New geologic bedrock mapping and analytical results from Aniak volcanic field, southwestern Alaska

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Purpose and Background

- The Alaskan Orocline is exhibited by the curvature of the bedrock geology from the Canadian cordillera to western Alaska and their bounding strike-slip faults.[1] (Figure 1).
- The earliest model of oroclinal formation concluded that western Alaska rotated 28º counterclockwise relative to eastern Alaska[2].
- Later, Coe et al. (1985) demonstrated that the Alaska orocline had likely formed by 40±11º counterclockwise in response to convergence between Eurasia and North America during the Late Cretaceous-Eocene [3].
- Recently, it has been argued that the Alaska Orocline formed in response to a combination of the convergence of North America and Eurasia and Aleutian subduction zone initiation [4, 5].
- ***We hypothesize that the oroclinal bending of southern Alaska is a composite feature that began with convergence between North America and Eurasia at ca. 70 Ma, followed by the initiation of Aleutian subduction at 46 Ma and a younger phase of bending related to the collision of the Yakutat oceanic plateau at 30 Ma.***

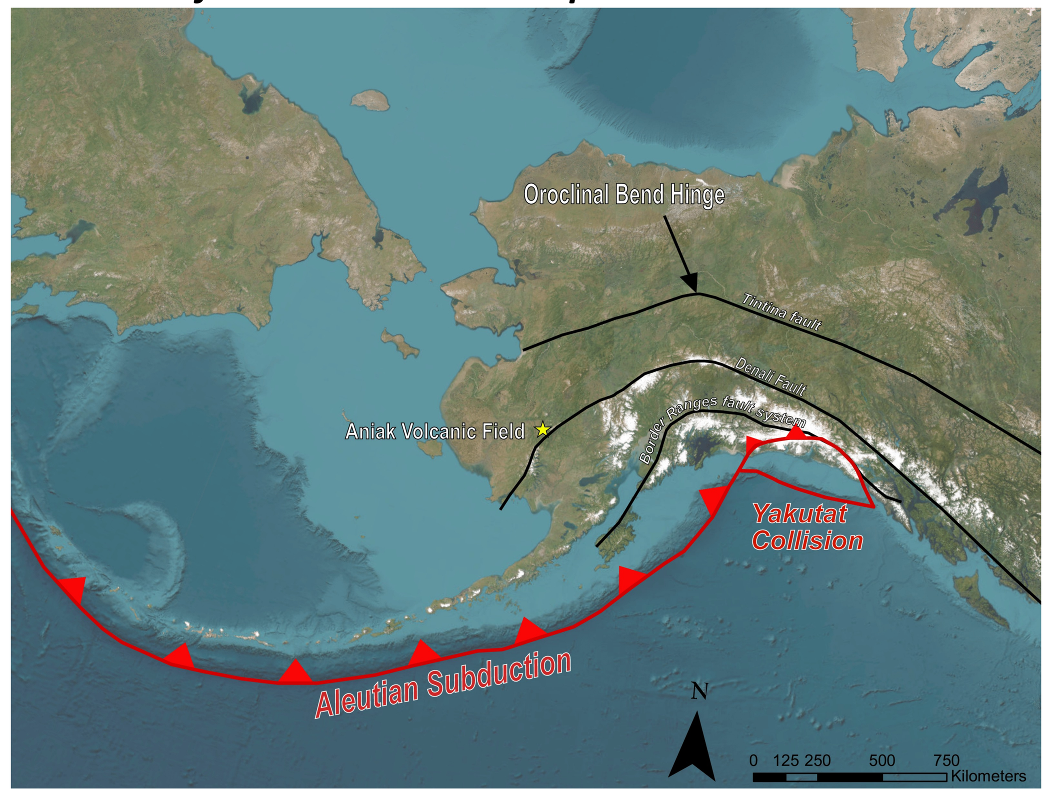


Figure 1: Satellite imagery of Alaska and the surrounding area illustrating the location of convergent boundaries (red lines with teeth in the direction of subduction). Yellow star show site locations Aniak volcanic field. Black lines are the traces of major strike-slip faults in Alaska demonstrating oroclinal bending.

- Aniak volcanic field was previously mapped as complexes composed primarily of altered basalt, andesite and trachyandesite porphyritic lava flows[6] and yielded a biotite $^{40}Ar/^{39}Ar$ age of 69.5 +/- 2.1 Ma [3].

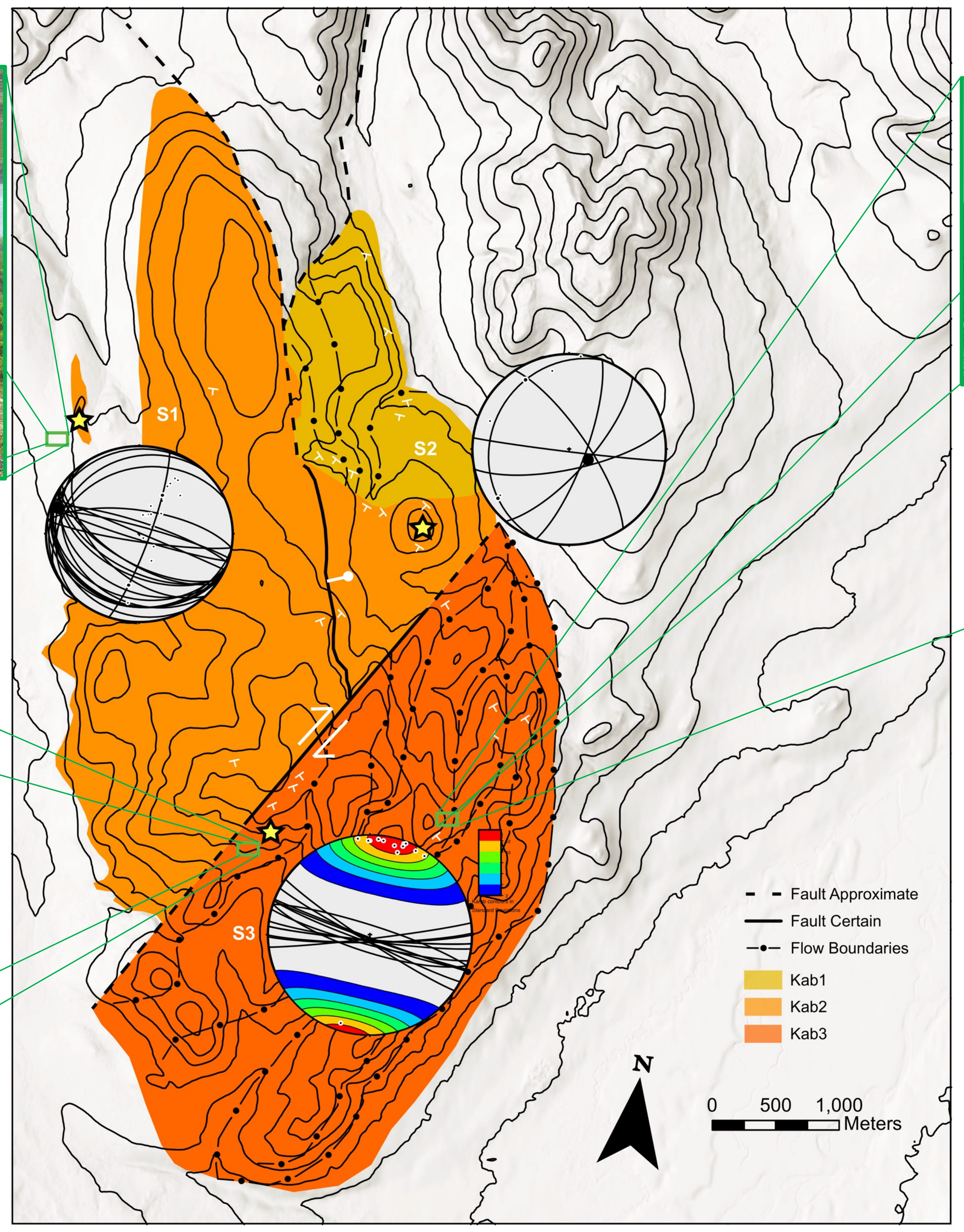
Methods

- Geologic Mapping at 1: 24,000 scale focused on stratigraphic and structural relationships among lava flows and intrusions
- Paleomagnetism Analysis:
  - Thermal and Alternating field Demagnetization
  - Natural Remanent Magnetization
  - Hysteresis Loops
  - Isothermal Remanent Magnetization
  - Magnetic Susceptibility vs. Temperature

Results

Figure 2: Columnar joints in unit Kab2, yellow lines are cooling surfaces of columnar joints.

Figure 3: Sheeted dikes with yellow lines to show width. Insert is of hackle marks in unit Kab3, with yellow lines illustrating the marks.



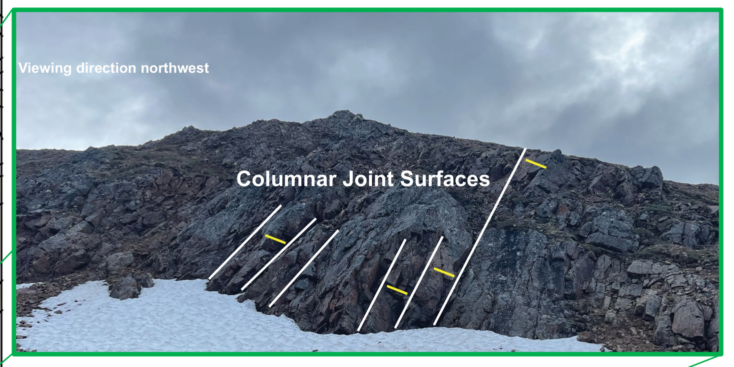


Figure 4: Columnar joints in unit Kab3, yellow line are the width of the columnar joints.

Figure 5: Geologic map of Aniak volcanic field with three petrographically distinct basalt flows and flow boundaries. There is NE-SW striking dextral strike-slip fault and NW-SE striking normal fault. Structural data includes: 1) strike and dip data of flows where bedding is present, 2) Stereonet data of dike margin orientations, interpreted as orthogonal to the extension (S3) 3) Stereonet data of columnar joints of a dike (S1), and 4) Stereonet data of columnar joints of lava flow s of unit Kab2 (S2).

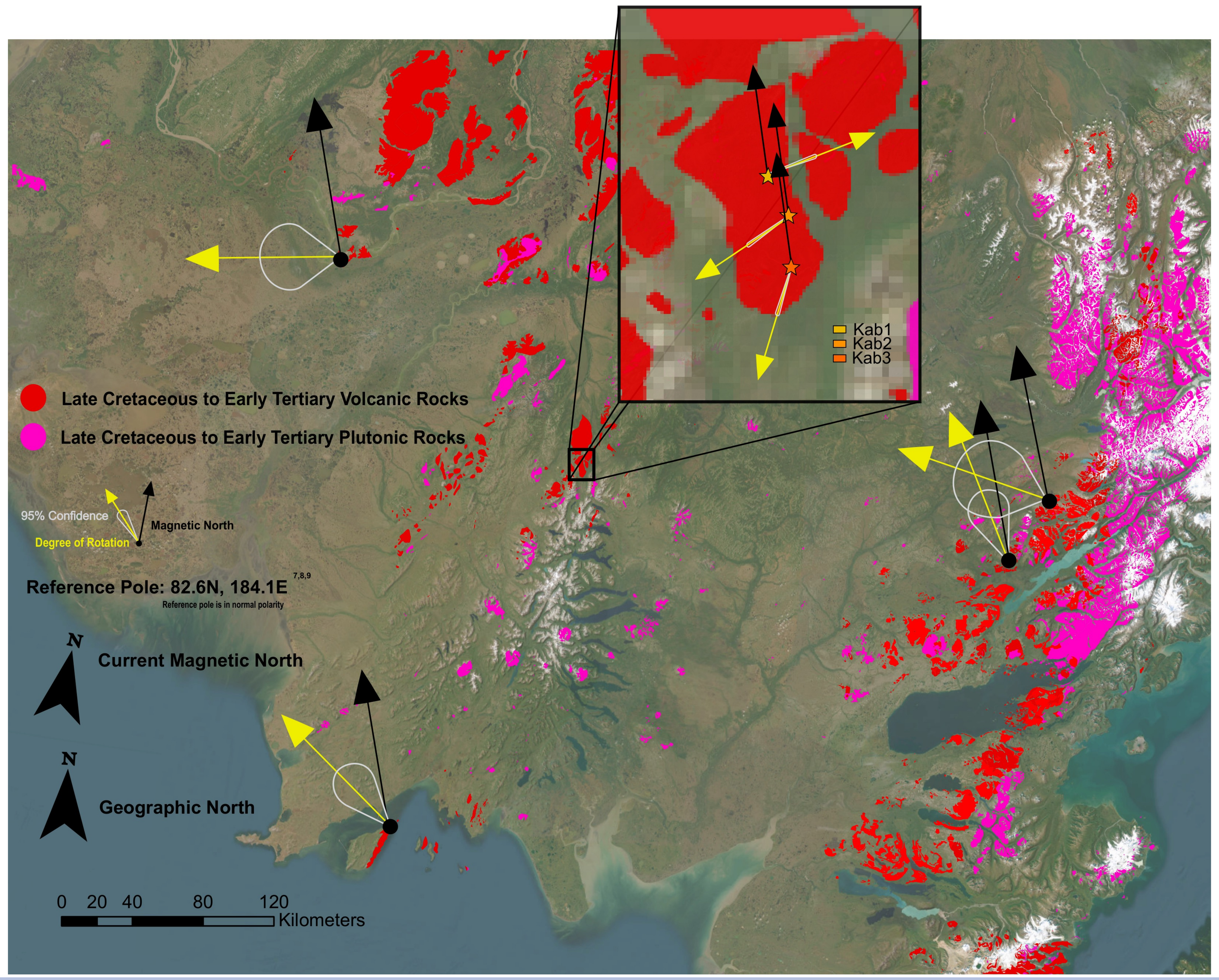


Figure 6: Simplified geologic map of western Alaska showing Late Cretaceous to Early Tertiary volcanic and plutonic rocks. Three samples are from each unit of the Aniak volcanic field; the colors of the stars correspond to the unit colors in Figure 5. Unit Kab2 and Kab3 are transposed to normal polarity. Other data were obtained from Coe et al. (1985) and altered to the same reference pole for stable North America[7,8,9]. Black arrows represent the expected declination with respect to the reference pole of stable North America during 65-85 Ma [7,8,9], and yellow arrows represent the observed declination.

Unit	Declination	Inclination	N	k	Alpha95
Kab1	69.9	33.1	16	252.05	2.3
Kab2	*237.10	47.00	11	281.94	2.70
Kab3	*196.60	54.70	9	659.69	2.00

Table 1: Samples from each unit with their corresponding declination, inclination, N (sample number), k (precision factor), Aplha95. *Kab2 and Kab3 have been transposed to normal polarity.

Conclusions

- Our 1: 24,000 scale geologic mapping revealed three petrological distinct flows, a NE-SW striking dextral strike-slip fault and an NW-SE striking normal fault.
- **In the preliminary data from the Aniak volcanic field, samples suggest a higher magnitude of counterclockwise rotation from paleomagnetic north from western Alaska than previously suggested, as well as one clockwise rotations.**

Discussion

- Stereonet data of dikes located near the dextral strike-slip fault indicates the extension direction as NE-SW (S3).
- The columnar joint of the dike plunges west perpendicular to the extension direction of NW-SE (S1).
- Columnar joint of the lava flow records that bedding dips shallowly to the west (S2).

- Coe et al. (1985) obtained 40±11º counterclockwise rotation in western Alaska. [3]
- **In the preliminary data from the Aniak volcanic field, we obtained a larger counterclockwise rotation than previously suggested for oroclinal bending and clockwise rotations.**
- To clarify the magnitude and sense of structural rotation, these preliminary paleomagnetic data present limitations that will require further attention:
  - The large k values seem to suggest that paleosecular variation may not be averaged
  - These initial interpretations assume that there are no remagnetizations.

Future Directions

Aniak volcanic field:

- Geochronology on samples to determine age relationships and further establish a timeline for rotation.
- Continue geologic mapping and sampling of the Aniak volcanic field, focusing on the northern section of the field.
- More paleomagnetic samples will be collected to determine whether the rocks record primary or secondary magnetization.

Other volcanic fields:

- Geologic mapping and sample collection of the Togiak volcanic field provide a broad sample set of volcanics dated at ca. 70 Ma.
- Geologic mapping and sample collection of Jack River volcanics dated at ca. 52 Ma to understand the younger phase of oroclinal bending.

Contact Information

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