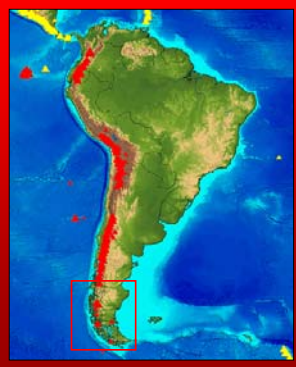
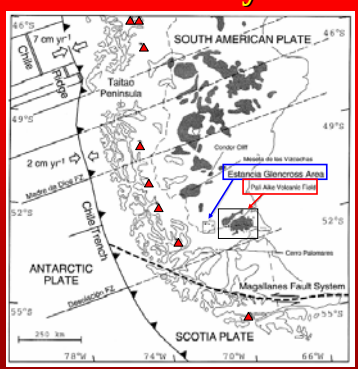
Cenozoic Volcanism of Patagonia, South America

Paul Agle

Study Area



Detailed Study Area



D'Orazio et al. (2001)

Estancia Glencross Area (EGA) Volcanics

- ~200km East of Andean Cordillera
- Buttes are volcanic necks with rare relict lava flows
- Intervening areas are reworked by glacial action

EGA Volcanics

D'Orazio et al. (2001)

EGA Petrography

- Age dates range from 8.5-8.0Ma
- Subalkaline basalts to basaltic andesites
- Porphyritic texture
  - Phenocrysts: Olivine and Clinopyroxenes
  - Groundmass: Plagioclase

EGA Geochemistry

- Primitive chemical signature
- High in Mg, Fe, Ni, Cr, V, and also SiO_2
- Very low in Al
- Sr ratios range from 0.7032-0.7034

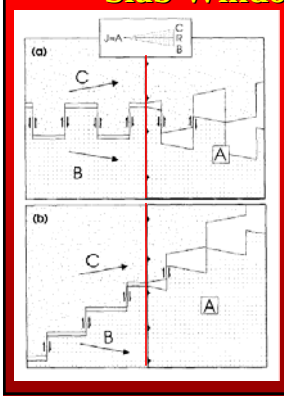
- Consistent with an intraplate or OIB, but less than 200km east of Andean Cordillera

Hypotheses

Need to introduce pristine asthenosphere beneath crust

- Slab-driven convection and upwelling
- Formation of a "SlabWindow"

Slab Window Hypothesis



Once ridge is subducted, upwelling material no longer cools to build the plates and they become "unzipped"

Upwelling mantle-derived magma either pools beneath crust or intrudes into it

Thorkelson (1996)

Slab Window beneath EGA

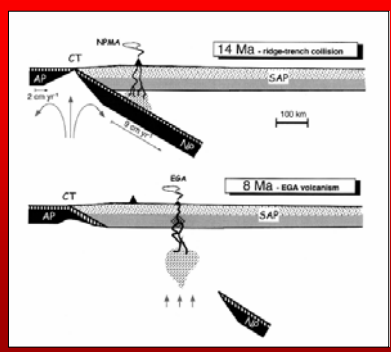
SAP- South American Plate

AP- Antarctic Plate

NP- Nazca Plate

CT- Chilean Trench

NPMA- Nazca Plate Magmatic Arc

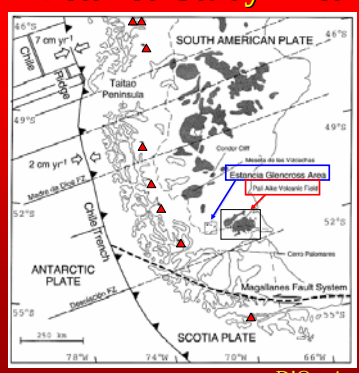


D'Orazio et al. (2001)

Support for Hypothesis

- Relative motion vectors put slab window beneath EGA at 10 Ma, 1-2 Ma before eruption
- No intermediate to deep earthquakes are present at this latitude

Detailed Study Area

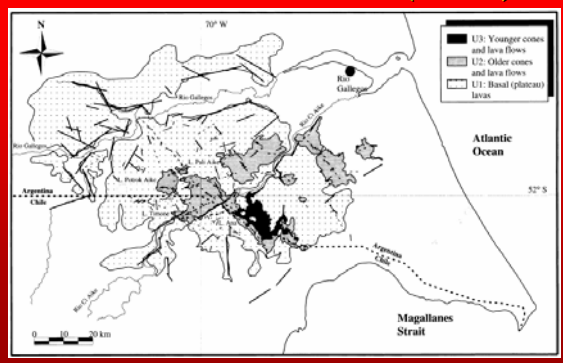


D'Orazio et al. (2001)

Pali Aike Volcanic Field (PAVF)

- ~90km East of EGA Volcanic Field
- Three stages of volcanism
  - Plateau forming tabular lava flows >100m thick
  - Old deeply eroded volcanic centers
  - Newer nearly pristine volcanic centers

Pali Aike Volcanic Field (PAVF)



D'Orazio et al. (2000)

PAVF Petrography

- Ages range from 3.78-0.17 Ma (oldest in the west)
- Mostly alkaline basalts
- Often include ultramafic garnet and/or spinel-bearing xenoliths

PAVF Geochemistry

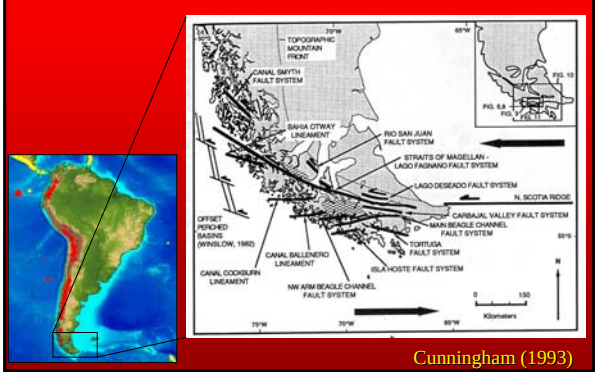
- Primitive chemical signature
- High in Mg, Ni, Cr, Ti
- Sr ratios of 0.70317-0.70339

- Again, typical of intraplate or OIB

Timing of Eruption

- Slab window should have been under PAVF at ~9Ma, but eruption does not begin until ~4Ma
- Unlike EGA with only 1-2 My lag
- Why did magma not intrude upper crust for almost 5 My?

Patagonian Orocline



Cunningham (1993)

Summary

SAP- South American Plate

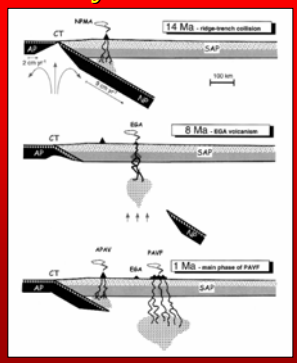
AP- Antarctic Plate

NP- Nazca Plate

CT- Chilean Trench

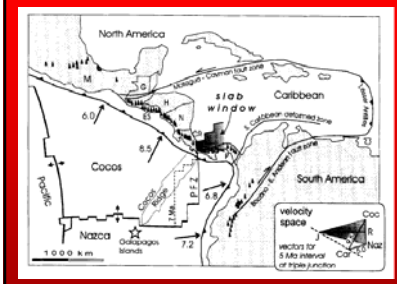
NPMA- Nazca Plate Magmatic Arc

APAV- Antarctic Plate Arc Volcanism



D'Orazio et al. (2001)

North American Analogs



Andesitic arc volcanics from Guatamala to Nicaragua

OIB-signatures similar to EGA and PAVF in Costa Rica and Panama

Also observed in California, where East Coast Range volcanics display typical arc signatures while inboard Southern California Basin volcanics are more primitive

Johnson and Thorkelson (1997)

Conclusions

- Although EGA and PAVF volcanic fields are very close to the Andean Cordillera, they are quite different compositionally
- This difference is probably due to primitive mantle upwelling through a "slab window"
- The EGA volcanics intruded the upper crust 1 2 My after the passage of the window, while the PAVF lagged ~6 My
- This lag was probably due to stress changes in the Patagonian Orocline
- Evidence for slab windows can be found along other destructive boundaries

Questions

References

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