

DIGITAL MAPPING TECHNIQUES 2026

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A Quaternary geologic map of the Alaska Peninsula – a work in progress

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Alaska – showing the study area



The study area for this remapping and new compilation consists of most of 13 1:250,000-scale quadrangles in Alaska. They are about equivalent in area to Ohio or Virginia.

Background

- Between the late 1970s and late 1980s, Quaternary geologic maps of the Alaska Peninsula were produced as part of the Alaska Mineral Resource Assessment project (AMRAP).
- In all, the maps covered parts of 13 1:250,000-scale quadrangles, from the Katmai region (Valley of Ten-thousand Smokes, Katmai National Park) to the Cold Bay and False Pass region at the southwestern end of the Alaska Peninsula

Original source data

- At the time, the data sources we had consisted of nearly complete coverage of 1:40,000-scale black and white aerial photography and nearly complete coverage of 1:63,360-scale topographic maps having 50- and 100-foot contour intervals.
- Given the focus on bedrock mapping (this was a mineral resource assessment project), we only had very limited field stations on the lowland parts of the peninsula.
- Nonetheless, we were able to establish a reasonably well-defined framework for the glacial history of the region and were able to discover several previously unreported volcanic centers on the southwest part of the peninsula.

Original processes



Much of our fieldwork was ship-based and helicopter supported. Here is a photo of the RV Don J. Miller at Pavlof Bay with Pavlof Volcano (2,518 m) and Pavlof Sister (2142 m) in the background on the southern end of the peninsula.

Geographic setting

- Geographically, the terrain of the Alaska Peninsula ranges in elevation from sea-level to more than 2,500 m. Trees are only present on the northern part of the peninsula, farther south the landscape is sub-Arctic tundra.
- Weather can be extreme with storms bearing greater than 100 knot winds, rain, and fog; at times all of the above at once. (Typically, we assumed we'd lose half our field time to weather.)

So what's new?

- Since the original mapping, we now have access to satellite imagery – similar to Google Earth and importantly for topography, “interferometric synthetic aperture radar” (IfSAR) that has 5-meter resolution – much better than the original topographic maps.
- I’m able to resolve in much greater detail the surficial deposits in the region that we just could not see using the black and white photography and existing maps.

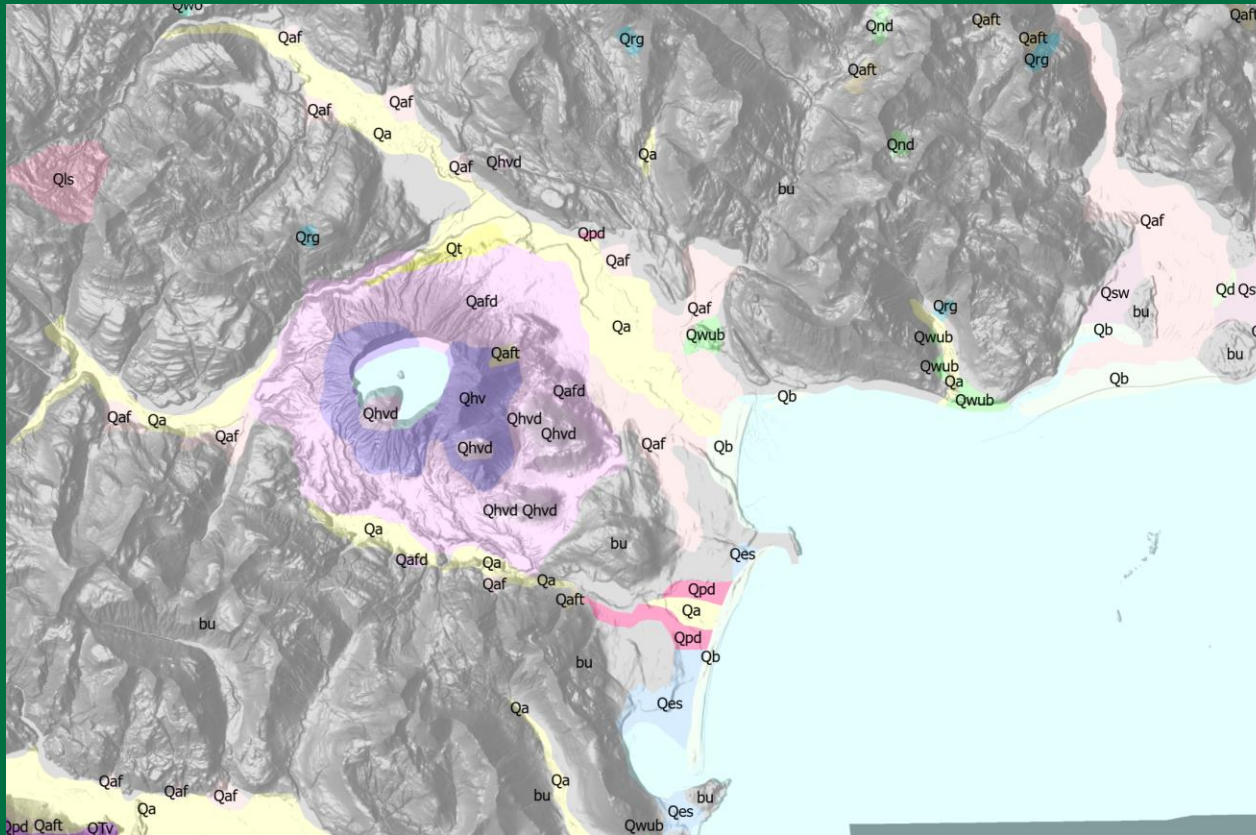
The new effort

- Several issues have become apparent at a general level. Surprisingly, as we moved northward on the peninsula, the published maps and underlying topographic maps for the Ugashik-Karluk tier and Naknek-Mount Katmai-Afognak tier are mis-registered by approximately 300 meters to the east. As a result, mapped features need to be shifted west to conform to the modern data.
- Secondly, the higher resolution topography allows far more accurate placement of unit boundaries – particularly moraine limits.

Glacial framework of the Alaska Peninsula

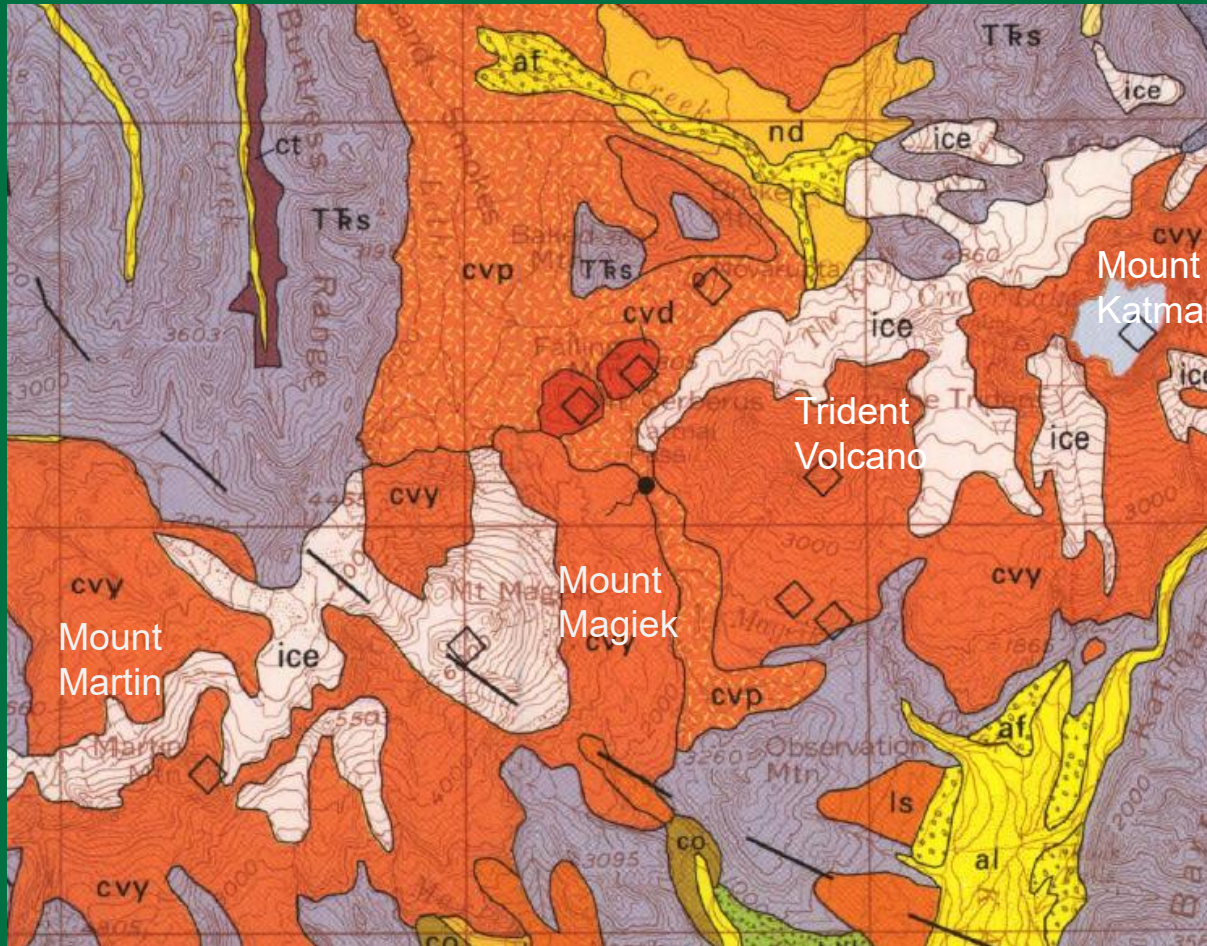
- The glacial deposits on the Alaska Peninsula are divided into several major episodes.
- Small Holocene glaciers and their deposits are also present and locally can be divided into earlier and later (Little Ice Age?) events.
- The latest Pleistocene Brooks Lake glaciation, has 4 recognized advances (Kvichak, Iliamna, Newhalen, and Iliuk, oldest to youngest, respectively).
- There are earlier glacial episodes locally preserved such as the Mak Hill glaciation and an even earlier Johnson Hill event. Distinguishing the Mak Hill and Johnson Hill deposits is challenging and subject to some controversy.

Digital capture of the published map



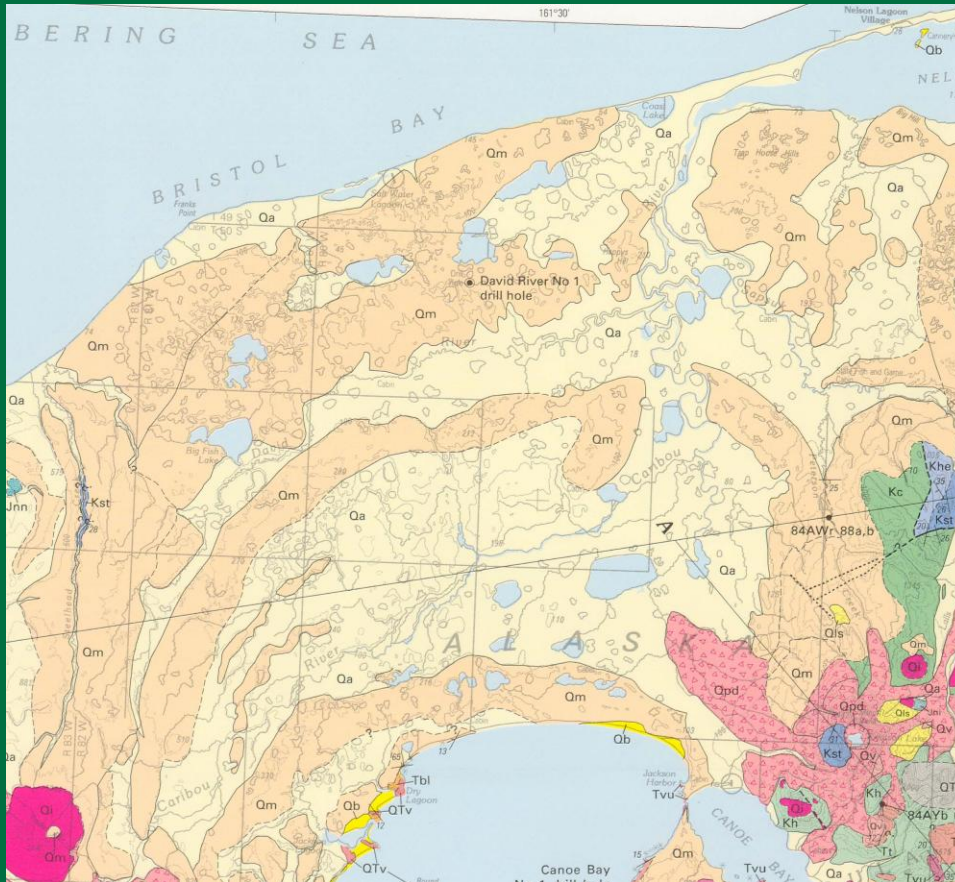
This is much of the same area after digitizing and layering on the shaded relief image derived from the IfSAR data.

Valley of Ten Thousand Smokes



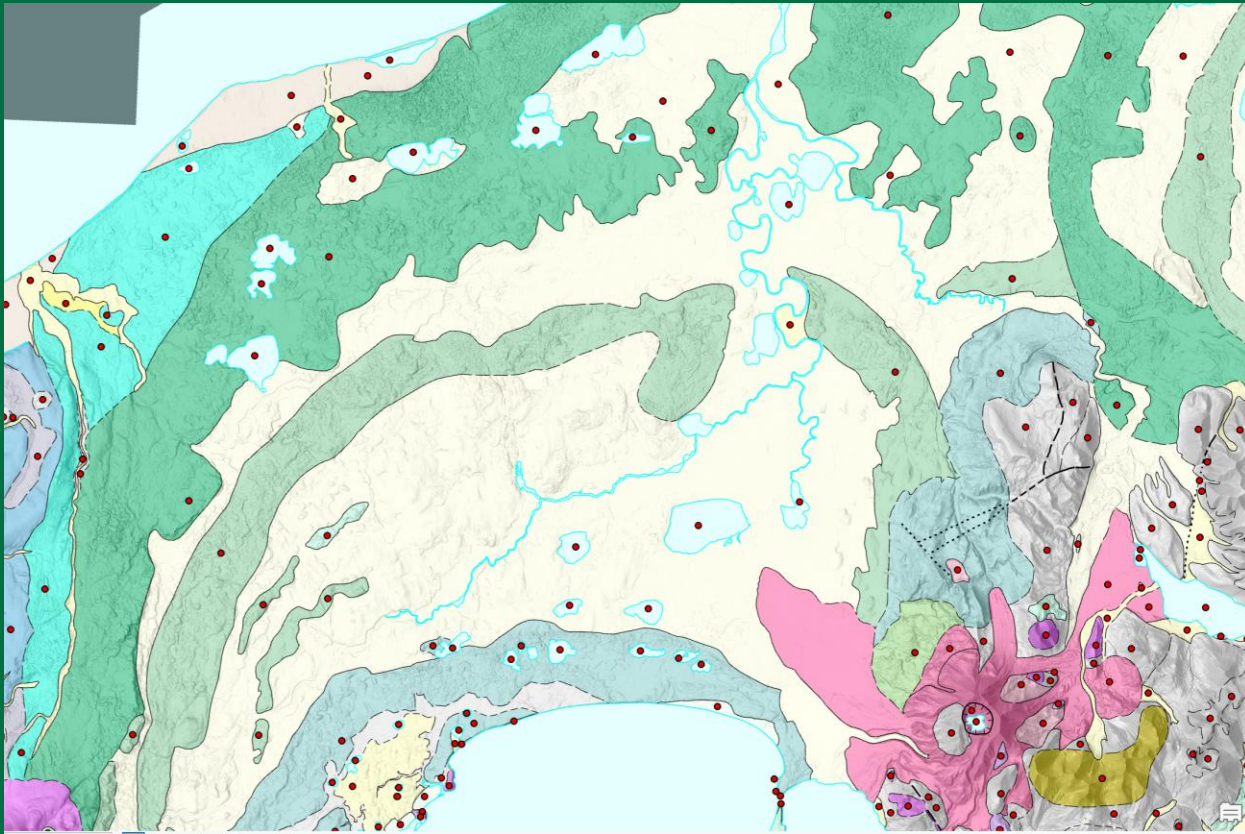
From the same original source as Kaguyak Volcano, this portion shows part of the Valley of Ten Thousand Smokes and in particular Trident volcano, and Mounts Katmai, Magiek, and Martin

Port Moller region glacial deposits



Moving to the southern end of the peninsula, this image is from the original mapping. That map did not distinguish the different glacial advances of the latest Pleistocene Brooks Lake glaciation. Shown also are the volcanic centers of Holocene Mount Dana in the lower right and Pleistocene Trader Mountain in the lower left

Glacial deposits assigned to events.



This is the working version for the new compilation. The previously mapped deposits have been assigned to their proper episodes, indicating that earlier Pleistocene glacial deposits lie outboard of the latest Pleistocene deposits on the upper left.

Key takeaways so far.

- The accumulation (or source) region for Latest Pleistocene glaciation on the Alaska Peninsula migrates inland as one travels northward.
- In the Cold Bay-False Pass region the ice-accumulation area was offshore and the extending glaciers flowed around the existing volcanic centers. Mesozoic rocks of the peninsula are no longer exposed, and in a sense, the Aleutian Islands start at Pavlof volcanic center in the Port Moller quadrangle. West of there, the peninsula only continues geographically because the volcanic centers are connected by the glacial deposits.
- To the north, the ice accumulation was partially on the peninsula and there is the suggestion that in the Katmai region, an ice cap was entirely on land.

Additional observations

- The web site of the Alaska Volcano Observatory (<https://avo.alaska.edu/>) lists 47 Quaternary volcanic centers on the Alaska Peninsula; this new mapping so far suggests this number should be increased to at least 65.
- Many of the newly recognized centers are represented by small plugs or stacked flows in the back arc region of the peninsula.
- However, a significant center, called Southwest Trident (Hildreth and others, 2000; 2003), formed in the 1950's, too late to appear on the topographic maps (1:250,000-scale and 1:63,360-scale sheets produced in 1951) and only briefly noted in AVOs description of Trident volcano.
- The higher resolution data suggests additional bedrock exposure is present in the lowlands of the Ugashik quadrangle; this is unfortunately an area where we had little ground truth.

Remaining challenges

- As the work continues, one of the challenges is distinguishing between landslides, rock glaciers, and Holocene moraines. Based on bedrock mapping that I participated in during the AMRAP projects, some bedrock units were particularly prone to landslides and I've done my best to take this into account. Generally, these landslides are not derived from cirques, which helps in their recognition.
- Distinguishing the various glacial advances is primarily based on position and weathering character. It is particularly hard locally to distinguish the youngest of the Brooks Lake advances from the earliest Holocene advances. Pinney and Beget (1991) have suggested that a later Brooks Lake advance, straddling the Pleistocene-Holocene boundary may be locally present, their Ukak advance.

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