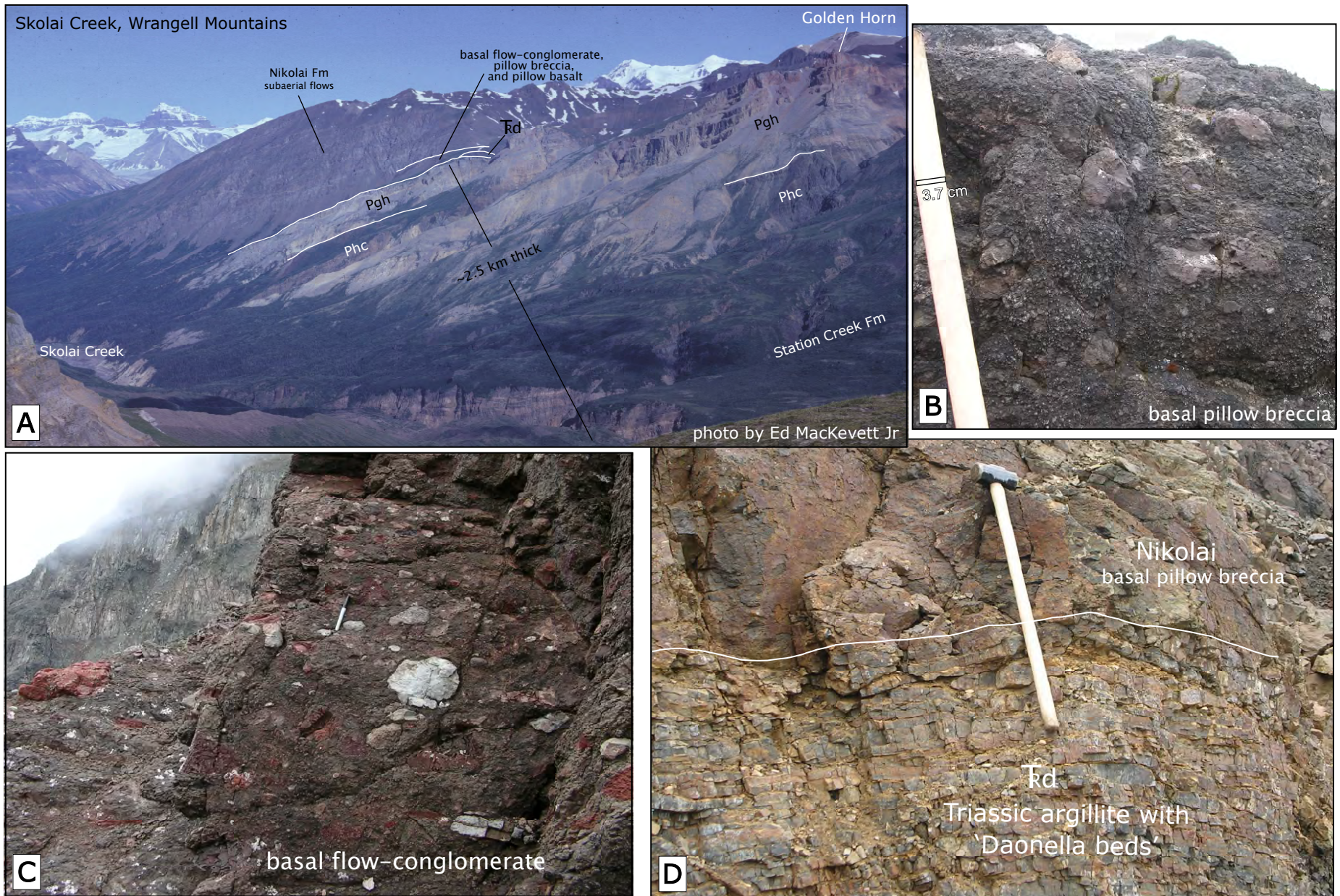
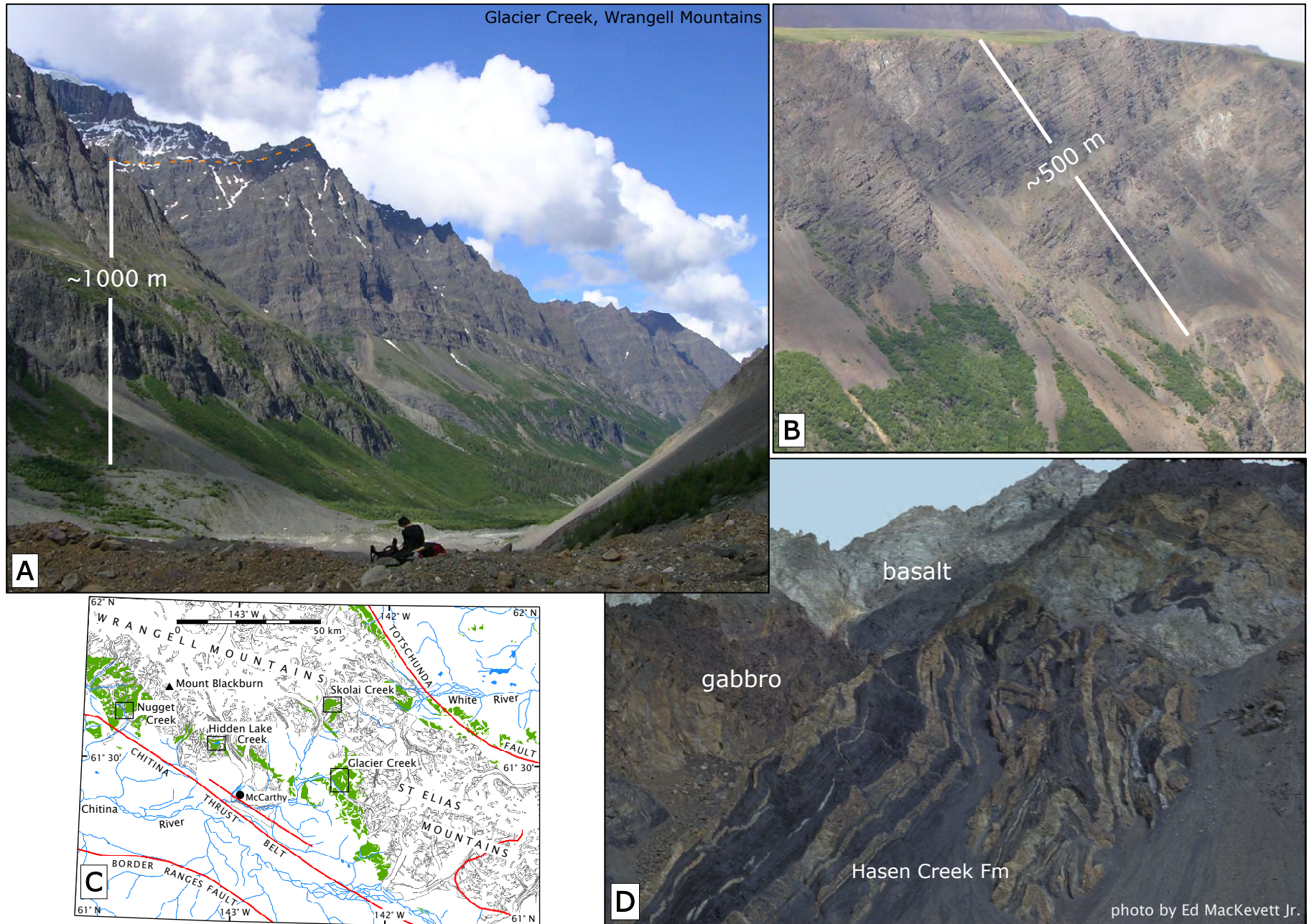


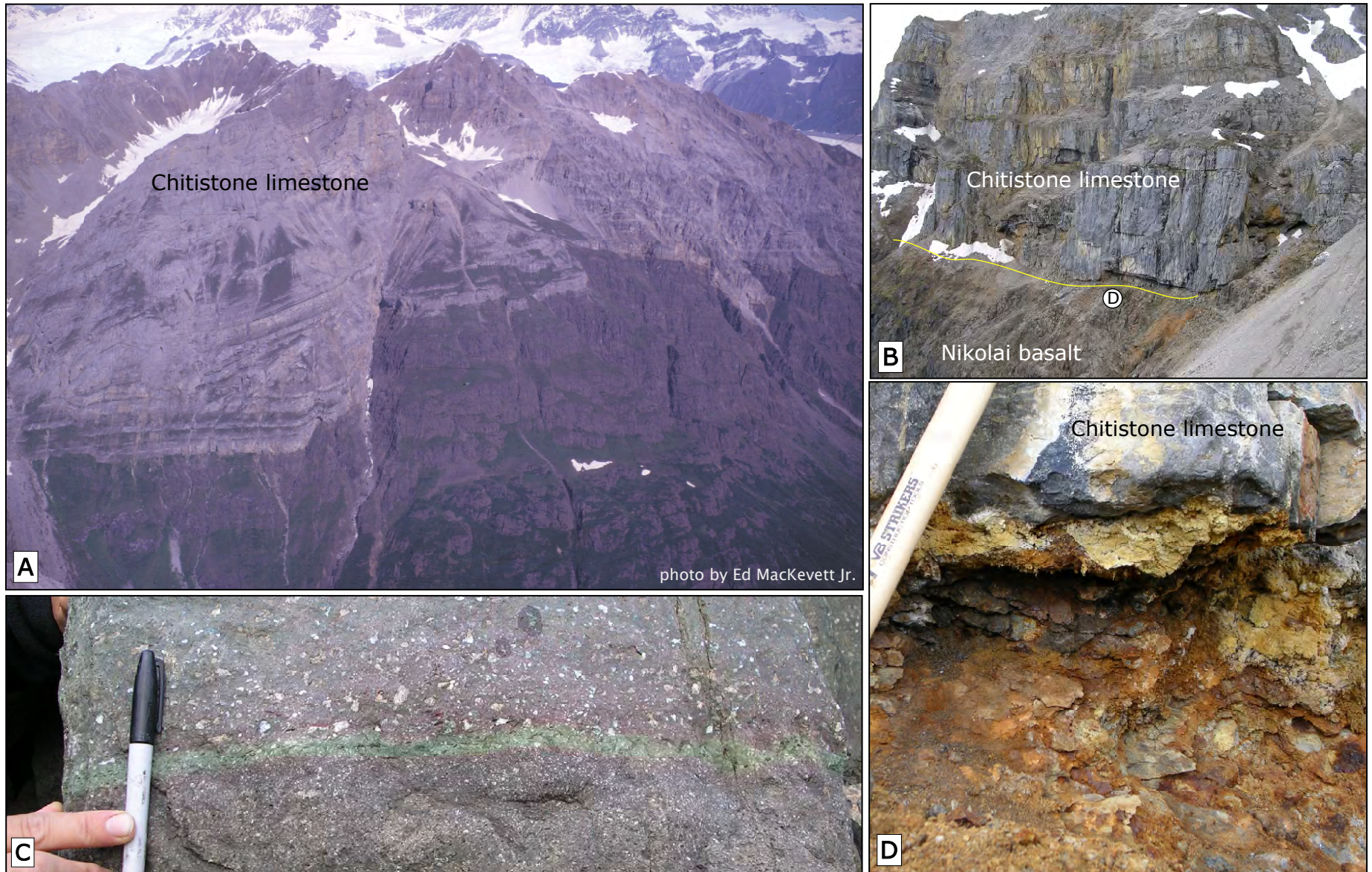
Supplementary figure 1. Photographs of base of Nikolai Formation in the Tangle Lakes area of the Amphitheater Mountains (location shown in Figure 3). (A) Sediment-sill complex and base of flood basalts on the west side of Lower Tangle Lake. Circled letters mark the location of the other photos. (B) Sills in the lower part of the submarine section. (C) Pillow basalt in the lowermost flow with fine-grained sediment filling spaces between pillows (marker for scale). (D) Carbonaceous non-fossiliferous black shale with parallel laminations overlain by mafic sill. (E) Lowermost flow directly overlying shale. (F) Thin-section scan of tuffaceous layers just below the base of sills in photograph B. (G) Photomicrograph of tuff from between sills, location indicated in photograph B.



Supplementary figure 2. Photographs of the base of Nikolai Formation north of Skolai Creek in Wrangell-St. Elias National Park. (A) Paleozoic arc rocks and marine sedimentary sequences underlying Nikolai basalts. Photograph by Ed MacKevett, Jr. (Phc, Hasen Creek Formation; Pgh, Golden Horn Limestone Lentil; TRd, Middle Triassic 'Daonella-beds'). (B) Basal pillow breccia just above Middle Triassic argillite and shale with *Daonella*. (C) Basal flow-conglomerate with rounded clasts of white limestone (<20 cm) derived from Golden Horn Limestone Lentil and red basalt (<40 cm) from Station Creek Formation. Marker (14 cm) for scale. (D) Argillite overlain by pillow breccia above the Golden Horn Limestone. Location of photographs B, C, and D are from just above area labelled TRd in photograph A.



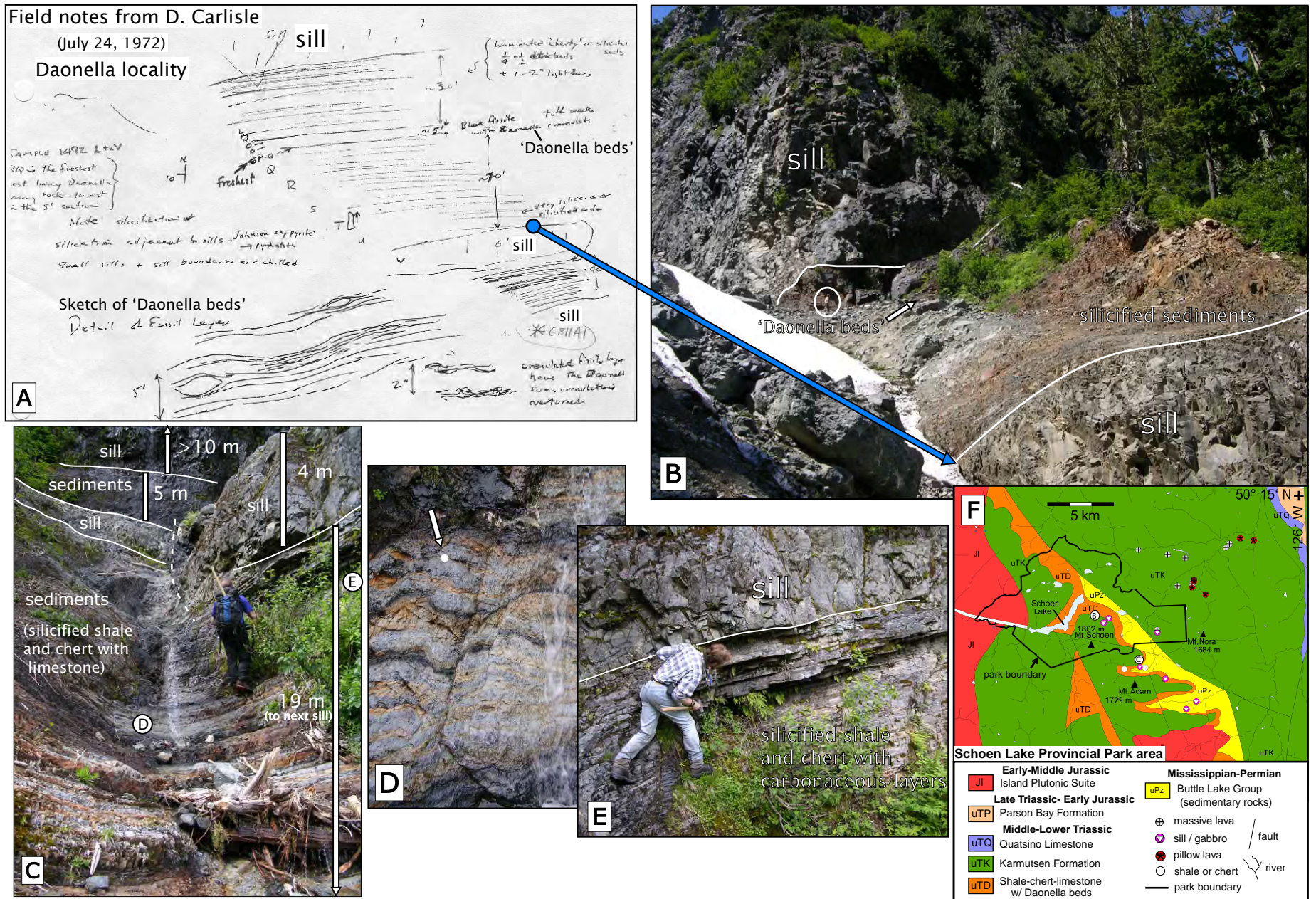
Supplementary figure 3. Photographs of flood basalts in the Glacier Creek area in Wrangell-St. Elias National Park and map of the southern part of the Wrangell Mountains. (A) Photograph of ~1000 m of subaerial basalt flows overlain by Chitistone Limestone (dashed orange line indicates the contact). Flows appear as a layer-cake stratigraphy but may vary in thickness and locally appear to terminate. (B) Photograph of ~500 m of thin and thick basalt flows. (C) Simplified map showing the distribution of the Nikolai Formation (green) in the Wrangell Mountains, derived from Wilson et al. (2005). The four areas of field study are outlined with labeled boxes. (D) Photograph of Hasen Creek Formation intruded and deformed by gabbroic rocks related to the Nikolai Formation. Photograph by Ed MacKevett, Jr.



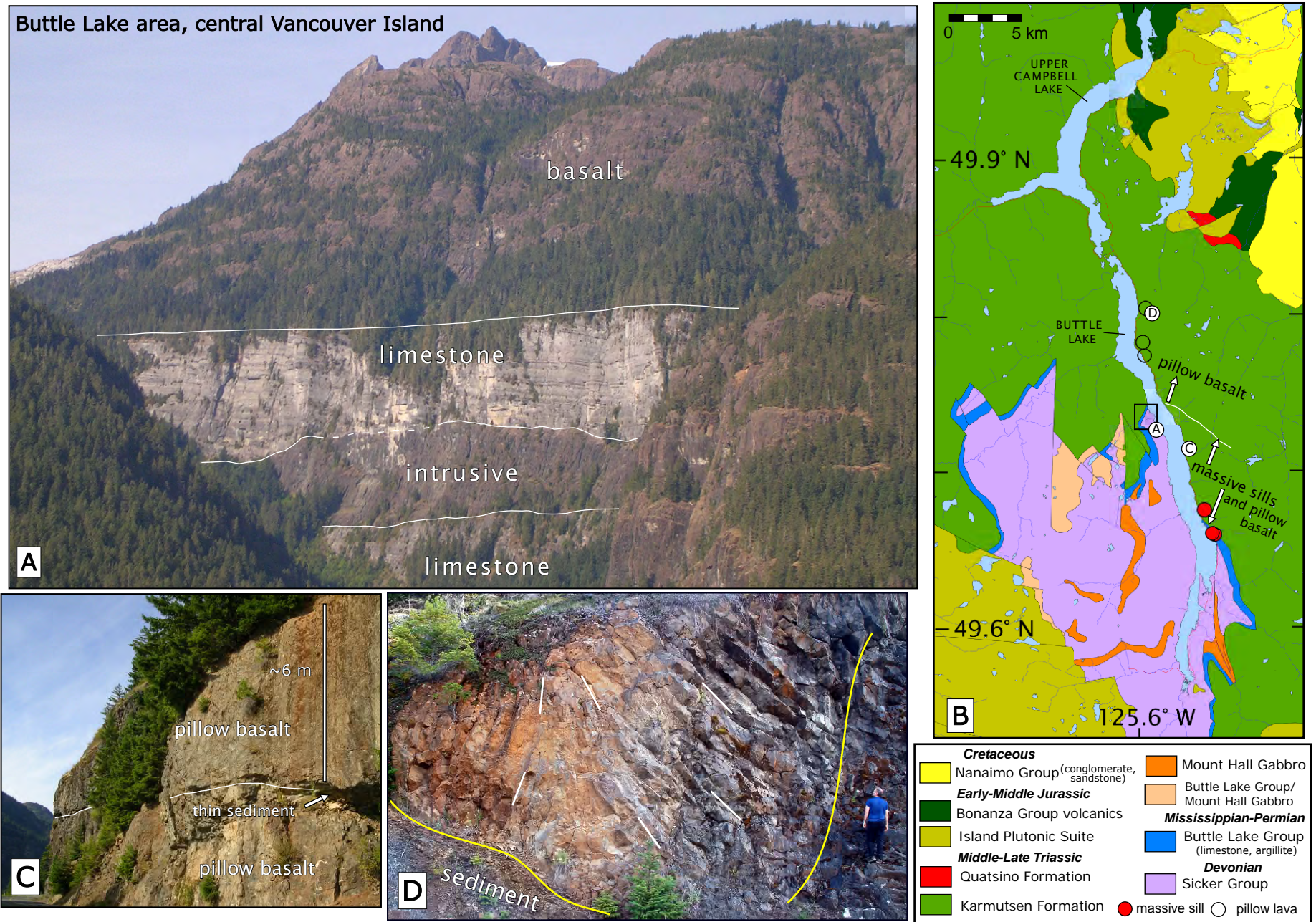
Supplementary figure 4. Photographs of the top of the Nikolai Formation around Hidden Lake Creek in Wrangell-St. Elias National Park. (A) Photograph of the top of the Nikolai Formation and overlying Chitistone Limestone, taken by Ed MacKevett, Jr. Several faults offset the contact. (B) Close-up photograph of massive micritic limestone overlying the Nikolai basalts. Location of photo D shown. (C) Close-up photograph of a contact between subaerial flows in the upper Nikolai Formation. Marker (14 cm) for scale. (D) Cobbles (<10 cm long) along the contact between the Chitistone Limestone and Nikolai Formation. The oxidized cobbles are subangular, closely packed, aligned along their long axis, and are glomeroporphyritic basalt identical to the uppermost flows of the Nikolai Formation. Sledgehammer handle (4 cm wide) for scale.



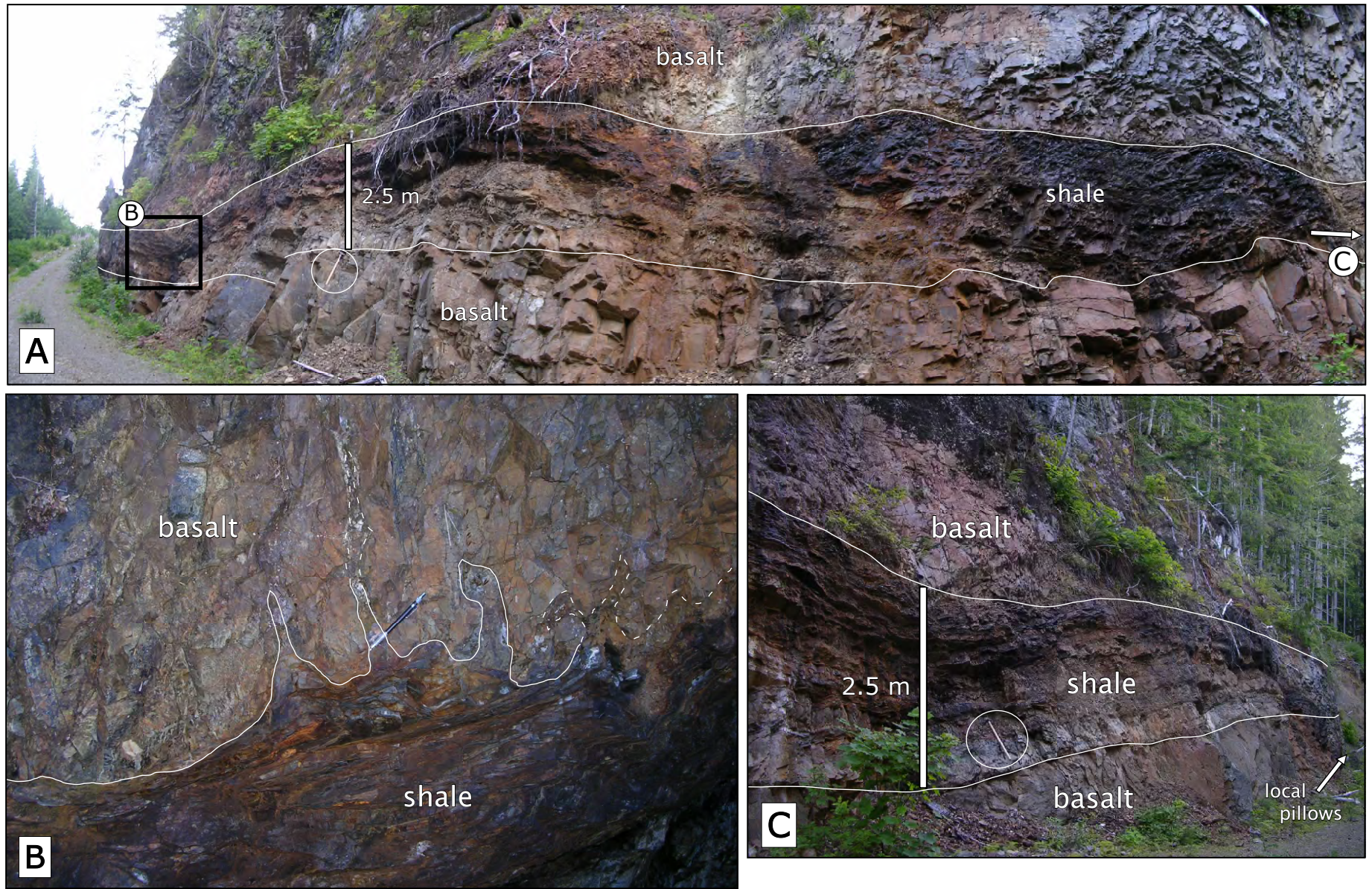
Supplementary figure 5. Photographs and map of the Nikolai Formation in southwest Yukon. (A) Vertically-oriented subaerial flows (<10 m thick) in the Kluane Ranges. Dall sheep (white dots) in center of photograph for scale. (B) Simplified map of southwest Yukon showing the distribution of the Nikolai Formation (black; after Israel, 2004; Israel and Van Zeyl, 2004; Israel et al., 2005). Stratigraphic column for Kluane Ranges derived from Read and Monger (1976), Israel et al. (2006), Israel and Van Zeyl (2005), and fieldwork. (C) Nikolai Formation overlain by Chitistone Limestone with Donjek River valley in far background. Dave Van Zeyl in center of photograph for scale. (D) Photograph of base of flood basalts in Wellgreen area, with Hasen Creek Formation overlain by pillow breccia and subaerial basalt flows of the Nikolai Formation.



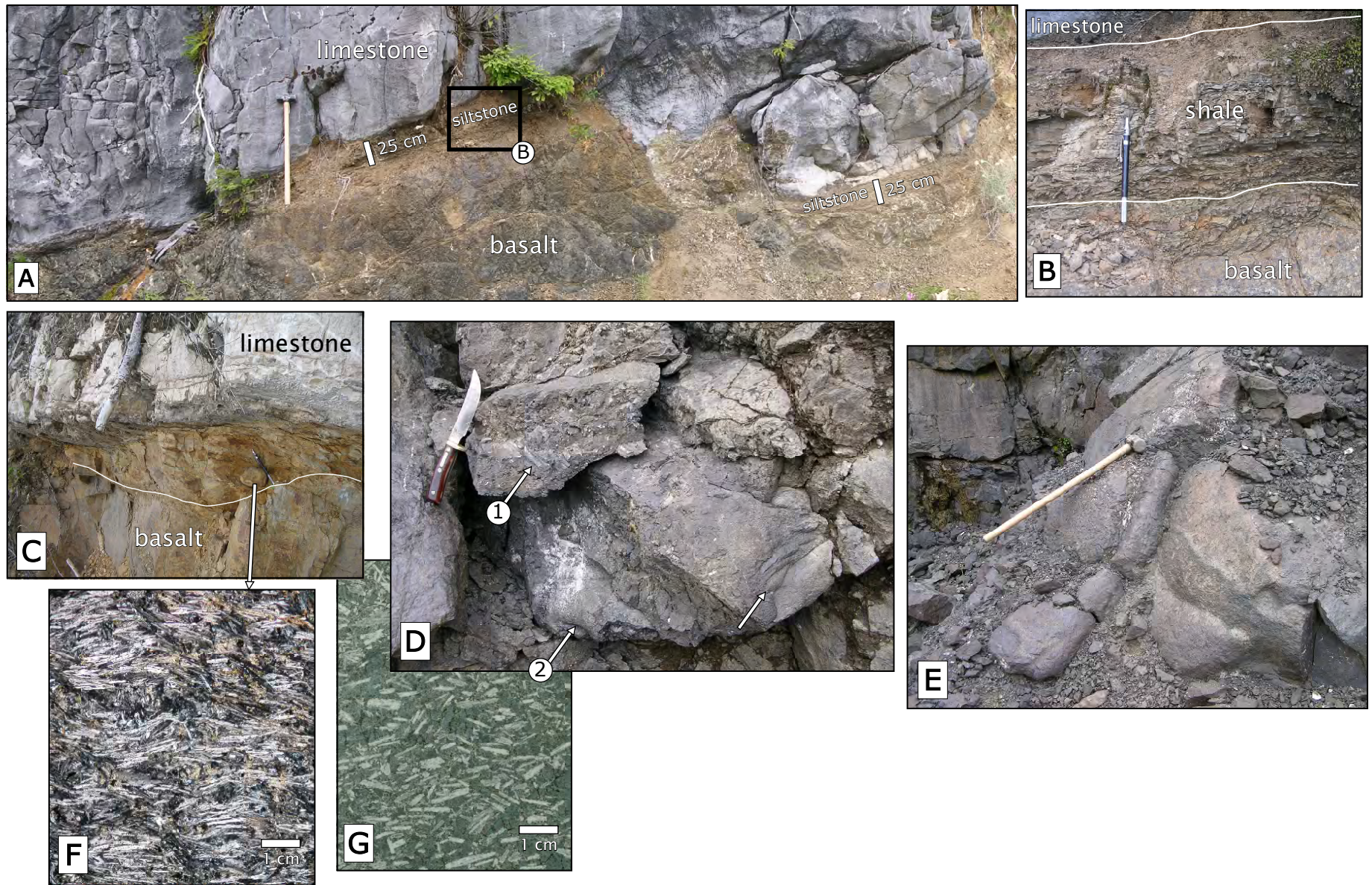
Supplementary figure 6. Field notes, photographs, and geologic map for the Schoen Lake area, Vancouver Island (location shown in Figure 5). (A) Field notes courtesy of Don Carlisle, taken at the *Daonella* fossil locality within the sediment-sill complex on the north side of Mount Schoen. (B) Photograph of *Daonella* locality depicted by field notes in A. (C) Silicified shale and chert with carbonaceous layers interbedded with mafic sills. (D) Deformed chert with carbonaceous layers (location of photo shown in C). Coin for scale. (E) Contact between sill and sedimentary sequences (location of photo shown in C). (F) Generalized geology for the Schoen Lake area with photograph and sample locations. Map derived from Massey et al. (2005).



Supplementary figure 7. Generalized geology and photographs of Buttle Lake area, Vancouver Island. (A) Photograph of contact between limestone of the upper Paleozoic Buttle Lake Group intruded by mafic sills, related to Karmutsen basalts, and overlain by pillow basalt of the Karmutsen Formation. (B) Geologic map of the Buttle Lake area showing locations of photographs. Map derived from Massey et al. (2005). (C) Photograph of contact between two pillowed flows with thin sediment layer along the contact. (D) Photograph of an unpillowed flow in the submarine section with radially-oriented columnar jointing and shale (<1 m thick) along the base.



Supplementary figure 8. Photographs of intra-Karmutsen sedimentary lens near the top of the Karmutsen southwest of Nimpkish Lake, northern Vancouver Island (location shown in Figure 5). (A) Panoramic photograph of lens of shale between two massive flows. Circled sledgehammer for scale. (B) Deformed shale with dewatering structures along the top of the lens (location shown in photo A). (C) Photograph of right side of lens, just to the right edge of A. Local pillow basalt occurs along the base.



Supplementary figure 9. Photographs from near Holberg Inlet, northern Vancouver Island (location shown in Figure 5). (A) Panoramic photograph of contact between top of the Karmutsen Formation and overlying Quatsino limestone. (B) Thin layers of siltstone between the Karmutsen basalts and Quatsino limestone (pen for scale; location shown in A). (C) Basalt-limestone contact with possible regolith along the contact (log ~1.5 m long for scale). (D) Close-up of ropy festoons (1) and the edge of a pahoehoe lobe (2) within Karmutsen Formation. Knife for scale. (E) Photograph of margin of pahoehoe lobe from same location as D. (F) Photomicrograph of plagioclase-rich, trachytic-textured basalt from C. (G). Photograph of cut slab of plagioclase megacrystic basalt flow common in upper part of the Karmutsen Formation.

REFERENCES CITED

- Israel, S., 2004, Geology of Southwestern Yukon: Yukon Geological Survey Open File 2004-16, scale 1:250,000.
- Israel, S., Tizzard, A. and Major, J., 2005, Geological map of the Duke River area (parts of NTS 115G/2, 3, 5, 6, 7), Yukon: Yukon Geological Survey, Open File 2005-11, scale 1:50,000.
- Israel, S., Tizzard, A. and Major, J., 2006, Bedrock geology of the Duke River area, parts of NTS 115G/2, 3, 4, 6 and 7, southwestern Yukon, in Emond, D. S., Bradshaw, G. D., Lewis, L. L. and Weston, L. H., eds., Yukon Exploration and Geology 2005: Yukon Geological Survey, p. 139-154.
- Israel, S. and Van Zeyl, D. P., 2004, Preliminary geological map of the Quill Creek area (parts of NTS 115G/5, 6, 12), southwest Yukon: Yukon Geological Survey, Open File 2004-20, scale 1:50,000.
- Massey, N. W. D., MacIntyre, D. G., Desjardins, P. J. and Cooney, R. T., 2005a, Digital Geology Map of British Columbia: Tile NM9 Mid Coast, B.C: B.C. Ministry of Energy and Mines, Geofile 2005-2.
- Read, P. B. and Monger, J. W. H., 1976, Pre-Cenozoic volcanic assemblages of the Kluane and Alsek Ranges, southwestern Yukon Territory: Geological Survey of Canada, Open-File Report 381, 96 p.
- Wilson, F. H., Labay, K. A., Shew, N. B., Preller, C. C., Mohadjer, S. and Richter, D. H., 2005, Digital Data for the Geology of Wrangell-Saint Elias National Park and Preserve, Alaska: U. S. Geological Survey Open-File Report 2005-1342, <http://pubs.usgs.gov/of/2005/1342/>.