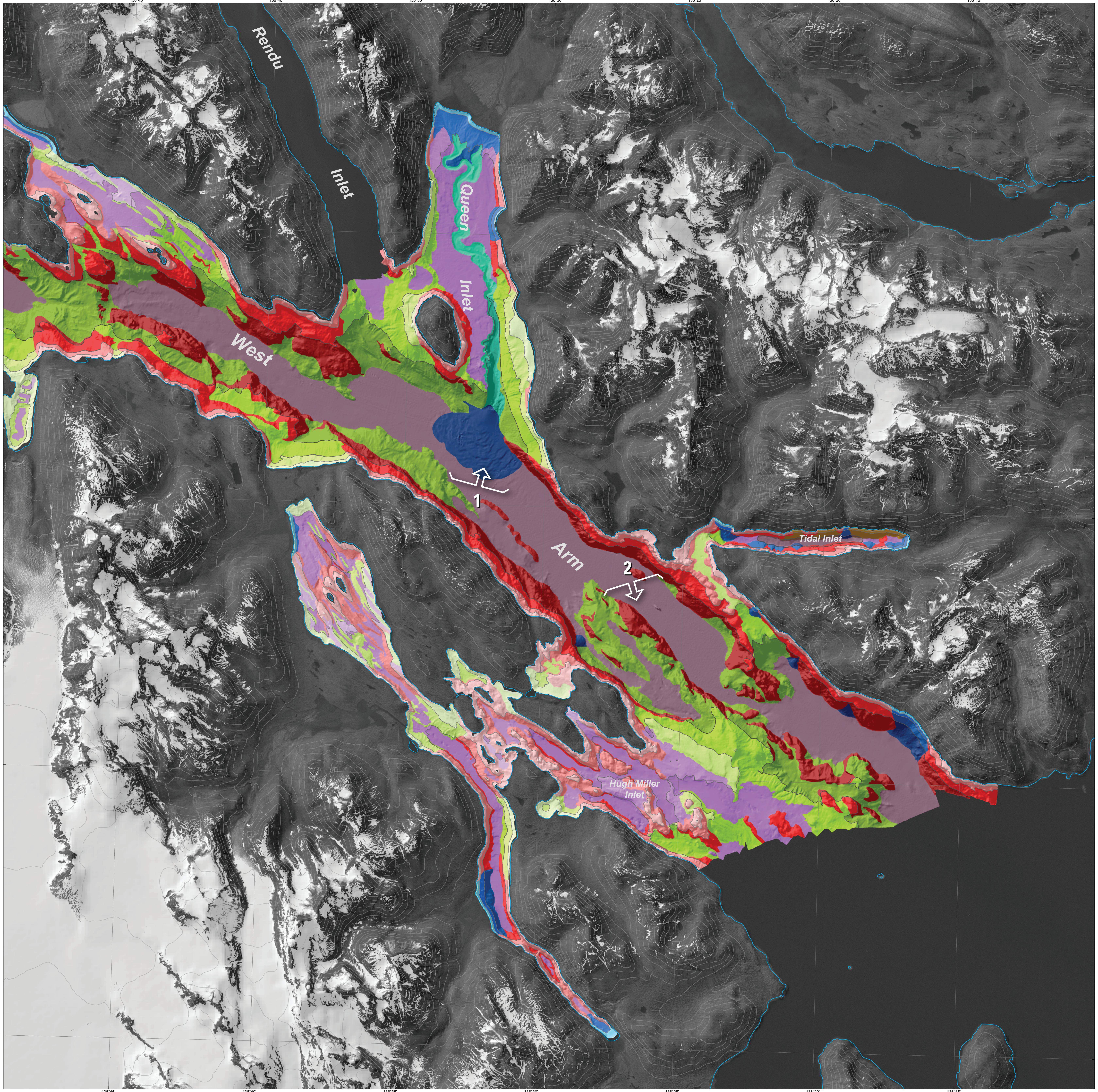
U.S. Department of the Interior
U.S. Geological Survey



LIST OF MAP UNITS

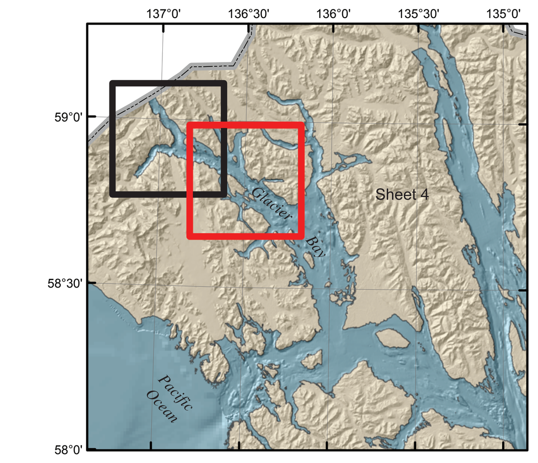
SHALLOW INFRALITTORAL: 0 m–5 m water depth
- Delta or fan
- Floor
- Moraine
- Wall

DEEP INFRALITTORAL: 5 m–30 m water depth
- Delta or fan
- Floor
- Moraine
- Rock outcrop or wall
- Slump

CIRCALITTORAL: 30 m–80 m water depth
- Delta or fan
- Floor
- Moraine
- Rock outcrop or wall
- Slump

CIRCALITTORAL (OFFSHORE): 80 m–200 m water depth
- Channel
- Delta or fan
- Floor
- Moraine
- Rock outcrop or wall
- Slump

MESOBENTHIC: 200 m–1,000 m water depth
- Channel
- Delta or fan
- Floor
- Moraine
- Rock outcrop or wall
- Slump



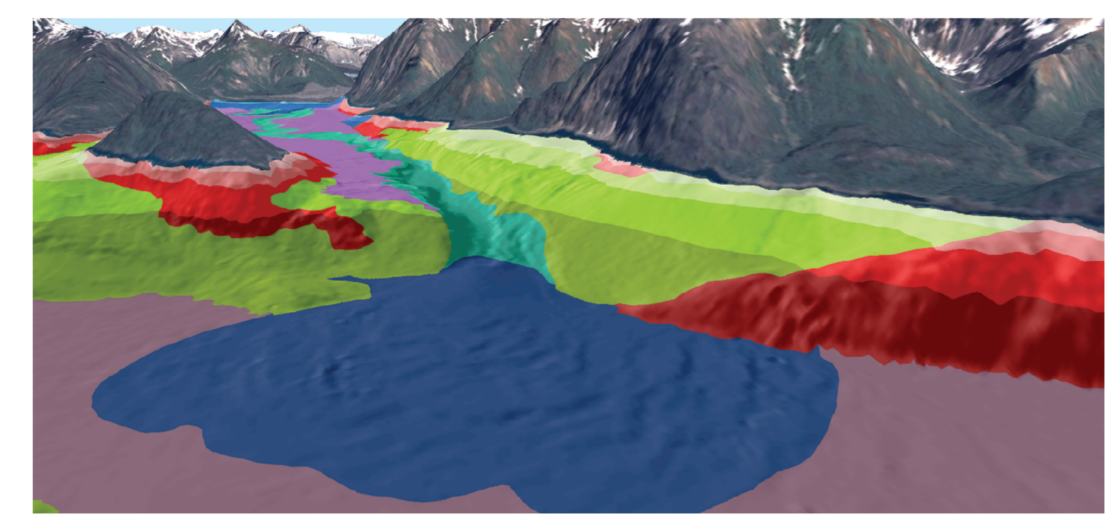
Location map showing CMECS geoform component maps of lower West Arm (this map, red) and upper West Arm (sheet 4, black), Glacier Bay National Park and Preserve, Alaska.

Discussion

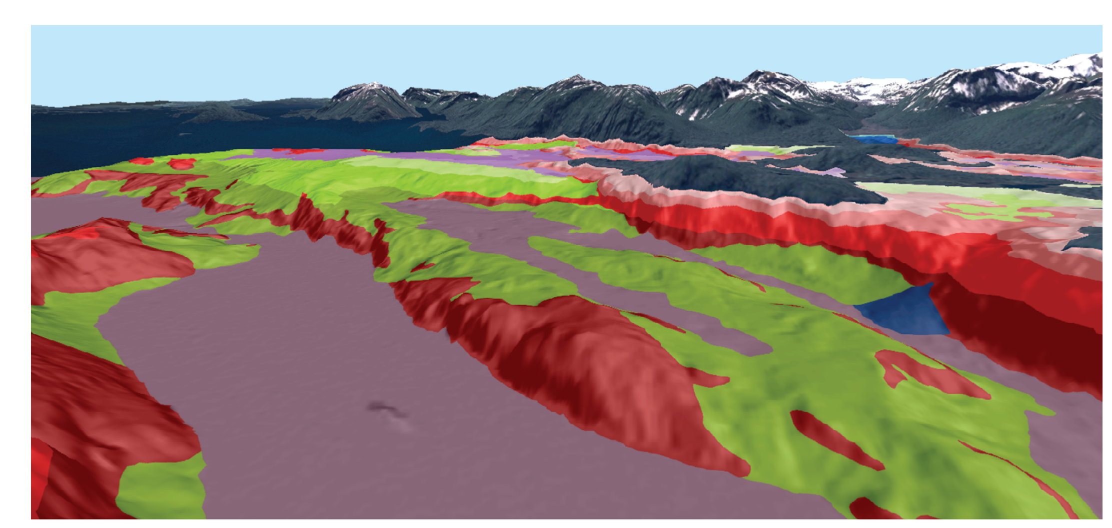
This map shows the primary morphologic features within West Arm, Glacier Bay National Park & Preserve, Alaska. The Coastal and Marine Ecological Classification Standard (CMECS, Madden and others, 2009) by the National Oceanic and Atmospheric Administration (NOAA) and NatureServe was used to classify various submarine landforms. Geoforms were manually selected from the multibeam bathymetry with the aid of video observations, seismic reflection profiles, bottom grab descriptions, knowledge of glacimarine processes, well-documented glacial history in the West Arm, and interpretations from other studies (for example, Cai, 1994).

Units displayed on this map represent the geoform component of the CMECS classification draped over the shaded-relief multibeam bathymetry. Geoforms shape the seascape and provide structure and channel energy, regulate bioenergetics, and control transfer rates of energy, material, and organisms (Madden and others, 2009). Geoforms are defined based on spatial scales ranging from megageoform (largest) to microgeoform (smallest). All units depicted in this map are mesogeoform scale, as they range in size from tens of meters to kilometers. All geoforms displayed are part of the megageoforms of continental margin and fjord. Smaller-scale landforms within the mesogeoform scale exist within the map units, including channel, slump, rock outcrop, and fan. Each geoform is divided into its respective CMECS benthic depth zone: shallow infralittoral (0–5 m), deep infralittoral (5–30 m), circalittoral (30–80 m), circalittoral (offshore) (80–200 m), and mesobenthic (200–1,000 m). Bathymetric contours represent the divisions between these depth zones. As water depth increases, the shade of color for each geoform darkens.

Deltas depicted are both fluvial and fully glacifluvial in origin and most are at least partially fed by glacial meltwater runoff. Morainal forms include kame terraces, morainal banks, push moraines, and complexes composed of multiple superimposed features, which formed in contact with and proximal to the terminus. Lithologically heterogenous, morainal banks are composed of poorly sorted sand and gravel, weakly stratified to massive diamicton, and stratified sand and mud. Seismic reflection profiles indicate that many of the prominent morainal banks within the West Arm are cored by bedrock and are therefore sills (Cai, 1994). Relict moraines are typically draped in distal mud, except where high-energy processes disrupt hemiplegic sedimentation, as in the tidally winnowed shallows of Hugh Miller Inlet. Similarly, rock outcrop and wall classes imply that the underlying morphology of the feature is bedrock controlled; however, owing to the large influx of glacially-sourced mud, even steeply-sloping bedrock features may have an extensive mud drape. (See the accompanying pamphlet for a more detailed discussion of substrate relations for each geoform.)



View 1. Perspective view looking north over the submarine fan at the mouth of Queen Inlet, a large hanging valley that intersects the mainstem of the West Arm. Owing to the high influx of sediment from nearby Carroll Glacier (visible in the background), Queen Inlet is one of the most dynamic environments in the lower West Arm, with a mean sediment accumulation rate of roughly 0.3 m/yr. The Queen Inlet Fan (foreground) is fed by a 10-km-long submarine channel, incised into the Holocene fill on the fjord floor (Carlson and others, 1989). Sediment is transported to the fan by way of turbidity currents, originating along the unstable slopes of the fjord head delta and by slumps and mudflows derived from unconsolidated sediment deposited on the steep walls of the inlet. The ripple-like structures visible on the surface of the fan are interpreted as compressional ridges, resulting from plastic deformation. Queen Inlet was formerly occupied by Carroll Glacier, which retreated to the head of the Inlet by the late 1800s. The submarine fan is believed to have begun forming shortly afterwards, associated with the growth of the Queen Inlet delta (Carlson and others, 1999). Vertical exaggeration in the perspective view, X1.5.



View 2. Perspective view looking south over the entrance to the West Arm and Hugh Miller Inlet. Seismic-reflection profiles indicate that this relatively shallow area sits atop bedrock and preglacial sediment (Cai, 1994). The extent of the mapped region roughly corresponds with the 1860 position of the terminus. Water depths here are the greatest in Glacier Bay, with many parts of the floor over 400 m below sea level. Consequently, the terminus occupied this position briefly during the 1860s as it rapidly retreated to the shallower inlets of the upper West Arm. Estimates of the rate of retreat through this interval are constrained by the 1879 position of the terminus, suggesting an average rate of retreat of 1.8 km/yr (Carlson and others, 1999). Cai (1994) identifies seven morainal banks deposited within this interval (one visible near the mouth of Tidal Inlet towards the left edge of the image), indicative of brief periods of quasi-stability punctuating the otherwise rapid retreat. Deglaciation of the shallower Hugh Miller Inlet appears to have occurred in a markedly different style. The morphology of this area indicates extensive down-wasting of relatively clean ice. During this interval, this branch of the Russell System would have maintained a relatively stable terminus, depositing the morainal complex visible at the mouth of Hugh Miller Inlet. Vertical exaggeration in the perspective view, X1.5.

Base from U.S. Geological Survey, National Elevation Dataset
NASA Landsat 7 Imagery, 1999
Universal Transverse Mercator Zone 8N Projection, WGS84

NOT INTENDED FOR NAVIGATIONAL USE

21°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2013

SCALE 1:50000
2 1 0 2 MILES
2000 0 2000 4000 6000 8000 10000 12000 14000 FEET
2 1 0 2 KILOMETERS

LAND CONTOUR INTERVAL 100 METERS
BATHYMETRIC CONTOURS: 30, 80, AND 200 METERS
SEA LEVEL, CYAN

ALASKA
MAP LOCATION

Seafloor geology mapped by T.O. Hodson, 2010. Based on multibeam sonar data collected in 2009 during NOAA NOS hydrographic surveys H12140, H12141, and H12142

GIS database and digital cartography by T.O. Hodson

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CMECS Geoform Component Map of Lower West Arm, Glacier Bay National Park and Preserve, Alaska

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Digital files available at http://pubs.usgs.gov/sim/3253/

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