Theories of Kula Plate and Ridge Subduction and the Effect on Aleutian Arc Evolution

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General Setting

- Aleutian Ridge
- Alaska Peninsula - Kodiak Is.
- Unimak Pass
- Current Pacific Plate Motion

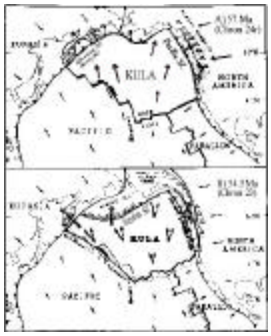
Vallier and others, 1994.

Format of Presentation

- Brief History of Time: Key Dates in Aleutian Arc Evolution
- Data, Interpretations, Relation to Arc Evolution, Problems
  - Grow and Atwater, 1970
  - Lonsdale, 1988
- "Peer" Pressure

A Brief History of Time

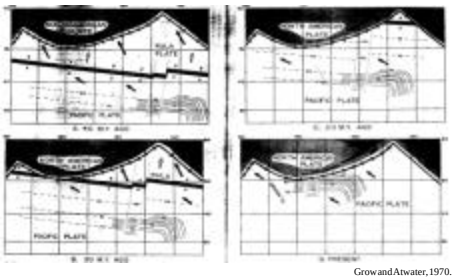
- Paleogene (c 57-55Ma) subduction zone jump
- 55-37 Ma major volumetric growth of Aleutian Ridge
- Mid-Tertiary hiatus in arc magmatism; uplift
- Mid-Miocene (15Ma) renewed volcanism
- Plio-Pleistocene volcanic resurgence



Lonsdale, 1988.

Grow and Atwater, 1970

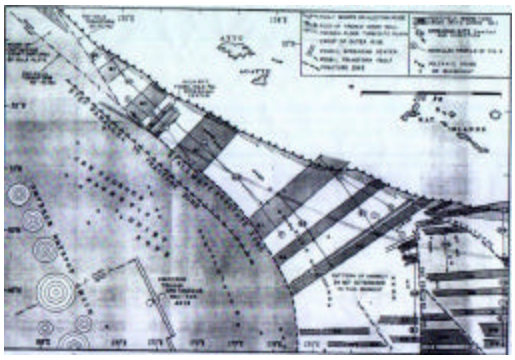
- E-W trending spreading ridge; Kula Plate ("all gone")
- Main Assumption:
  - PP motion relative to NA, 6cm/yr throughout Cenozoic



Grow and Atwater, 1970.

- From their plate reconstructions, the ridge intersected trench in Central Aleutians at 30 my ,
  - If spreading rates were not exactly constant, ridge and trench interaction could have 10 my uncertainty in time of contact
- Almost length of Aleutian Arc is an erosional unconformity and plutons due to orogenic event, roughly in Early Miocene (20-25mya)
  - Within level of uncertainty of ridge-trench interaction
  - Hypothesis: subducting the active ridge would introduce thermal anomalies, which could produce uplift and increased magmatic activity
- In east, the ridge would have hit 10 Ma, but if ridge broke up or ridge trench interactions caused a slow down, could have happened later and caused the Plio-Pleistocene event
- Possible problems:
  - assumed constant PP motion (last 65 my), Hawaii-Emperor bend records major PP motion change at 43 Ma

Lonsdale, 1988



Lonsdale, 1988.

58.6-55 Ma Change in Spreading Direction

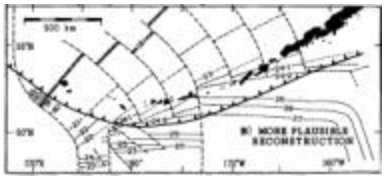
- Due to along-strike variations in degree of asymmetric spreading with fastest south-flank accretion at eastern end
- No Evidence for end Paleocene change in Emperor Seamounts, therefore 58.6-55 Ma change due solely to change in Kula Plate motion
- Theory: subduction jumped to the Aleutians from Bering Sea (Koryak), not sufficient amount of material in trench to have slab-pull effect, pulled west by slab-pull

43 Ma Cessation of Spreading

- Last Chron identified: 18r (43.6-42.7 Ma)
- Good timing: Chron 18r cessation and fusion of KP and PP is the same time of major change in PP motion recorded at Hawaii-Emperor Seamount Bend
- Pacific plate believed to have changed direction due to the influence of northward moving Australia, Kula Plate lost identity when velocity of northern PP margin became close enough that spreading between them ceased; fusion possibly served to limit SW-ward veering of Pacific

New Interpretations and Relation to Key Evolutionary Events

- Late Eocene decline could be due to change in PP motion
- Extrapolation of the 43 Ma Kula Ridge crest
  - When KP was beneath Central Aleutians, 4-6Ma, had been welded shut for almost 40my, timing suggests possible effects on Plio-Pleistocene volcanic resurgence, not in Miocene



Lonsdale, 1988.

"Peer" Pressure

- Grow and Atwater, 1970:
  - Lack of data and erroneous assumptions
    - Had no knowledge of H-E bend
  - Kula Plate motions inaccurate (based on erroneous PP motions)
  - Timing of interactions and relation to key evolutionary events are most likely inaccurate
- Lonsdale, 1988:
  - Compelling ideas on causes of Kula motion change and H-E elbow
  - Appealing timing of cessation of spreading (43 Ma)
  - However, data used in sweeping reconstructions is small