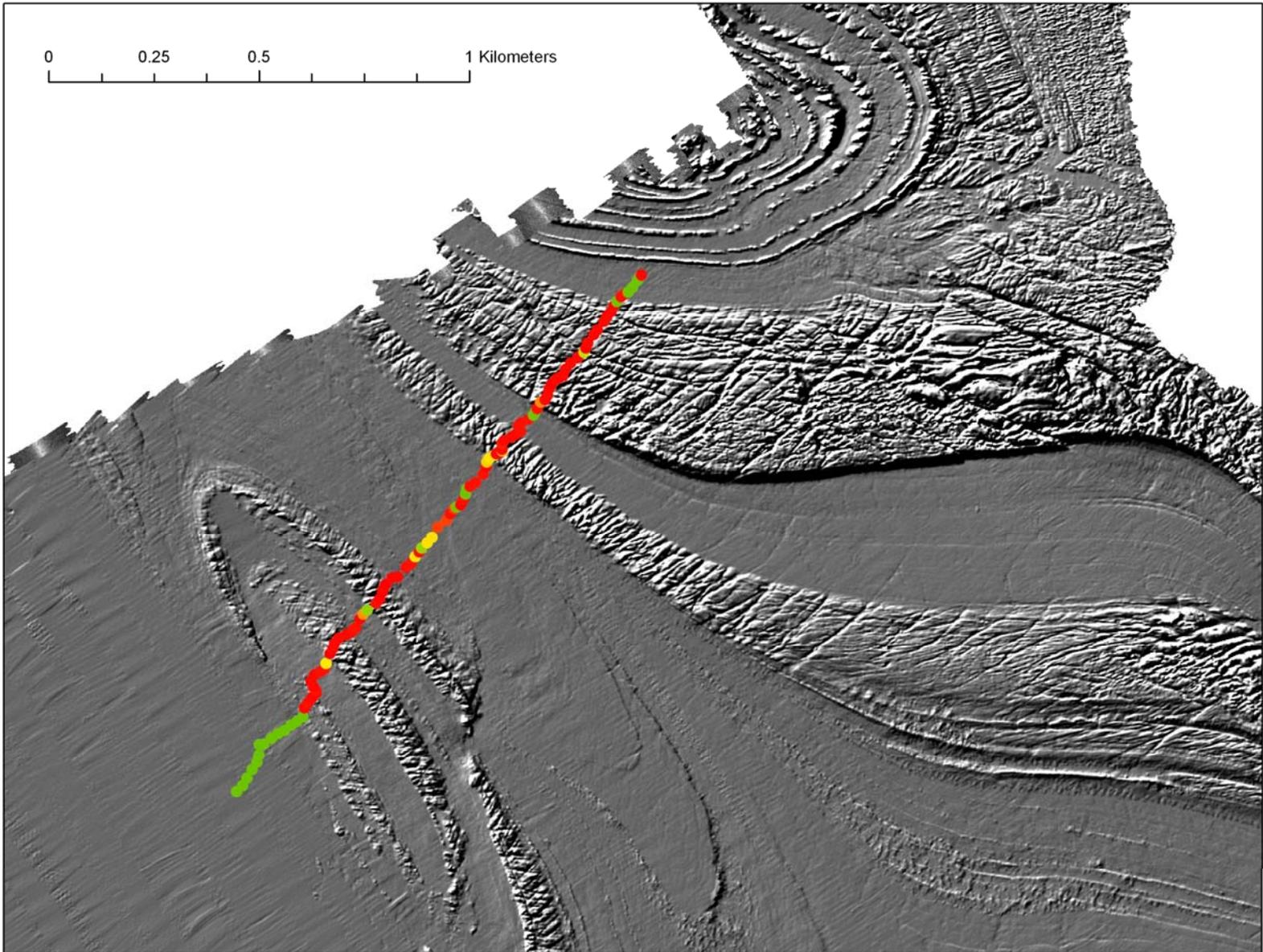
----- observations for 10 sec windows at 1 min intervals -----

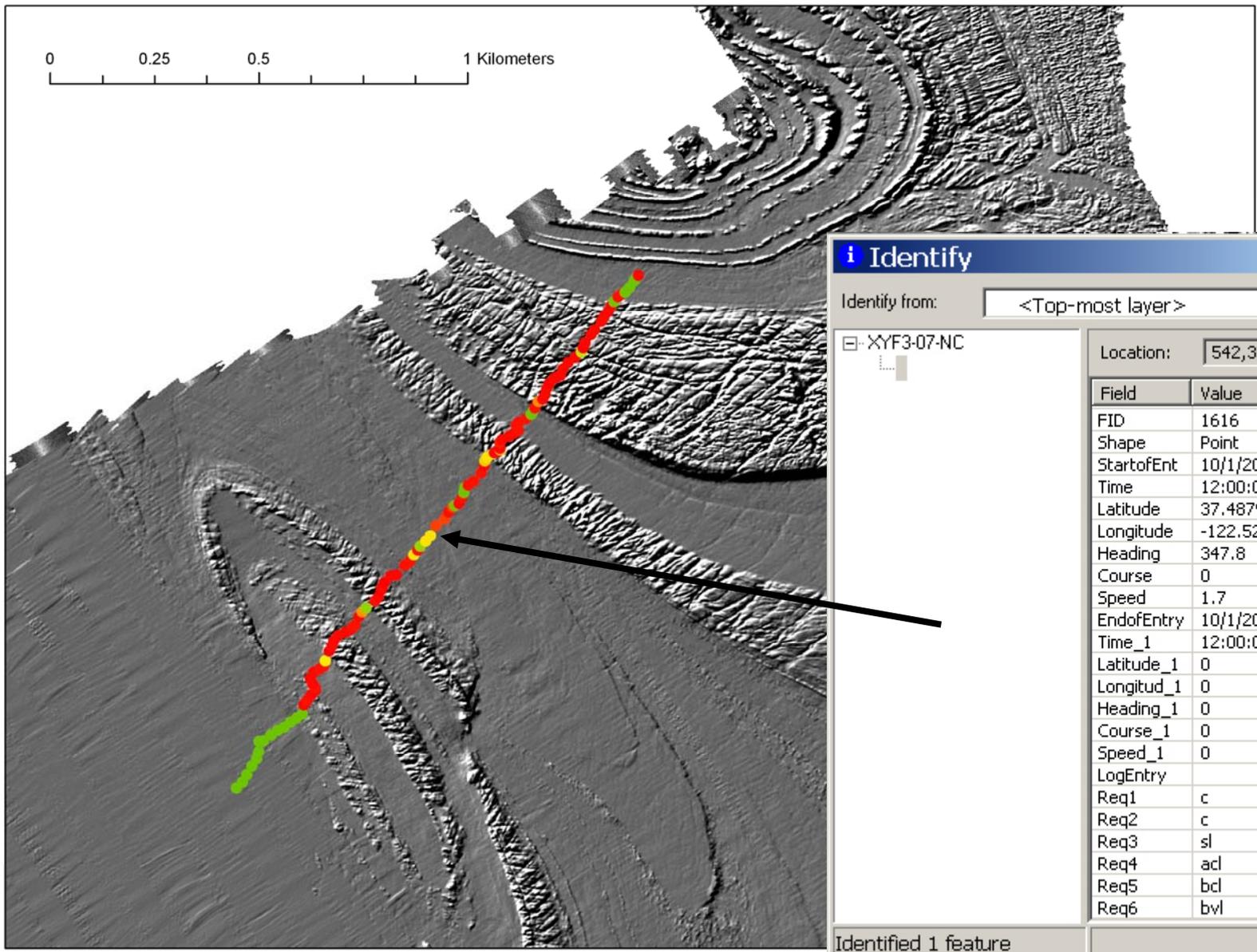
- Primary/Secondary Substrate (>50%, >20%)
  - mud, sand, gravel, cobble, boulder, rock
- Slope
  - Flat 0-1° ... steeply sloping 30-60°
- Abiotic and Biotic Complexity
  - Low, moderate, high
- Biocoverage
  - Low, moderate, high

----- entered when observed during 10 sec window -----

- Macro-Microhabitat
  - Joints, crevices...
  - Scour, ripples...
  - Algae, gorgonians, sponges...
  - Tubes, tracks, holes...
- Key species
  - Flatfish, rockfish, other fish...







**Identify** [?] [X]

Identify from: <Top-most layer>

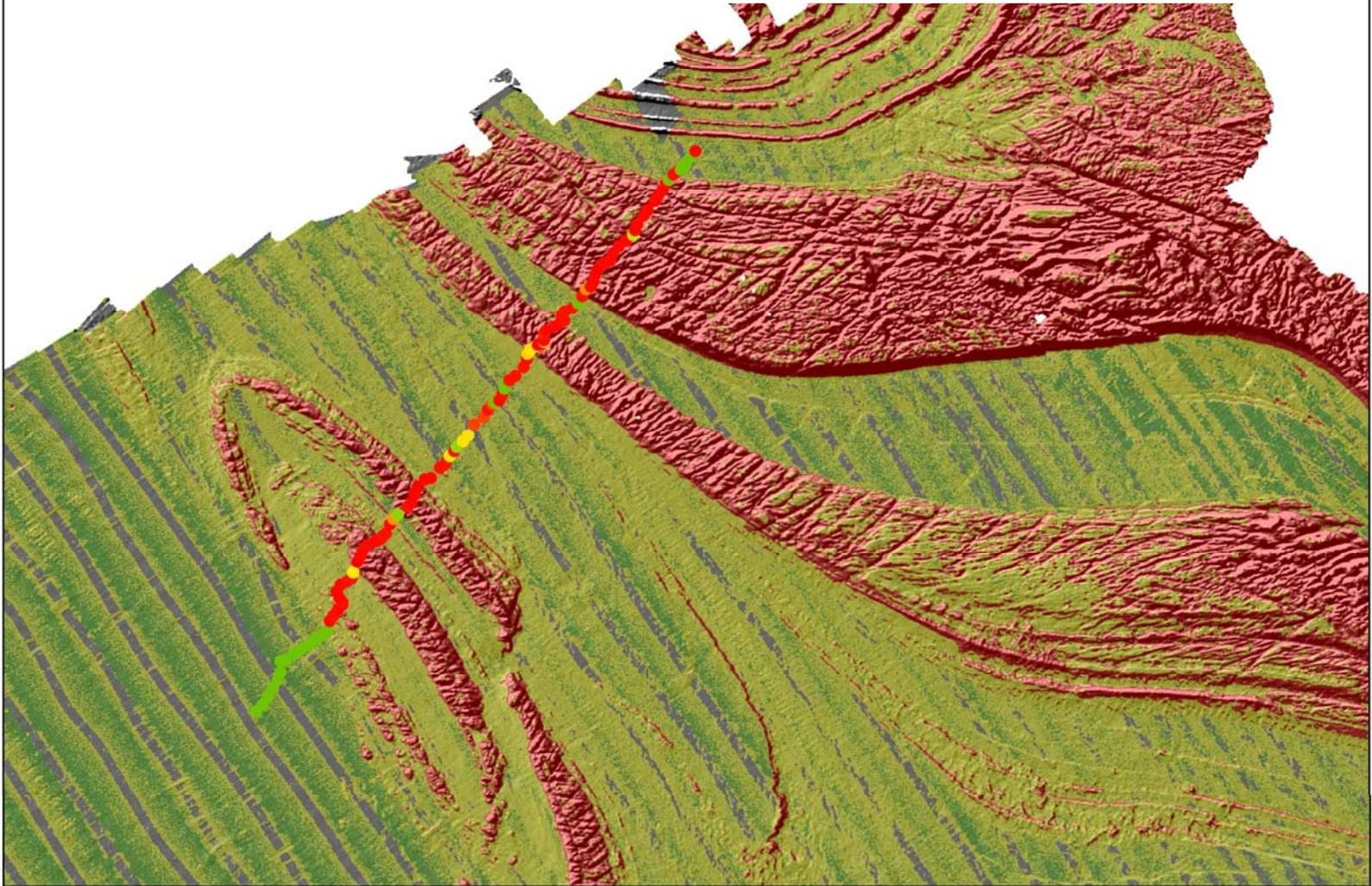
XYF3-07-NC

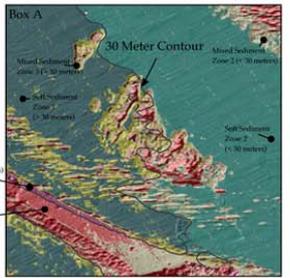
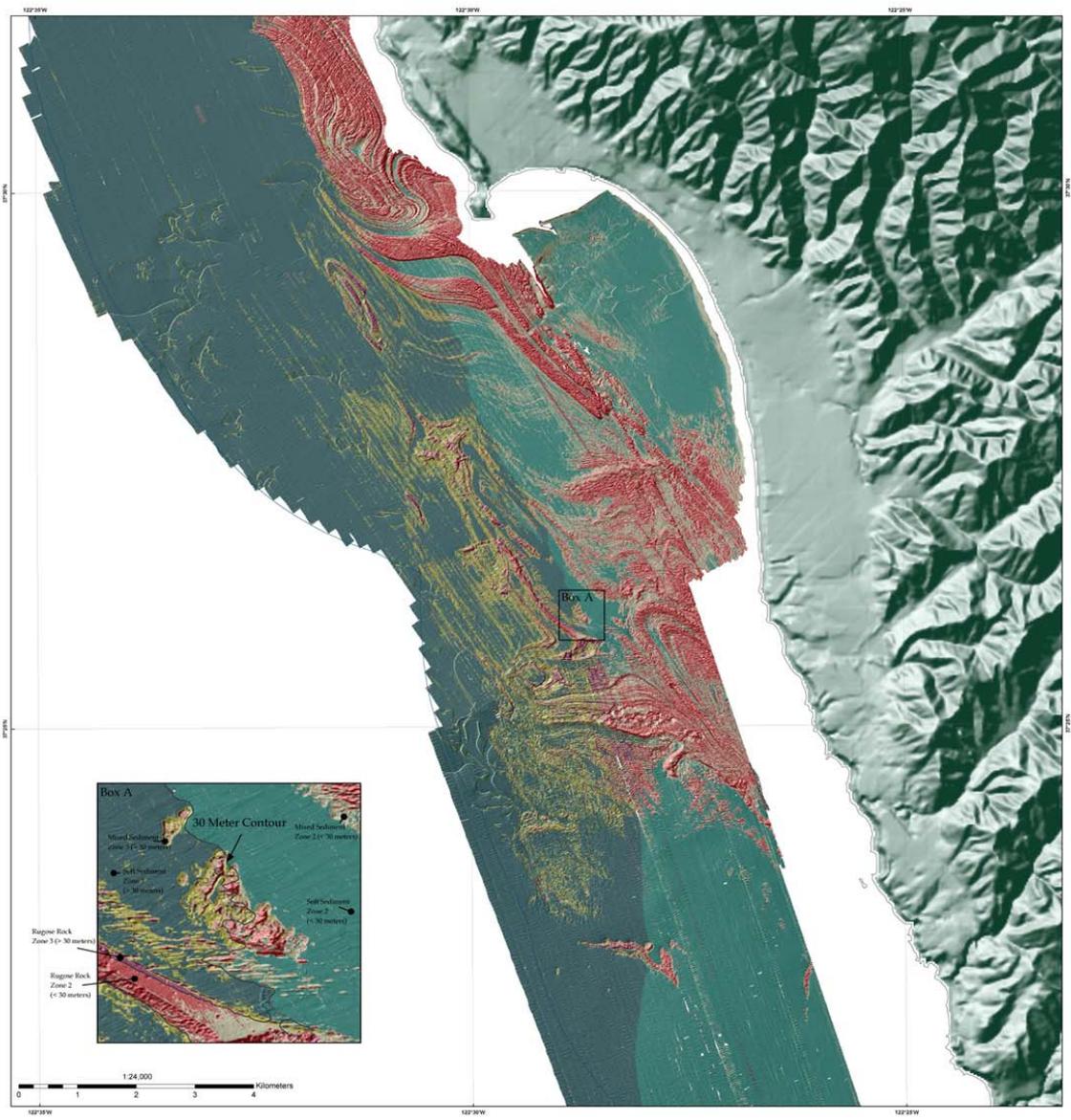
Location: 542,326.611 4,1

Field	Value
FID	1616
Shape	Point
StartofEnt	10/1/2007
Time	12:00:00 AM
Latitude	37.487952
Longitude	-122.521276
Heading	347.8
Course	0
Speed	1.7
EndofEntry	10/1/2007
Time_1	12:00:00 AM
Latitude_1	0
Longitude_1	0
Heading_1	0
Course_1	0
Speed_1	0
LogEntry	
Req1	c
Req2	c
Req3	sl
Req4	acl
Req5	bcl
Req6	bvl

Identified 1 feature

mud/mud – sand/sand & low complexity = 1 (soft/low cmplx)  
sand/gravel – cobble/boulder & low-med complexity = 2 (mixed/moderate)  
boulder/boulder – rock/rock & med-high complexity = 3 (hard/high)





### Map Information

Datum - WGS 1984  
Projection - UTM Zone 10

3-mile limit

### Seafloor Character Map

Zone 2 - shoreline to 30 meters water depth	Zone 3 - 30 meters to 100 meters water depth
Soft Sediment	Soft Sediment
Mixed Sand, Gravel and Rock	Mixed Sand, Gravel and Rock
Rugose Rock	Rugose Rock

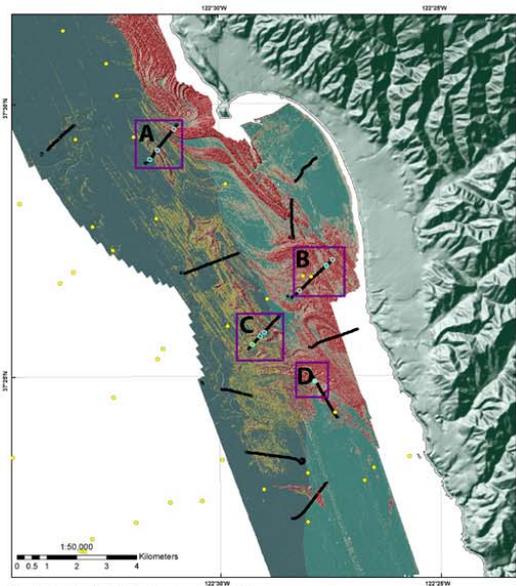
The seafloor character map was produced using video-supervised maximum likelihood classification of the bathymetry and intensity of return signals from sonar systems. A summary of the video data collected for the purpose of supervising the classification is shown on Plate Sheet #2. Classification parameters (frequency, intensity variability (homogeneity) and entropy) and backscatter intensity were used as variants in the classification. The substrate classes have been divided into the California Marine Life Protection Act depth zones required in this area. Zone 2 is subdivided to 20 meters and 1 (20 to 100 meters). This interpretation is depicted over shaded relief bathymetry shown on Plate Sheet #2.

Soft sediment, mixed deposits composed of sand and mud, comprises 71% of the region, or 124 sq km. Soft sediments in depth zone 2 and 74 sq km in zone 3. Mixed sand, gravel and rock, which includes typically forms a thin veneer over bedrock, comprises 16% of the area mapped, or 23 sq km. 13 sq km in zone 2 and 10 sq km in zone 3. Rugose corals, rugose rock comprises the 13%, or 20 sq km of the region. 18 sq km in zone 2 and 4 sq km in zone 3.

Class	Zone	Area (sq km)	Percent of Zone	Percent of Area
Soft sediment	Zone 2	74	100	21
Mixed sand, gravel and rock	Zone 2	16	23	9
Rugose rock	Zone 2	13	30	13
Soft sediment	Zone 3	74	100	21
Mixed sand, gravel and rock	Zone 3	9	12	4
Rugose rock	Zone 3	4	5	2

NOTE: Regions lacking one of the component datasets could not be classified. Those regions are shown in either white, for regions which were rock classified due to lack of bathymetry data, or grey for regions which were not classified due to lack of backscatter data.





Seafloor Character map shows Moon Bay about 17° showing the location of various seafloor character areas used to define and ground truth the classification. Location of the detailed photographs (A through D) and subsurface sediment sample locations (yellow circles) are also shown.

**A**

Detailed Seafloor Character Map of the Moon Bay area. The exposed bedrock which crops out from the sea floor provides ideal conditions for the various fish and birds that reside in the region nearby. See Table Sheet 17 for a more detailed look at the bathymetry and water dimensions of the region.

1. Seafloor character 12 meters water depth. From the bathymetric character of the rock, seafloor depth, complexity, and species richness.

2. Seafloor character 18 meters water depth. From the bathymetric character of the rock, seafloor depth, complexity, and species richness.

**B**

Detailed Seafloor Character map of a section of the San Geronimo Peak, see Table Sheet 18. The bathymetry is a major asset in this location, with most of the bathymetric data of the bathymetry. For a perspective view of the bathymetry, see Figure 6 of Table Sheet 17.

1. Seafloor character 12 meters water depth. From the bathymetric character of the rock, seafloor depth, complexity, and species richness.

2. Seafloor character 18 meters water depth. From the bathymetric character of the rock, seafloor depth, complexity, and species richness.

**C**

Seafloor Character map showing a complex region of bedrock seafloor with interesting natural areas and deep ground sediments.

1. Seafloor character 12 meters water depth. From the bathymetric character of the rock, seafloor depth, complexity, and species richness.

2. Seafloor character 18 meters water depth. From the bathymetric character of the rock, seafloor depth, complexity, and species richness.

3. Mixed rubble and sand 18 meters water depth. From a flat sea, surrounding seagrass and coral beds and surrounding sea floor from the surface. From the bathymetric character of the rock, seafloor depth, complexity, and species richness.

4. Soft sediment 12 meters water depth. From the bathymetric character of the rock, seafloor depth, complexity, and species richness.

**D**

Detailed Seafloor Character map north of Moon Bay.

1. Seafloor character 12 meters water depth. From the bathymetric character of the rock, seafloor depth, complexity, and species richness.

2. Seafloor character 18 meters water depth. From the bathymetric character of the rock, seafloor depth, complexity, and species richness.

3. Mixed rubble and sand 18 meters water depth. From a flat sea, surrounding seagrass and coral beds and surrounding sea floor from the surface. From the bathymetric character of the rock, seafloor depth, complexity, and species richness.

### Central California Mapping Project Half Moon Bay Sheet

**DRAFT**

September 2007

### Map Information

North  
W E S

Scale: 1:50,000  
Datum - WGS 1984  
Projection - UTM Zone 10

#### Ground truthing data locations for Seafloor Character Map

- usSEABED Sample Locations
- Soft Sediment < 30 m
- Mixed Sand, Gravel and Rock < 30 m
- Rugose Rock > 30 m
- Soft Sediment > 30 m
- Mixed Sand, Gravel and Rock > 30 m
- Rugose Rock > 30 m

During late September, 2007, the authors took a 1000-ton survey boat behind the NOAA ship R/V Talisman to track the location of collection seafloor depth values and more than 100 high quality still photographs in an effort to both define and confirm ground truthing locations for the Seafloor Character map (Table Sheet 17) of the study area. Current seafloor character data is based on the ground truthing data. The ground truthing data is a combination of 11 seafloor habitat, 12 ground truthing, non-ground truthing, and 13 well documented data points. All data were collected from observations of more than 120 percent ground truthing and habitat analysis were recorded approximately every 100 meters using ground truthing. All ground truthing data points are identified in the table below.

Seafloor character data from 100 samples in the usSEABED database. Locations are shown as yellow dots on the upper left panels and will be used to further refine the classification maps.

Complexity: In the context of marine habitat management, habitat habitat complexity can be defined into sub-level and basic categories. The term refers to the visual identification of local structural and structural characteristics that provide potential refuge for both juvenile and adult species.

Visual habitat: Includes coarse sand, gravel, silt/clay, and rubble with rock exposures smaller than 2 meters, confined to visually and morphological characteristics of seafloor habitat.

Soft sediment: Includes muds to very fine sands and muds (silt and clay size particles), unconfined visually, and sample data of characteristics of sediment types.

## Accuracy Assessment with usSEABED Samples

usSEABED	No. of Samples	Classified Substrate Grid		
		Agree	Disagree	Accuracy
Hard and Mixed	8	7	1	0.88
Soft	137	101	36	0.74
Total	145	108	37	0.74

## Accuracy Assessment with Video Observations Points

- Translate substrate-complexity combinations into numerical classes

mud/mud – sand/sand & low complexity = 1 (soft/flat)

sand/gravel – cobble/boulder & low-moderate complexity = 2 (mixed)

boulder/boulder – rock/rock & moderate-high complexity = 3 (hard)

linear correlation of 172 observation points to 1 meter classified grid      0.24

- Rectifying differences in navigation accuracy between sonar data and video points
  - Better tracking
  - Block averaging the interpretation:

linear correlation after 20 meter block averaging      0.31

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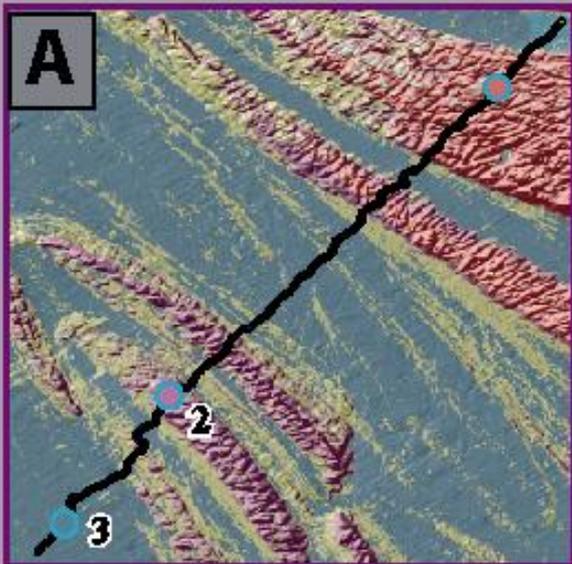
Thank You

831-427-4754

[walrus.wr.usgs.gov/nearshorehab](http://walrus.wr.usgs.gov/nearshorehab)



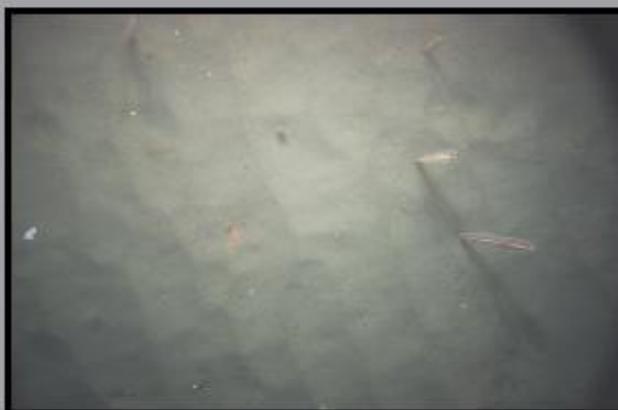




Detailed Seafloor Character Map of the Maurericks area. The exposed bedrock which crops out from the seafloor provides relief and contributes to the generation of waves that make the region notable. See Folio Sheet #5 for a more detailed look at the bathymetry and wave dynamics of the region.



1. Rugged bedrock (25 meters water depth). Note the fractured character of the rock, moderate abiotic complexity, and sparse biotic cover. Note also the alga, brittle star, and ophiuroid.



3. Unconsolidated fine to medium sand (39 meters water depth). Note the degraded low-frequency directional oscillatory ripple pattern, erect pebbles, and absence of open burrows.



2. Rugged bedrock (34 meters water depth). Note the thin sediment veneer, scattered shell debris, low abiotic complexity and star starfish.