Data Repository

Bedrock gorge incision via anthropogenic meander cutoff

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EXPANDED METHODS

Disclaimer

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Discharge estimation

Field estimation of discharge on 14 August 2018 was accomplished using the cross-section method for channel area and the float method for water velocity. Depth was measured every 5 m using a decimeter-graduated stadia rod across a 58 m-wide alluvial channel reach between (64.397065, -142.02203) and (64.397596, -142.022886) (Fig. DR1, Table DR1–2). Trapezoidal integration of the cross section yielded wetted area (Fig. DR2). Three float trials in the thalweg yielded 35 m surface water travel times (41.83, 38.36, and 38.65 seconds) and thus velocities; multiplying the average of the three surface velocities by 0.85, a common coefficient for riverbeds of intermediate roughness, constrained average channel velocity. The final discharge estimate represents the product of wetted area and average channel velocity.

Analysis of a cross-channel elevation profile extracted from the ArcticDEM across the field channel cross-section site estimates the discharge required to exceed the sediment transport threshold (Fig. DR3). The width and discharge, based on the product of cross-sectional area (also via trapezoidal integration) and velocity determined using grain size parameters described below in the variable power flow resistance equation of Ferguson (2007, 2012) were used to iteratively solve stream power until it exceeded the local sediment transport threshold.

Grain size distribution

Scaled photos were collected (64.397065, -142.02203) on 14 August 2018 for estimation of grain size distribution in browser-based ImageJ software (https://imagej.nih.gov/ij/). Measurement of 326 visible intermediate grain axes yielded a distribution from which the median represents D_{50} and the size greater than 84% of the distribution represents D_{84} (Figs. DR 4–5). The grain size site is located upstream of the bedrock-bank gorge (Fig. DR6).

DATA AVAILABILITY

Field measurements and grain size photos that support the findings of this study are available in this supplementary materials file and through the U.S. Geological Survey Alaska Science Center Science Portal at https://doi.org/10.5066/P94TE5C8. Historical air photos used in this study were accessed on June 10, 2021 at earthexplorer.usgs.gov under entity IDs AR5810030164407, ARBM02080202674, and ARBM4J610010088. The ArcticDEM 3.0 and Maxar World Imagery were accessed via ArcGIS Online in ArcMap 10.8.1 on June 9, 2021 and may be viewed at livingatlas.arcgis.com/wayback/?active=1049&ext=-142.08325,64.37391,-141.98145,64.39855. Fairbanks precipitation data were accessed on June 15, 2021 at ncdc.noaa.gov/cdo-web/datatools/findstation. Fortymile River discharge data were accessed on June 15, 2021 at waterdata.usgs.gov/monitoring-location/15348000/.

TABLES

FIGURES

DATA REPOSITORY REFERENCES CITED

Ferguson, R., 2007, Flow resistance equations for gravel- and boulder-bed streams. Water Resources Research, v. 43, W05427, doi: 10.1029/2006WR005422.

Ferguson, R.I., 2012. River channel slope, flow resistance, and gravel entrainment thresholds. Water Resources Research, v. 48. doi:10.1029/2011WR010850

Wilson, F.H., Hults, C.P., Mull, C.G, and Karl, S.M, comps., 2015. Geologic map of Alaska: U.S. Geological Survey Scientific Investigations Map 3340, http://dx.doi.org/10.3133/sim3340.

Table DR1: Field observations

Latitude	Longitude	Elevation (m)	Wetted width (m)	Bank material
64.39707	-142.022	496.4772	58	alluvium
64.39255	-142.026	486.7842	46	mix
64.39232	-142.026	483.1887	59	mix
64.392	-142.026	482.9225	50	mix
64.39174	-142.026	480.7397	40	mix
64.39023	-142.025	478.054	37	mix
64.38998	-142.025	476.9681	36	mix
64.38948	-142.024	474.6137	31	mix
64.38921	-142.024	473.445	35	bedrock
64.38898	-142.024	473.7743	17	bedrock
64.38873	-142.024	471.7559	23	bedrock
64.38846	-142.024	471.8863	27	bedrock
64.38799	-142.024	470.8667	18	bedrock
64.38774	-142.023	471.5271	25	bedrock
64.38749	-142.024	473.1097	15	bedrock
64.38703	-142.025	481.1505	25	bedrock
64.38684	-142.025	480.5823	15	bedrock
64.38671	-142.026	480.8028	19	bedrock
64.3866	-142.026	482.0939	38	bedrock
64.38652	-142.027	483.0835	36	bedrock
64.38631	-142.027	482.6047	29	bedrock
64.38613	-142.027	480.7736	36	bedrock
64.386	-142.028	480.8994	29	bedrock

Table DR2: Channel cross-section data

Tape distance (m)	Water depth (m)
0	0
5	0.6
10	0.5
15	0.4
20	0.65
25	0.75
30	0.7
35	0.5
40	0.4
45	0.25
50	0.35
55	0.4
58	0

Figure DR1: Field photo of discharge and grain size estimation site looking north (upstream). Photo by Adrian Bender.

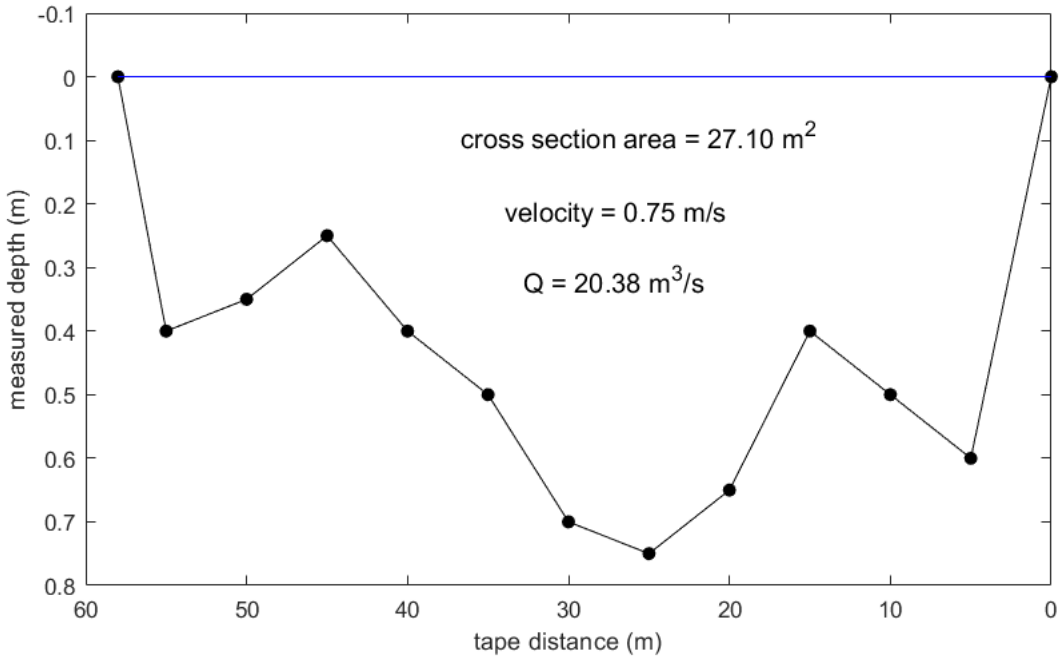

Figure DR2: Field-measured channel cross section (Q = discharge).

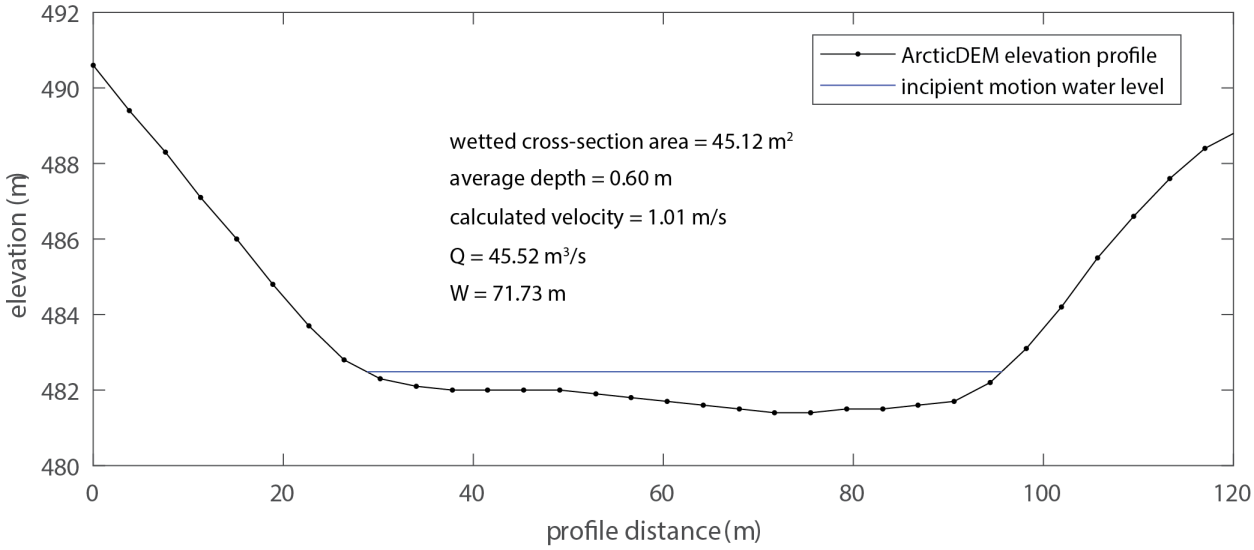

Figure DR3: ArcticDEM channel cross section analyzed using the variable power flow resistance equation of Ferguson (2007, 2012) to compute velocity and cross-section area required for discharge and width to exceed the local incipient sediment transport threshold (Q = discharge, W = wetted width).

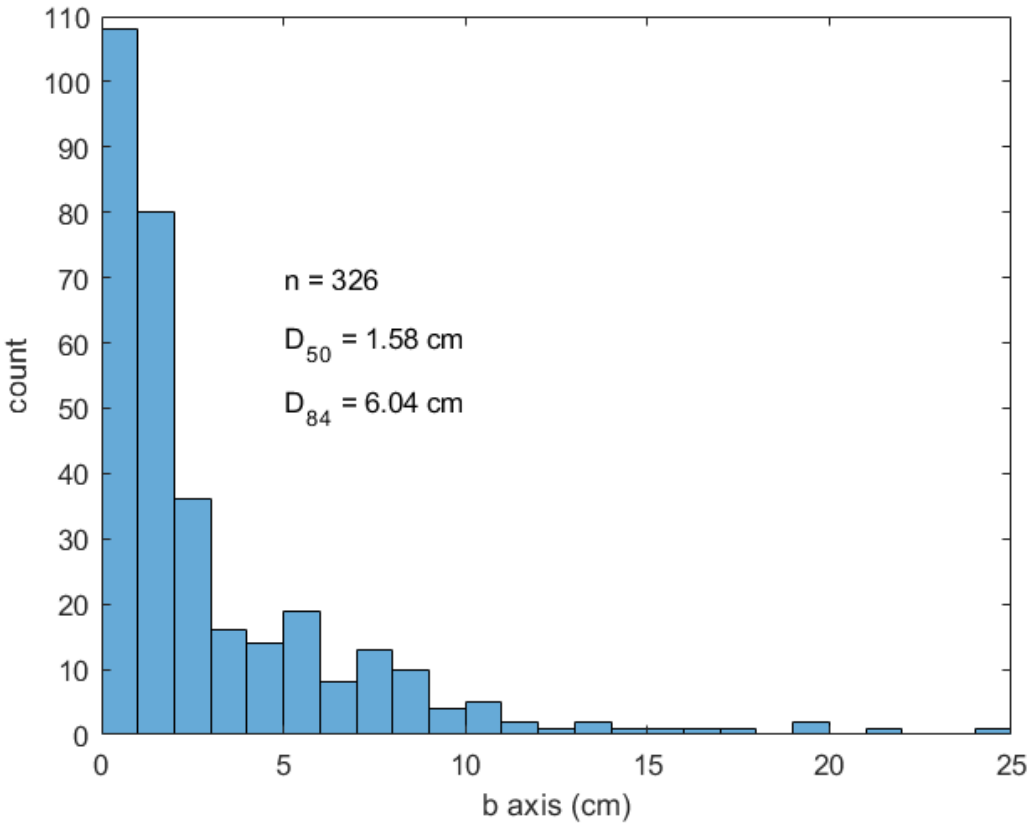

Figure DR4: Grain size distribution.

Figure DR5: Scaled photos used for grain size distribution in ImageJ software. Photos by Adrian Bender.

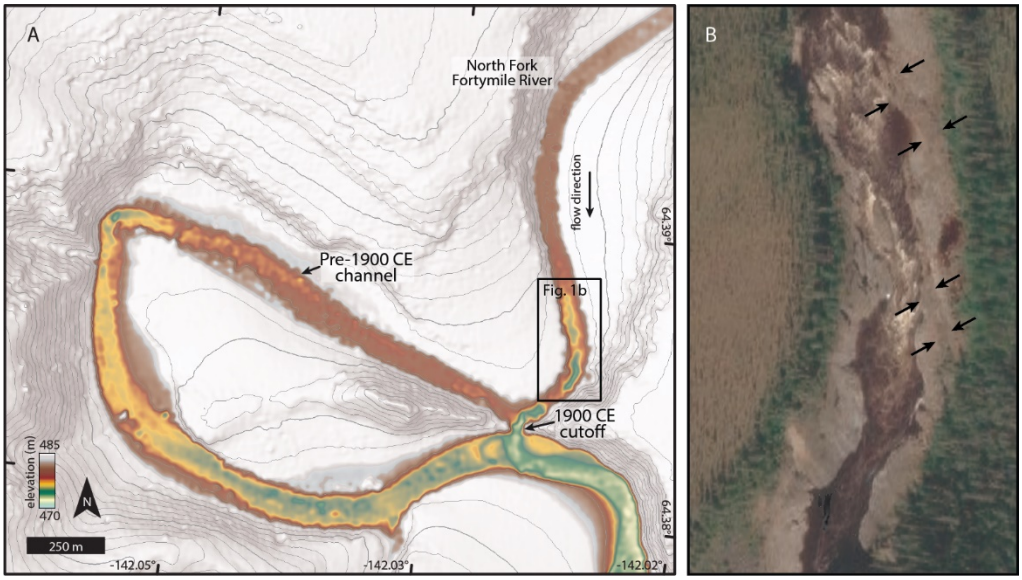

Figure DR6: (A) ArcticDEM site map with 2019 satellite image detail map location indicated. (B) 2019 Maxar satellite image with black arrows indicating the location of a basalt dike within the knickzone. East bank bedrock is granodiorite, west bank bedrock is schist (Wilson et al., 2015).