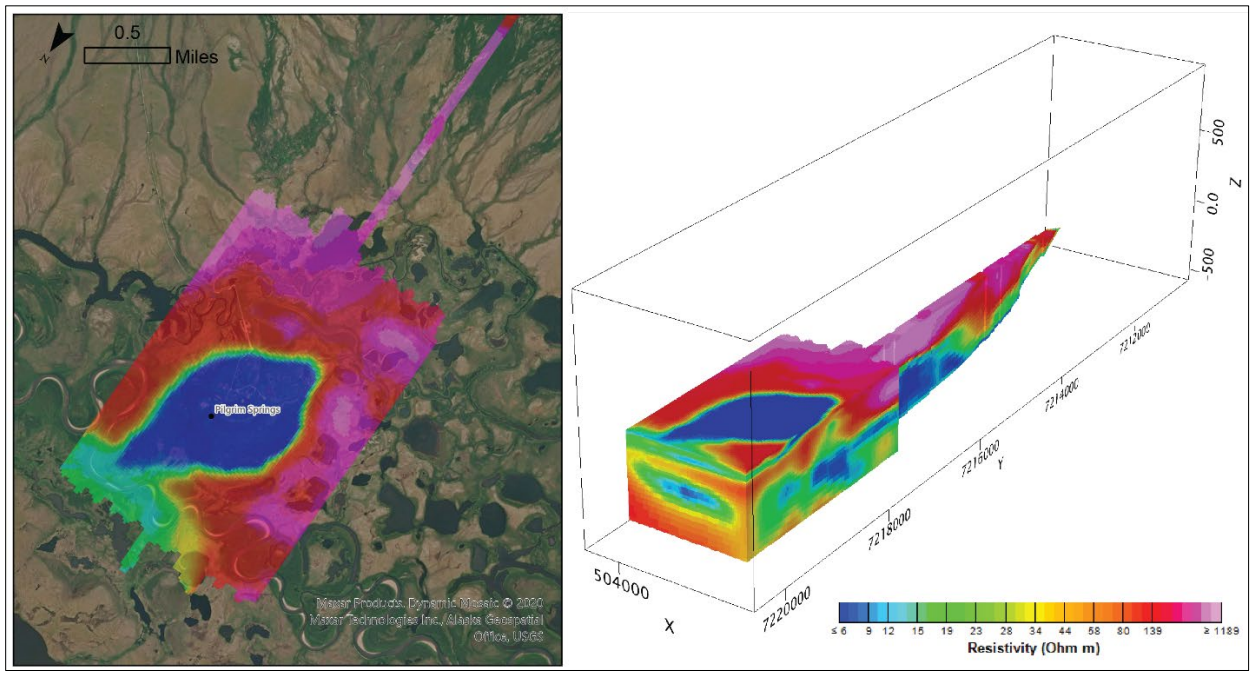
PILGRIM HOT SPRINGS AIRBORNE ELECTROMAGNETIC SURVEY, SEWARD PENINSULA, ALASKA

Eric I. Petersen, Logan A. Fusso, Abraham M. Emond, SkyTEM Canada Incorporated, Aqua Geo Frameworks LLC, and John C. Eichelberger

Geophysical Report 2025-1



3D model of subsurface resistivity at Pilgrim Hot Springs. **Left:** resistivity slice at -20 m elevation mapped over the Pilgrim Hot Springs area; low resistivity region in blue is indicative of near-surface thawed area resulting from geothermal springs. **Right:** perspective view of 3D resistivity voxel with 2x vertical exaggeration; this model can be used to map thaw zones and constrain subsurface geologic structure.

2025
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PILGRIM HOT SPRINGS AIRBORNE ELECTROMAGNETIC SURVEY, SEWARD PENINSULA, ALASKA

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INTRODUCTION

The Pilgrim Hot Springs airborne electromagnetic survey covers a portion of the Southwest corner of the Bendeleben quadrangle, north-northeast of Nome, Alaska (fig. 1). The survey was conducted to characterize subsurface electrical resistivity variations, supporting interpretations of hydrothermal circulation, fluid pathways, and near-surface thaw zones. The resulting dataset provides insights into the geologic framework and supports geothermal exploration by enabling evaluation of subsurface conditions, identification of energy prospects, and guidance for future drilling.

Time-domain electromagnetic data were acquired using the helicopter-mounted SkyTEM 306HP system on September 8–9, 2023, by SkyTEM Canada Incorporated. A total of 73.2 line-kilometers were flown over a single survey block measuring 10.7 square kilometers. The block was flown with north–south line orientation and a nominal spacing of 100 meters, reduced to 50 meters near the center. Mean ground clearance was 35.8 ± 15.7 meters, with a nominal survey speed of 101.4 ± 7.8 km/hr.

Data were inverted using Aarhus Workbench EM software to produce two subsurface resistivity models. SkyTEM Canada Incorporated generated a preliminary model from a laterally constrained inversion (referred to in the data files as "skytem_lci"), which applies only along-track constraints. Aqua Geo Frameworks produced a spatially constrained inversion model (referred to in the data files as "agf_sci"), which incorporates both along-track and cross-track constraints. The Aqua Geo Frameworks model is recommended for end-users, as it resolves finer-scale structures, including layering in the near-surface thaw zone (fig. 2). We also provide a 3D voxel dataset registered to elevation rather than raw depth for the model.

The data and metadata are available from the Alaska Division of Geological & Geophysical Surveys website at https://doi.org/10.14509/31452.

DELIVERABLES

This document provides an overview of the survey and includes text and figures of selected primary and derivative products. Table 1 lists available data packages. Table 2 provides a catalog of full-scale maps available for downloading. Please consult the metadata, project report, and digital data packages for more information and data.

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[2] SkyTEM Canada Incorporated, 151 Yonge Street, 11th floor, Toronto, ON M5C 2W7
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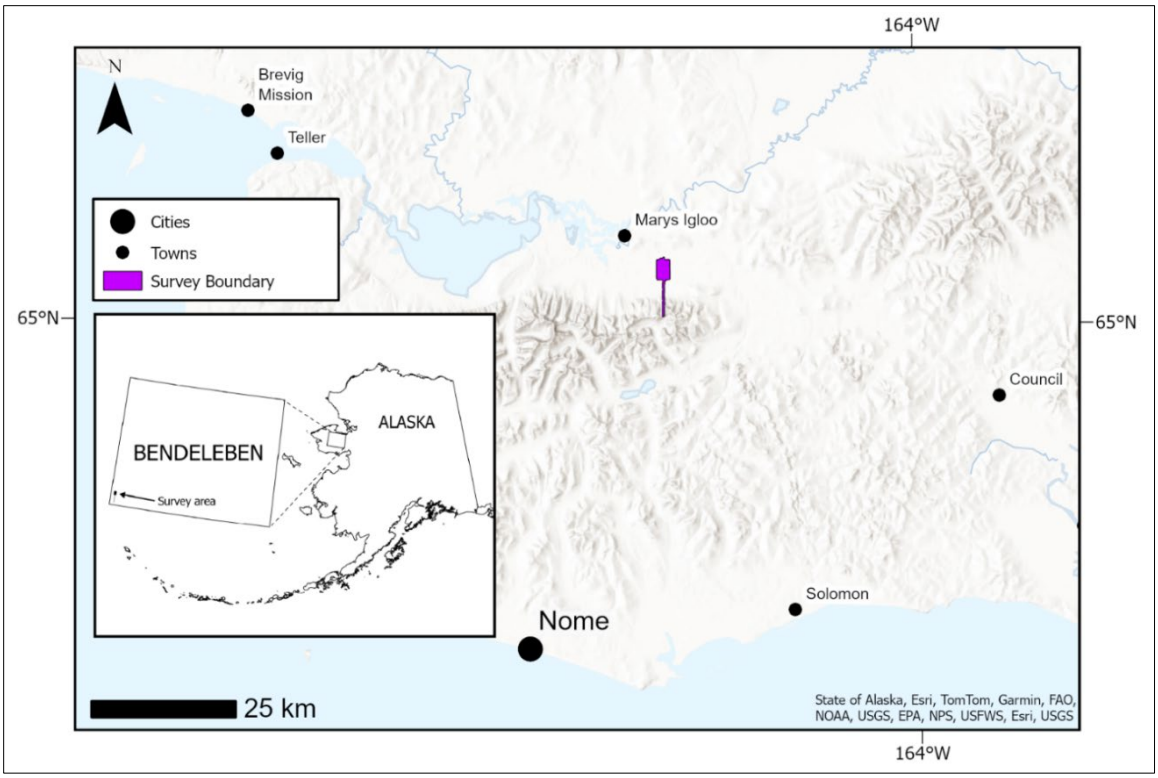

Figure 1. Location map of the Pilgrim Hot Springs geophysical survey boundary. The inset map shows relevant 1:250,000-scale quadrangles in western Alaska.

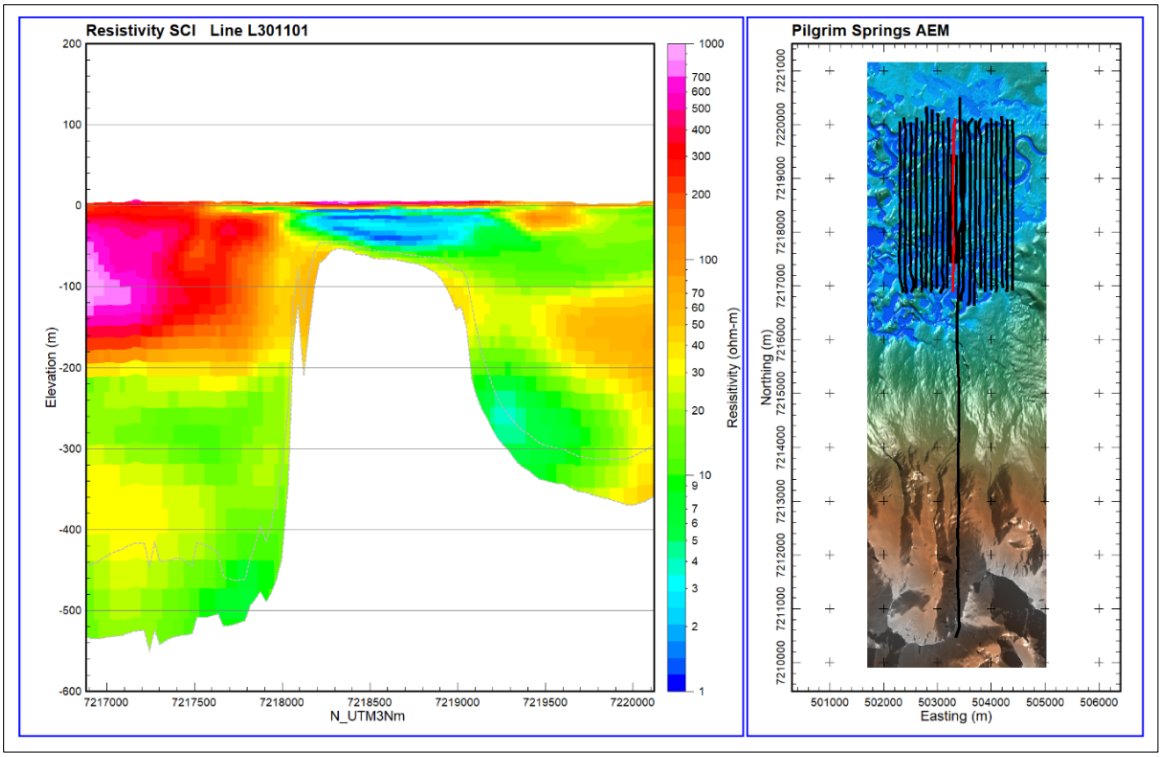

Figure 2. Left: Example resistivity-depth profile L301101 from the Aqua Geo Frameworks (agf_sci) model, displaying resolved near-surface layering in the low-resistivity area (blue tones) associated with geothermally derived thaw. **Right:** Map of survey block and flightlines with L301101 highlighted in red.

Table 1. Data available for download

Data Package	Description
ascii_data	ASCII format line data, other ASCII data
databases_geosoft	Geosoft format database of final line data, other Geosoft format databases
documents	Project report, inversion report, calibration and system response reports
grids_geosoft	Oasis montaj Geosoft GRD format gridded data
grids_tif	Geographically registered data value rasters of gridded data, GeoTiff format
kmz	Keyhole Markup Language (KML) kmz archive files of project data, including selected resistivity voxel layers. Viewable on Google Earth and other compatible programs
maps_pdf_format	Printable and geographically registered maps in PDF format.
models_resistivity	Models of subsurface resistivity inverted from measured EM response. agf_sci is recommended model for end-users.
vector_data	Line path and survey boundary in Esri shapefile (shp) format

Table 2. Full-scale printable maps are available in Portable Document Format (.pdf) at 300 dpi. See Appendix A for previews of these maps in reduced-resolution page-sized format. The page-sized format is intended for reference and search purposes only.

Map Title	File Name
Flight path	sheet01_seward_em_pilgrim_flightpath.pdf
Resistivity Model Elevation Slices	
Modeled resistivity, voxel layer at 20 m below sea level	sheet02_seward_em_pilgrim_agf_sci_res_voxel_278_-20m.pdf
Modeled resistivity, voxel layer at 60 m below sea level	sheet03_seward_em_pilgrim_agf_sci_res_voxel_258_-60m.pdf
Modeled resistivity, voxel layer at 160 m below sea level	sheet04_seward_em_pilgrim_agf_sci_res_voxel_208_-160m.pdf
Modeled resistivity, voxel layer at 280 m below sea level	sheet05_seward_em_pilgrim_agf_sci_res_voxel_148_-280m.pdf

ACKNOWLEDGMENTS

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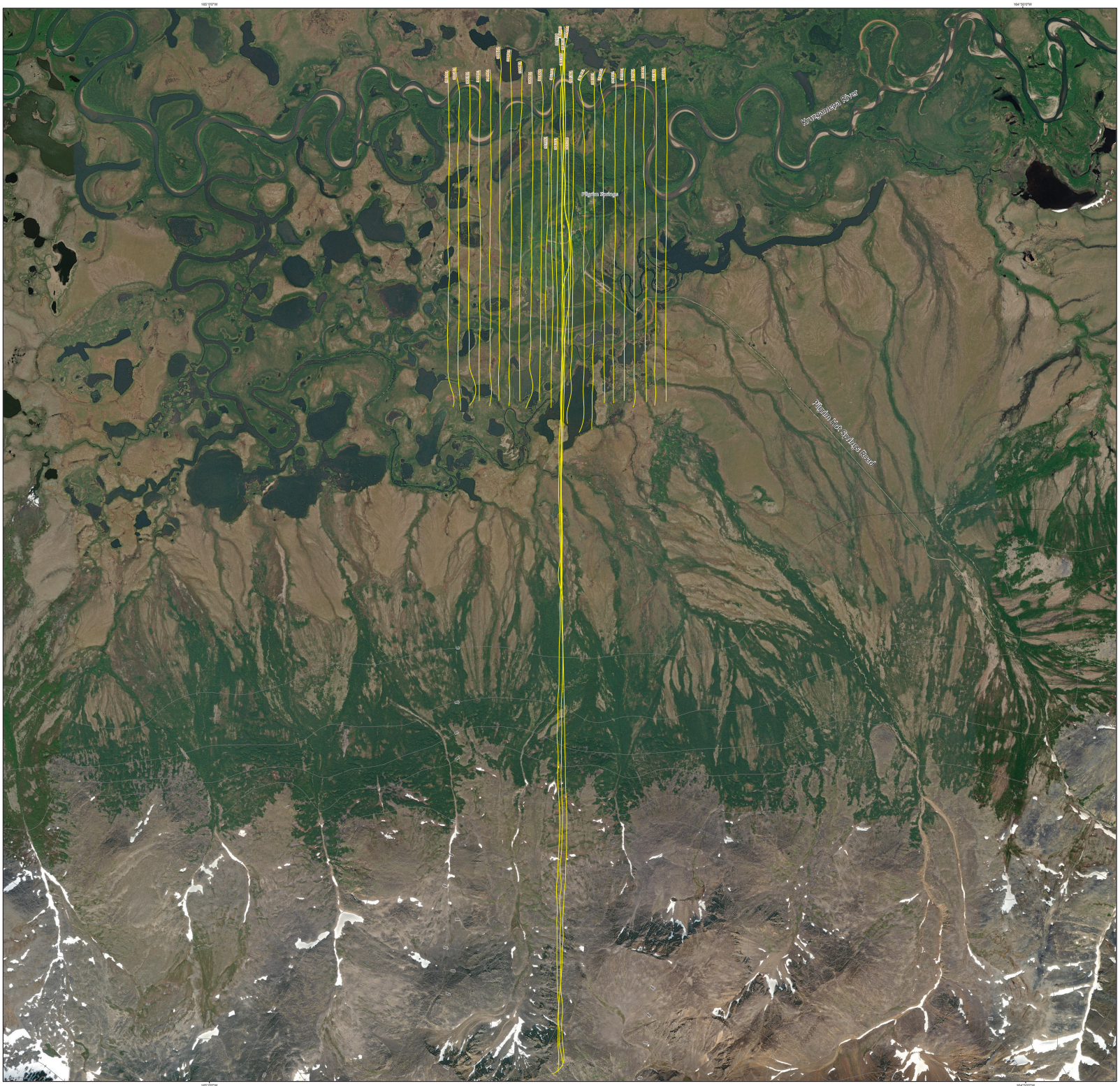


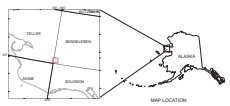
Flight Path
Pilgrim Hot Springs airborne electromagnetic survey, Seward Peninsula, Alaska

by

Petersen, E.I.[1], Fuso, L.[1], Emond, A.M.[2,3], SkyTEM Canada Incorporated[4], Aqua Geo Frameworks LLC[2], and Eichelberger, J.C.[1]

2025

Flight Paths, Survey Line Number Labeled



Location of map area

SCALE 1:12,000

CONTOUR INTERVAL 100 METERS

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[2] Aqua Geo Frameworks, 10949 Ridge Road, Fort Laramie, Wyoming 82212
[3] formerly Alaska Division of Geological & Geophysical Surveys, 3354 College Rd, Fairbanks, AK 99709
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SKYTEM

AGF
Aqua Geo Frameworks

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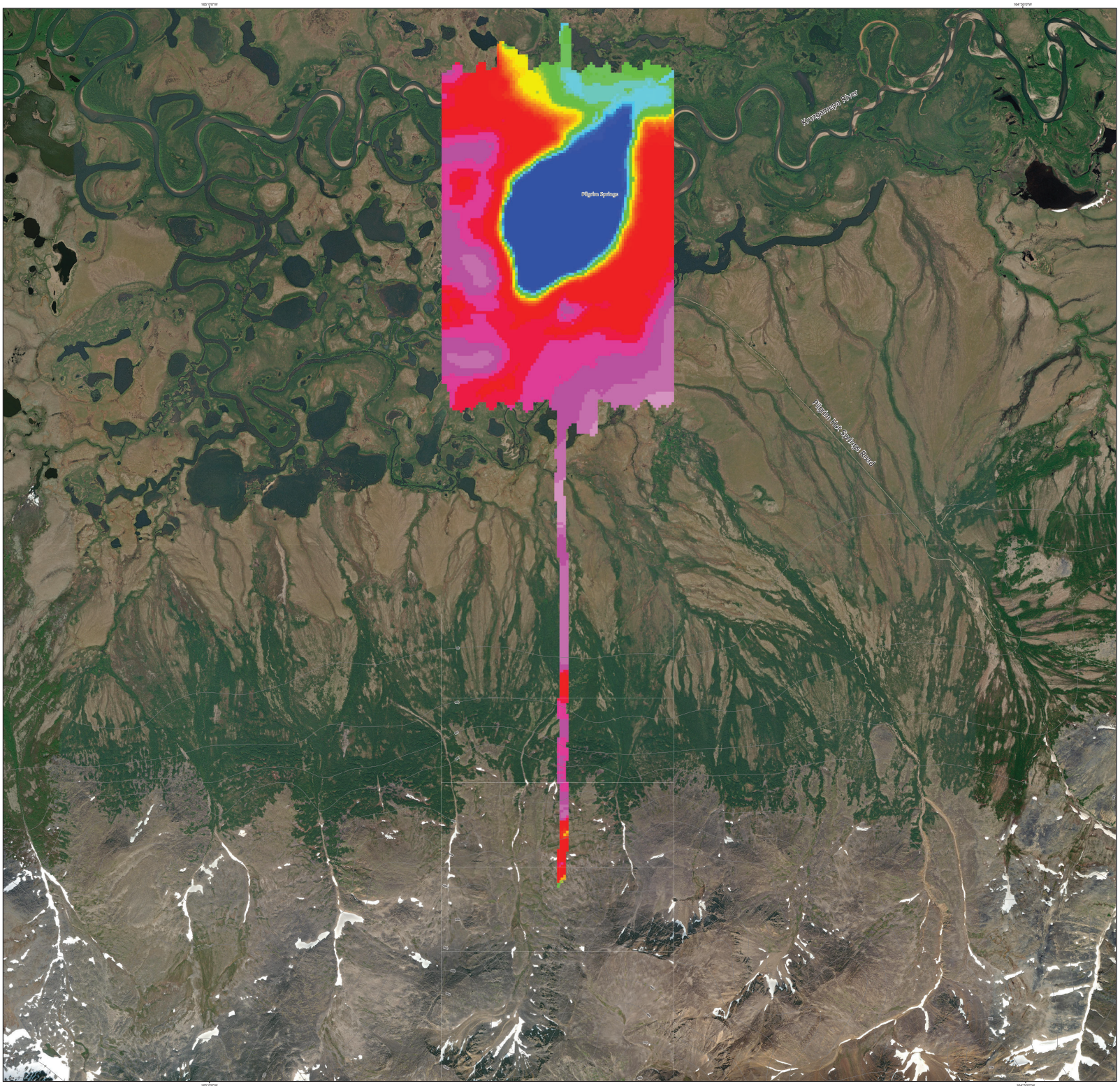

Modeled Resistivity, Voxel Layer at 20 m Below Sea Level
Pilgrim Hot Springs airborne electromagnetic survey, Seward Peninsula, Alaska

by

Petersen, E.I.[1], Fuso, L.[1], Emond, A.M.[2,3], SkyTEM Canada Incorporated[4], Aqua Geo Frameworks LLC[2], and Eichelberger, J.C.[1]

2025

≤ 6 9 12 15 19 23 28 34 44 58 80 139 ≥ 1189

Resistivity (Ohm m)

SCALE 1:12,000

CONTOUR INTERVAL 100 METERS

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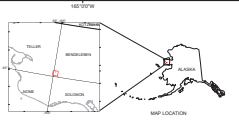

Location of map area

SKYTEM

AGF
Aqua Geo Frameworks

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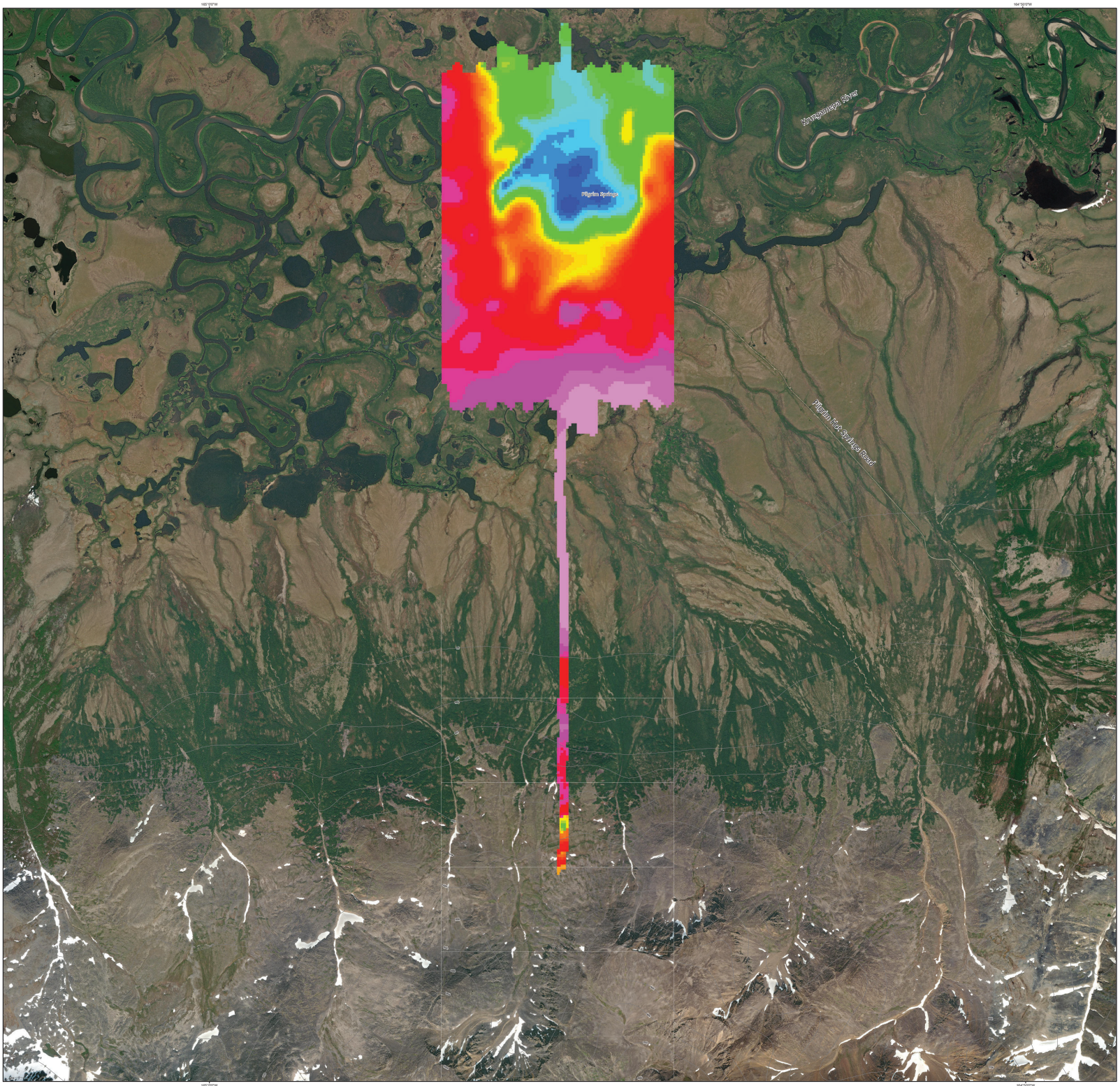

Modeled Resistivity, Voxel Layer at 60 m Below Sea Level
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by

Petersen, E.I.[1], Fuiso, L.[1], Emond, A.M.[2,3], SkyTEM Canada Incorporated[4], Aqua Geo Frameworks LLC[2], and Eichelberger, J.C.[1]

2025

≤ 6 9 12 15 19 23 28 34 44 58 80 139 ≥ 1189
Resistivity (Ohm m)

SCALE 1:12,000
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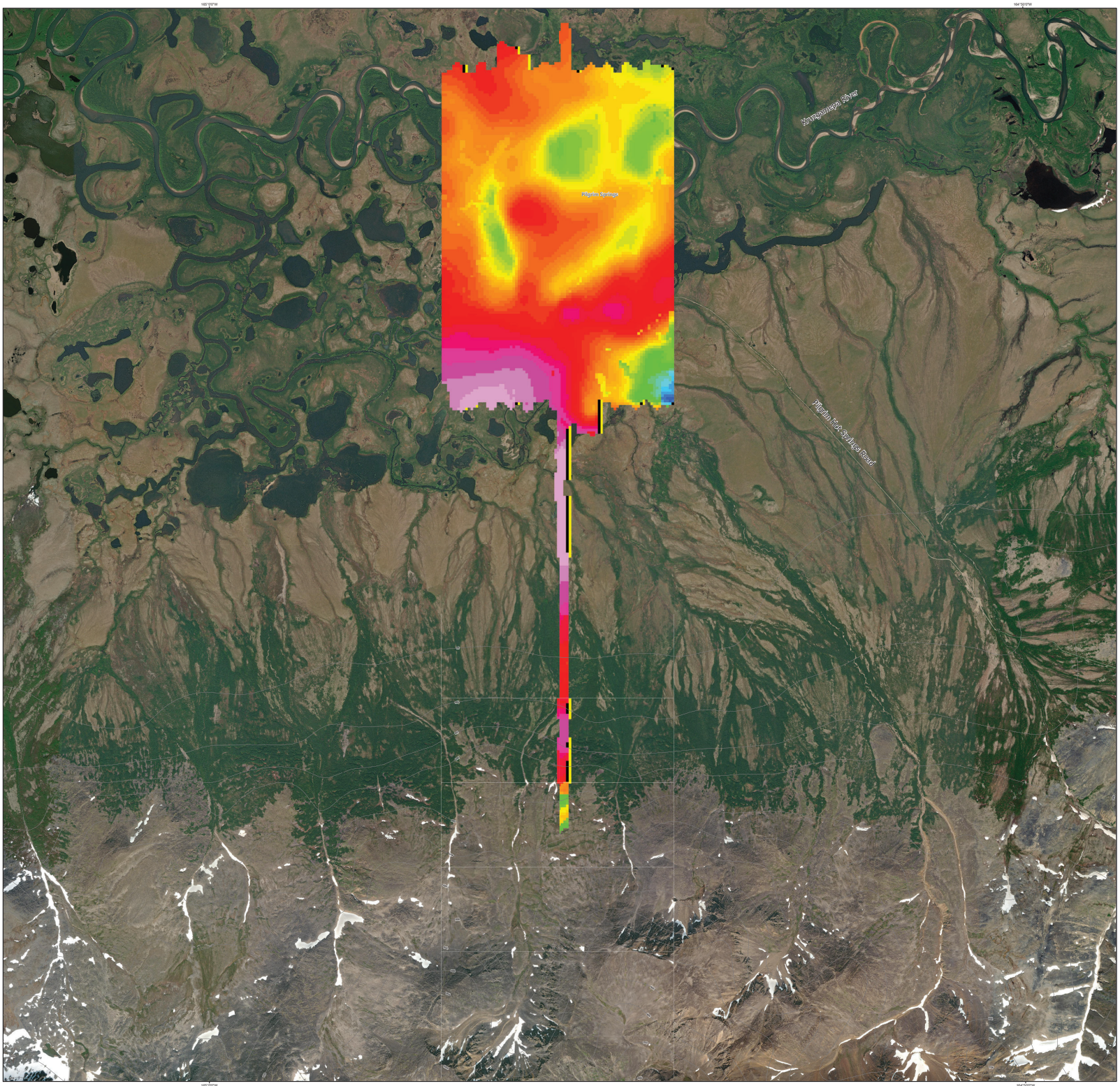

Modeled Resistivity, Voxel Layer at 160 m Below Sea Level
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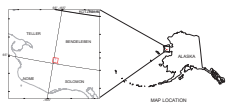
Resistivity (Ohm m)



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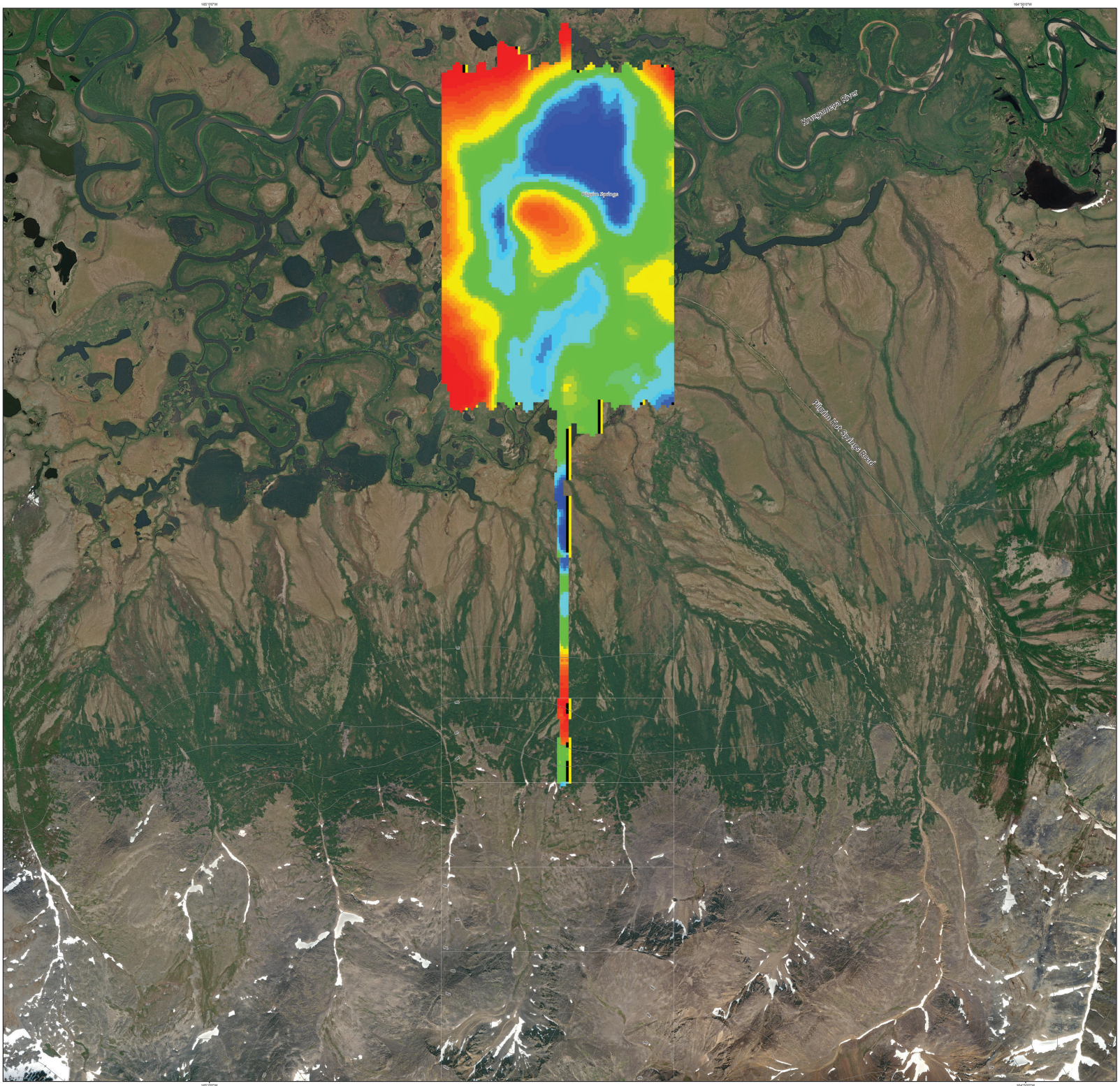

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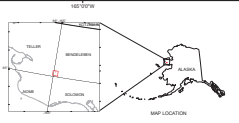

MAP LOCATION

Location of map area

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