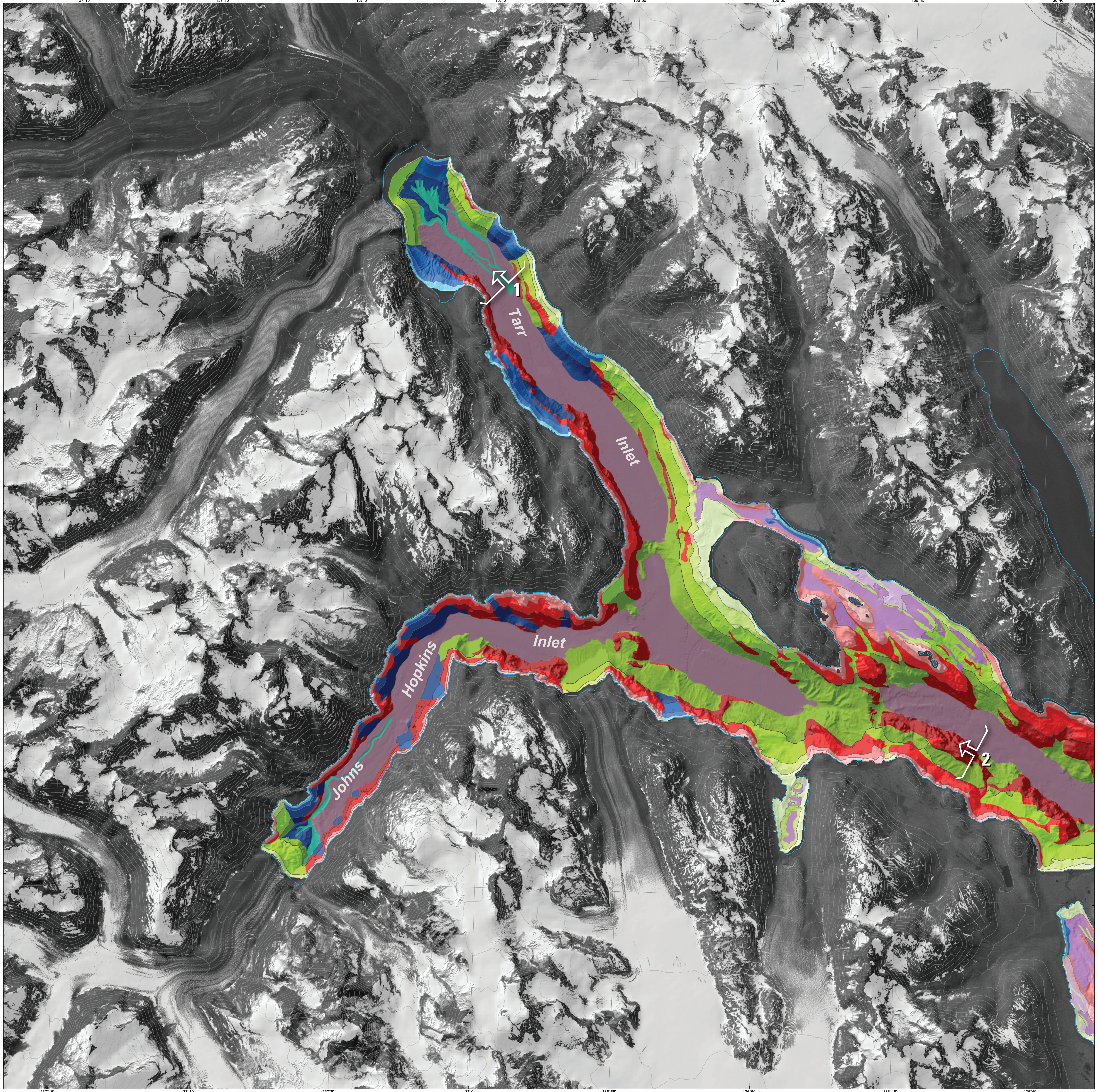
U.S. Department of the Interior
U.S. Geological Survey

Scientific Investigations Map 3253
Sheet 4 of 4
Pamphlet accompanies map



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

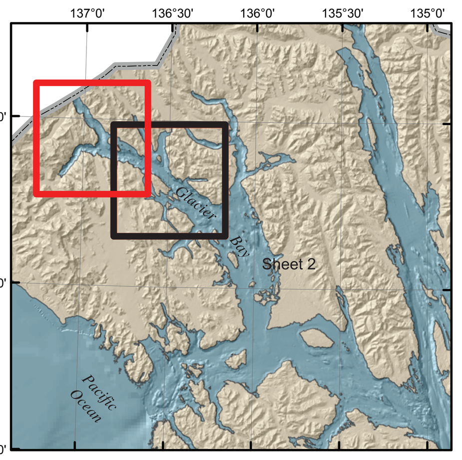
- Delta or fan
- Floor
- Moraine
- Rock outcrop or wall
- Slump

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



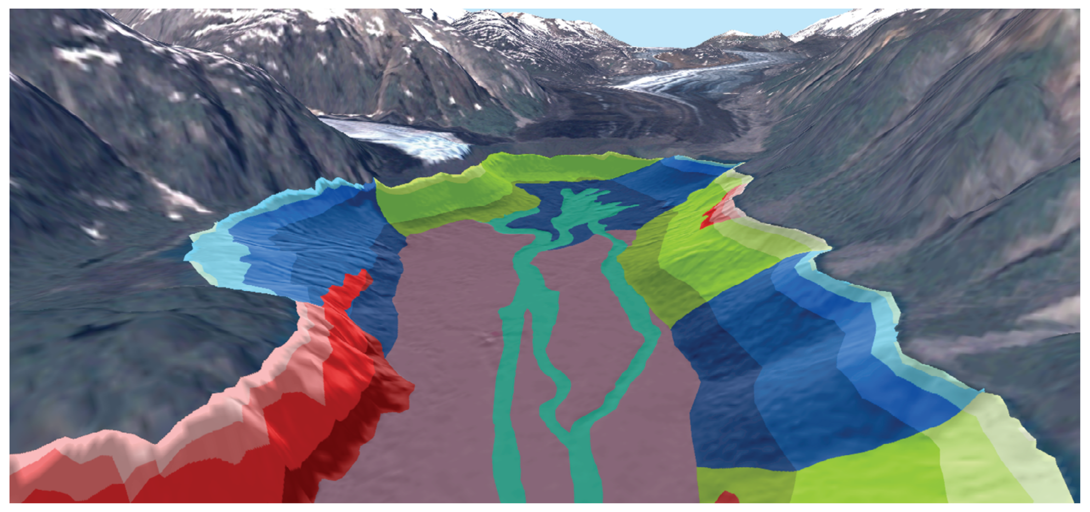
Location map showing CMECS geoform component maps of lower West Arm (sheet 2, black) and upper West Arm (this map, red), Glacier Bay National Park and Preserves, Alaska.

Discussion

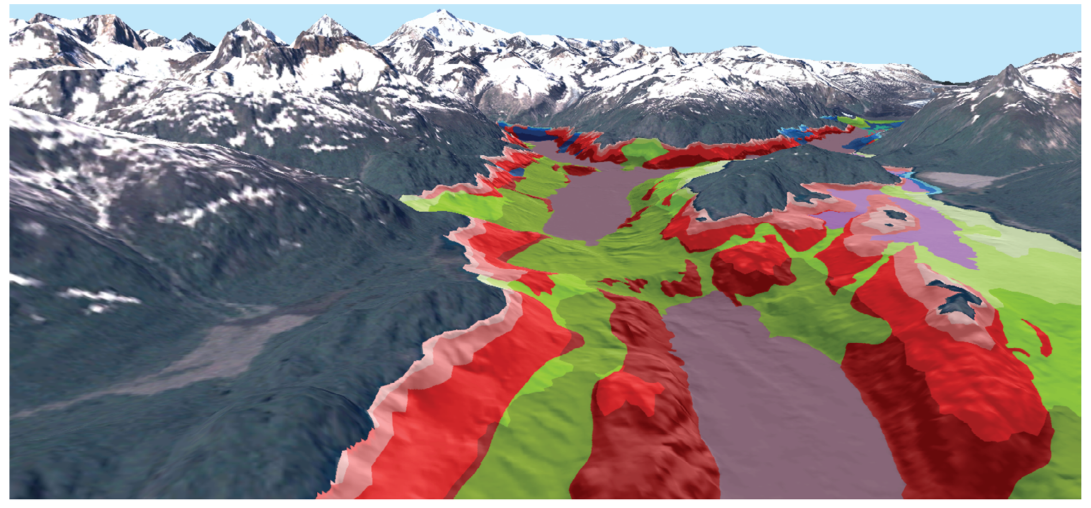
This map shows the primary morphologic features within West Arm, Glacier Bay National Park & Preserve, Alaska. The Coastal and Marine Ecological Classification Standard (CMECS, Madden and others, 2009) by the National Oceanic and Atmospheric Administration (NOAA) and NatureServe was used to classify 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 glaciofluvial 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 heterogeneous, 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 hemipelagic 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.)



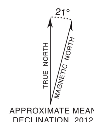
View 1. Perspective view looking north over the termini of Margerie and Grand Pacific Glaciers at the head of Tarr Inlet, one of the largest tributary inlets with active tidewater termini in Glacier Bay. Sediment accumulations rates in Tarr Inlet are some of the highest in the world, averaging more than 4 m/yr near the head of the fjord, and decreasing to about 0.2 m/yr at the mouth (this study). The bulk of sediment is delivered by the lateral meltwater streams that discharge along both sides of the two glaciers. The submarine channel that originates along the steep unconsolidated slopes of the fjord-head deltas and morainal banks, has been traced roughly 6km down Tarr Inlet (Cai and others, 1997). The Tarr basin has been infilling since the terminus retreated from the mouth of the inlet in the 1890s. Historically, sediment entering the basin has been confined by the relict morainal bank at the mouth of the inlet. The 2009 bathymetry indicates that this morainal bank may be approaching its capacity as a sediment trap, forcing excess sediment to bypass Tarr Inlet. At present, the bypassing sediment constitutes a small fraction of the total sediment entering Tarr; however as more efficient pathways evolve, a second depocenter may develop at the mouth of the inlet. Vertical exaggeration in the perspective view, X1.5.



View 2. Perspective view looking northwest over the morainal bank that divides the basins of the upper and lower West Arm. The head of Tarr Inlet and Jaw Point of Johns Hopkins Inlet are visible in the background. While the precise age of this morainal bank is unknown, observational evidence constrains the date of deposition to sometime between 1860 and 1879. Based on predicted retreat rates, the terminus probably occupied this position during the middle to late 1870s. Given the rapid retreat rates characterizing this interval, it is unlikely that the terminus persisted at this location for more than a few years. At present, this sill is the primary bathymetric barrier between the lower West and upper West Arm. The ridge-like structures across the up-fjord side may be annual push moraines, formed by the temporary wintertime advances of the terminus. Visible in the background are morainal and ice-contact deposits exposed near the mouths of Tarr and Johns Hopkins Inlets. These features are associated with a brief interval of quasi-stability, which occurred as the ice retreated from the main trunk of the West Arm. Following this interval, the termini in Tarr and Johns Hopkins Inlets have moved asynchronously to their modern positions. 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



APPROXIMATE MEAN DECLINATION, 2012

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

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 Upper 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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