

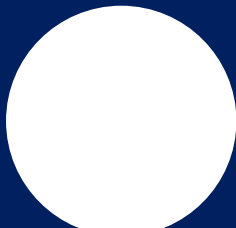
Applications of Drone Imagery and Thermal Remote Sensing in Energy Resource Exploration

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September 22nd, 2026
Alaska Geosummit

State of Alaska
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Why Drones?

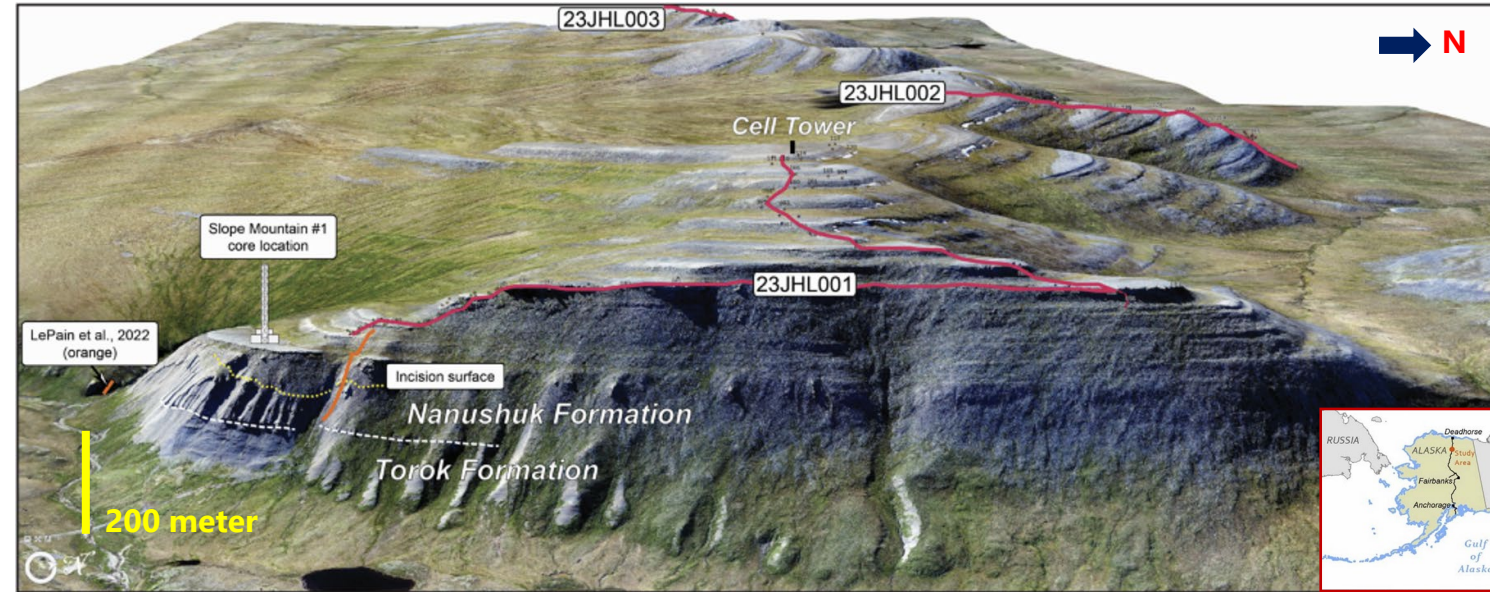


Challenges of Fieldwork in Alaska

- Remote locations
- Limited accessibility
- High logistical costs
- Wildlife
- Weather constraints
- Safety concerns on steep cliffs
 - How do we safely map inaccessible outcrops?
 - How do we improve geological interpretation?

UAVs data acquisition is;

- ✓ Safer, faster, and cheaper
- ✓ Higher resolution
- ✓ Repeatable



Orthorectified imagery draped over elevation model (DEM) of Slope Mountain, acquired by FODAR and licensed for use by USGS.

Summary: UAVs have become one of the most powerful field tools for modern energy geology.

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Products

Thermal Anomaly Detection

Orthomosaic

Geologic Interpretation

Structural Analysis

DEM/DSM

Drone Imagery

3D Tile Model

Digital Outcrop Modeling

Resource Assessment

Thermal Imagery

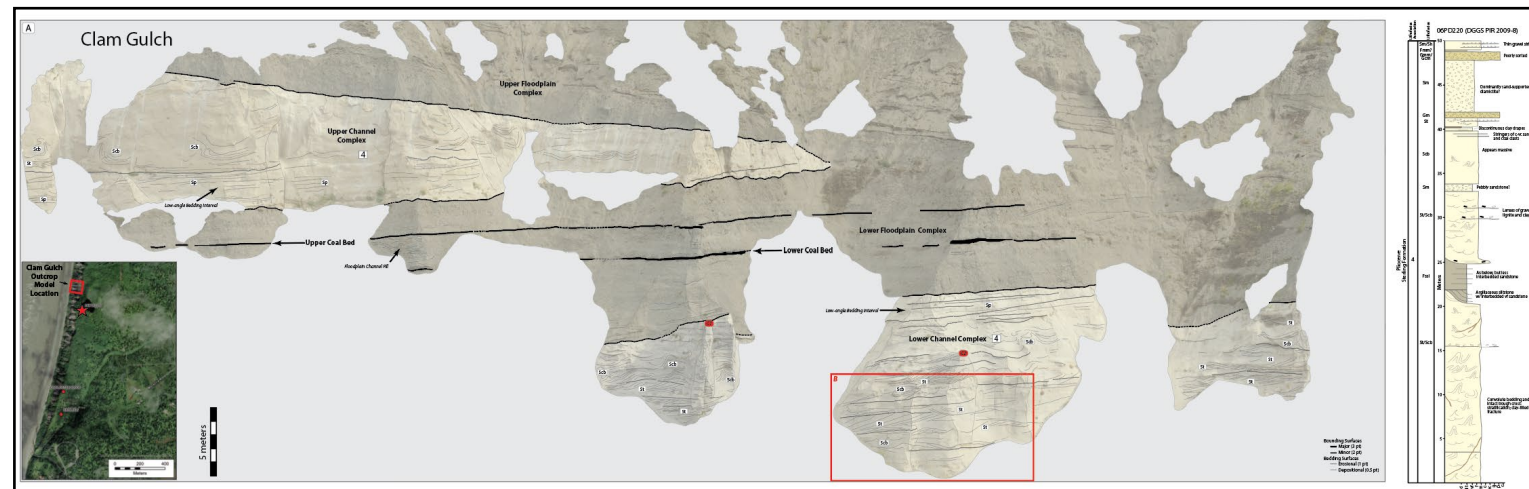
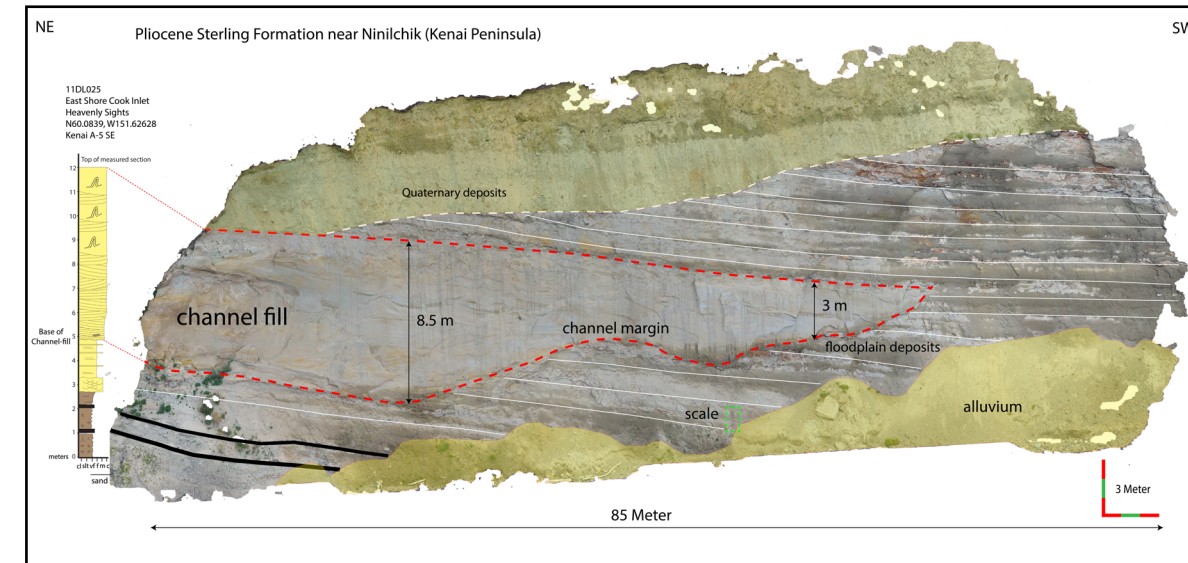
Case Study 1: ARCCS – Drone Applications for Geological Characterization

Alaska Railbelt Carbon Capture and Storage (ARCCS)

- Collaborative project led by the University of Alaska Fairbanks, DGGs, ARI, and other partners to evaluate Alaska's potential for **safe, long-term geological storage of carbon dioxide (CO₂)**.
- The project integrates field geology, subsurface characterization, and geophysical data to identify and assess potential CO₂ storage reservoirs and sealing formations in the Cook Inlet Basin, Alaska.

UAV-Derived Data & Applications:

- Acquiring high-resolution imagery of inaccessible exposures.
- Generating 3D digital outcrop models for geological interpretation.
- Mapping lithologic contacts, bedding, fractures, and faults.
- Improving understanding of reservoir and caprock architecture.
- Providing spatial datasets that complement field observations and subsurface data.



(Interpreted by J. H. Long)

Case Study 2: Understanding the Structural Style and Deformation History on the East Central North Slope

Structural Measurements

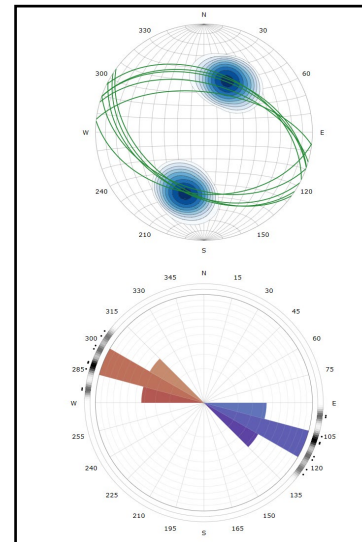
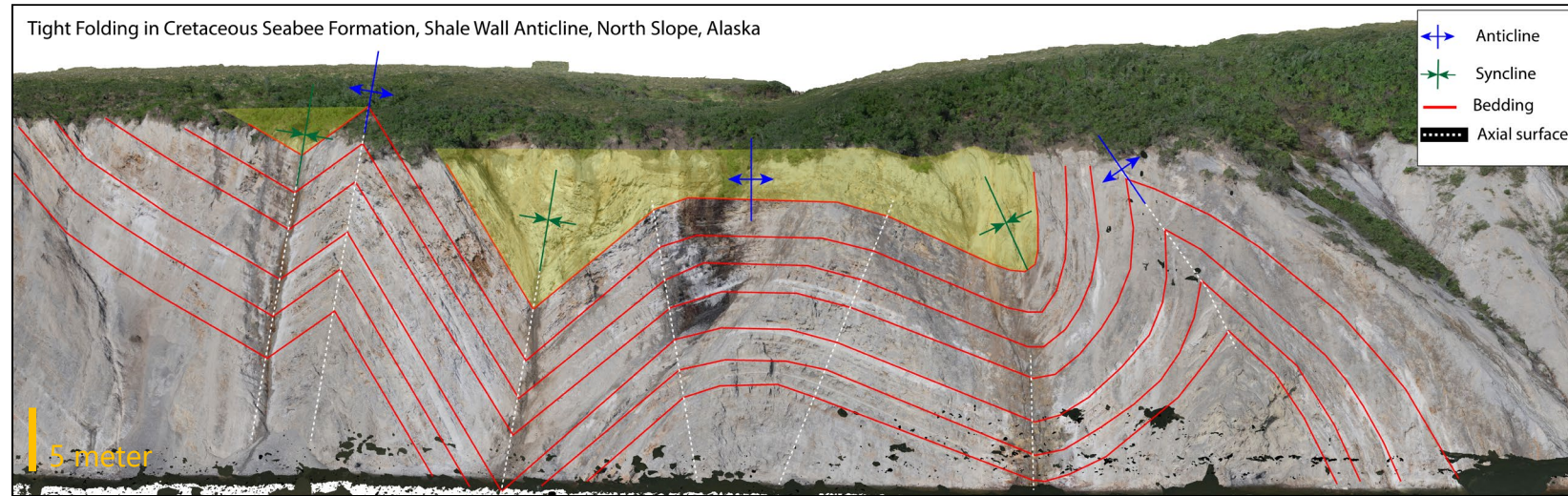
- Bedding, fault & fracture orientation
- Fold axes / axial surfaces
- Define fold geometry and structural domains
- Quantify displacement, spacing and continuity

Deformation Analysis

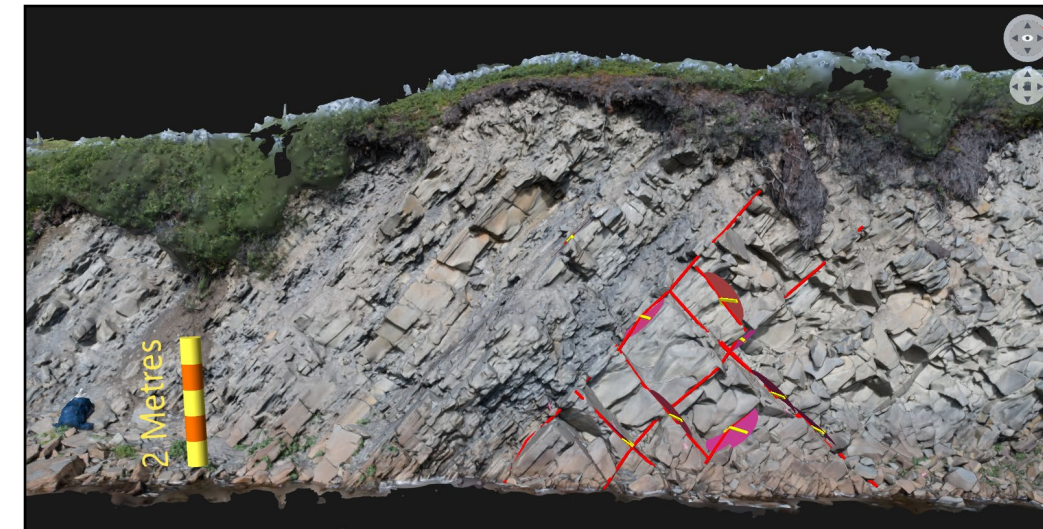
- Identify fracture/fault sets
- Cross-cutting relationships
- Relative timing of deformation
- Estimate shortening / strain

Regional Interpretation

- Connect outcrop-scale structures to regional faults and folds
- Improve cross sections and structural models
- Provide analogs for subsurface interpretation



Stereonet & Rose diagram



Fracture measurement in the Nanushuk Formation (East Central North Slope)

FUTURE VISION



- Build an open-access, statewide digital outcrop library that transforms drone imagery into reusable geologic data (research, education, and future energy-resource evaluation).

Expand the Digital Outcrop Library

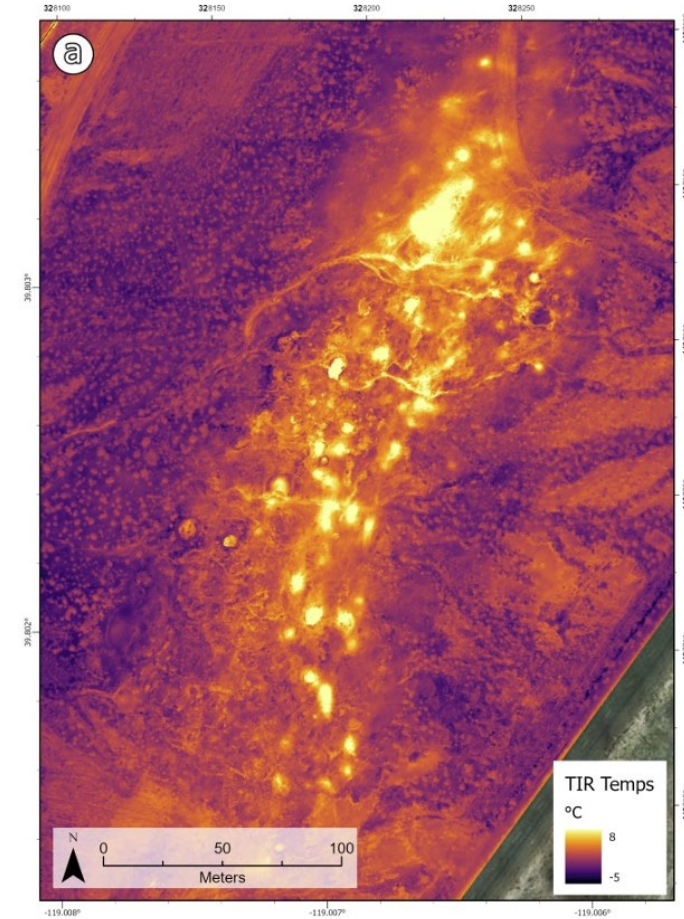
- Continue systematic acquisition of key Alaska outcrops
- Capture inaccessible and rapidly changing exposures
- Build a long-term digital record of important geologic sections

Move From Visualization → Quantitative Geology

- Stratigraphic architecture & facies analysis
- Structural measurements & deformation analysis
- Fracture/fault characterization
- Reservoir and seal analog studies
- Thermal mapping for geothermal investigations

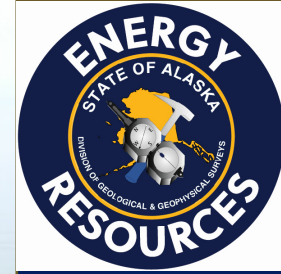
Open-Access Drone Data Repository

- Raw imagery
- Orthomosaics
- DEMs
- 3D digital outcrop models
- Interpretations / derived datasets



TIR Imagery of heated ground in the northern portion of the Brady Geothermal Field, Nevada (Brailo et al., 2025).

Acknowledgements



- ❖ Trystan Herriott (DGGS)
- ❖ Mandy Willingham (Montana Bureau of Mines & Geology)
- ❖ Peter Flaig (UT-BEG)
- ❖ Jared Gooley (USGS)
- ❖ Gabe Wolken (DGGS & UAF)
- ❖ Bob Gillis (DGGS)

Funding:

- State of Alaska
- Arctic Strategic Transportation and Resources (ASTAR) Capital Improvement Project
- U.S. Geological Survey STATEMAP program
- U.S. Department of Energy

