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Open-File Report 2022-1085
Sheet 2 of 2

Base from General Bathymetric Chart of the Oceans gridded bathymetry data, 2021
Universal Transverse Mercator projection, zone 8N
World Geodetic System of 1984

Figure 1. Map showing the Queen Charlotte-Fairweather fault system in southeastern Alaska and western British Columbia.

An approximately 1,150-kilometer (km)-long transform boundary between the Pacific and North American plates stretches from Yakutat, Alaska, to the southern tip of the Haida Gwaii archipelago in British Columbia, Canada (fig. 1). In the north, the boundary is defined by the approximately 300-km-long onshore Fairweather fault, which steps offshore at Icy Point and becomes the Queen Charlotte fault for the remaining about 850 km southward along the continental shelf edge and slope, to the vicinity of the Queen Charlotte triple junction where the Pacific, North American, and Explorer tectonic plates meet. The fault system accommodates primarily right-lateral shear and has generated seven earthquakes with greater than magnitude (M) 7 during the past 100 years (Tréhu and others, 2015; Brothers and others, 2020). A M7.8 thrust event near Haida Gwaii in 2012 and a M7.5 strike-slip event west of Craig, Alaska, in 2013 highlighted the hazards associated with the fault system (Lay and others, 2013; Yue and others, 2013). Although the Queen Charlotte fault is one of the world's most seismically active strike-slip faults, its precise location and geomorphic expression along the seafloor has never been mapped using comprehensive, high-resolution marine geophysical approaches.

A bathymetric terrain model (fig. 2) was compiled from six different multibeam surveys of the previously unmapped Queen Charlotte fault offshore of southeastern Alaska and Haida Gwaii archipelago. The multibeam survey data were collected between 2005 and 2018 under a cooperative agreement between the U.S. Geological Survey, Natural Resources Canada, the Alaska Department of Fish and Game, and the National Oceanic and Atmospheric Administration. The terrain model that was generated from the multibeam data is published as a 30-meter resolution georeferenced tagged image file format (GeoTIFF) in Andrews and others (2022).

The seabed morphology is characterized by the following sets of features (fig. 3):

- numerous submarine canyons, gullies, channels and fan aprons that have been offset by horizontal motion on the Queen Charlotte fault;
- elongate pull-apart basins and pressure ridges associated with bends and jogs on the Queen Charlotte fault;
- submarine landslides, scarps, scars, and mass transport deposits; and
- broad sediment aprons located seaward of major shelf sea valleys (that is, trough-mouth fans) that expand across the continental slope and rise of the eastern Gulf of Alaska, delivering sediment to the Baranof Fan and Chirikof channel systems.

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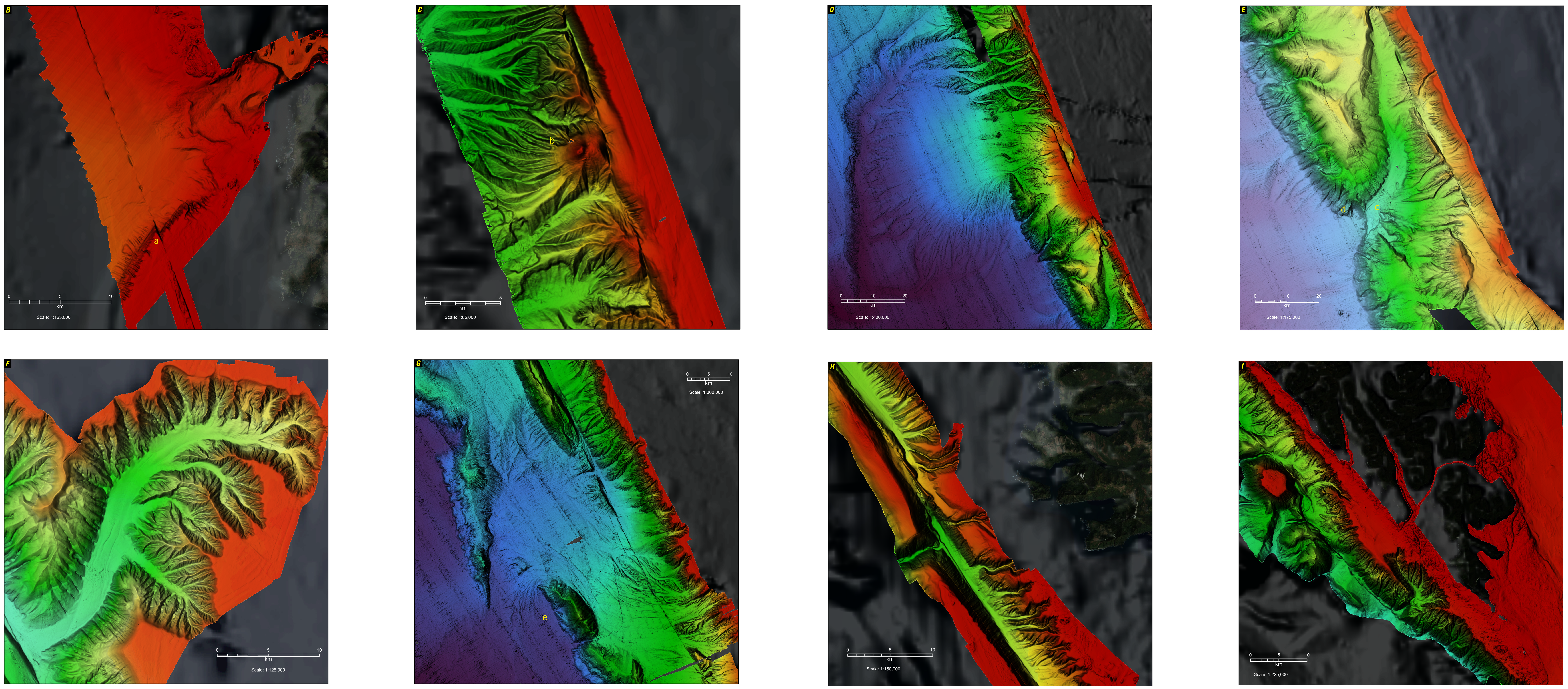

Figure 3. Two-dimensional (2D) perspective views of the Queen Charlotte fault system in southeastern Alaska and western British Columbia. A, Overview map rotated 62 degrees west from true north; the hillshaded bathymetry is vertically exaggerated three times. B, An approximately 900-meter (m) right-lateral offset at map point "a" along the southern margin of the Yakobi Sea Valley provides an estimate of cumulative fault movement since glacial ice receded from the valley; arcuate features at the mouth of Cross Sound are recessional moraines left behind as the ice sheet retreated into Icy Strait and Glacier Bay (Brothers and others, 2020). C, Incised gullies and canyons originating at the continental shelf-edge have been cut and translated by movement along the fault; a small volcanic cone at map point "b" is observed along the western edge of the fault (Prouty and others, 2020). D, Submarine canyons and slope gullies feed the Baranof fan and channel; during sea level lowstands, glacial sediments were transported through the Chatham Sea Valley and deposited onto the continental shelf-edge and slope (Brothers and others, 2019; 2020). E, Steep tectonically deformed topography along the lower slope is intersected by a submarine canyon, forming a knick-point at map point "c" and plunge pool at map point "d" by the erosive action of sediment flows. F, Noyes Canyon incises the continental shelf and takes a 90-degree northward turn as it meets the fault. G, Submarine fan lobes formed by sediment flows emanating from the Dixon Sea Valley during sea level lowstands; the fan surfaces have been offset by repeated movement along the fault (Brothers and others, 2020), and a series of steep elongate ridges at map point "e" have formed in response to tectonic deformation. H, Fault-parallel valleys to the west of Graham Island illustrate the influence of faulting on submarine canyon and gully evolution. I, Along-strike stepovers along the fault create complex deformation patterns and seafloor morphology seaward of Moresby Island; the fault steps around a series of knolls and ridges and cut across the mouth of Moresby Canyon. Location of study are shown on figure 1.

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Systematic Mapping of the Ocean-Continent Transform Plate Boundary of the Queen Charlotte Fault System, Southeastern Alaska and Western British Columbia—A Preliminary Bathymetric Terrain Model

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Map not intended for navigational use.

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