ORIGIN OF THE REGIONALLY DISTINCTIVE DACITIC TO RHYOLITIC MAGMA SERIES ERUPTED AT HAYES VOLCANO, THE EASTERNMOST VOLCANO OF THE ALEUTIAN-ALASKA ARC

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Key Takeaways

• Hayes volcano produced regionally distinctive magmas throughout its known eruptive history
  – Different groups have same parental magma, but variable differentiation depths
• Similar/same isotopic source(s) and parental magma(s) as nearest neighbor, Spurr volcanic complex
• Slab trajectory controls geochemistry beneath Hayes
An Introduction to Hayes Volcano

Waythomas & Miller (2002)
Regional Tectonic Setting

Compositional Groups at Hayes

- **Rhyolite**
  - High-Sr Group
    - Tephra A, B, D-F, H
  - High-Sr Group (Tephra G)
  - High-Si Group
  - Previously published

- **Dacite**

- **Graphs**
  - wt. % Na₂O + K₂O vs. wt. % SiO₂
  - Sr/Y vs. Y (ppm)
  - wt. % CaO vs. wt. % FeO*
Hayes Volcano & Mt. Spurr

Hayes – hydrous minerals
Spurr – anhydrous minerals

LeBas et al. (1986)
Why is Hayes Distinctive?

Relative to Spurr and other neighboring volcanoes, Hayes is:

• Similar crustal thickness
• displaced further from the trench
• higher above the slab surface

Increased P and T releases additional water from the Pacific Plate beneath Hayes.

Water expands garnet stability to lower pressures and allows amphibole to be a stable crystallizing phase at 1.2 Gpa (30 - 40 km).

Hayes preserves minimal evidence for sediment contamination OR slab melt components

Each volcanic system defines its own isotopic field

Near neighbors, Spurr and Hayes, share the same source or mixture of sources.
Revisiting the Elevated Sr/Y Signature

All whole rock - Dacites ONLY (63 – 66 wt. % SiO$_2$)

- The primary distinction between Hayes and Spurr is the role for amphibole and garnet.
- Lower crustal process – fractional crystallization of an isotopically similar primary magma.
Hayes Petrogenetic Modeling – A Summary

**KEY**
- High-Sr Group
- High-Si Group

**Diagram**
- Naknek Fm. Sandstone
  - High-Sr Group AFC (Pl, Am, Mag, Ap)
  - High-Sr Group FC (Pl, Am, Mag, Ap)
  - High-Sr Group AFC (Am, Pl, Opx, IIm)
- High-Si Group multi-stage AFC (Pl, Bt, Am > Opx > Ox, Zrn, Ap)
- Granodioritic Plutons
  - High-Sr Group FC (Am, Pl, Opx, IIm)
- Parental magma: Spurr andesite (FC at 1.0 GPa)
  - mantle-derived basalt

**Upper Crust**
- High-Sr Group FC (Pl, Am, Mag, Ap)
- High-Sr Group FC (Pl, Am, Mag, Ap)
- High-Sr Group FC (Pl, Am, Mag, Ap)

**Lower Crust**
Graphical Summary

Not to scale

No slab melting!

High-Si Rhyolites

High-Sr (Sr/Y) Dacites & Rhyolites

Hayes

Low-P FC & AFC

Med-P AFC

High-P FC

Common parent
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• Similar/same isotopic source(s) and parental magma(s) as Spurr
• Slab trajectory controls geochemistry beneath Hayes
Thank you!
Questions?