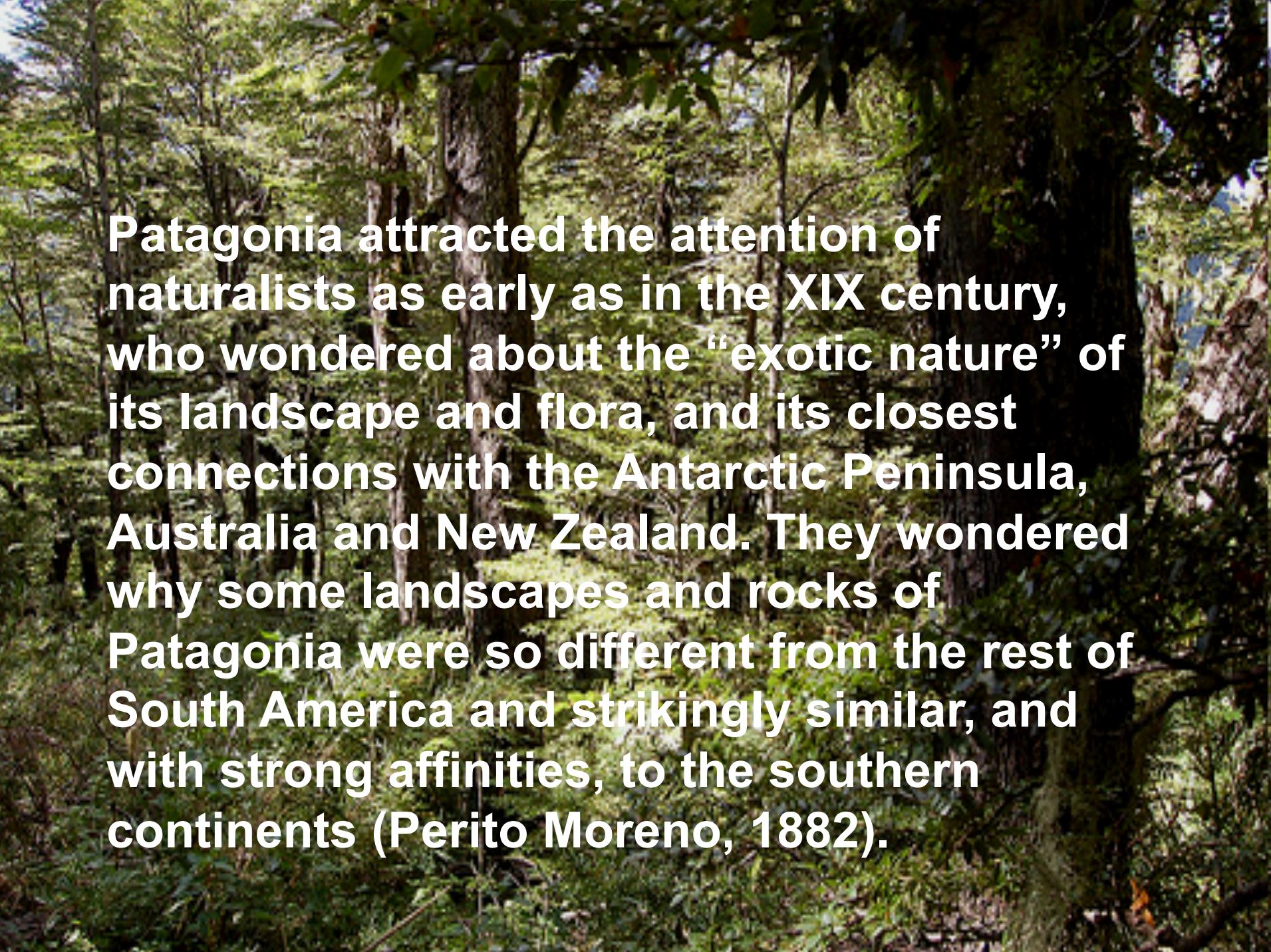


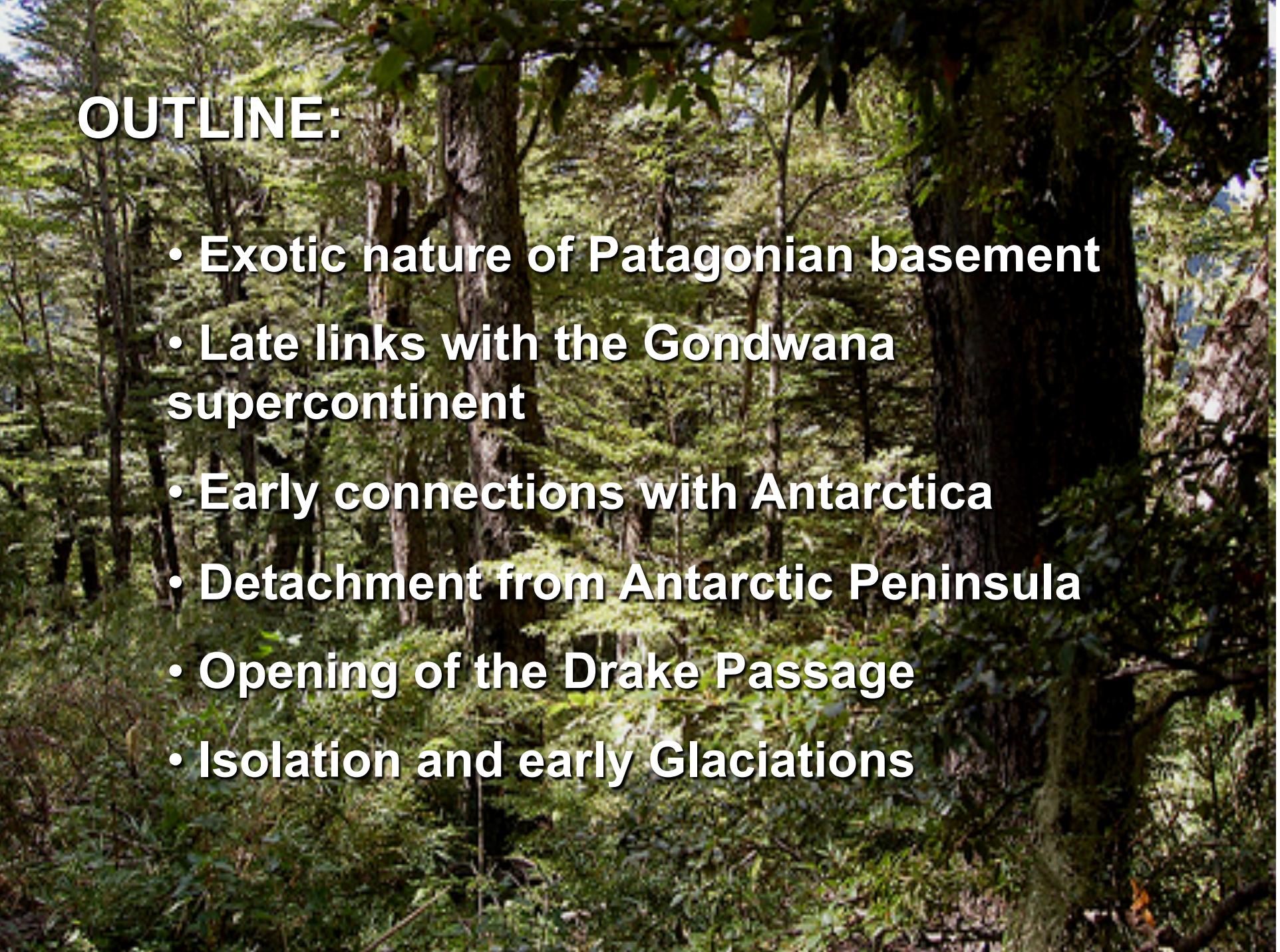
The Patagonia Terrain's Exotic Origins



Víctor A. Ramos
Instituto de Estudios Andinos
Universidad de Buenos Aires - CONICET



Patagonia attracted the attention of naturalists as early as in the XIX century, who wondered about the “exotic nature” of its landscape and flora, and its closest connections with the Antarctic Peninsula, Australia and New Zealand. They wondered why some landscapes and rocks of Patagonia were so different from the rest of South America and strikingly similar, and with strong affinities, to the southern continents (Perito Moreno, 1882).



OUTLINE:

- Exotic nature of Patagonian basement
- Late links with the Gondwana supercontinent
- Early connections with Antarctica
- Detachment from Antarctic Peninsula
- Opening of the Drake Passage
- Isolation and early Glaciations

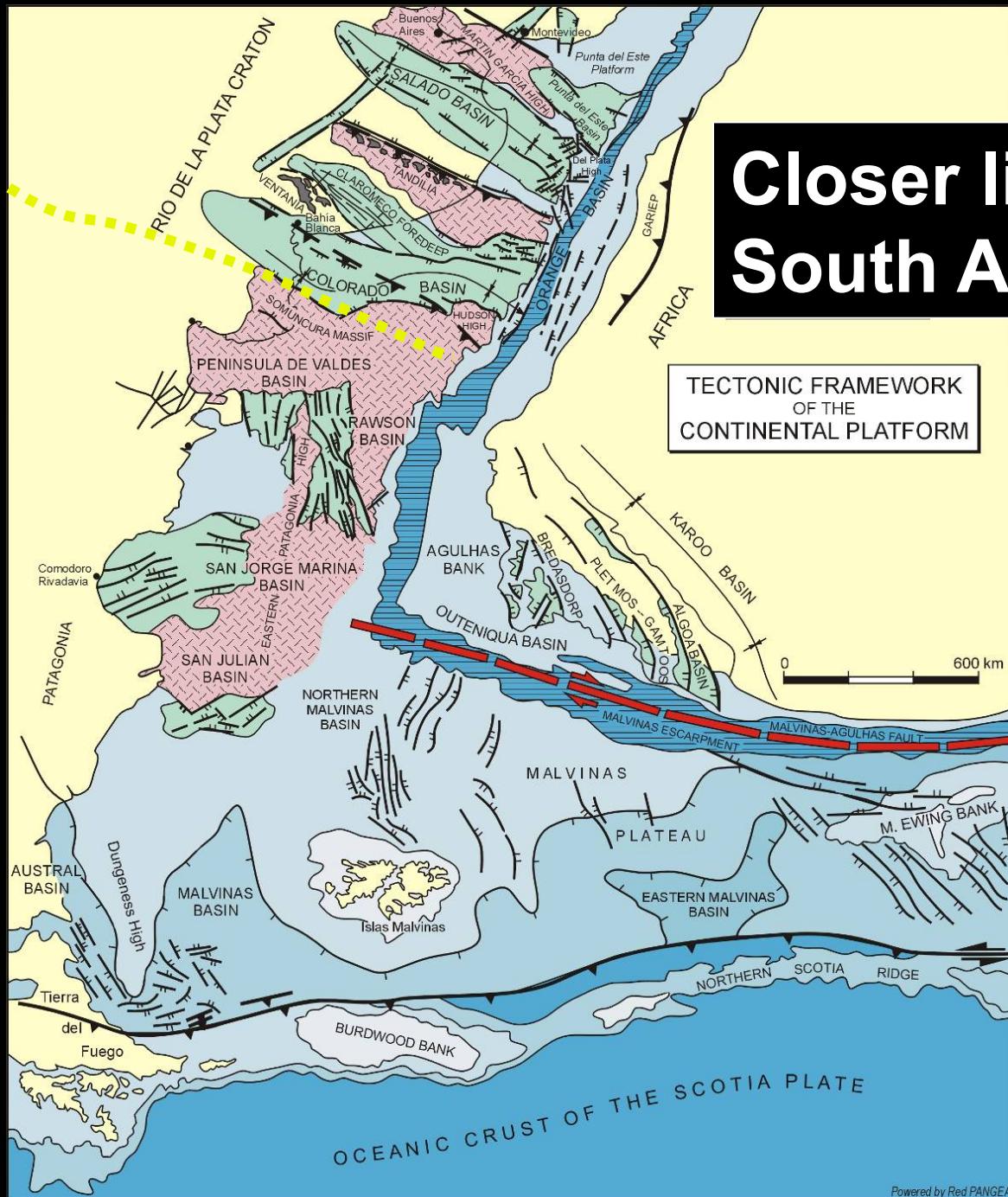
PATAGONIAN BASEMENT

Exotic Patagonia



Almeida (1976)

Closer links with South Africa



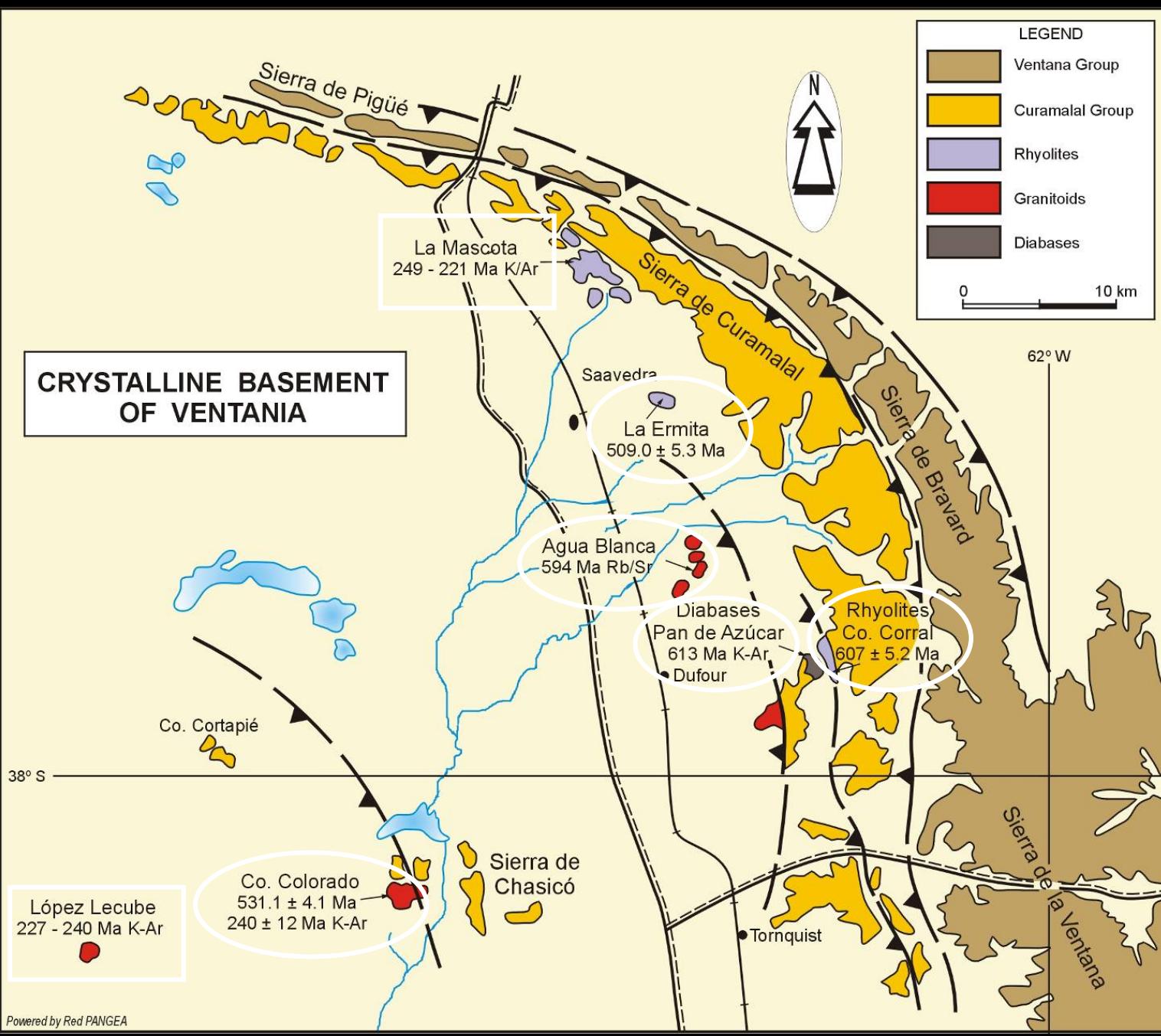
Ramos (2008)

PALEOZOIC HISTORY

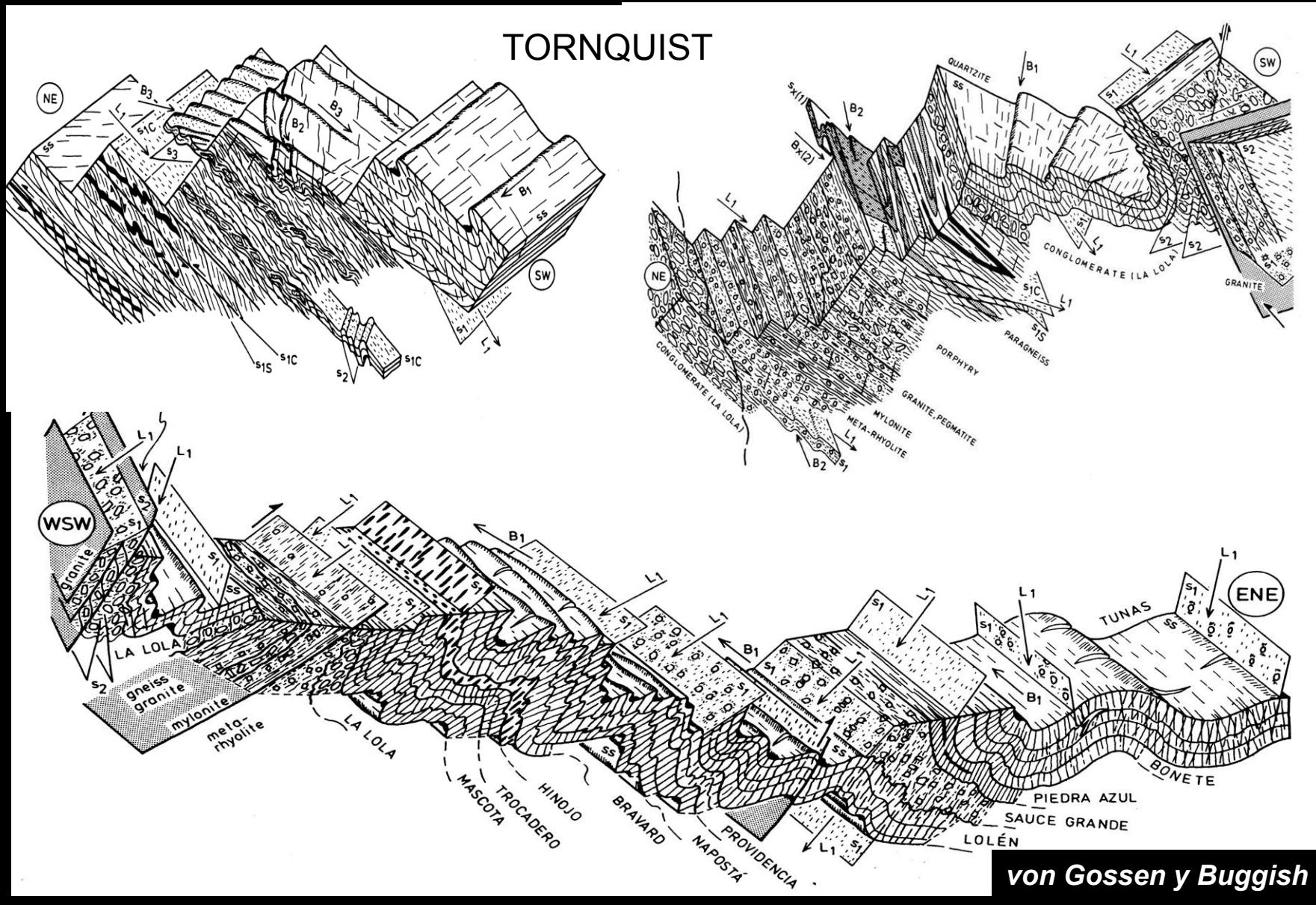




Sierras de la Ventana



STRAIN IN QUARTZITES

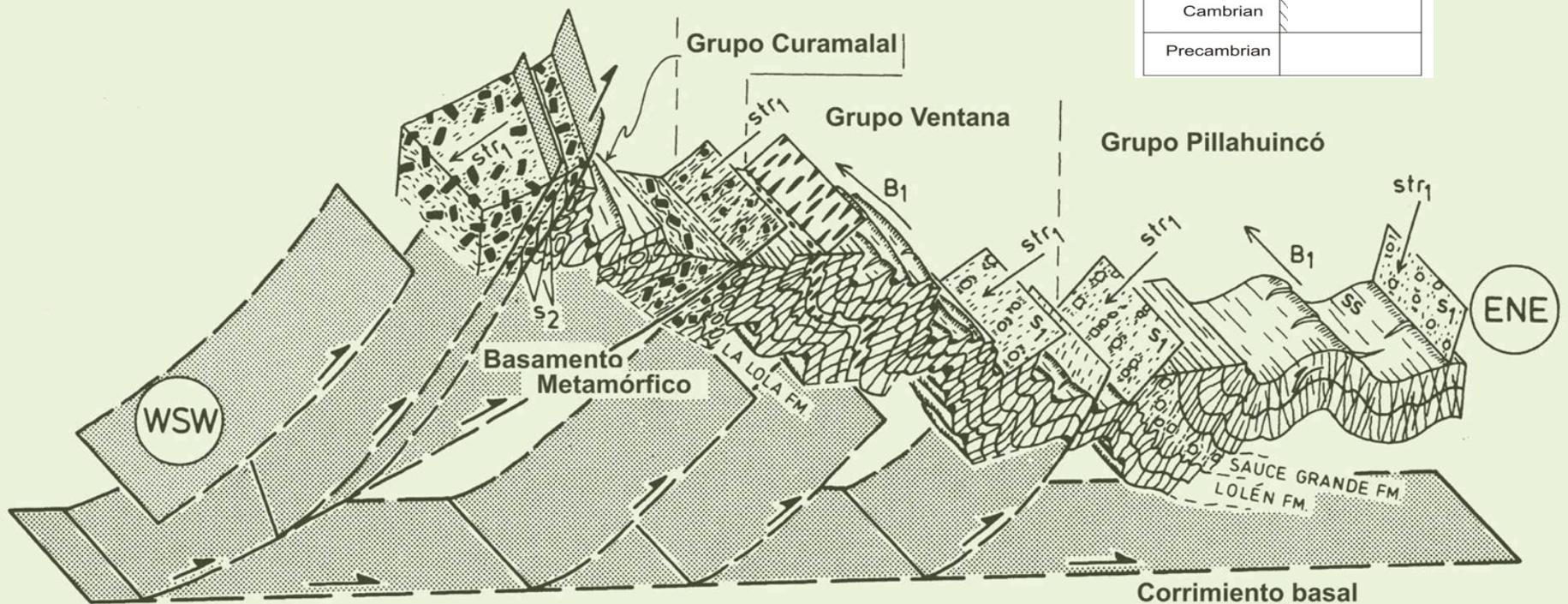


von Gossen y Buggish (1990)

DEEP STRUCTURAL STYLE

Time constraints in deformation

VENTANIA SYSTEM



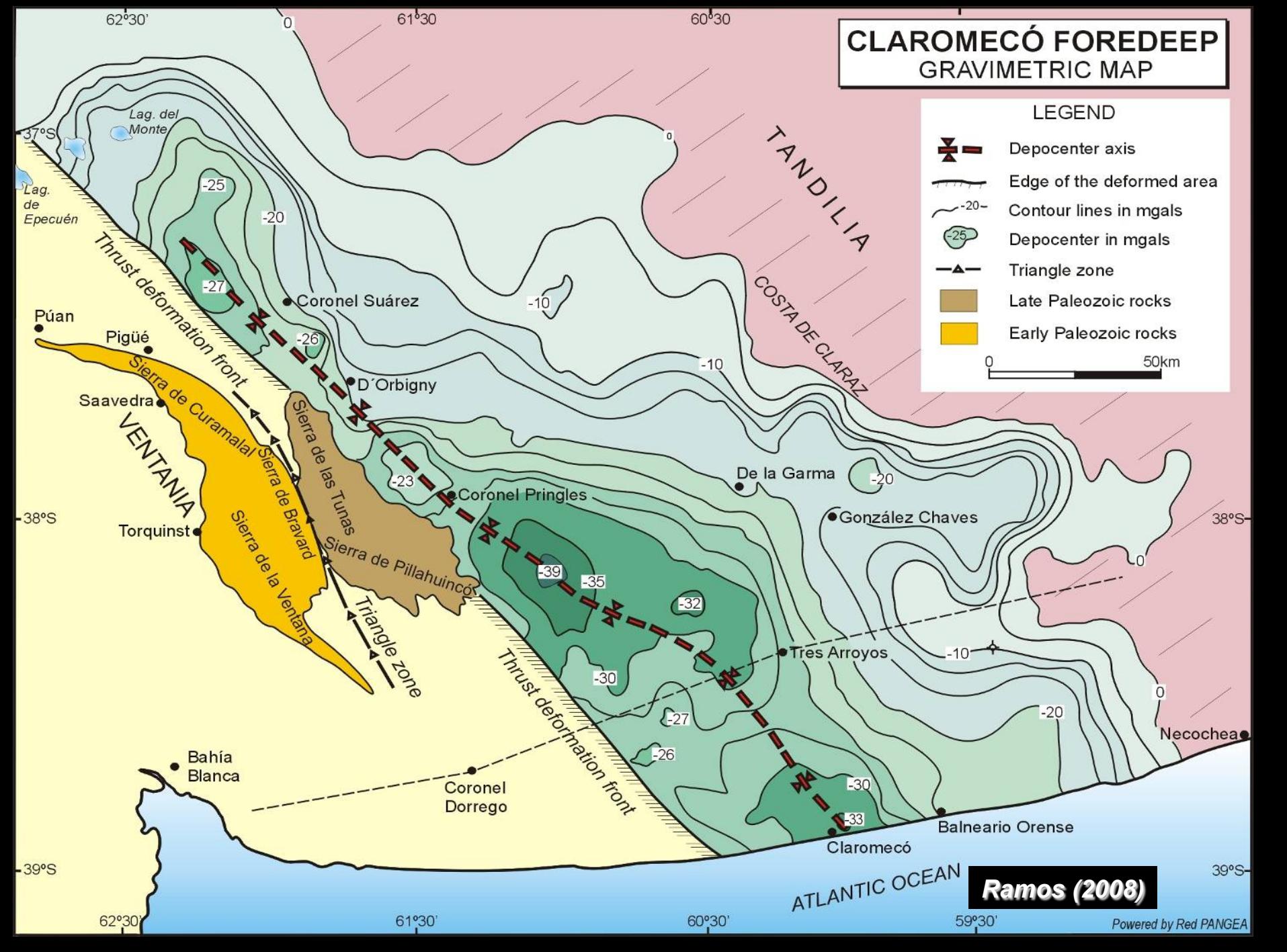
von Gossen y Buggish (1989)

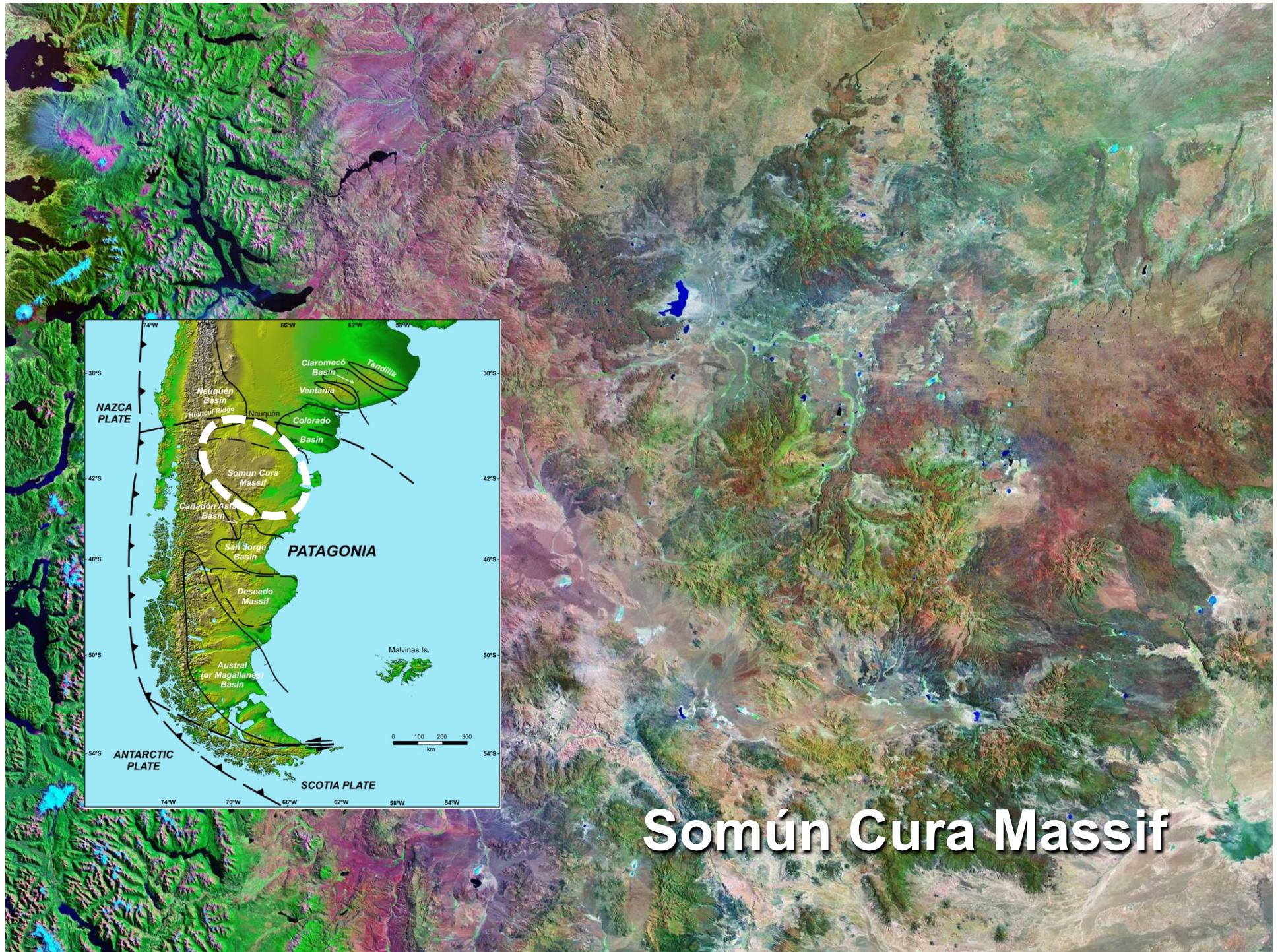
CLAROMECÓ FOREDEEP GRAVIMETRIC MAP

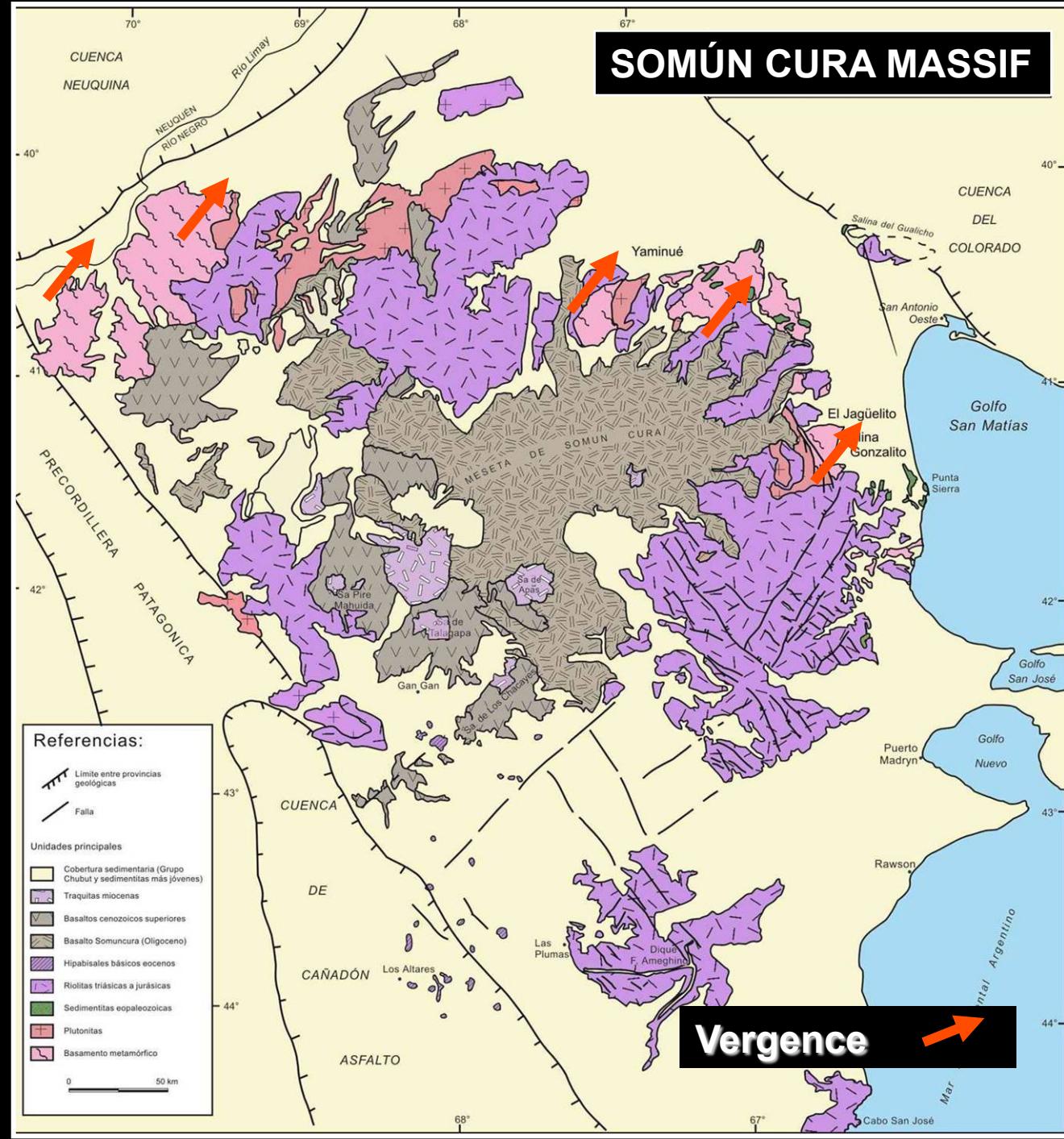
LEGEND

- Depocenter axis
- Edge of the deformed area
- Contour lines in mgals
- Depocenter in mgals
- Triangle zone
- Late Paleozoic rocks
- Early Paleozoic rocks

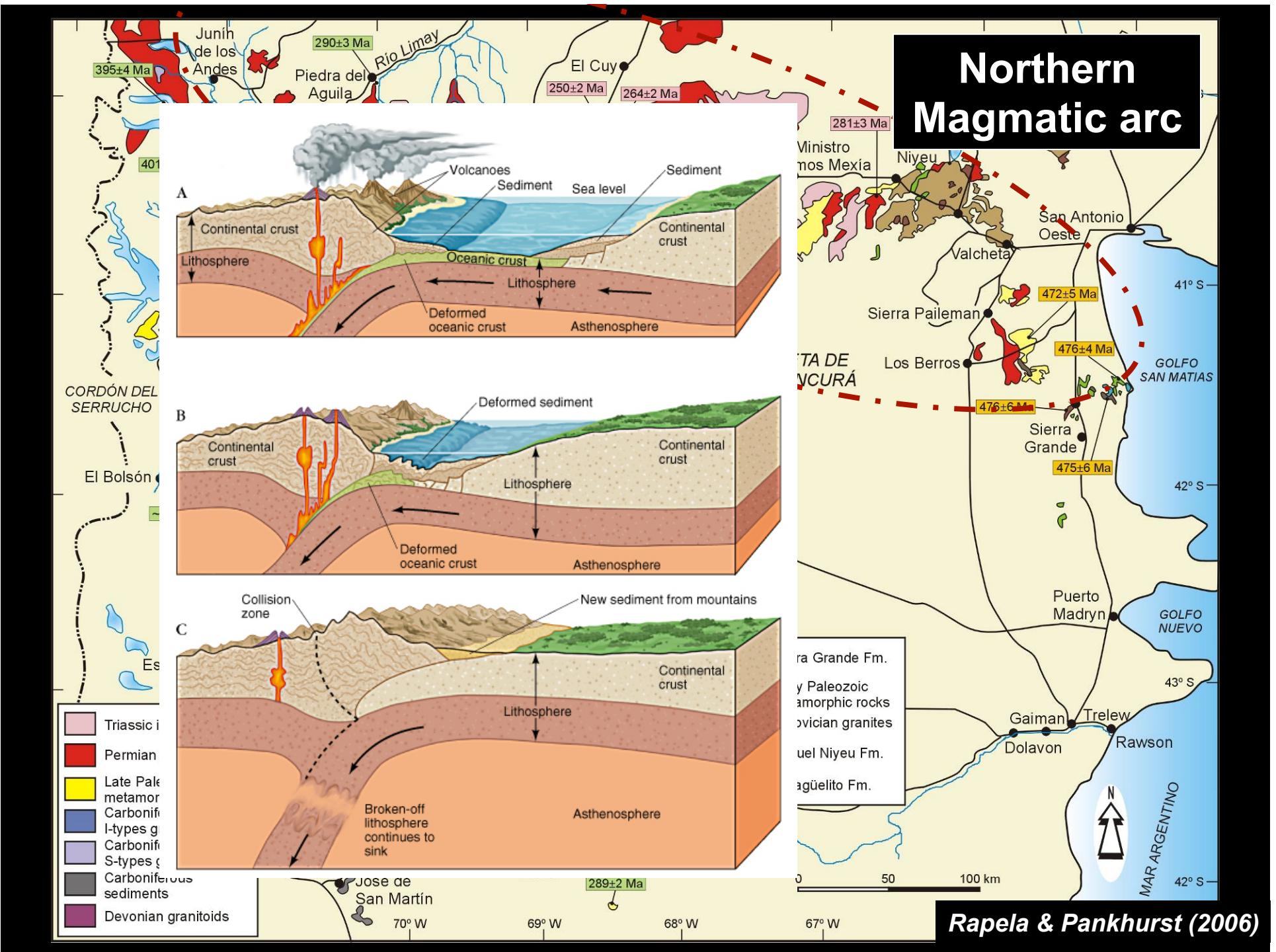
0 50km



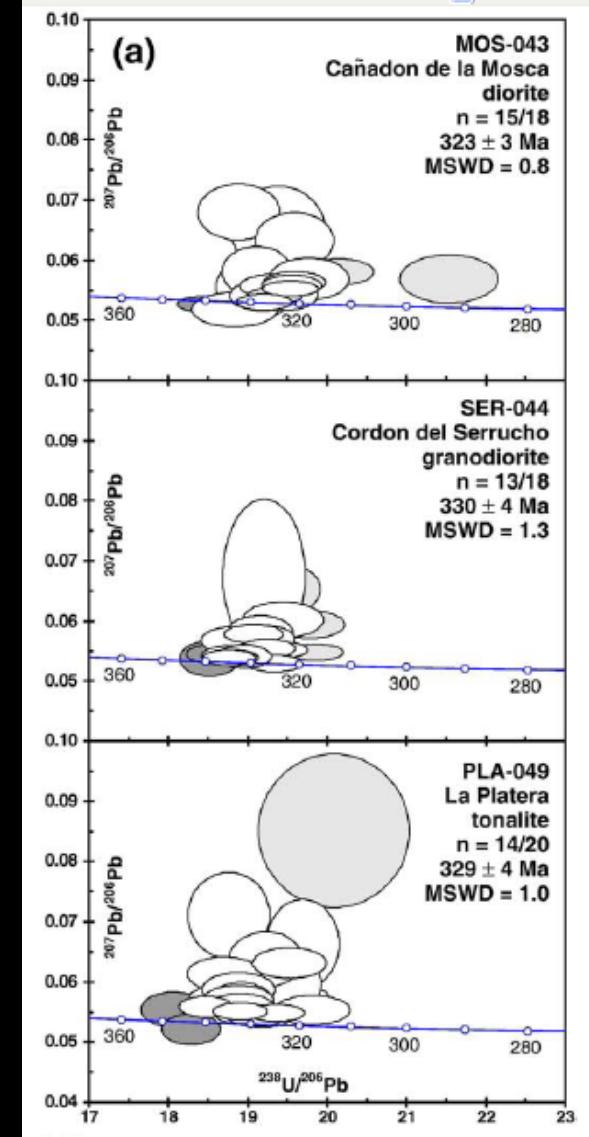
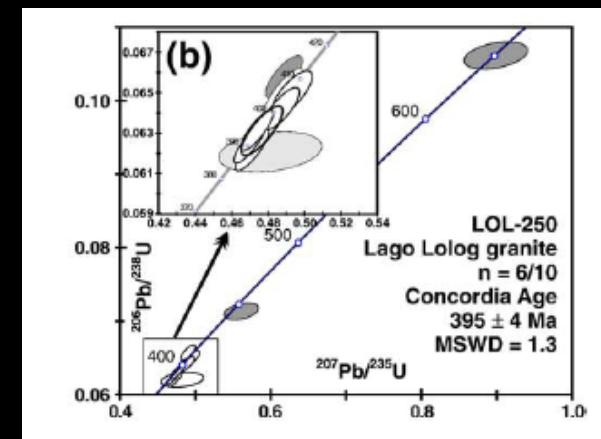
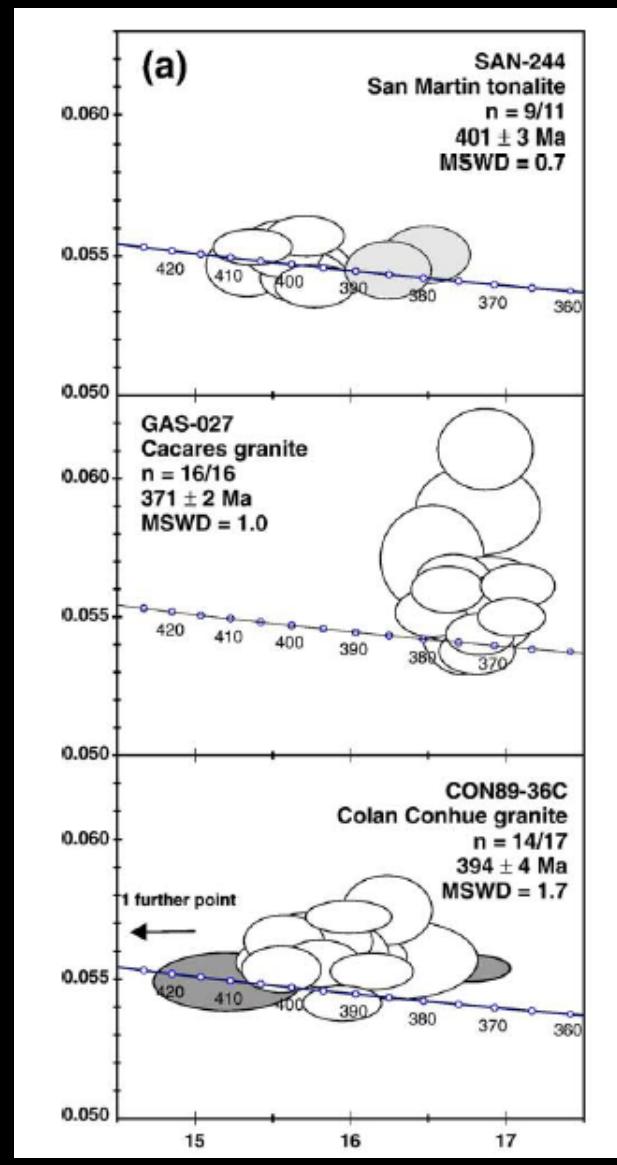




Northern Magmatic arc



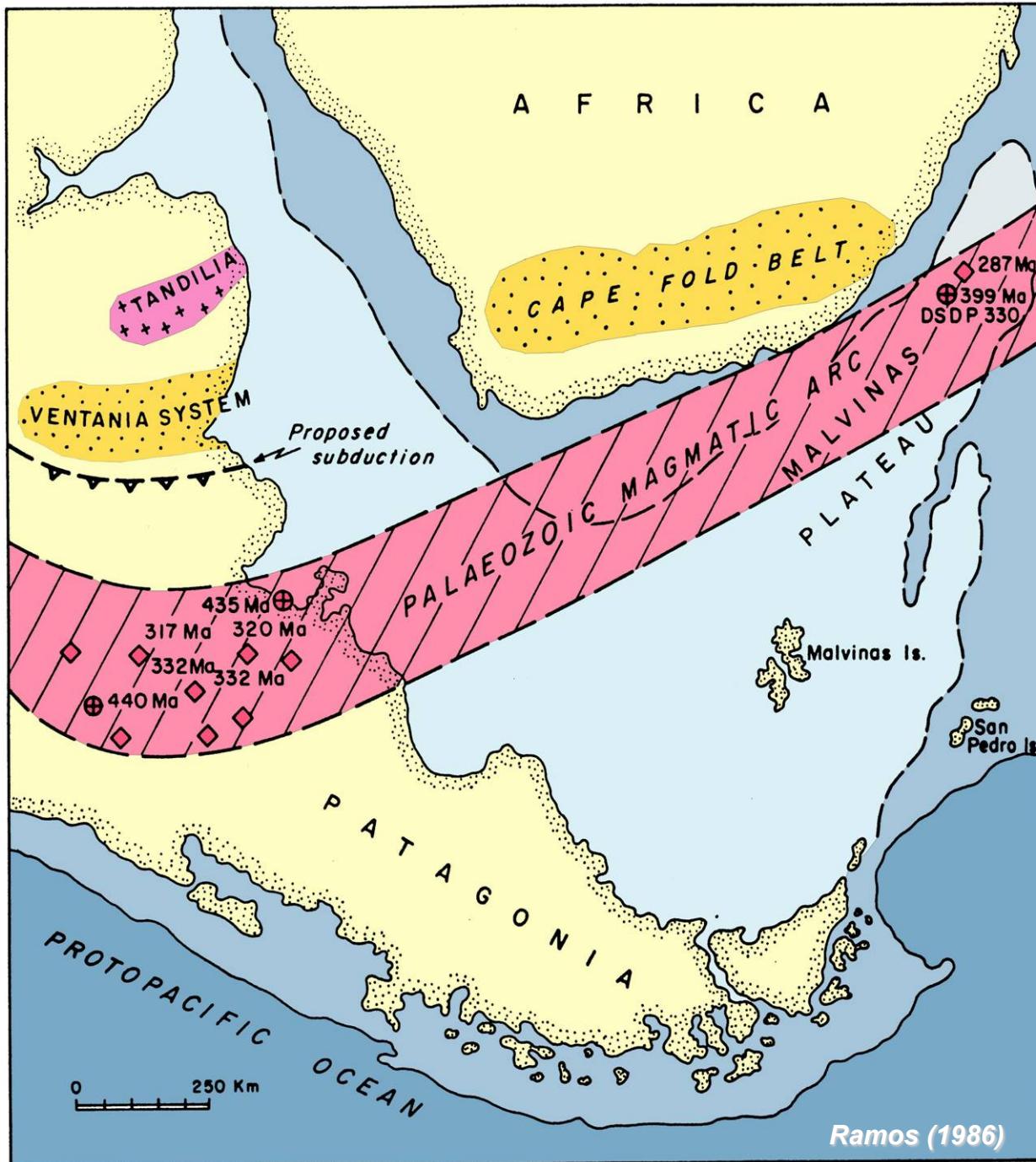
DEVONIAN TO EARLY CARBONIFEROUS MAGMATIC ARC

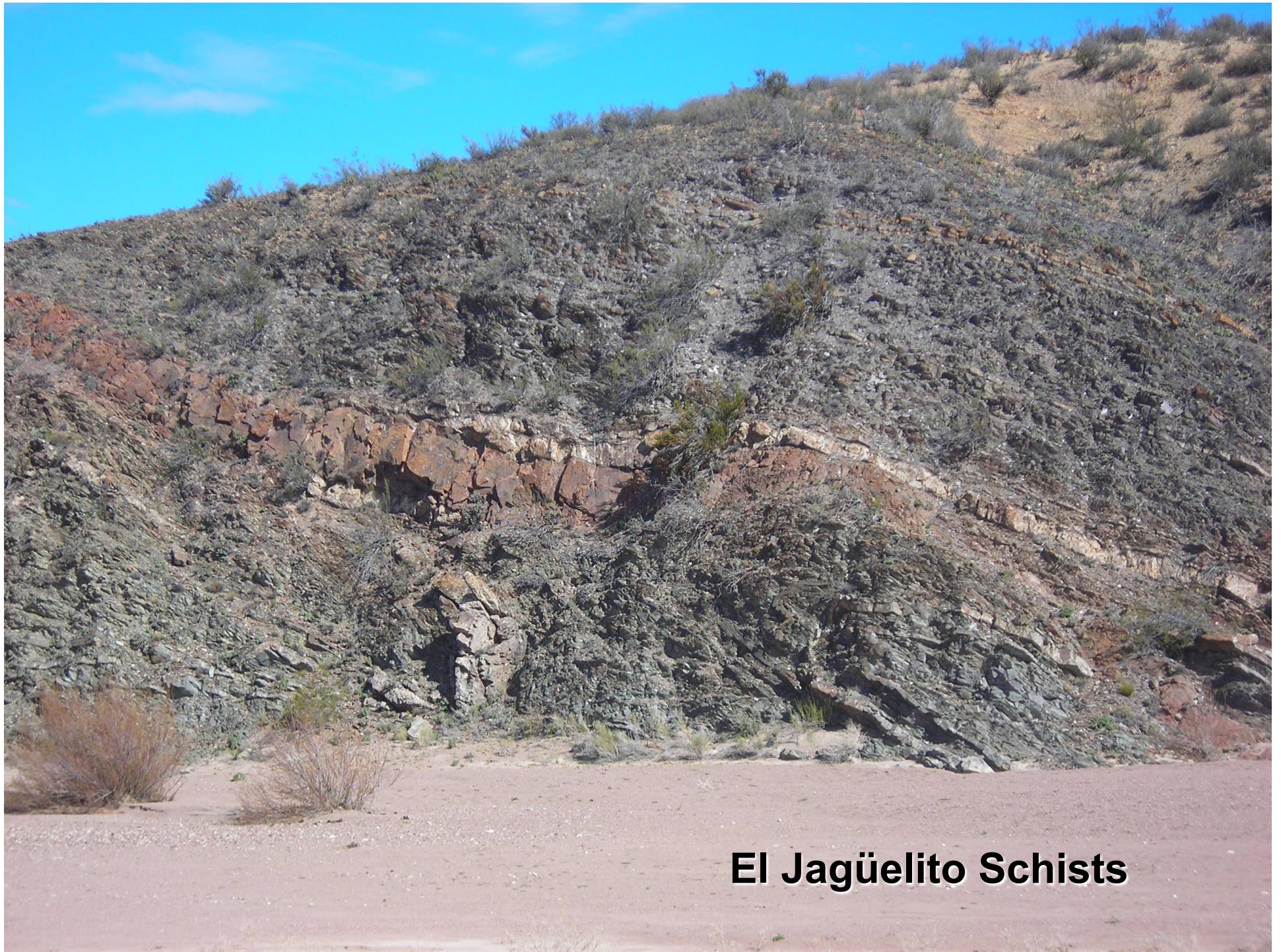


PATAGONIA

Evidences:

- Geophysical
- Magmatism
- Isotopic
- Geochemical
- Geochronology
- Structural
- Sedimentary
- Metamorphism
- Paleomagnetic





El Jagüelito Schists

EL JAGÜELITO SCHISTS

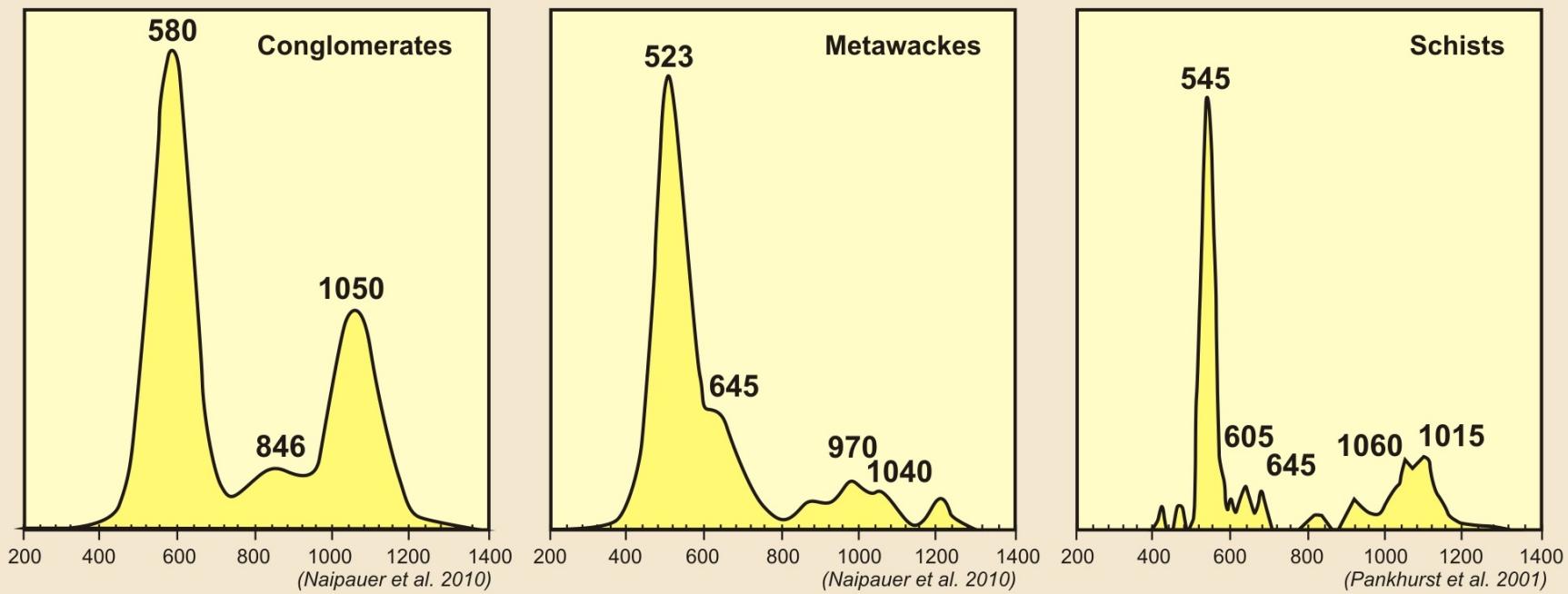
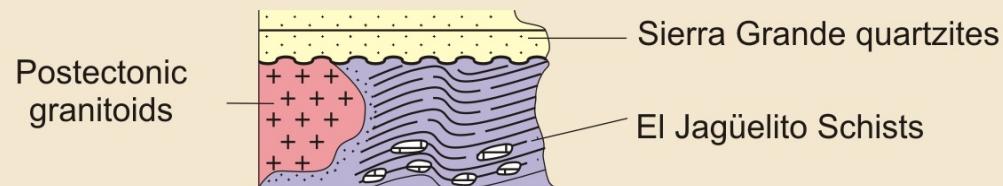
A metasedimentary sequence of wackes and conglomerates in greenschist facies

Detrital zircons:

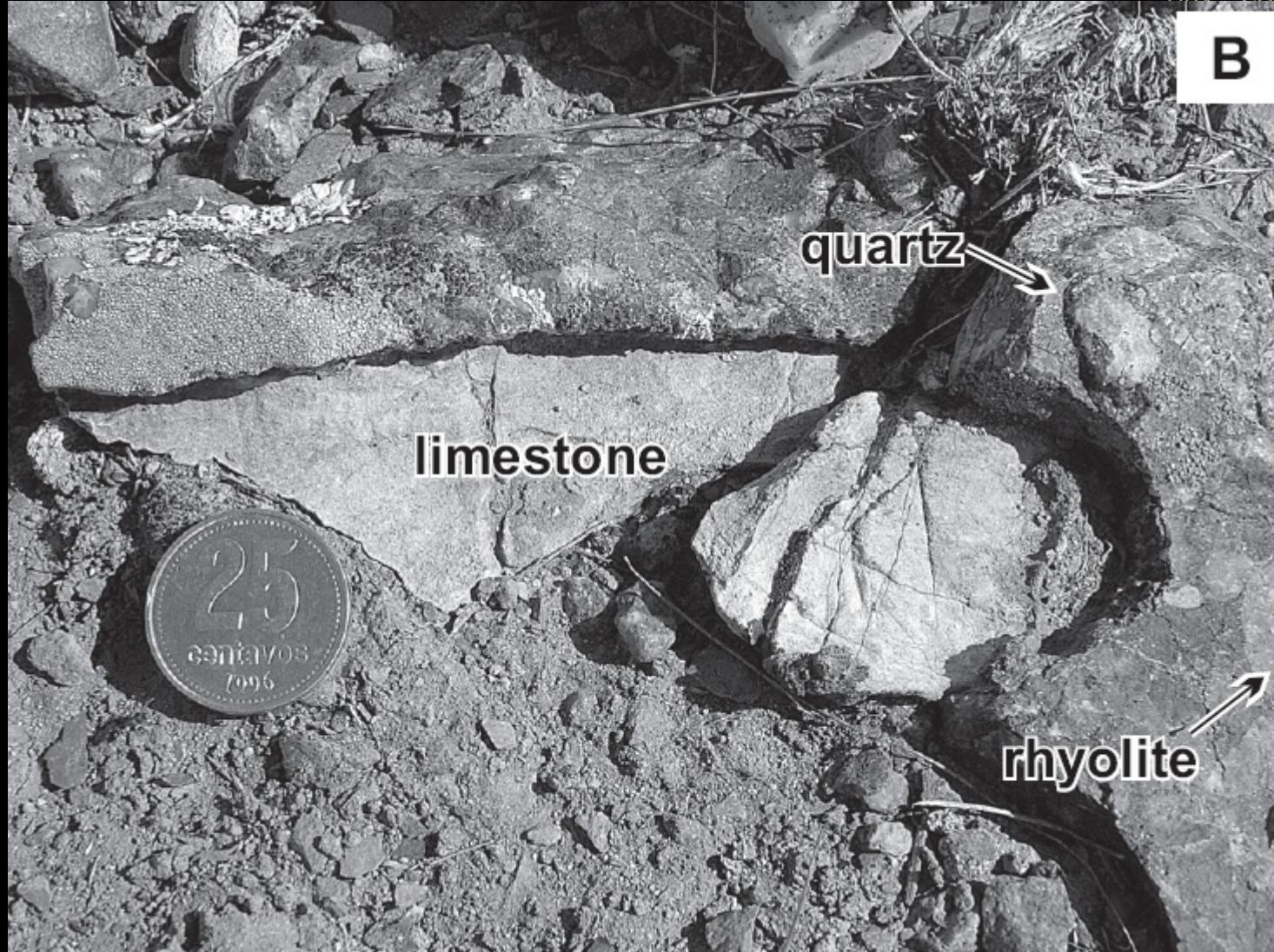
Grenvillian provenance
Panafrican zircons

Carbonate clasts:

Middle Early Cambrian Archeocyatids
Australia - Antarctic province



Archeocyatids in the El Jaguelito Schists



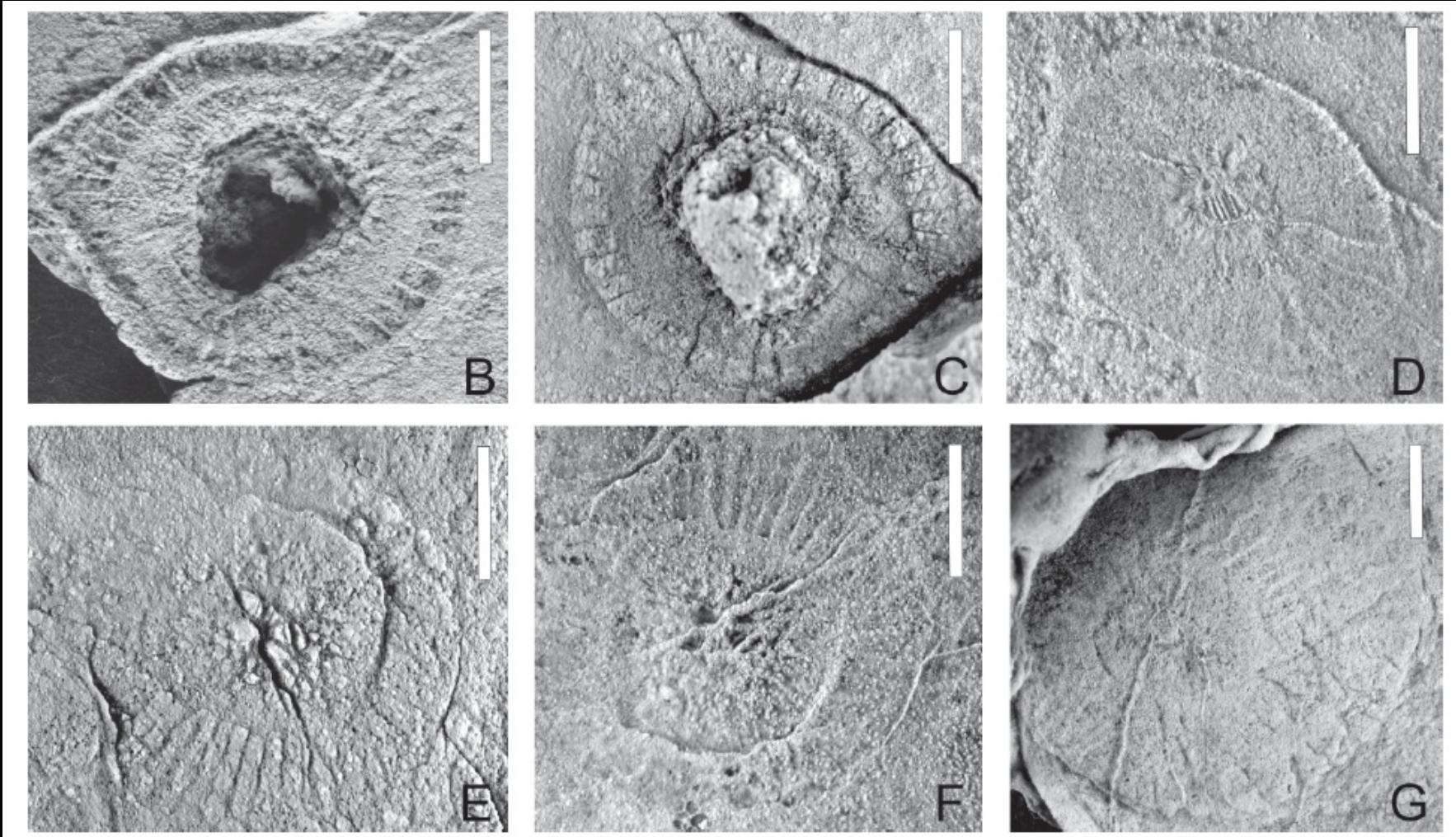
Gonzalez et al., 2011

Archeocyatids in the El Jaguelito Schists



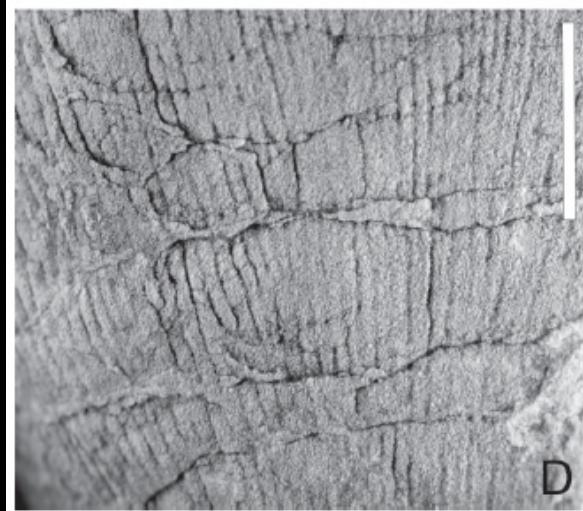
Gonzalez et al., 2011

Archeocyatids in the El Jaguelito Schists



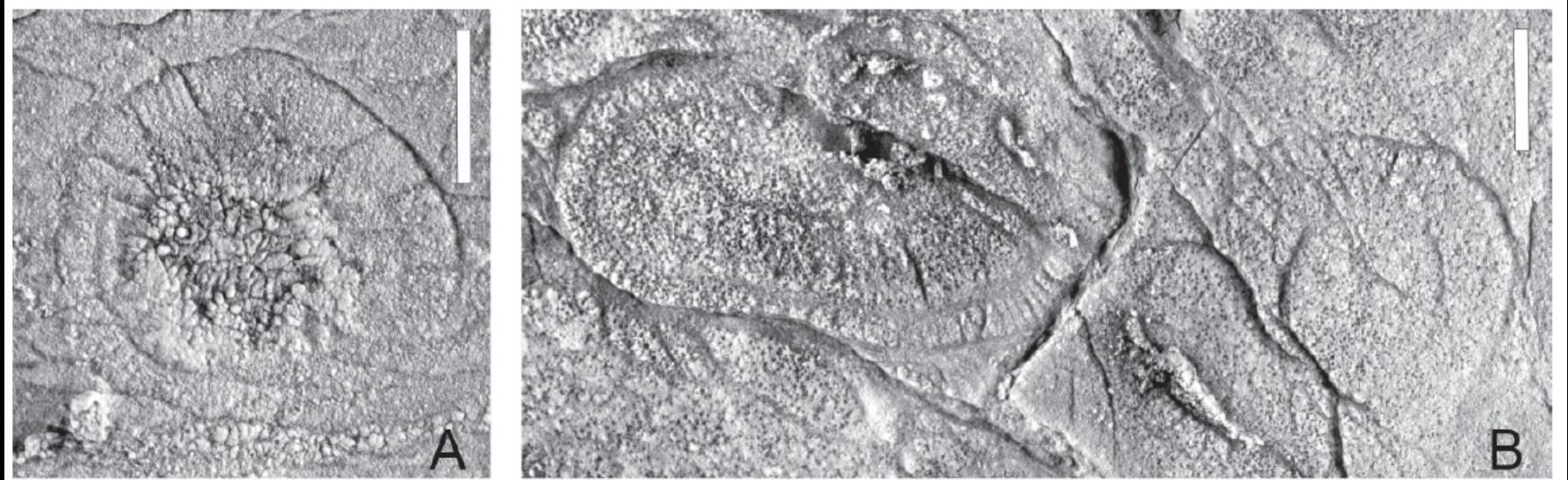
Gonzalez et al., 2011

Archeocyatids in the El Jaguelito Schists



Gonzalez et al., 2011

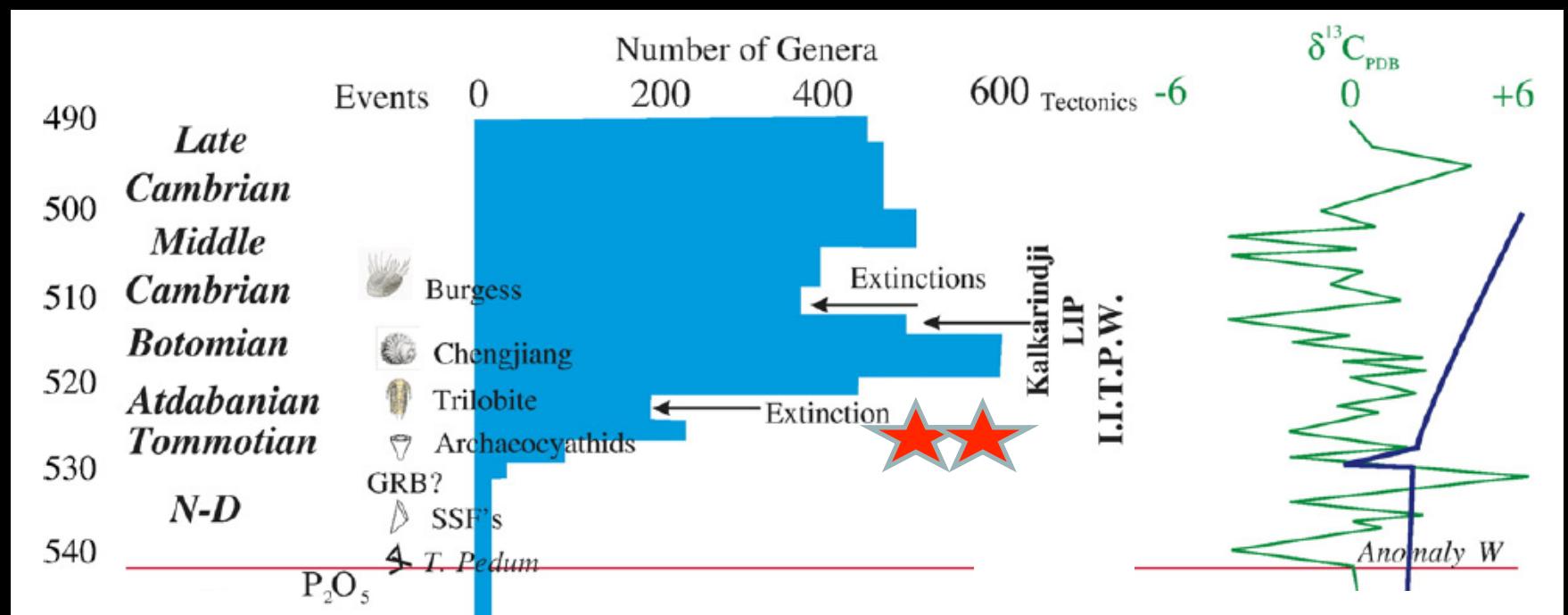
Archeocyatids in the El Jaguelito Schists



- Middle Early Cambrian of the Antarctica-Australia Province exclusive from Eastern Gondwana.
- Strong affinities with carbonate platforms of Central Transantarctic Mountains of Eastern Gondwana.

Gonzalez et al., 2011

Biochron of the Archeocyatids In Eastern Gondwana (Shackleton Limestones)



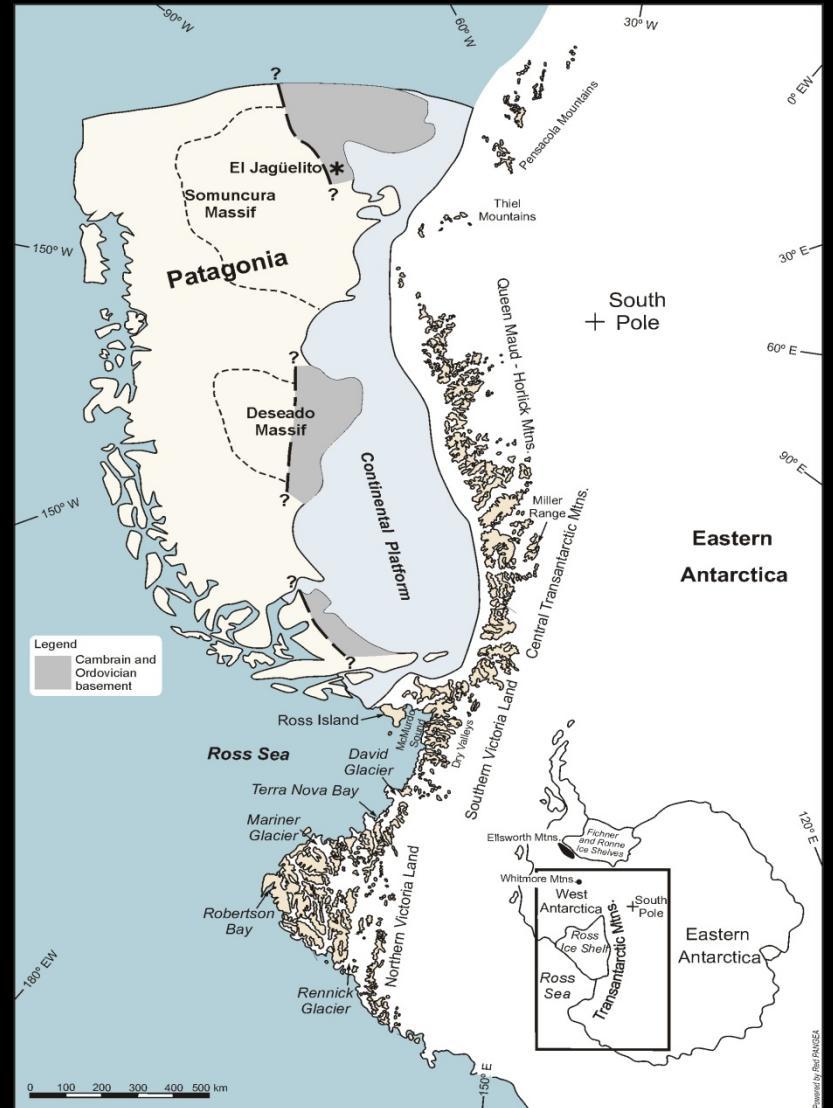
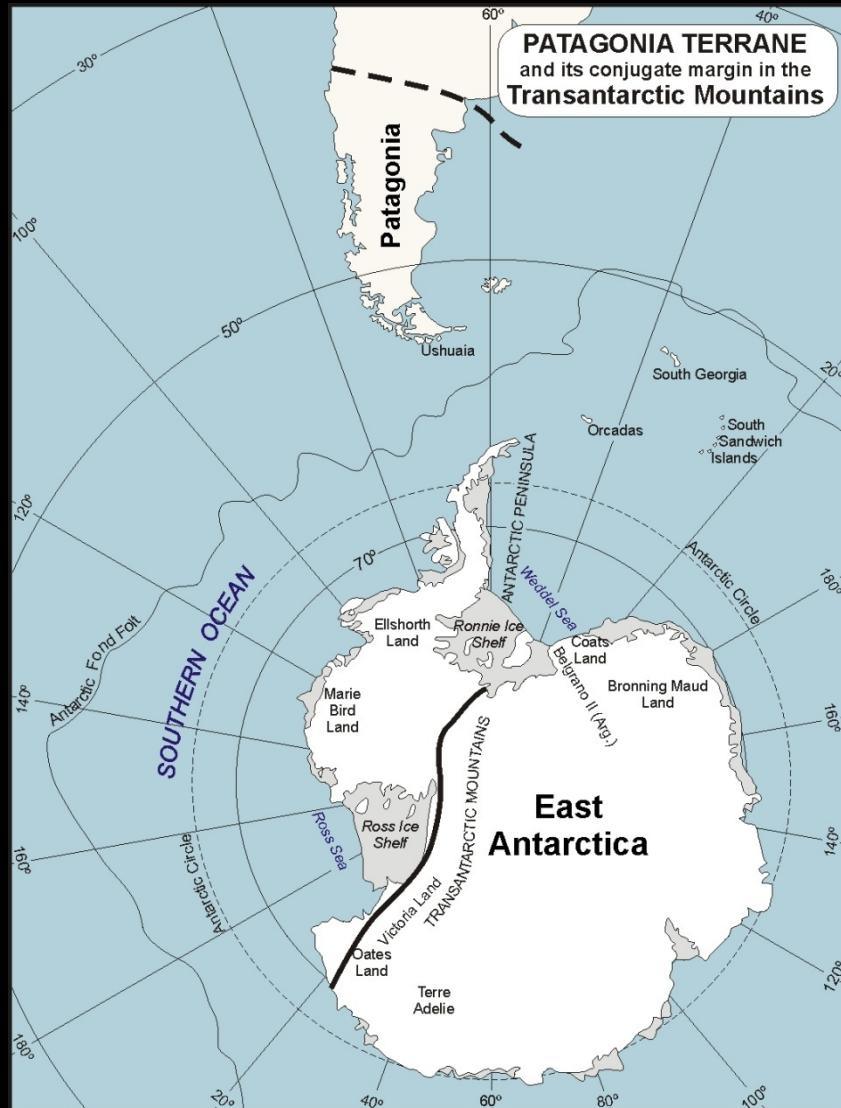
Proliferation of Archoecyathids in Australia-Antarctica

Meert and Lieberman (2008)

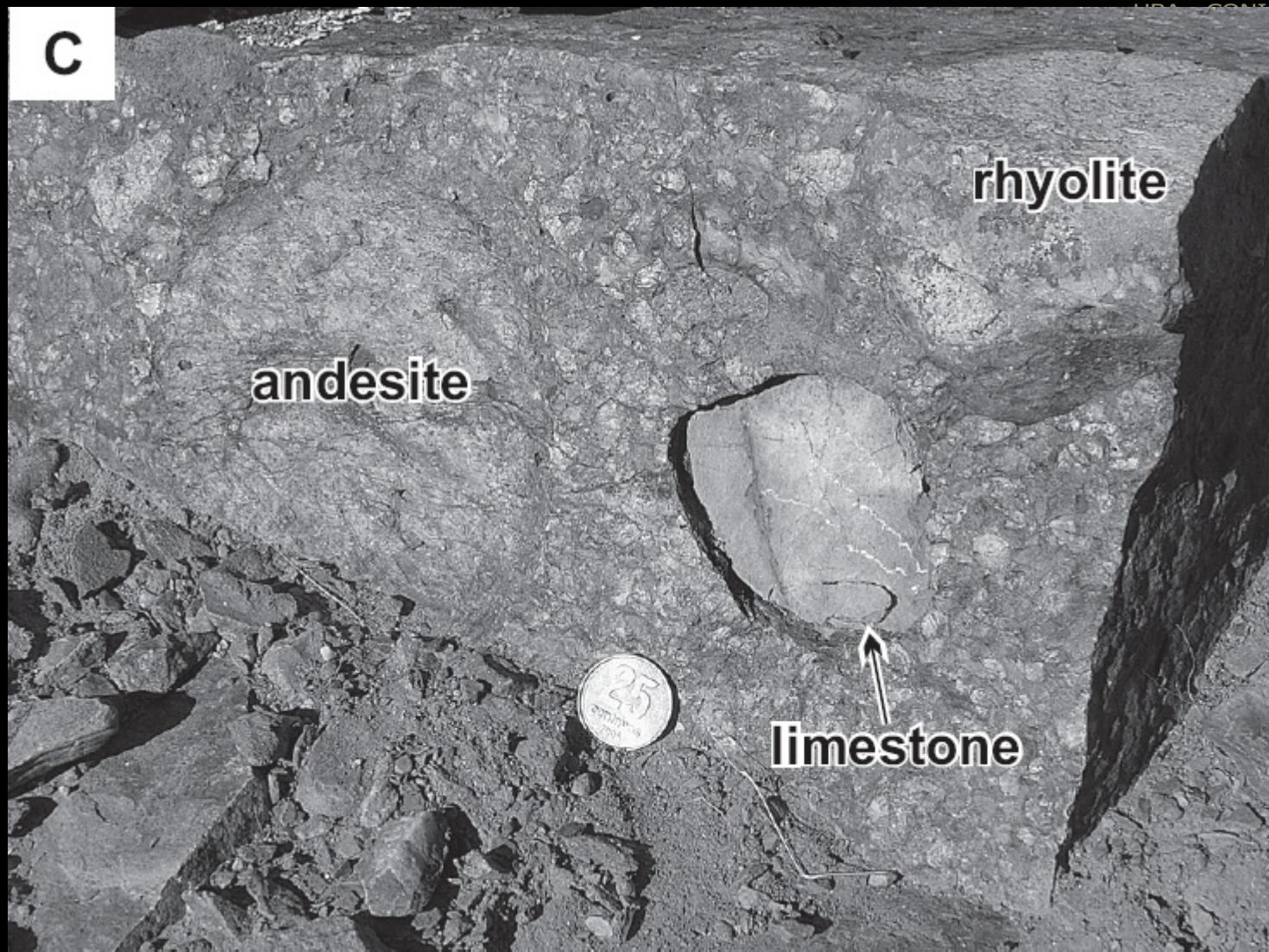
Strongly folded Early Cambrian Shackleton Limestone



Archeocyatids In Eastern Gondwana



Volcanic rock clasts In the El Jaguelito Schists



Gonzalez et al., 2011

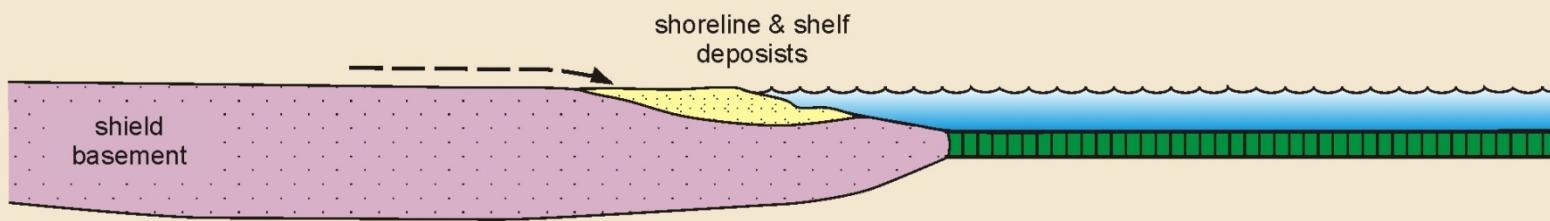
Granitoids in the El Jaguelito Schists



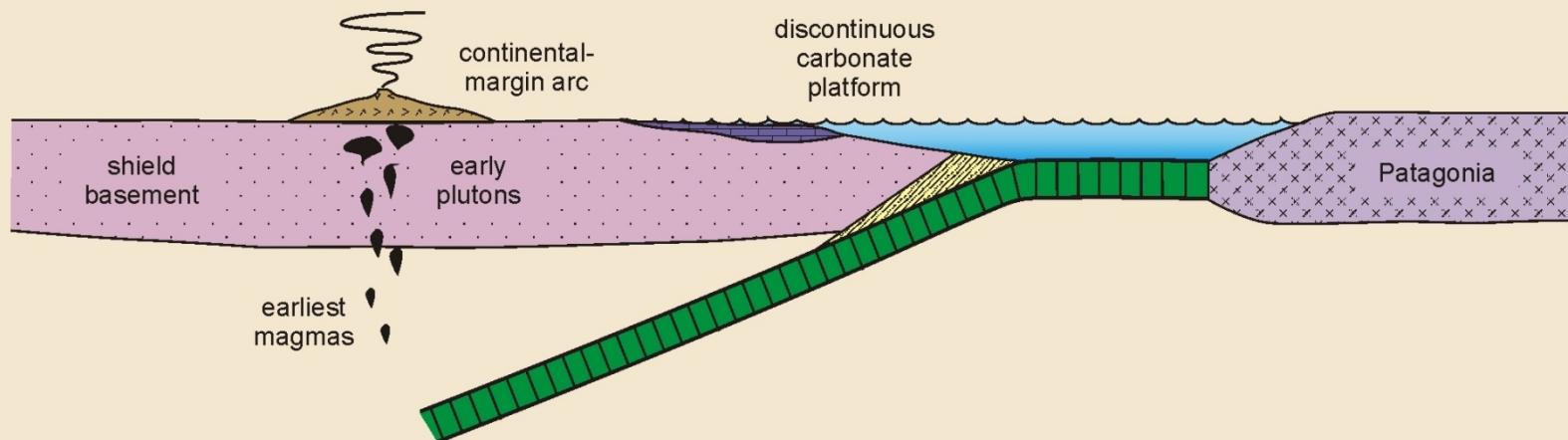
Gonzalez et al., 2011

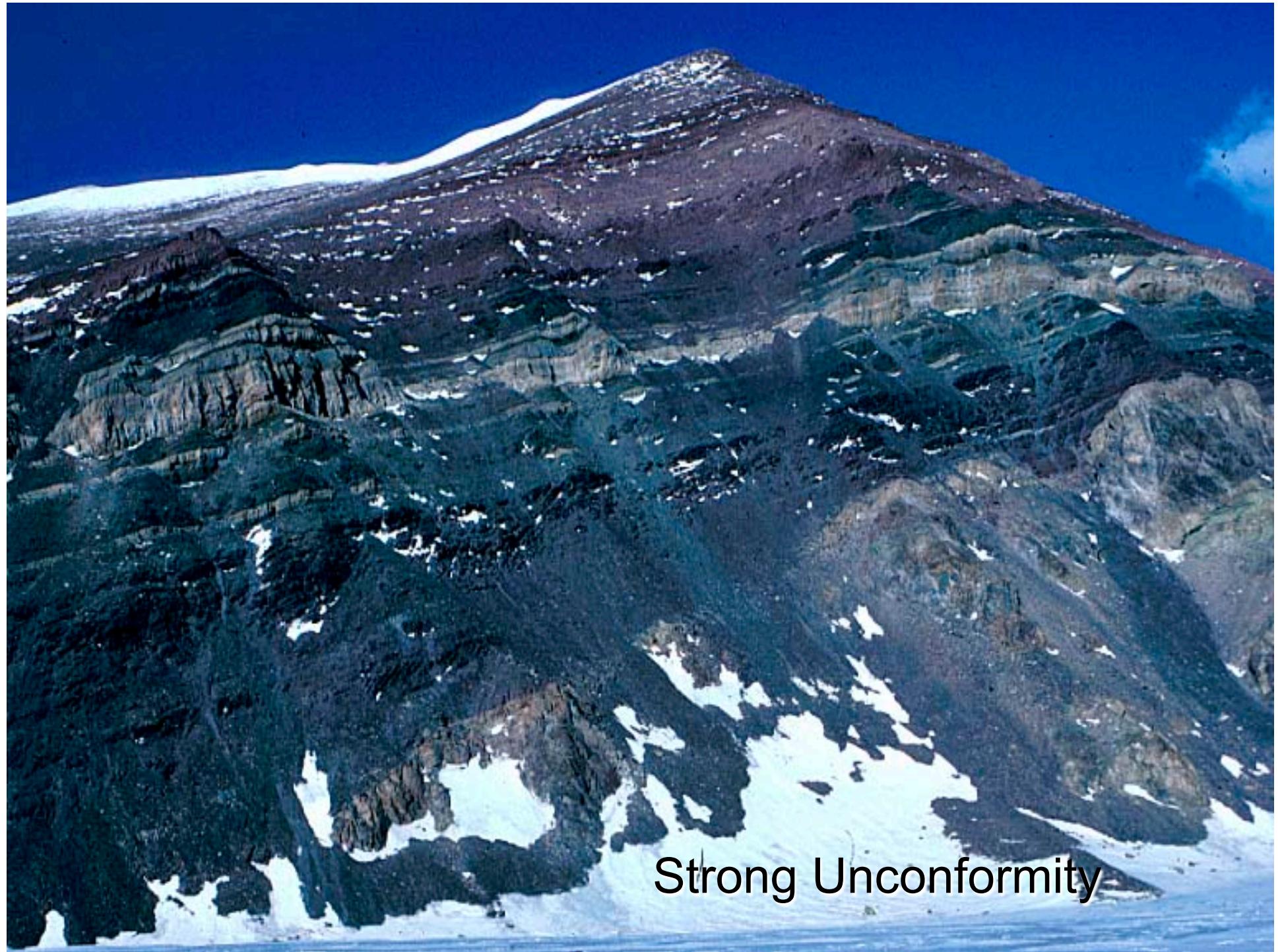
Transantarctic Mountains

A. ca. 670-580 Ma: passive margin



B. ca. 850-515 Ma: active platform and early arc

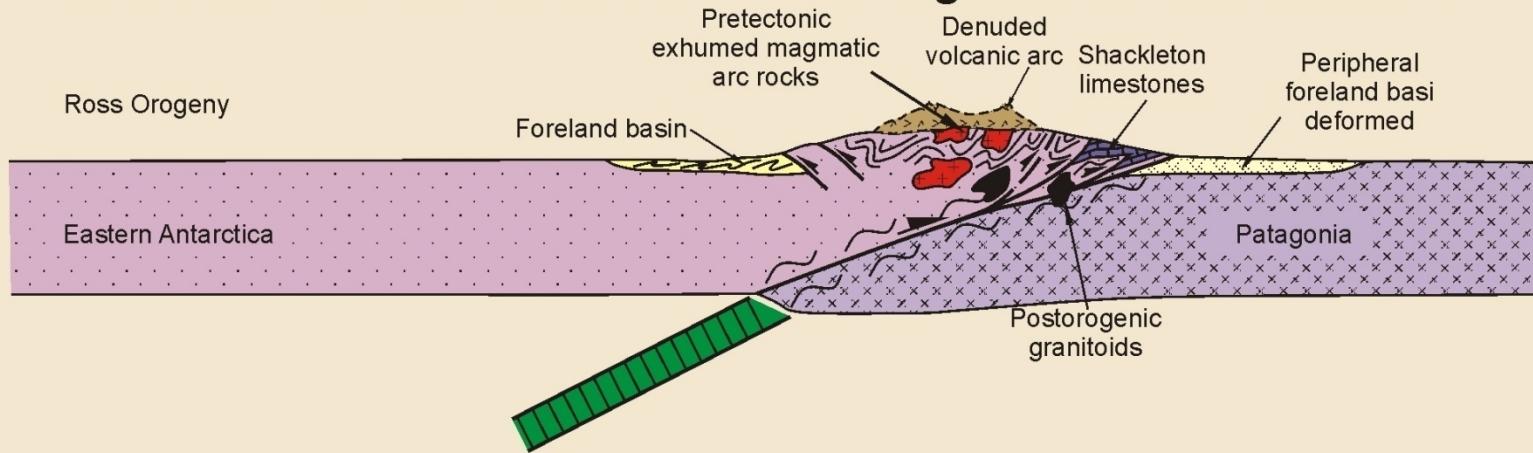




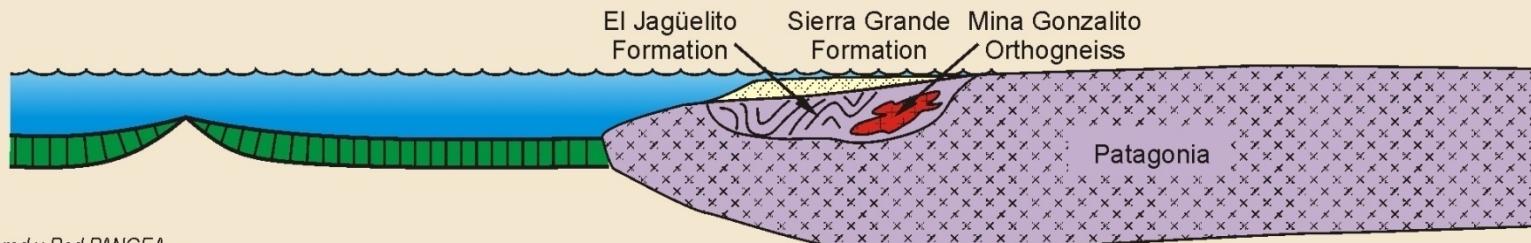
Strong Unconformity

Transantarctic Mountains

C. ca. 515-485 Ma: Pre and late tectonic granitoids and collision



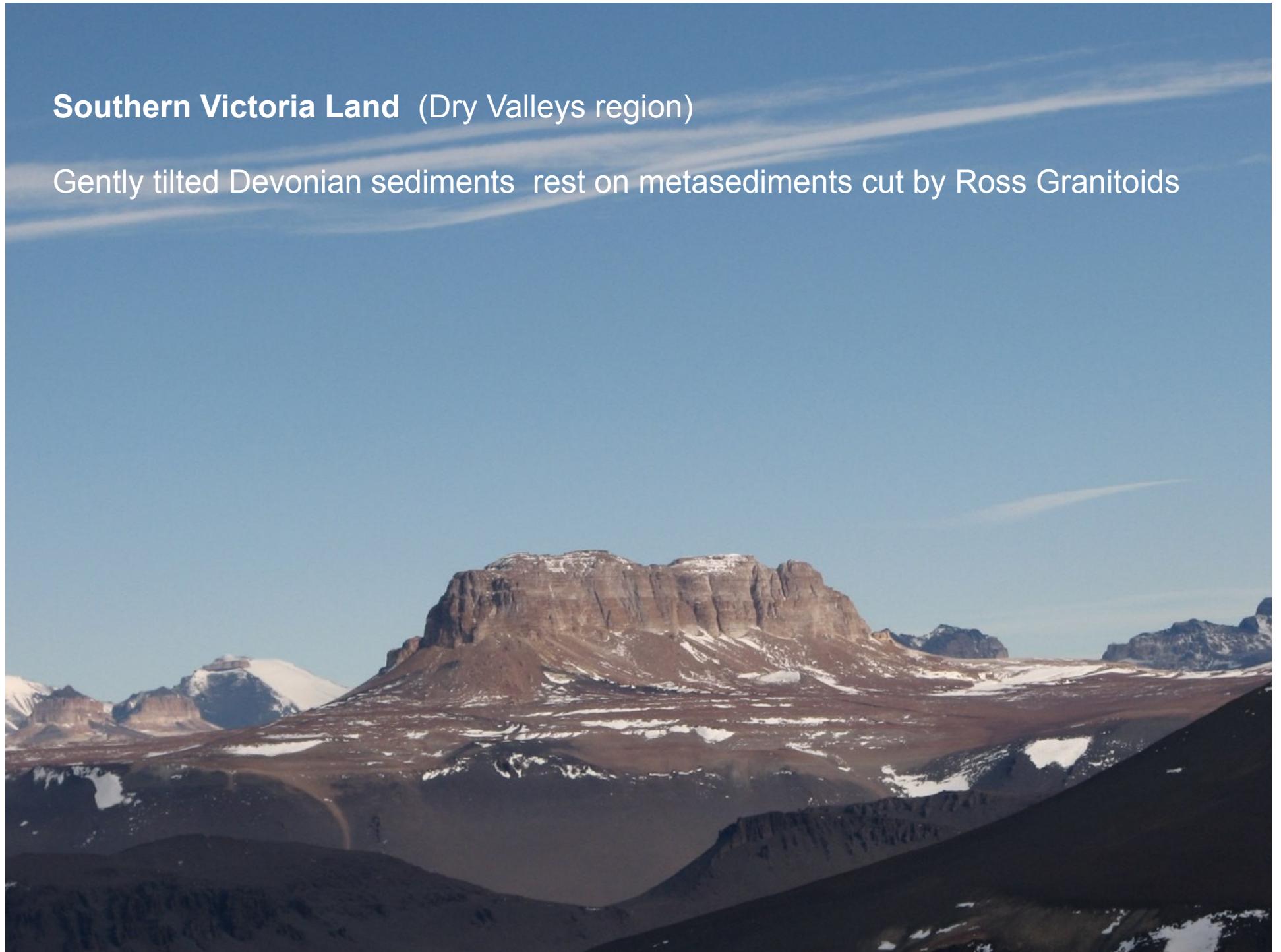
D. ca. 445-400 Ma: Silurian-Devonian clastic passive margin



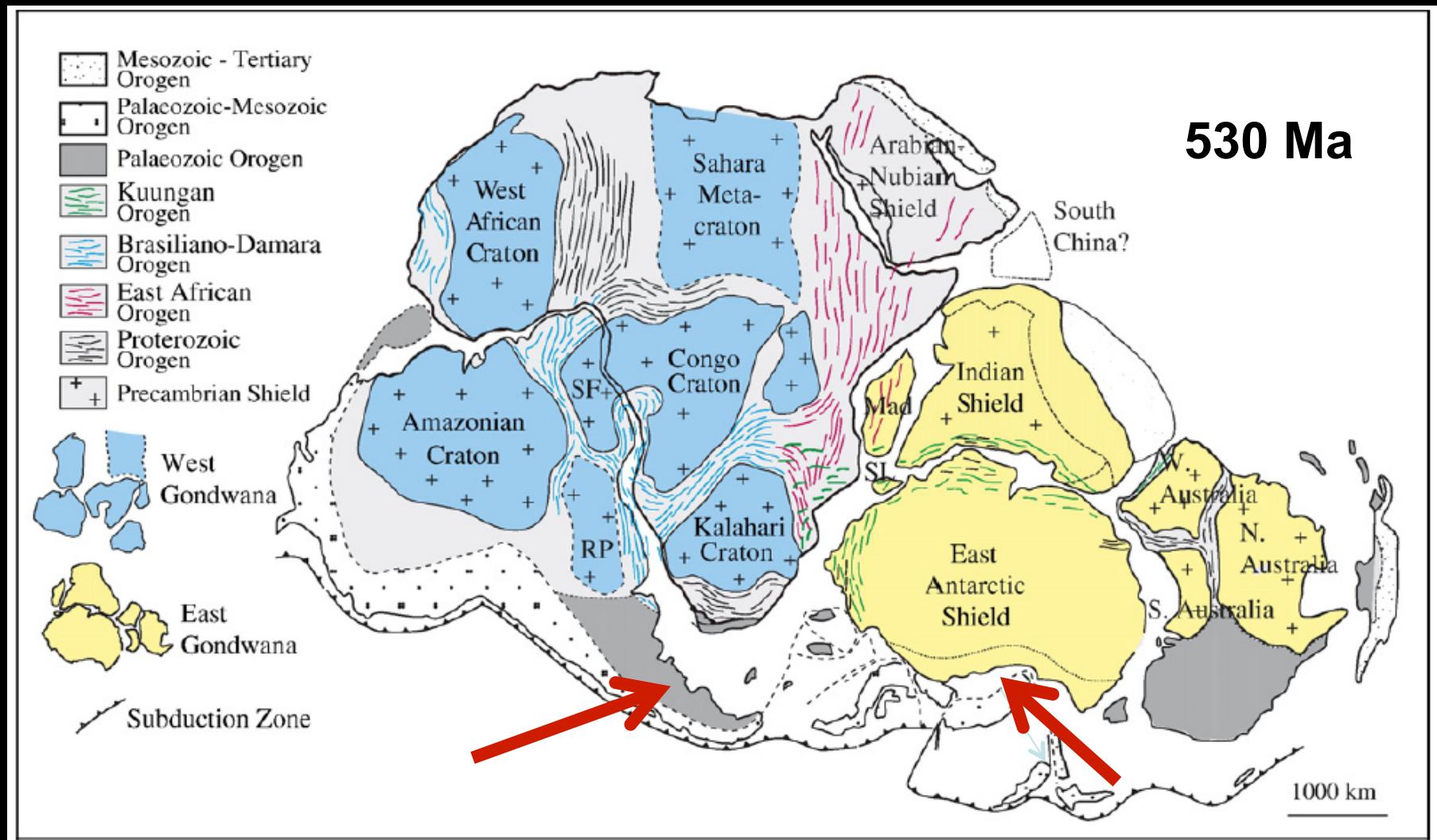
Powered by Red PANGEA

Southern Victoria Land (Dry Valleys region)

Gently tilted Devonian sediments rest on metasediments cut by Ross Granitoids

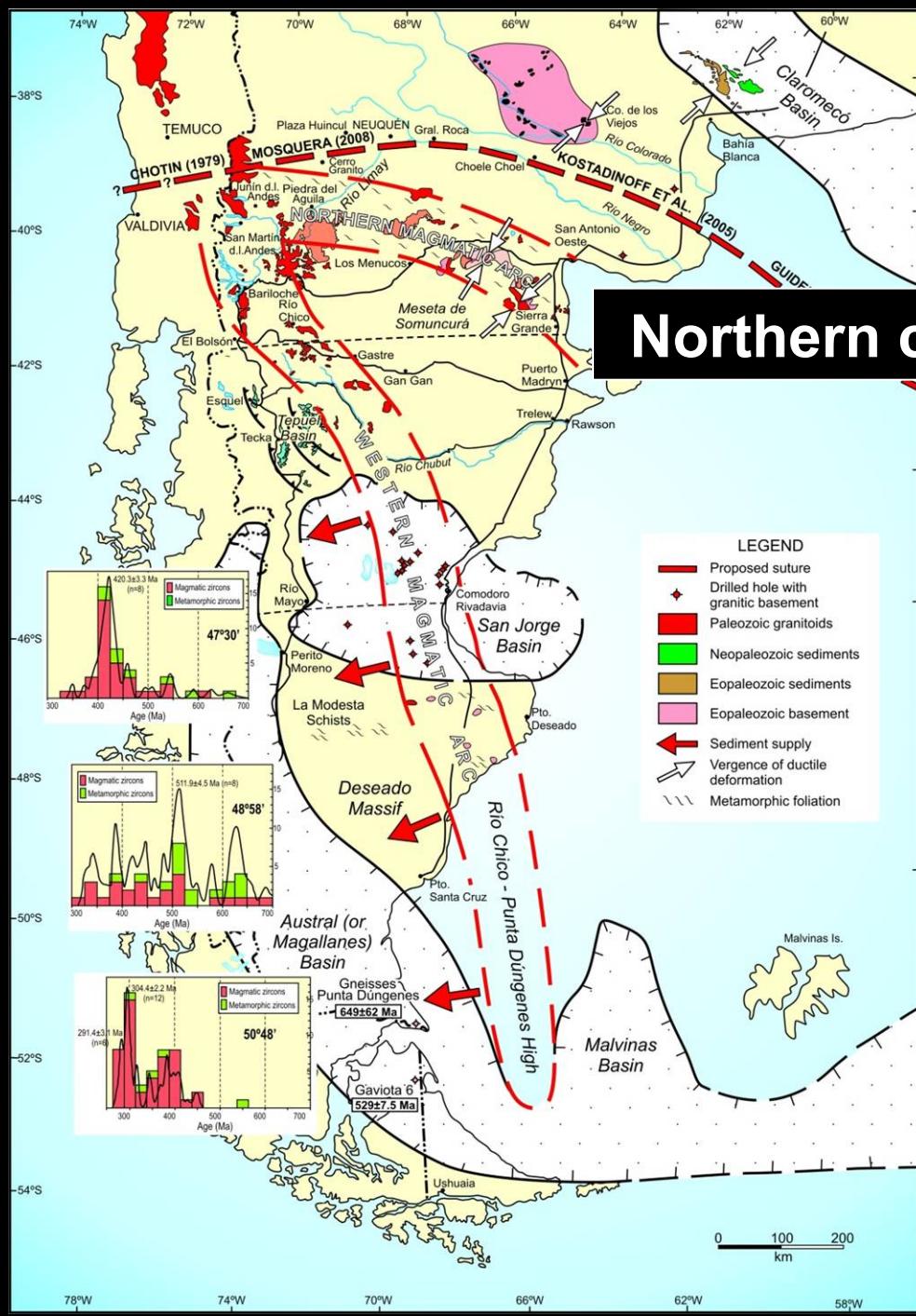


PATAGONIA: Western Gondwana Eastern Gondwana



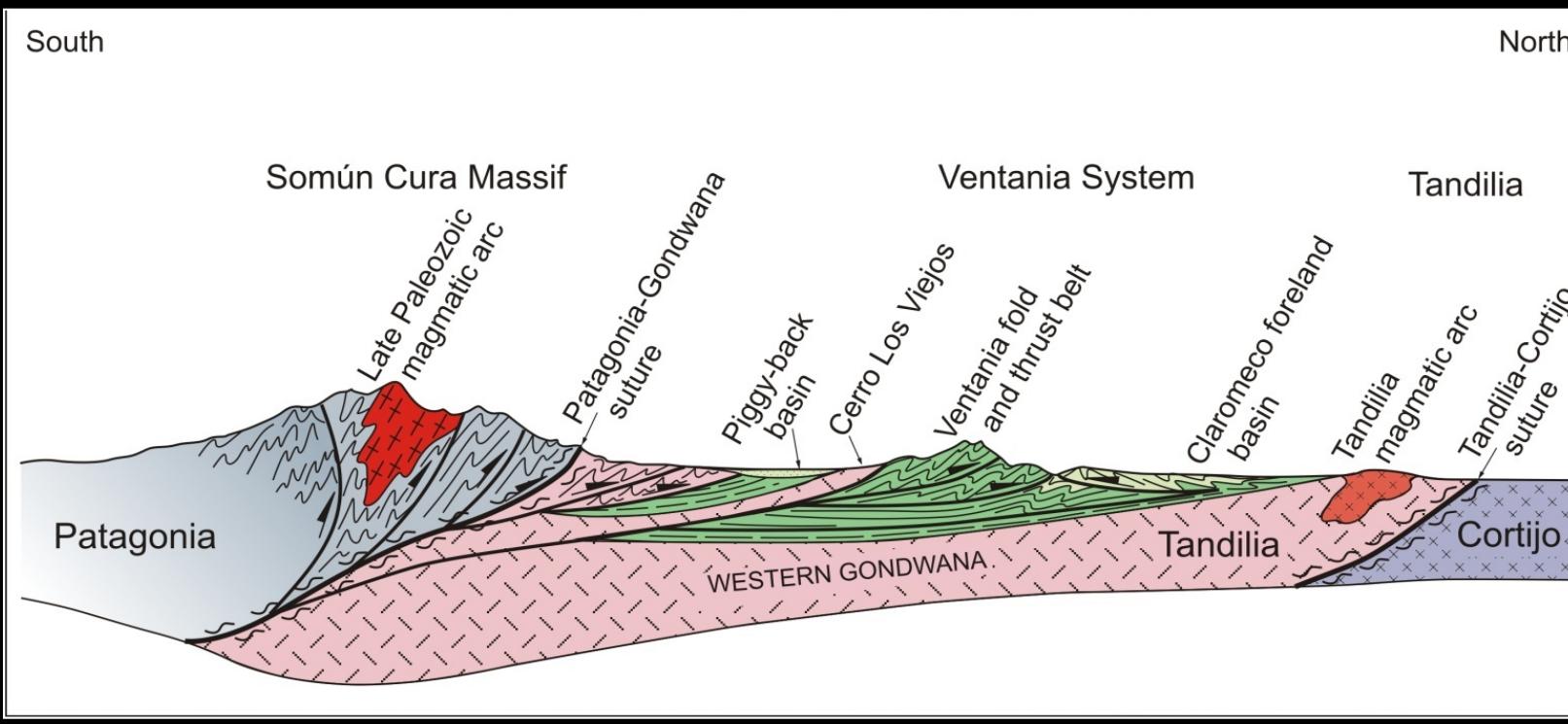
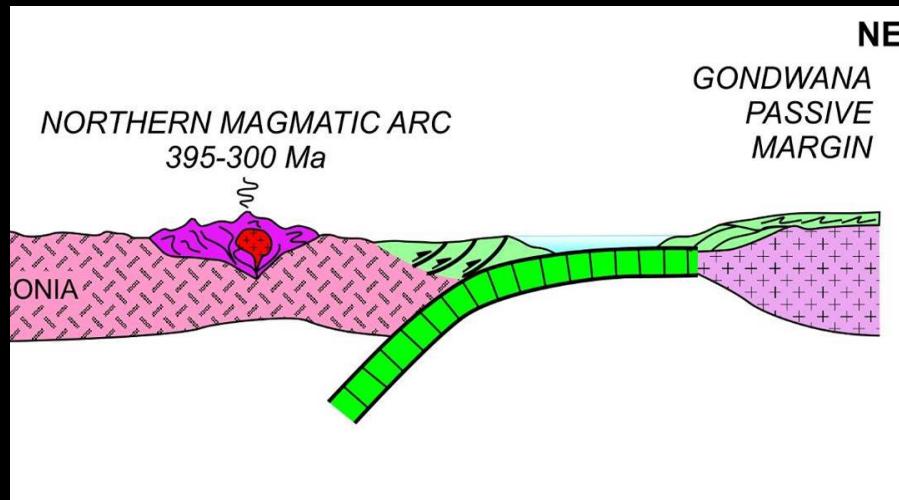
Gray et al. (2007)

Northern collisional belt

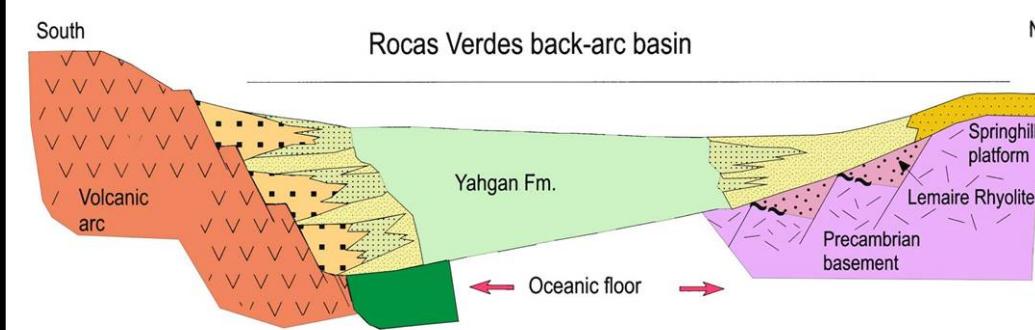
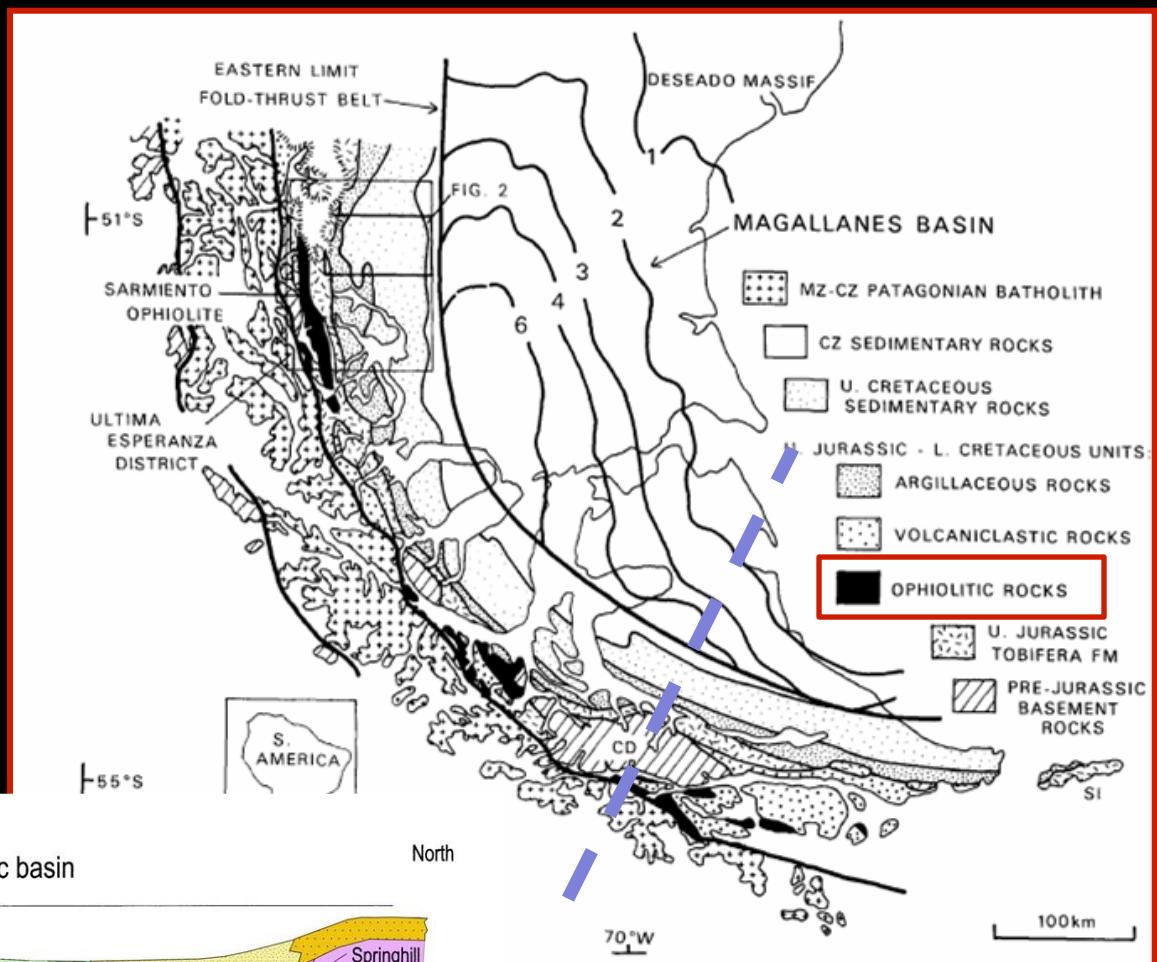


IMPLICATIONS

- 1) Andean-type stage
- 2) Collisional stage

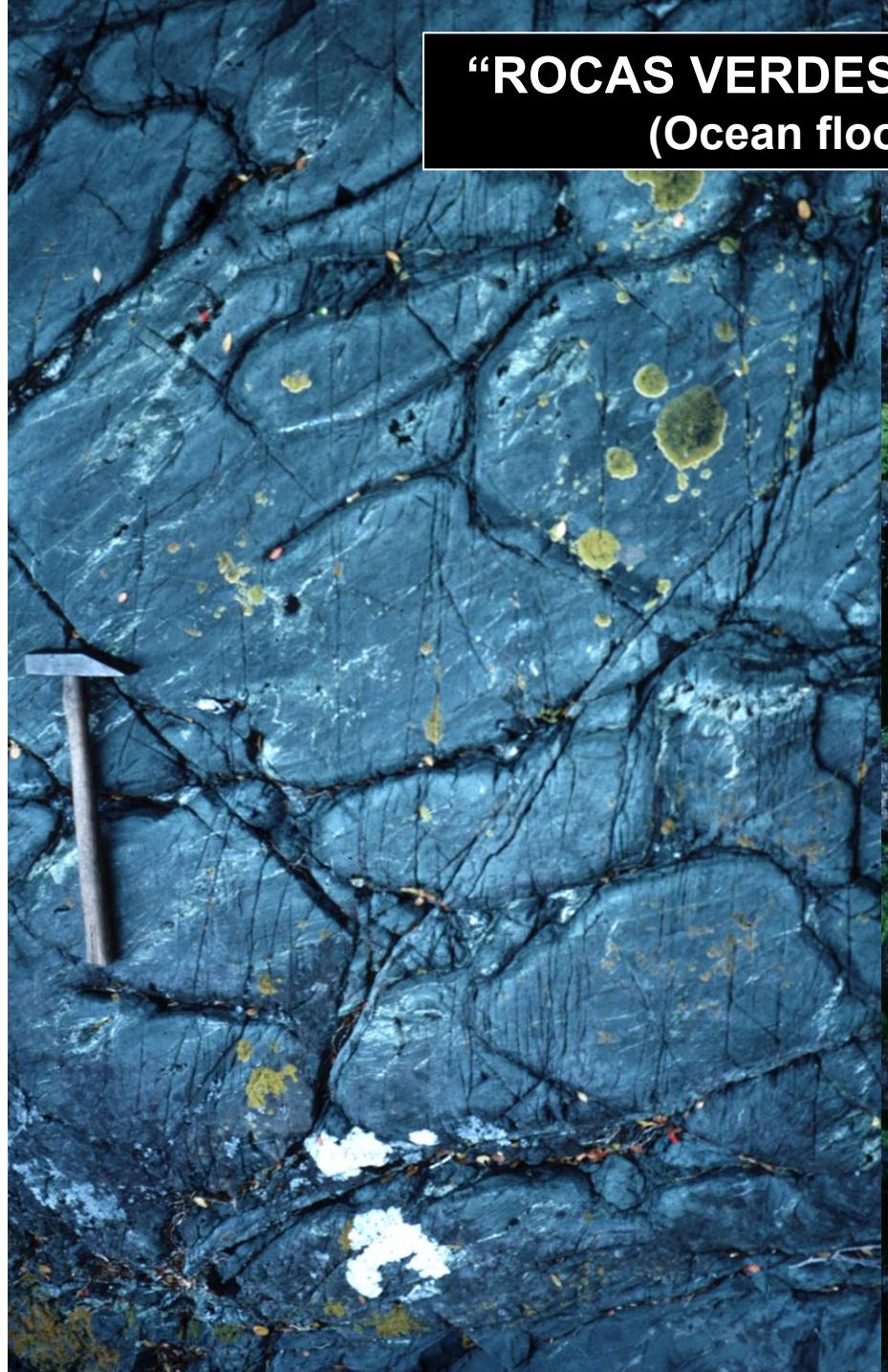


“ROCAS VERDES” MARGINAL BASIN

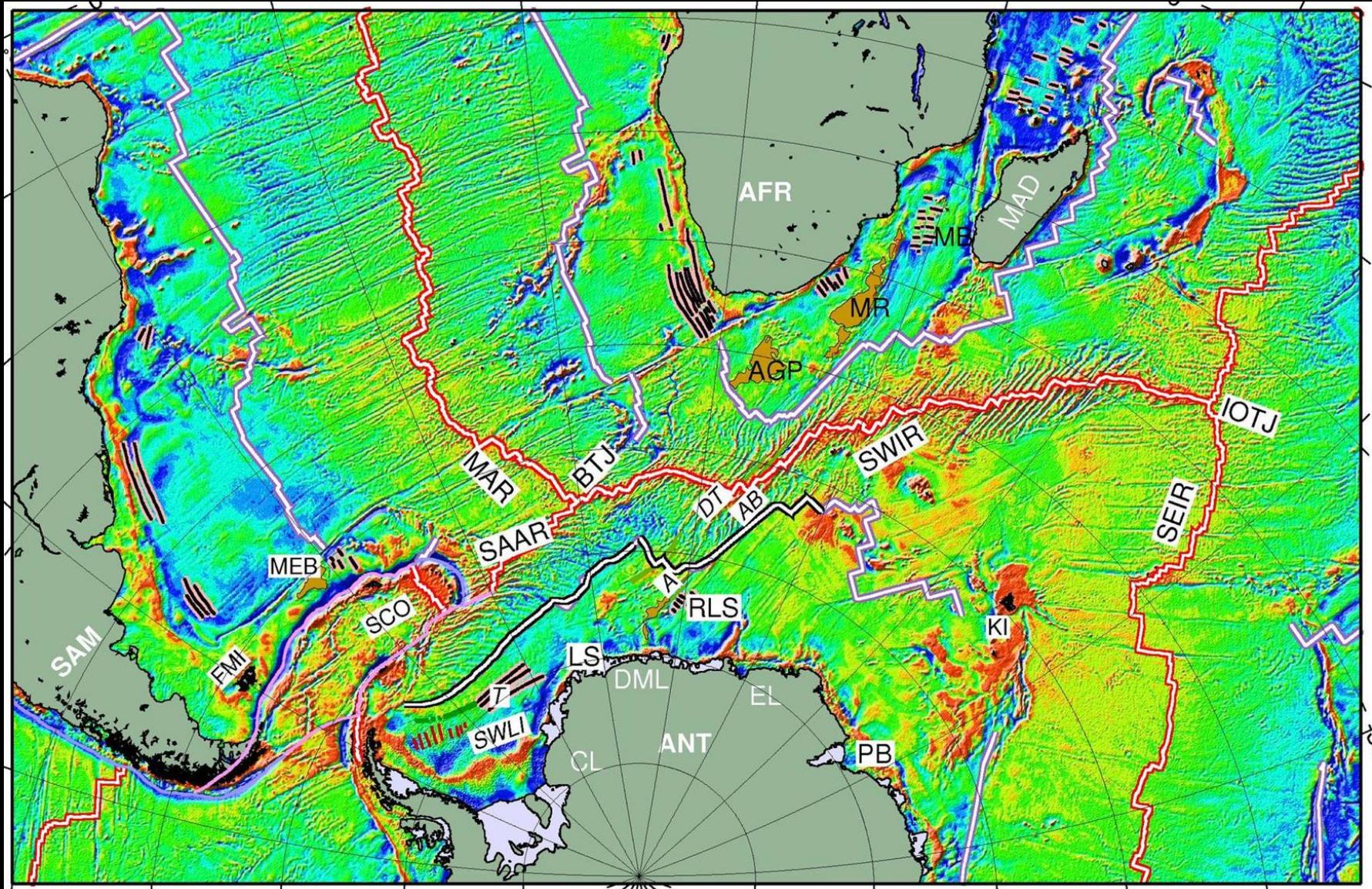


Dalziel (1981)

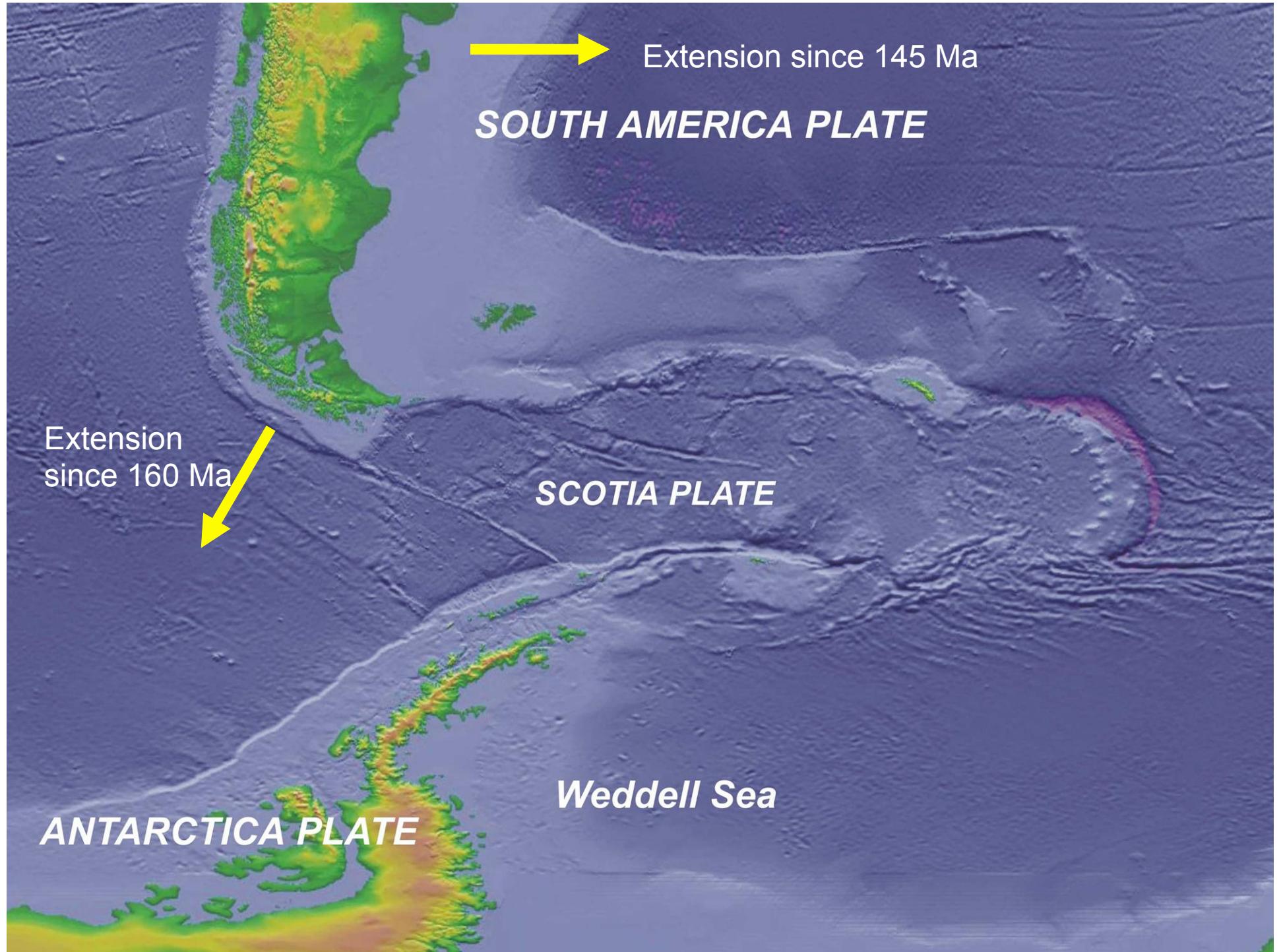
“ROCAS VERDES” MARGINAL BASIN
(Ocean floor of the basin)

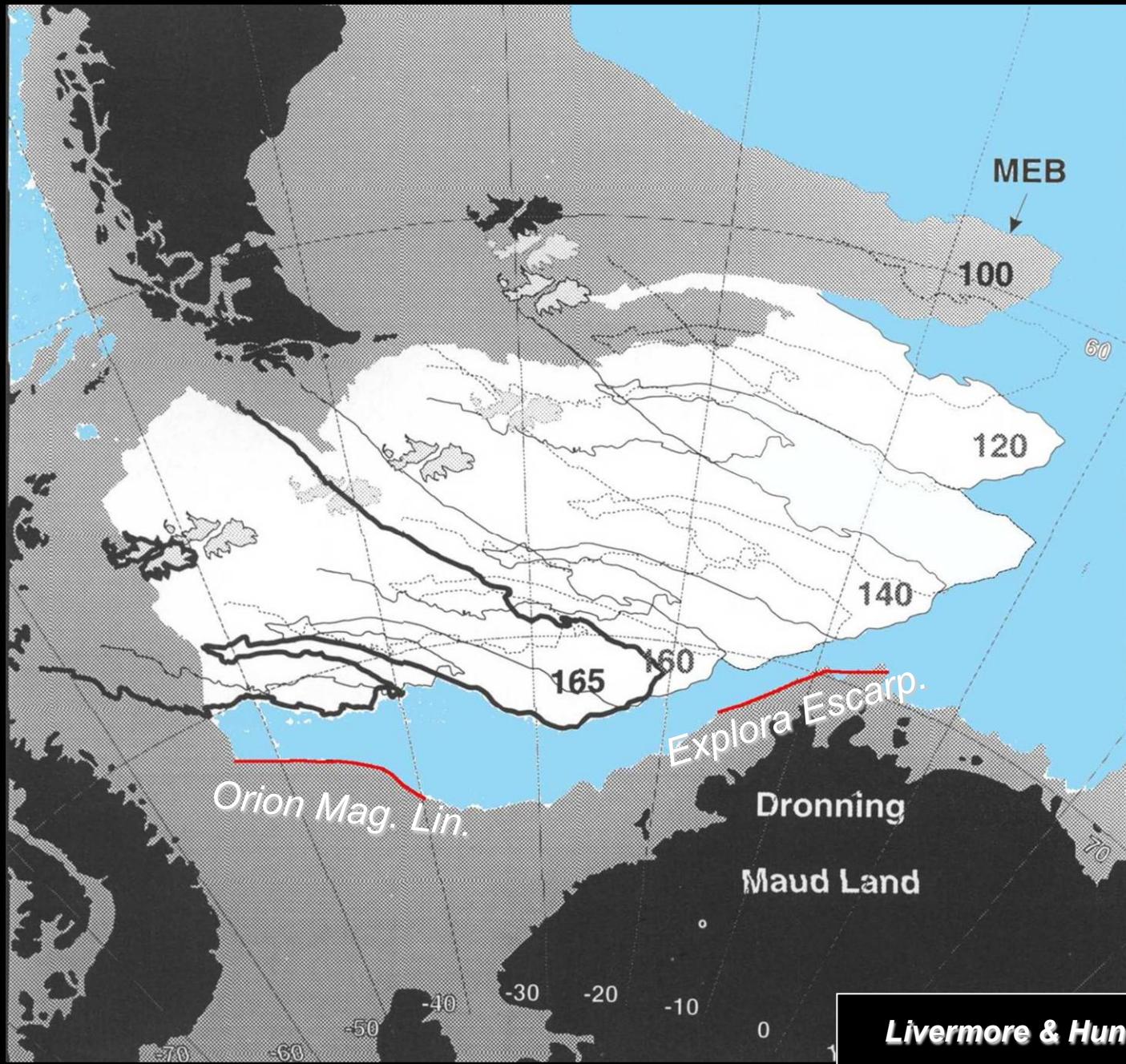


MAGNETIC ANOMALIES AND OCEANIC RIDGES



Ghidella et al. (2007)

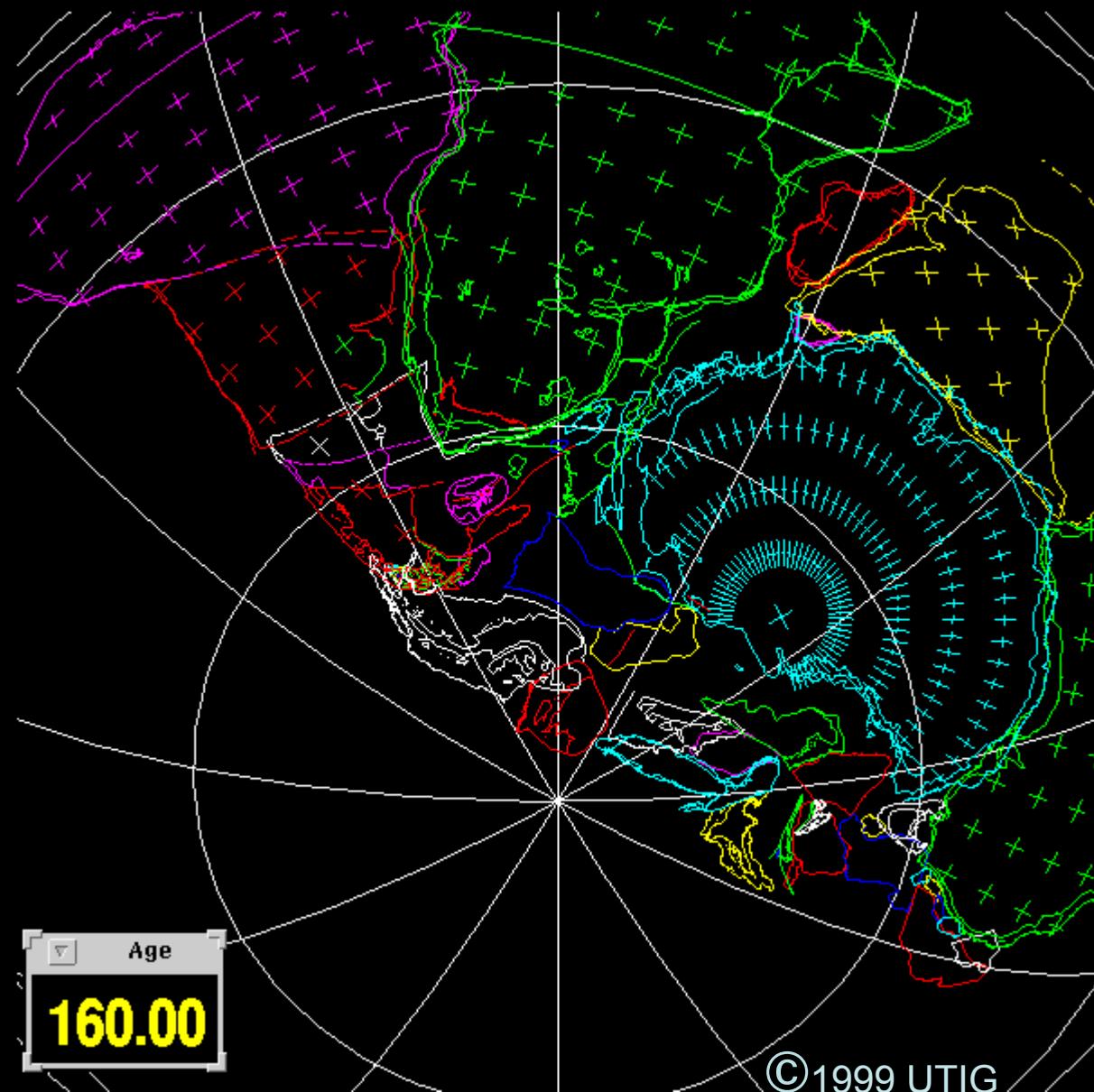




Livermore & Hunter (1996)

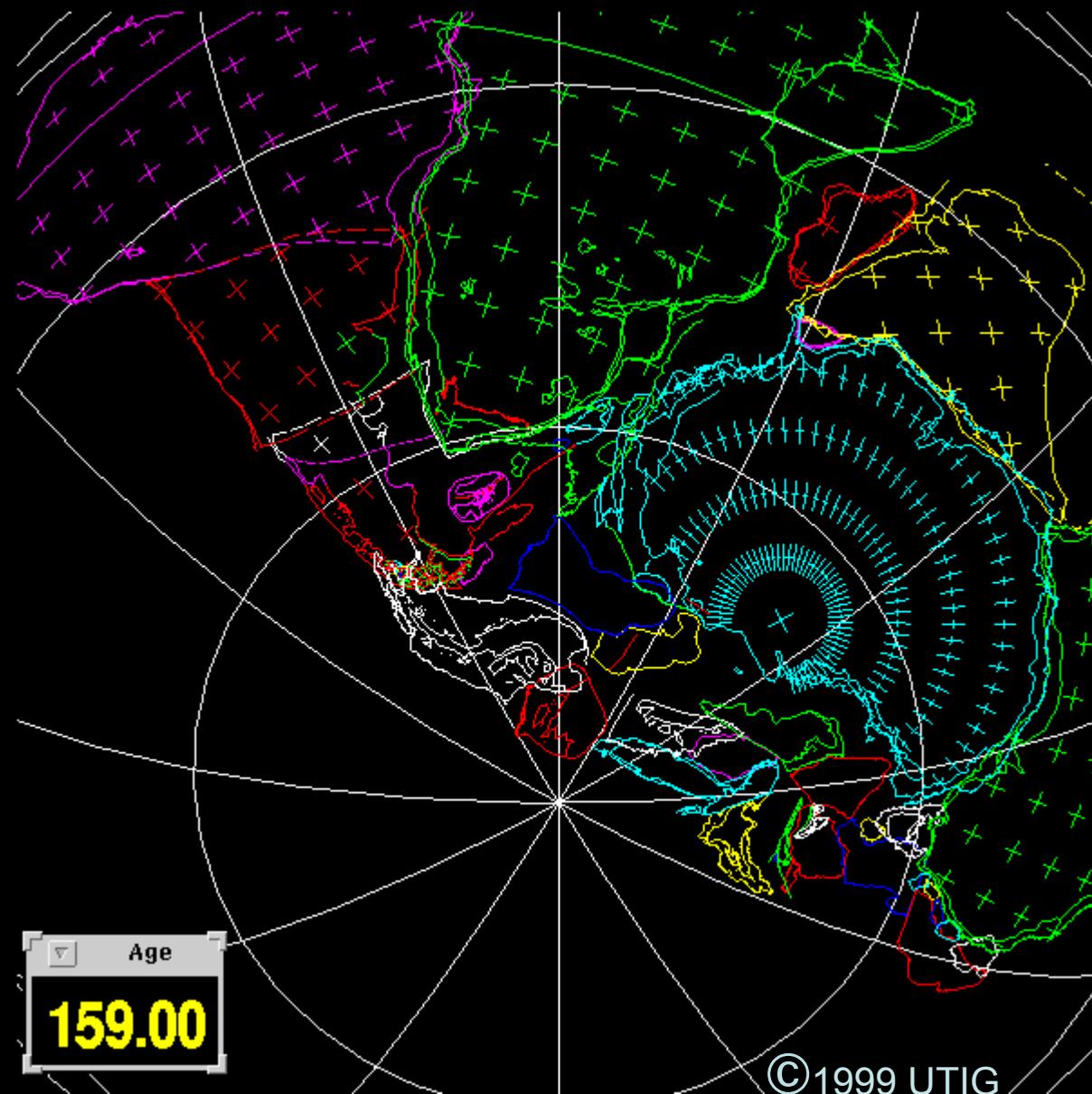
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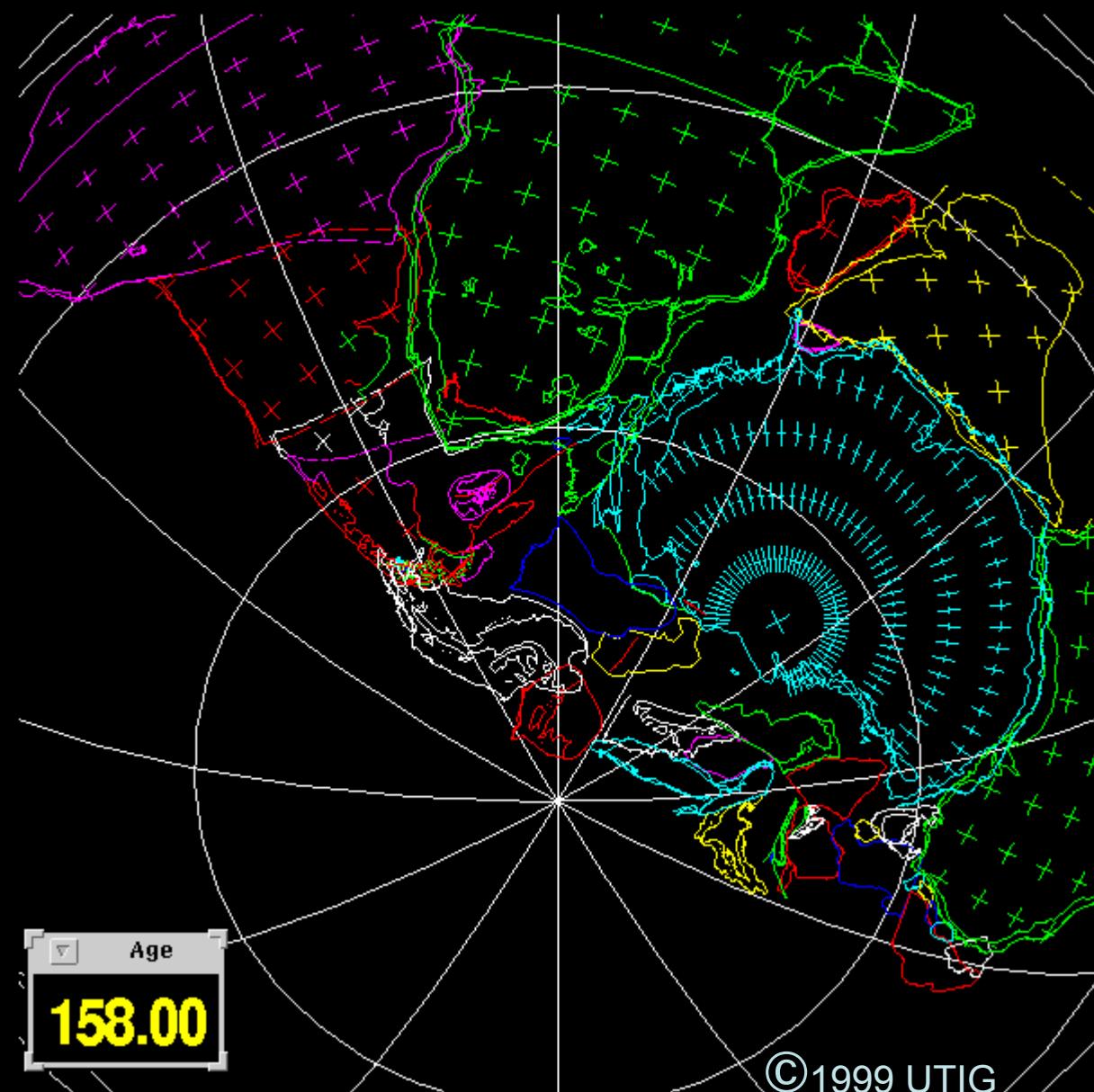
©1999 UTIG



159.00

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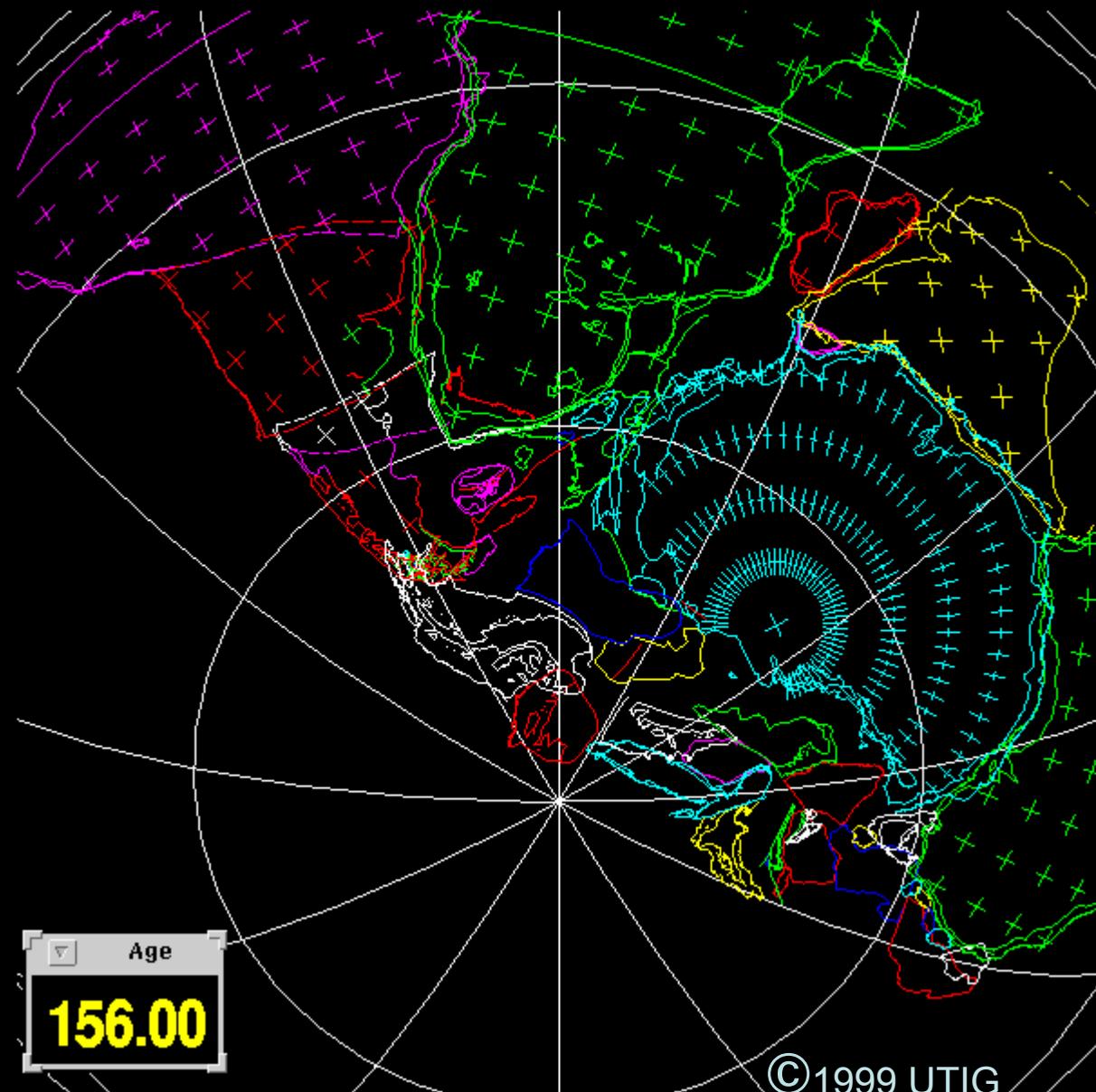
©1999 UTIG

Age
157.00

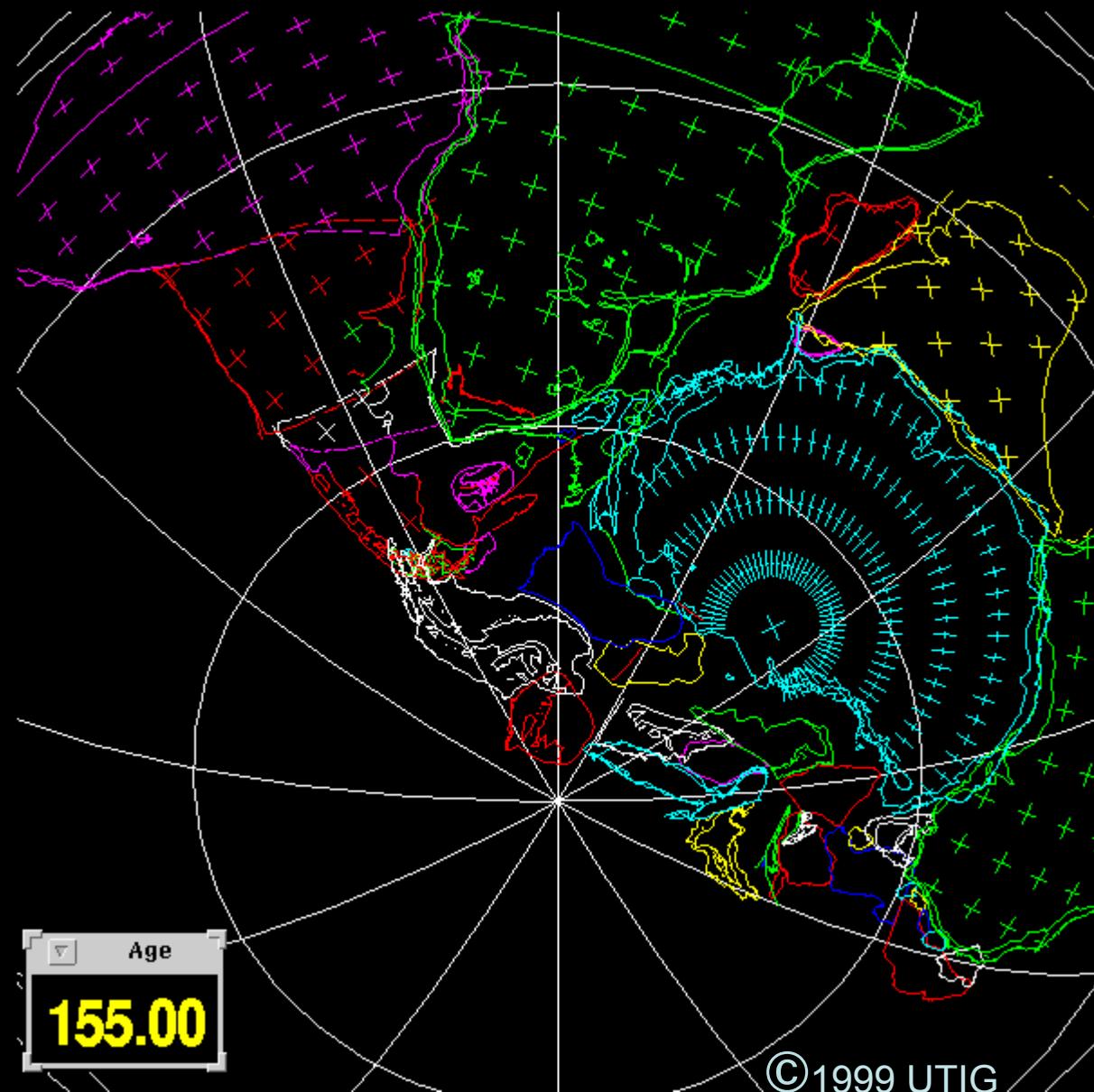
©1999 UTIG

156.00

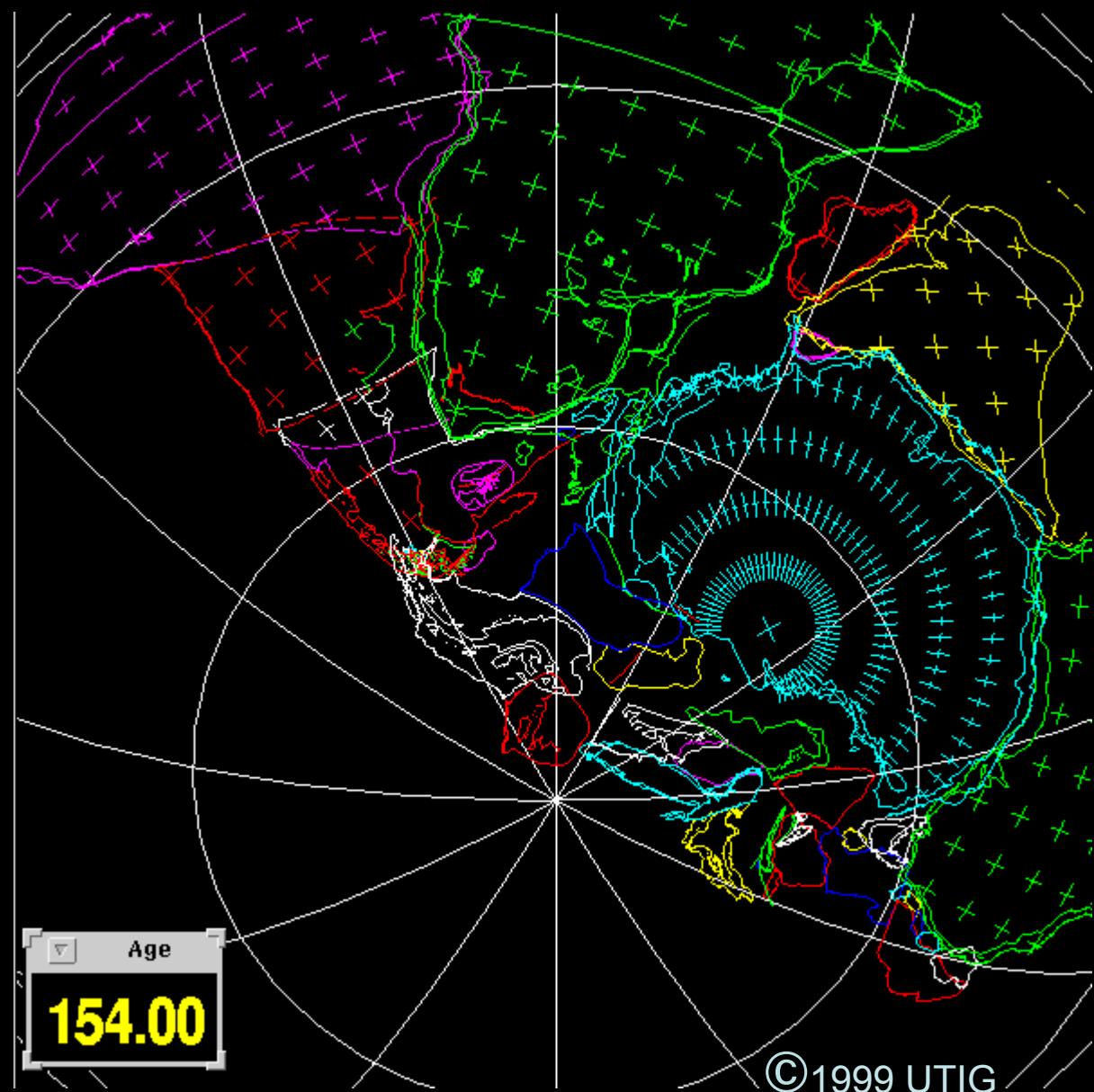
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155.00



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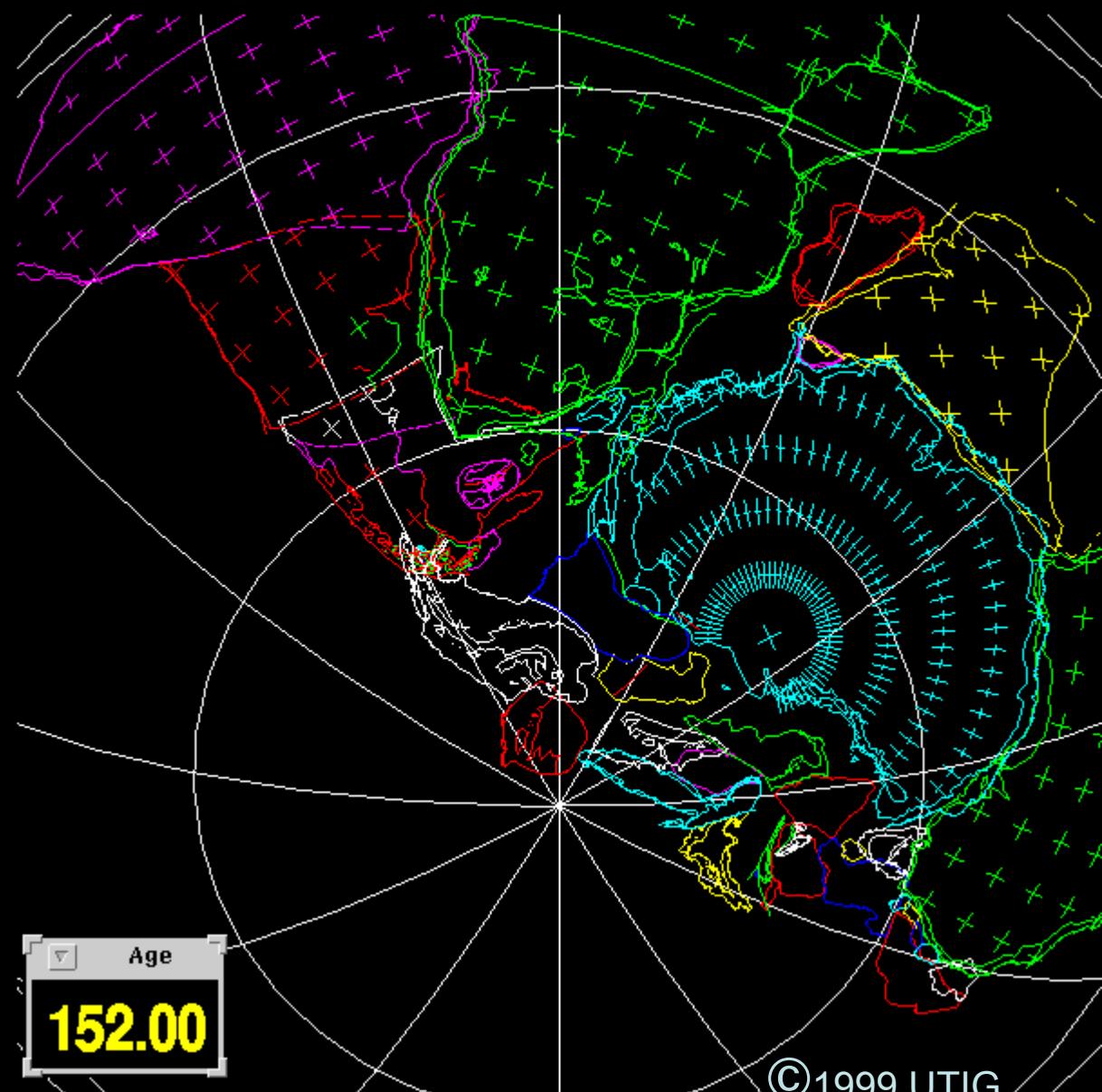
©1999 UTIG

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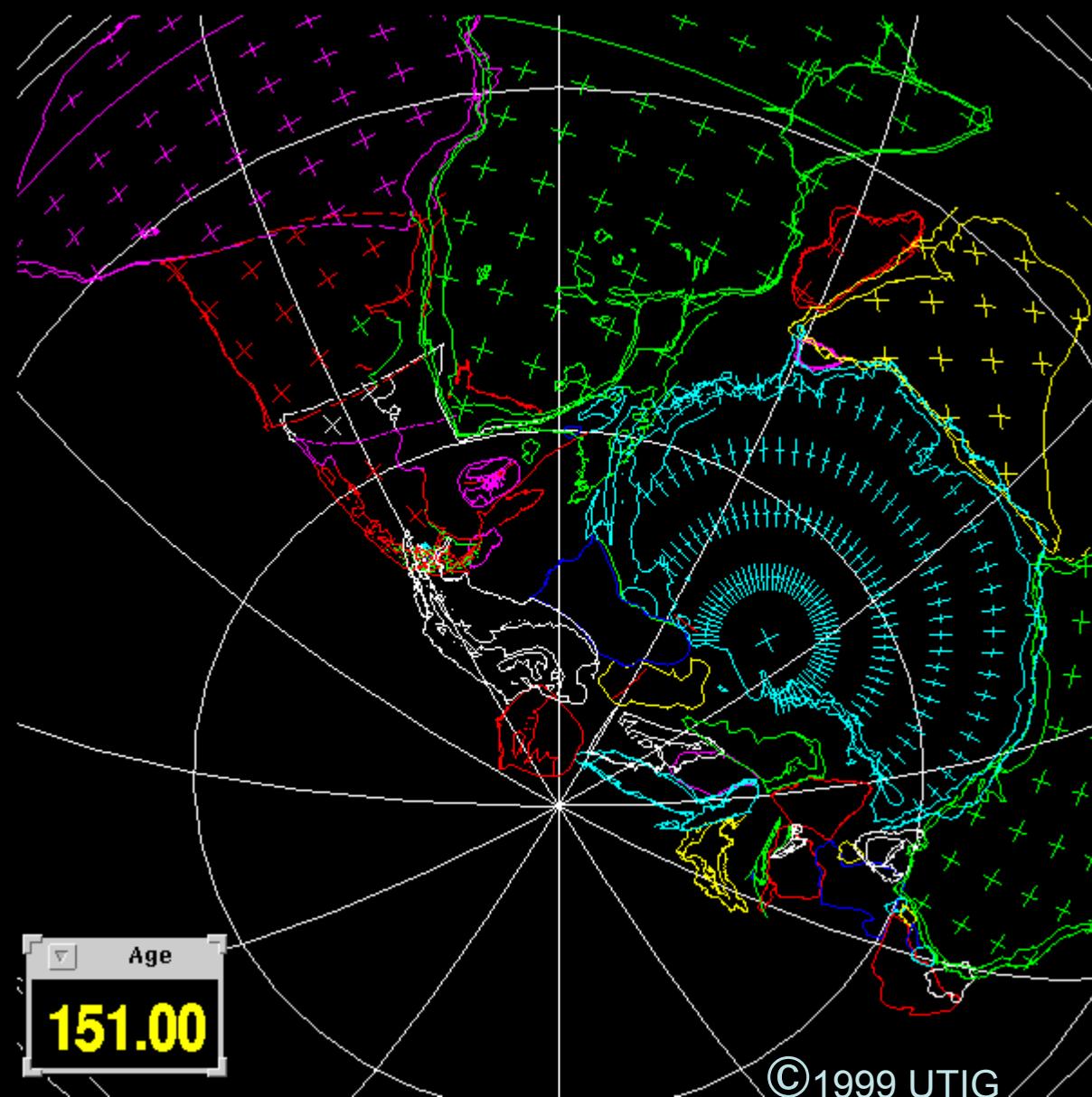
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©1999 UTIG



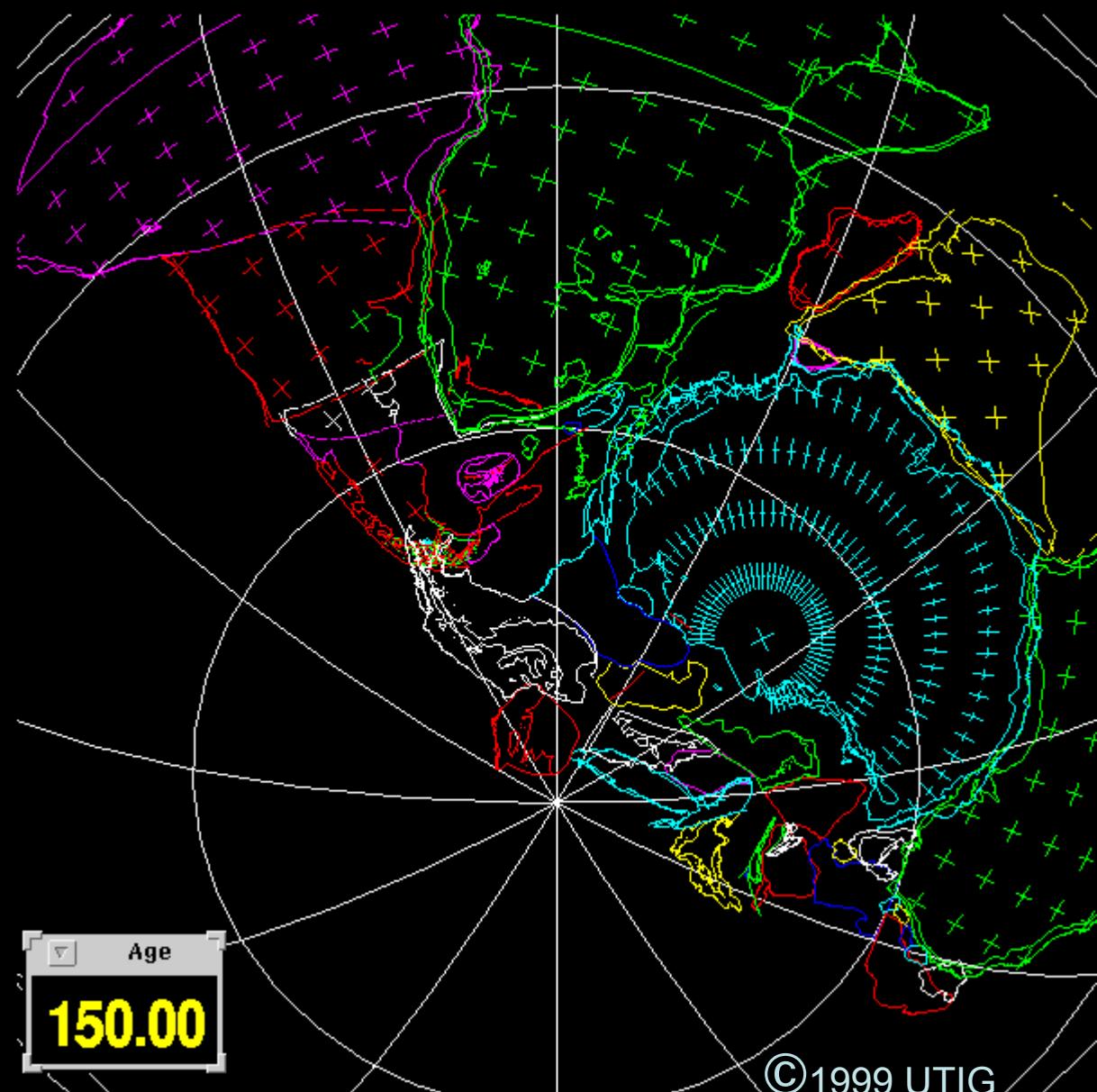
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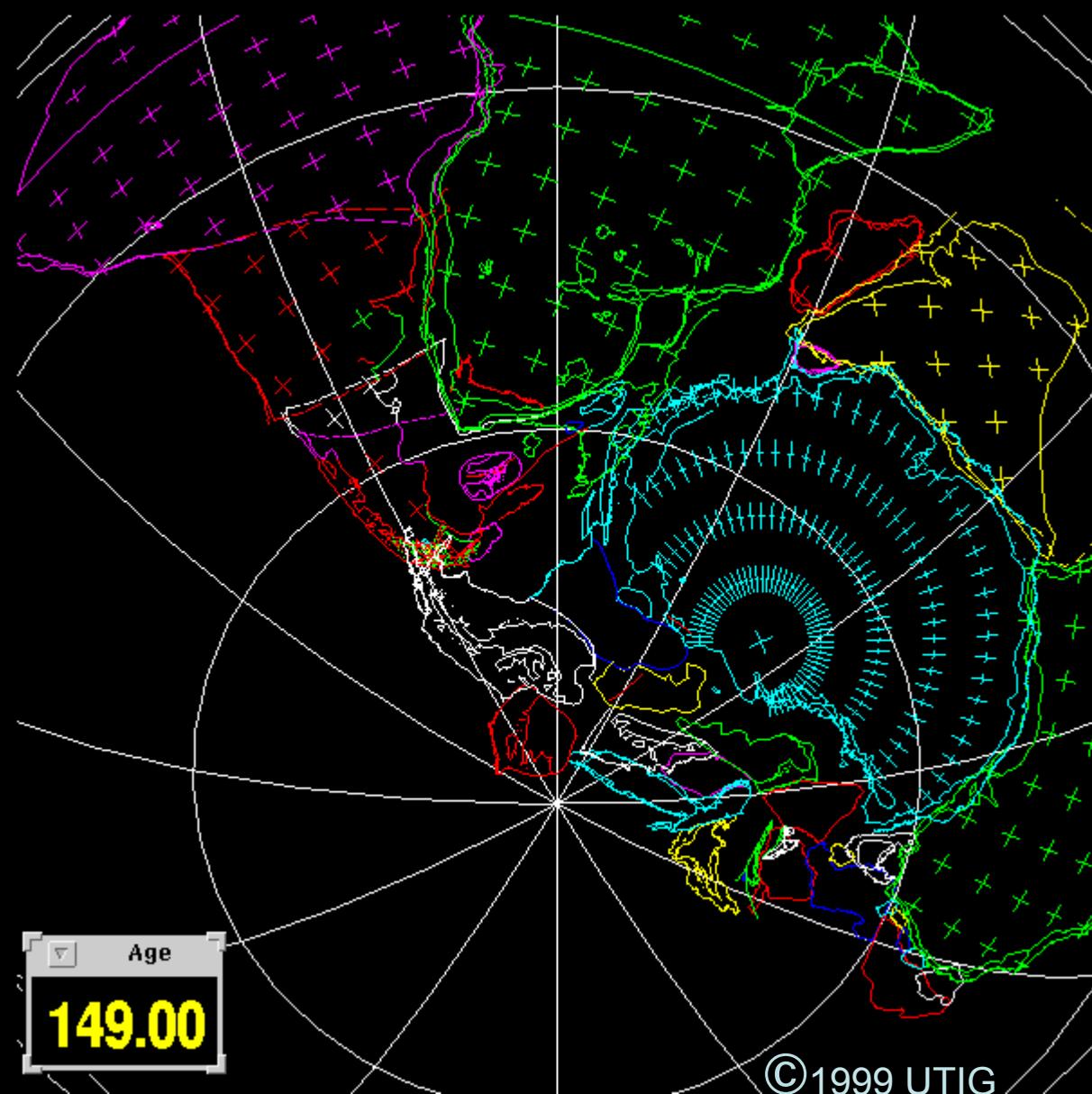
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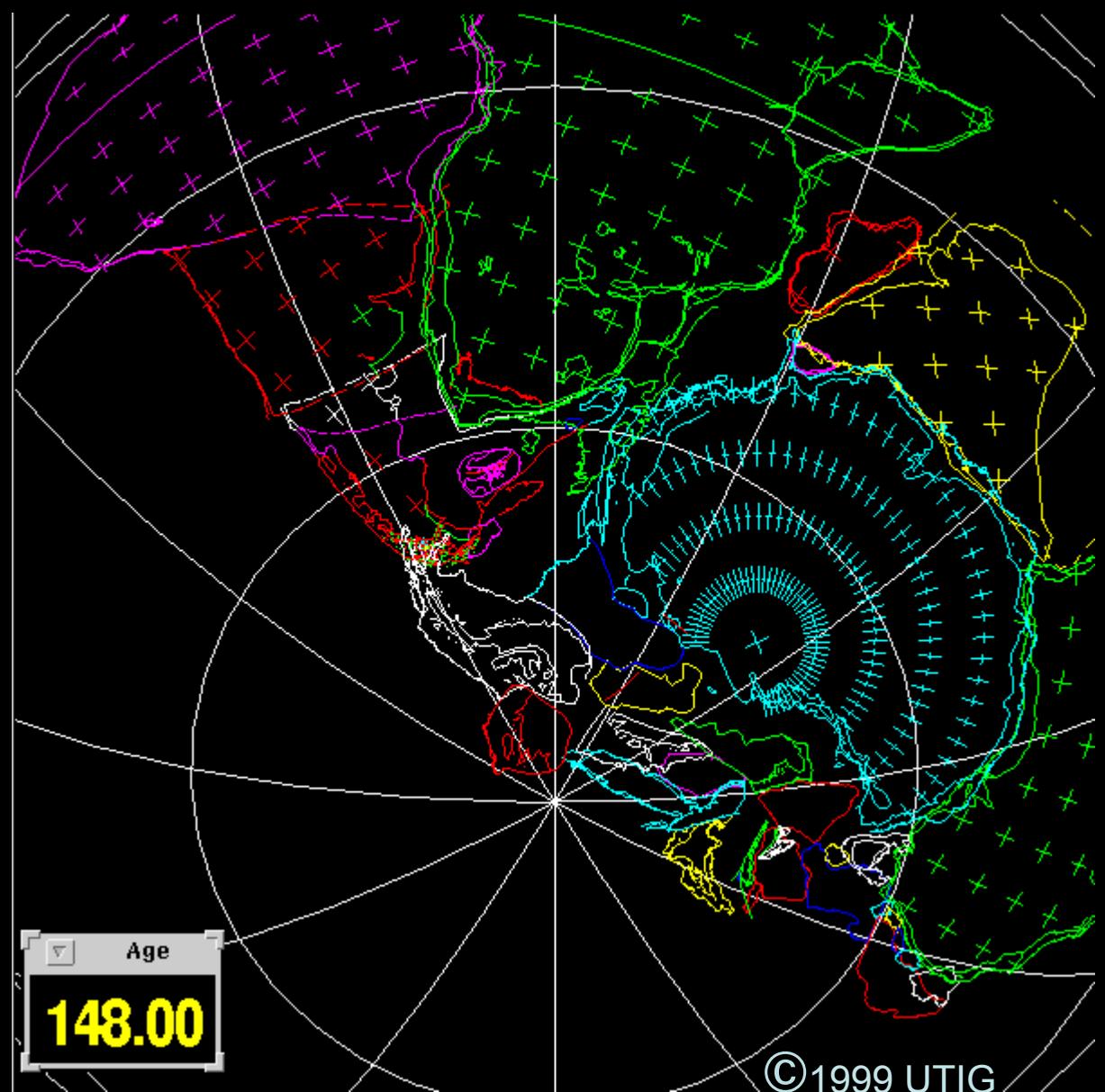
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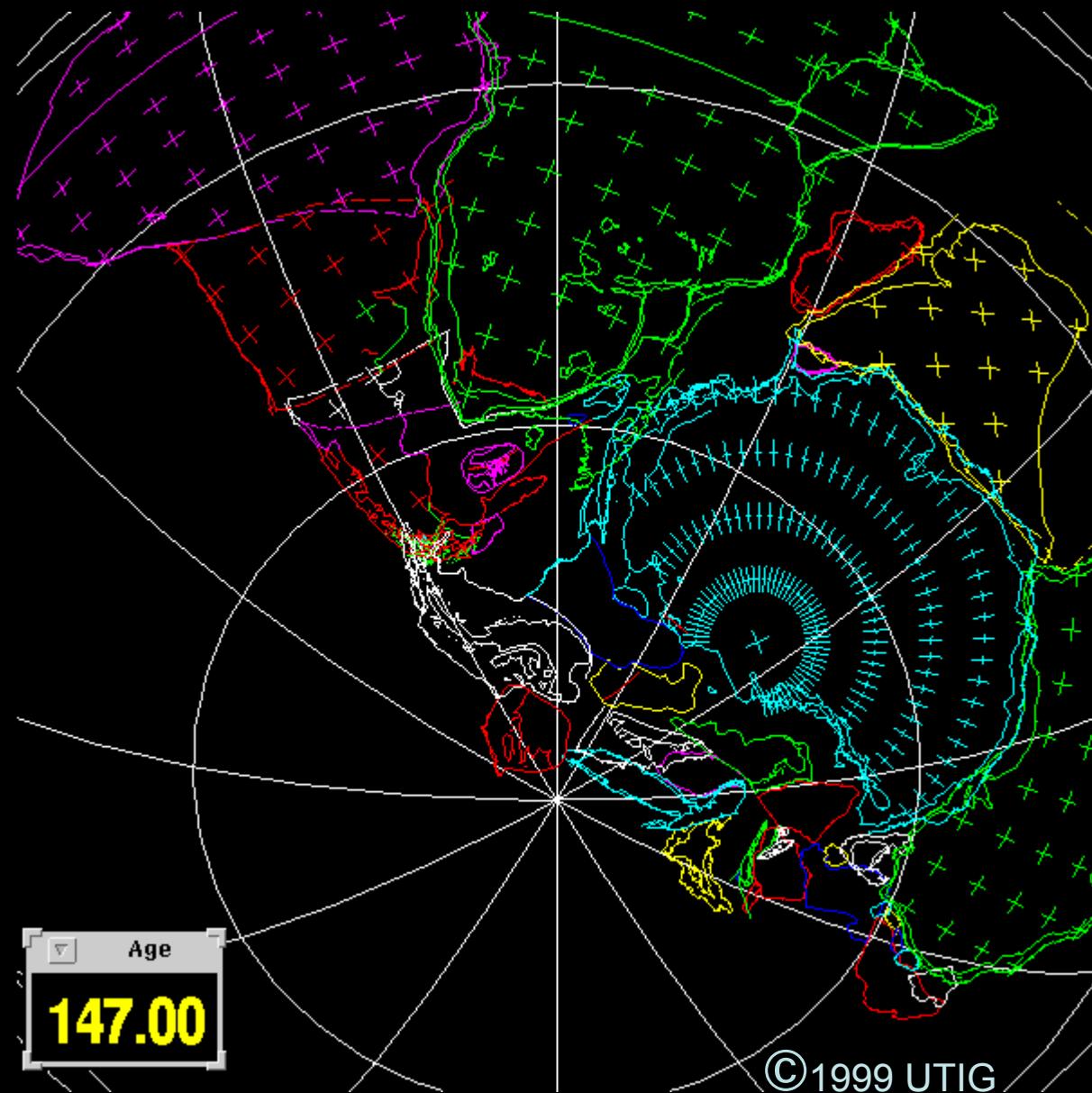
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 Age
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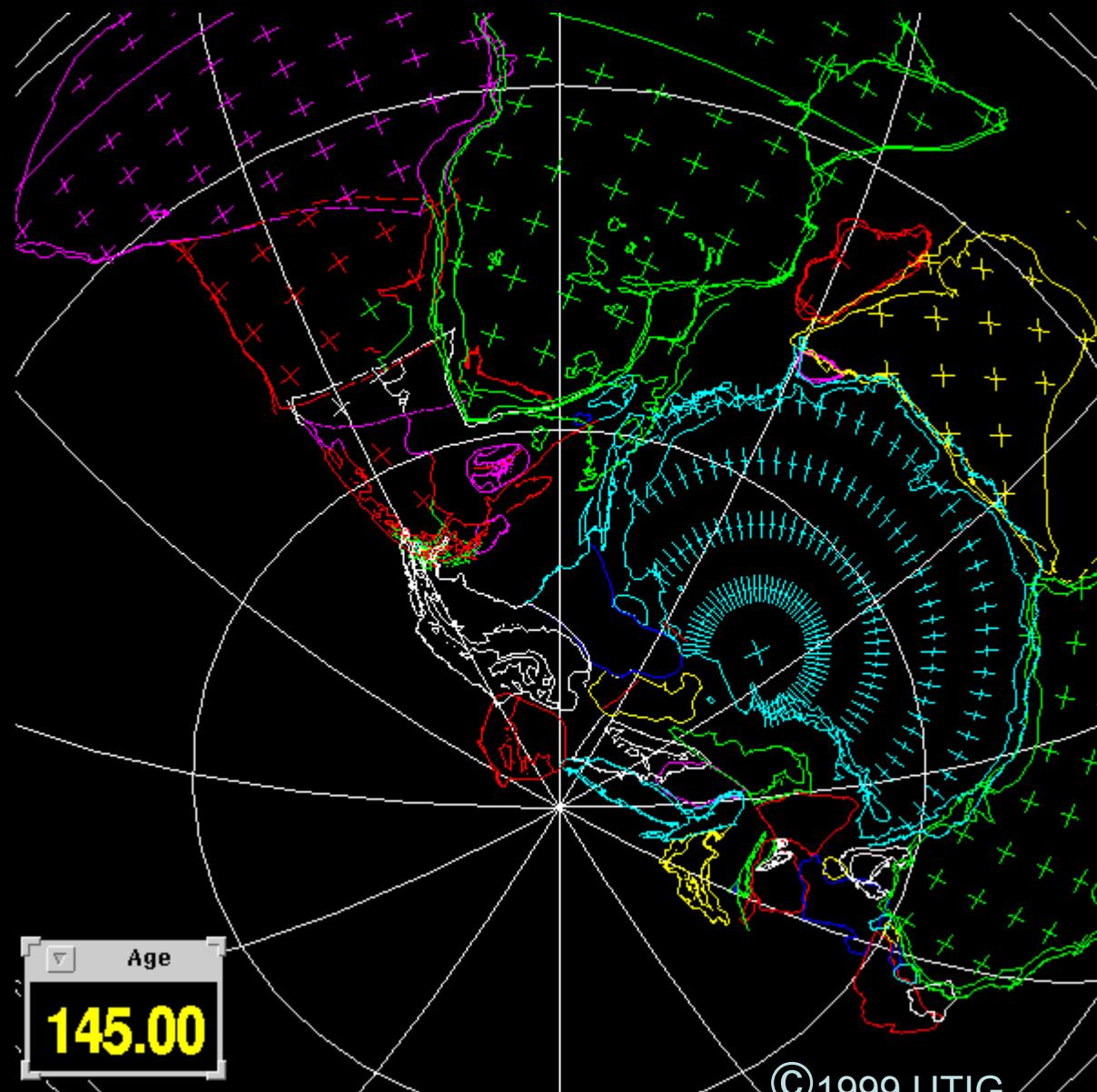
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Age

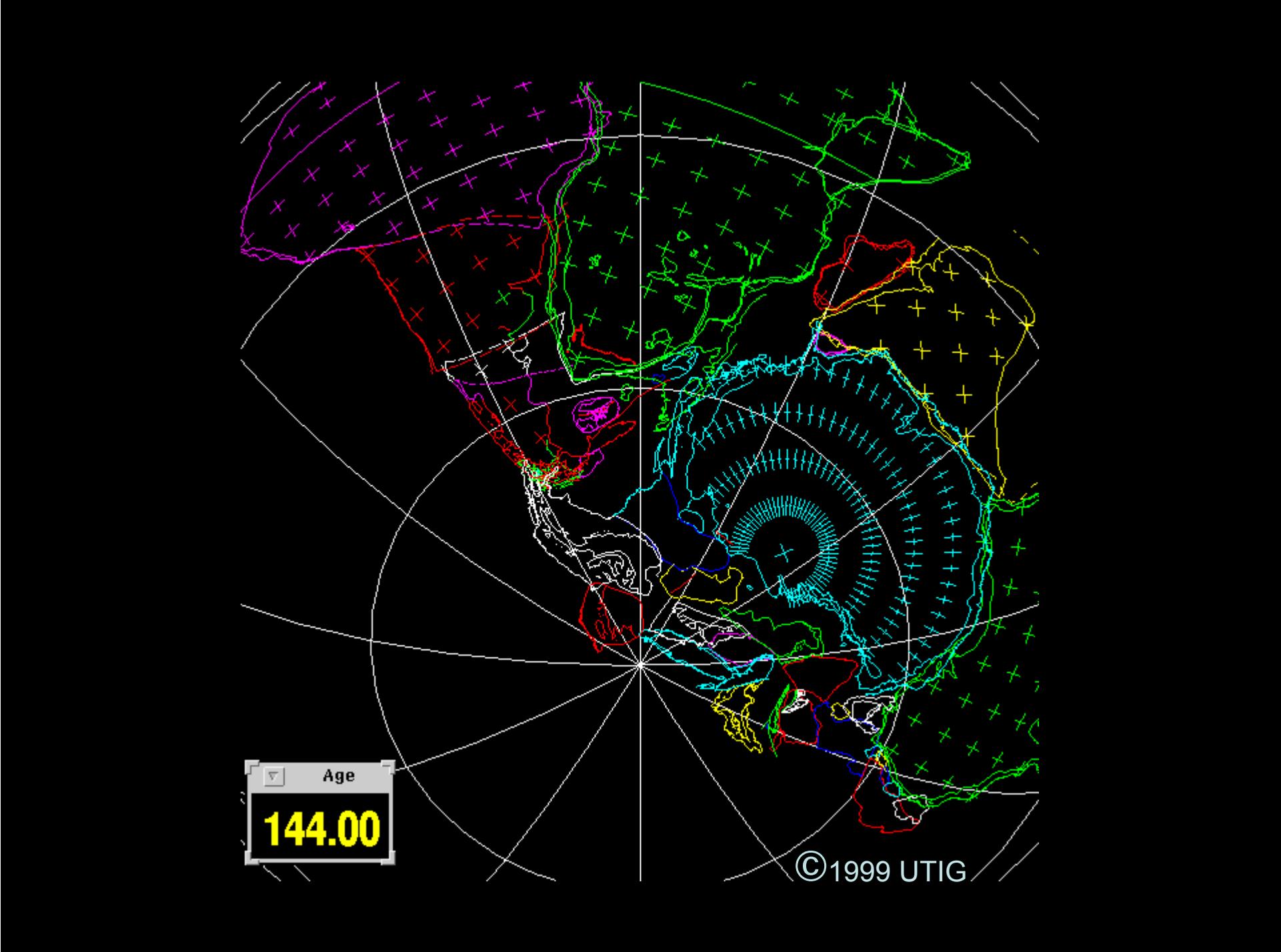
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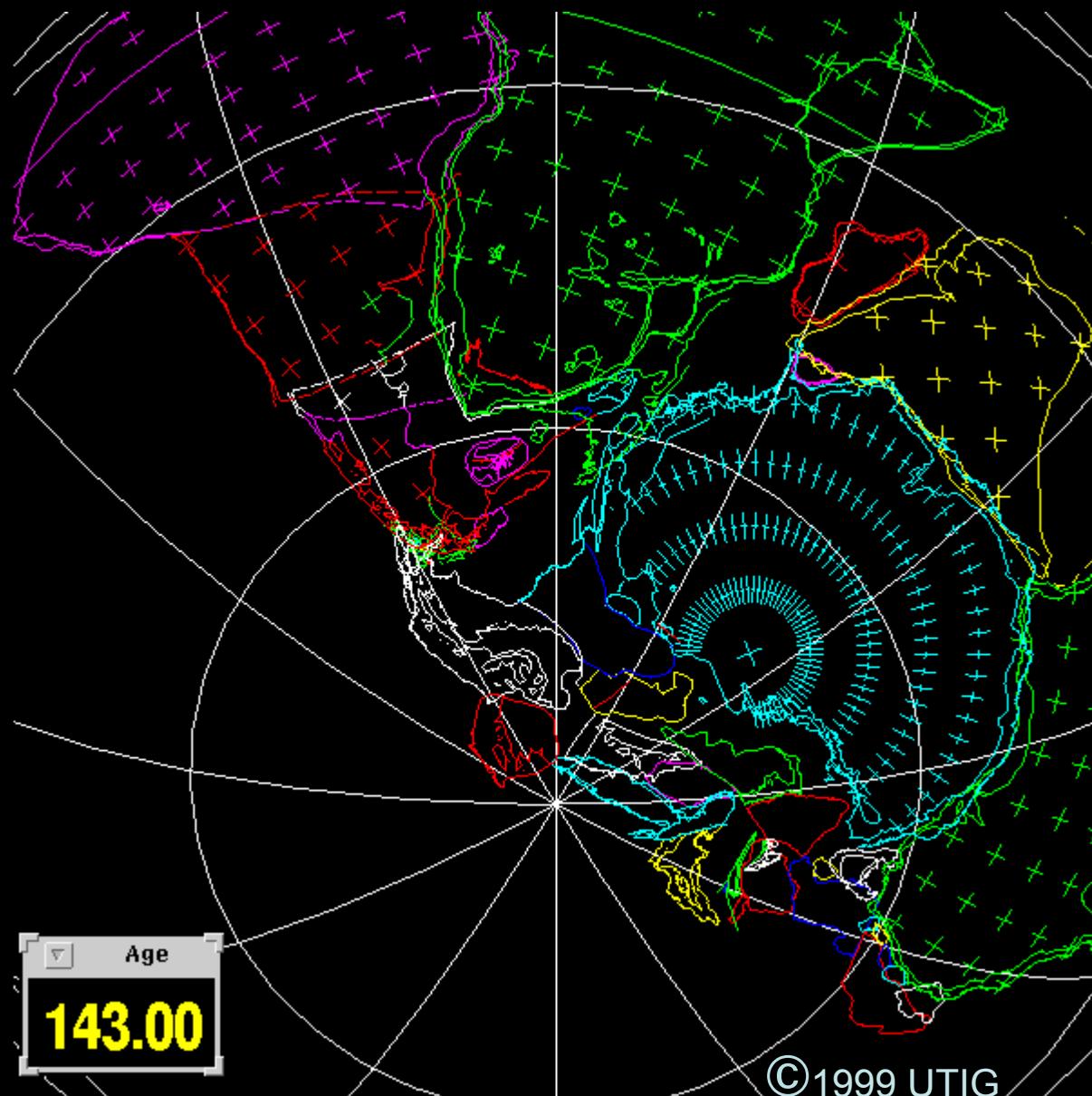
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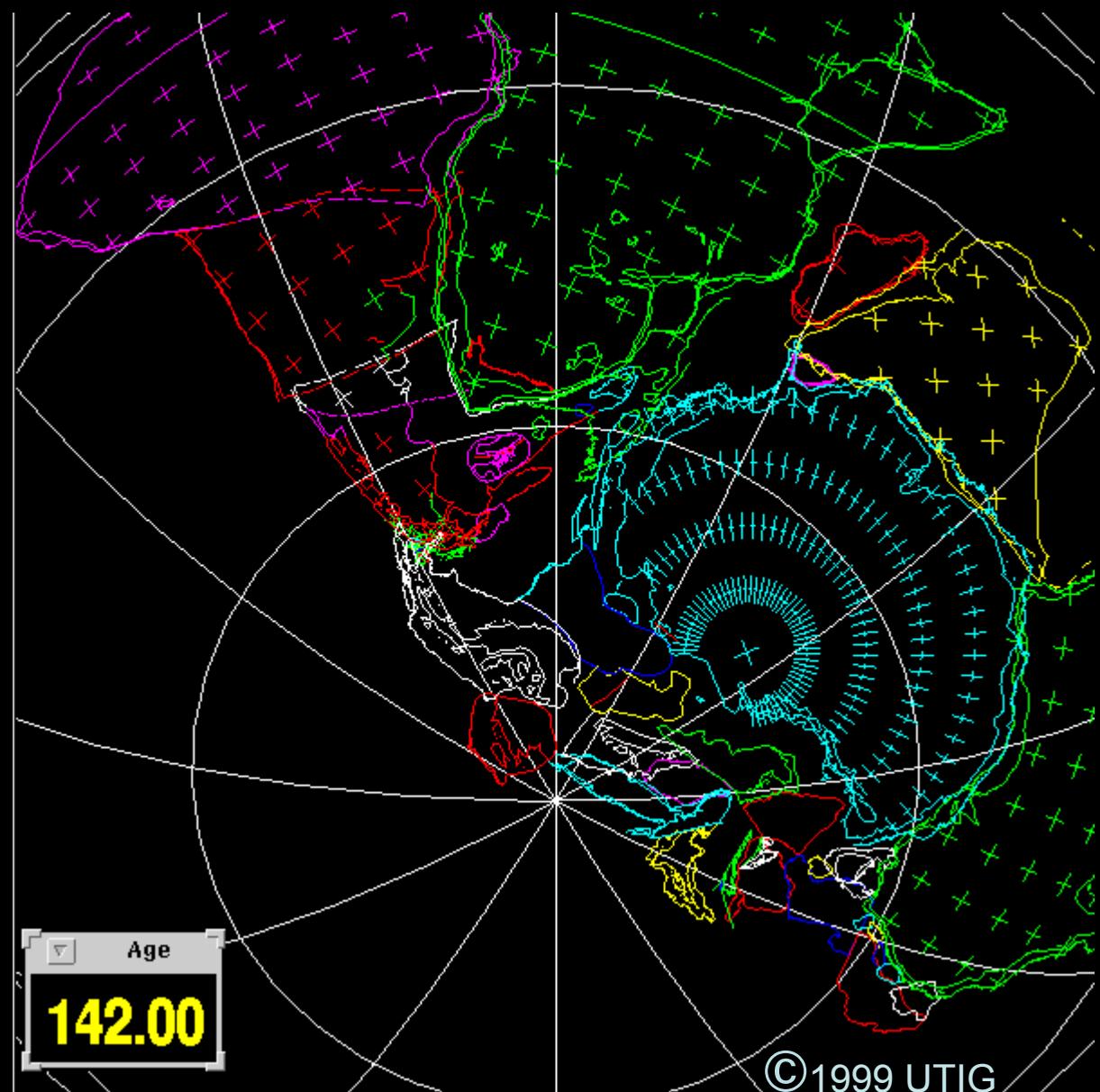
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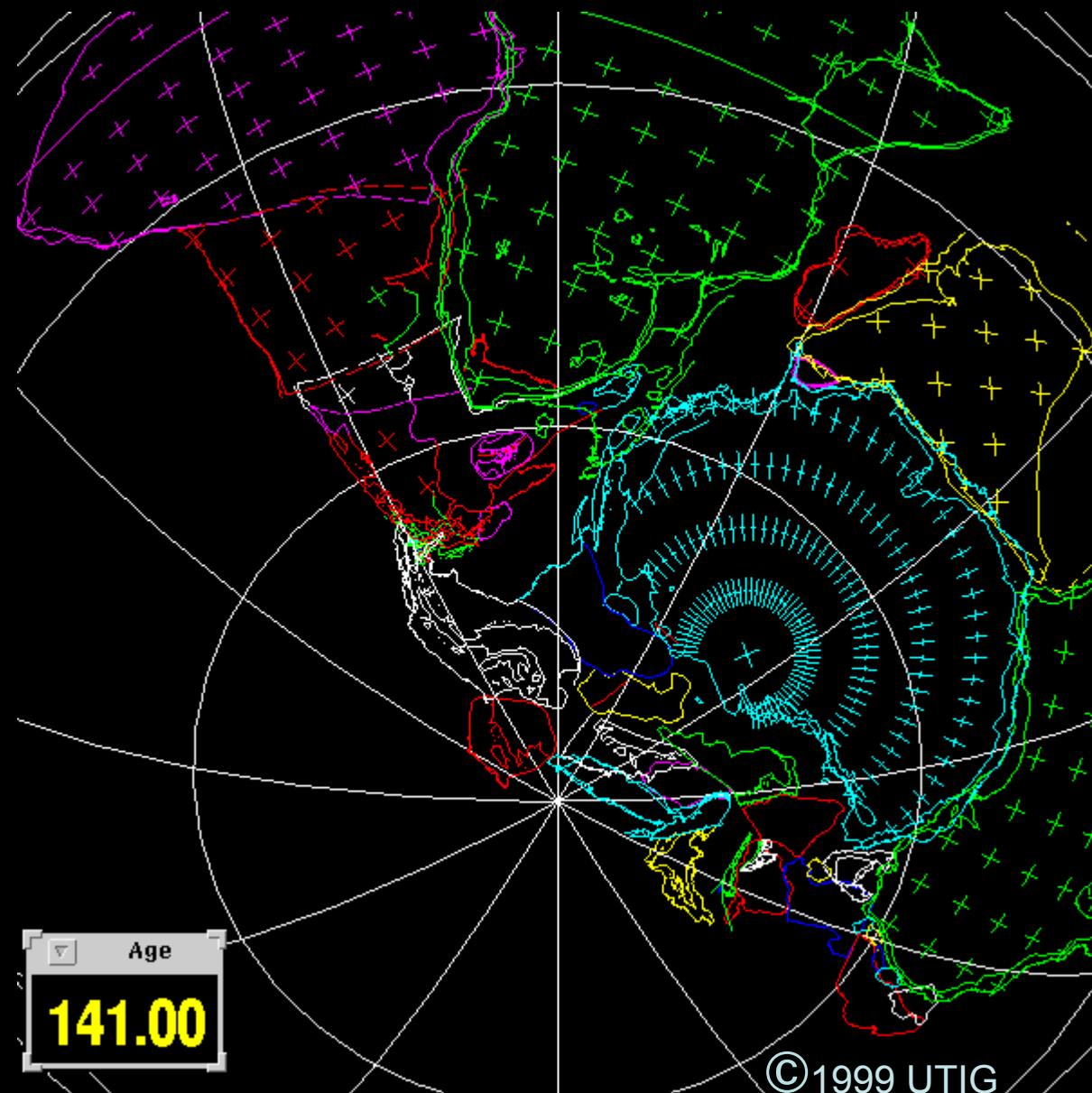
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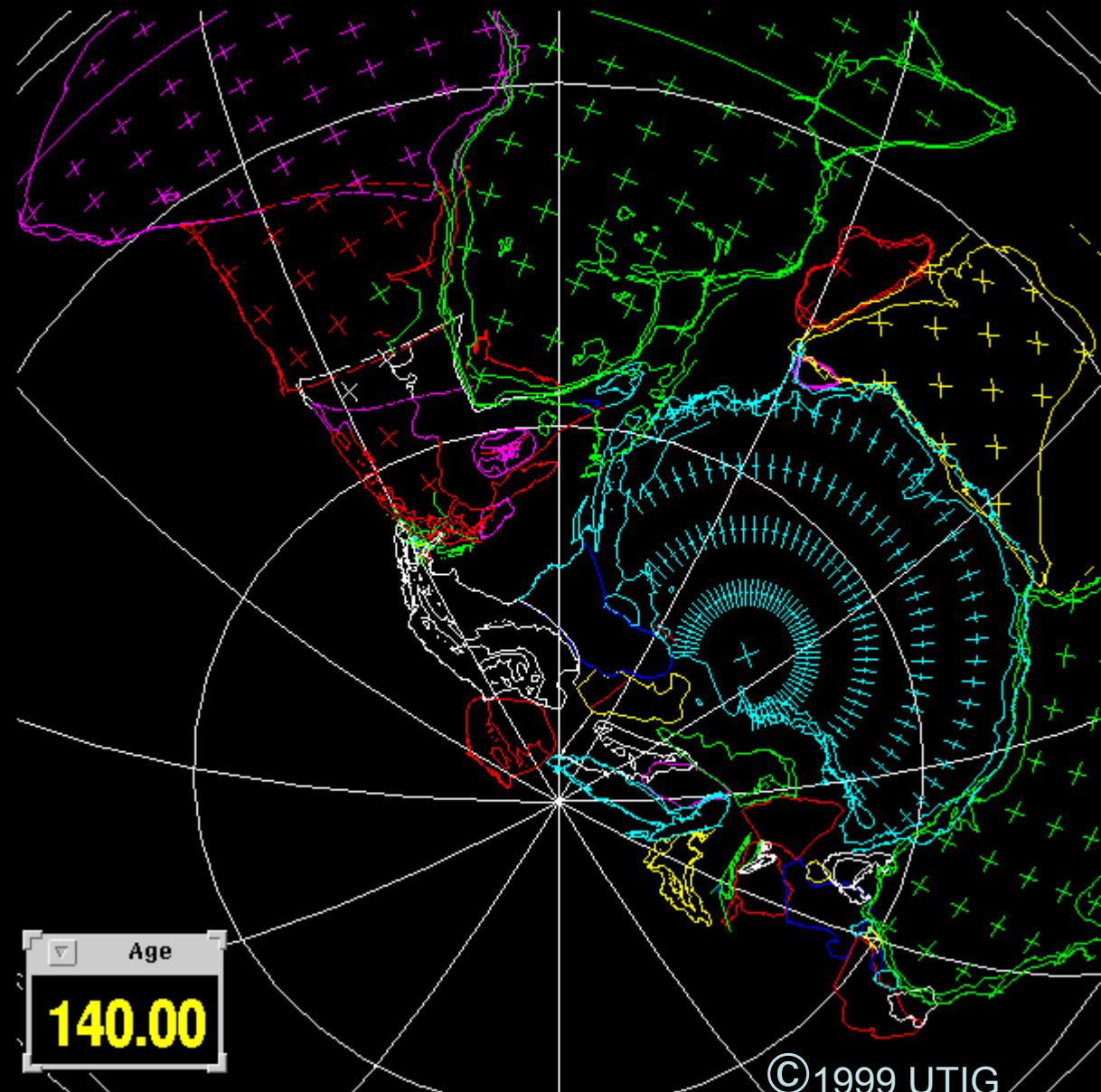
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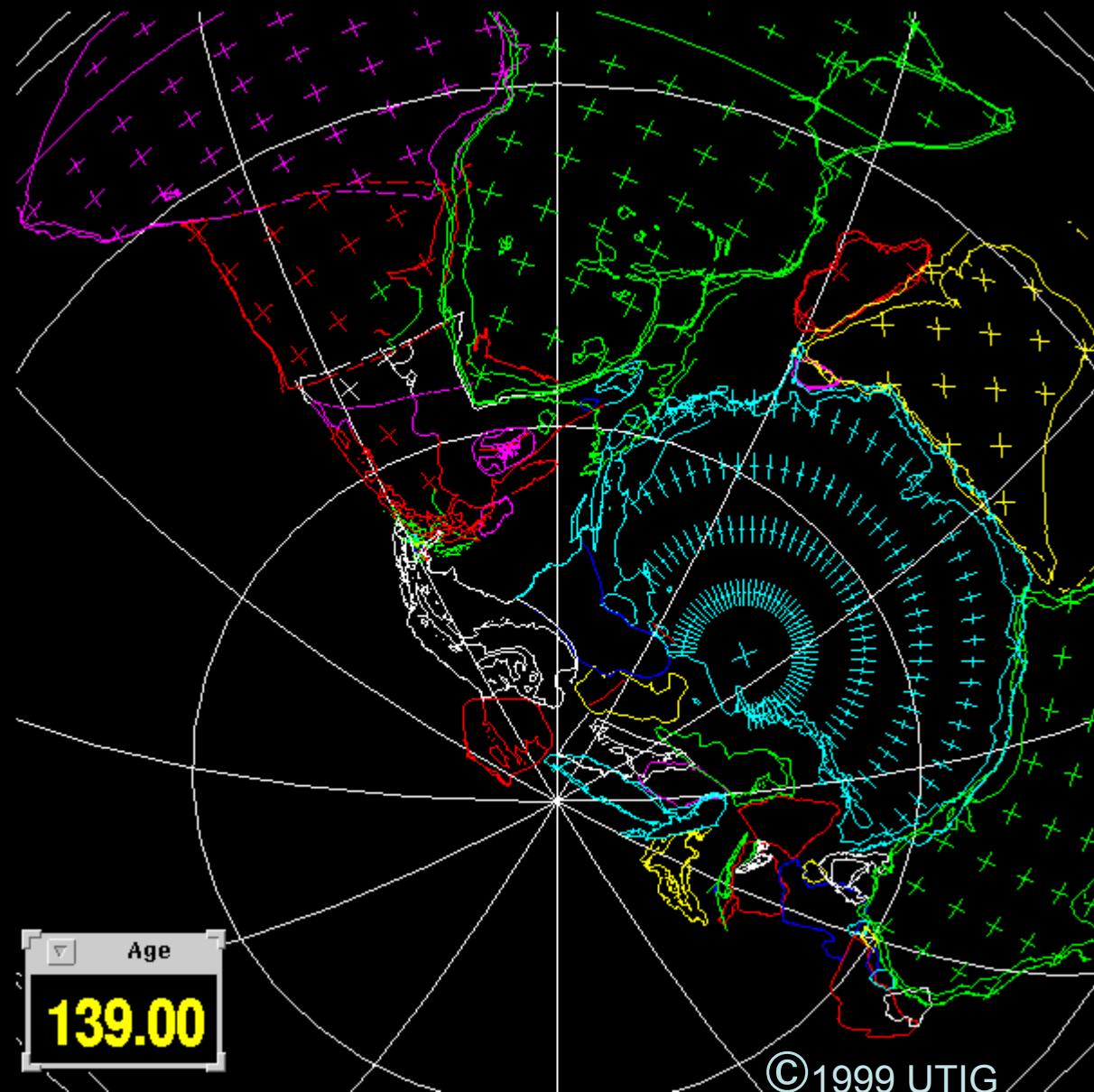


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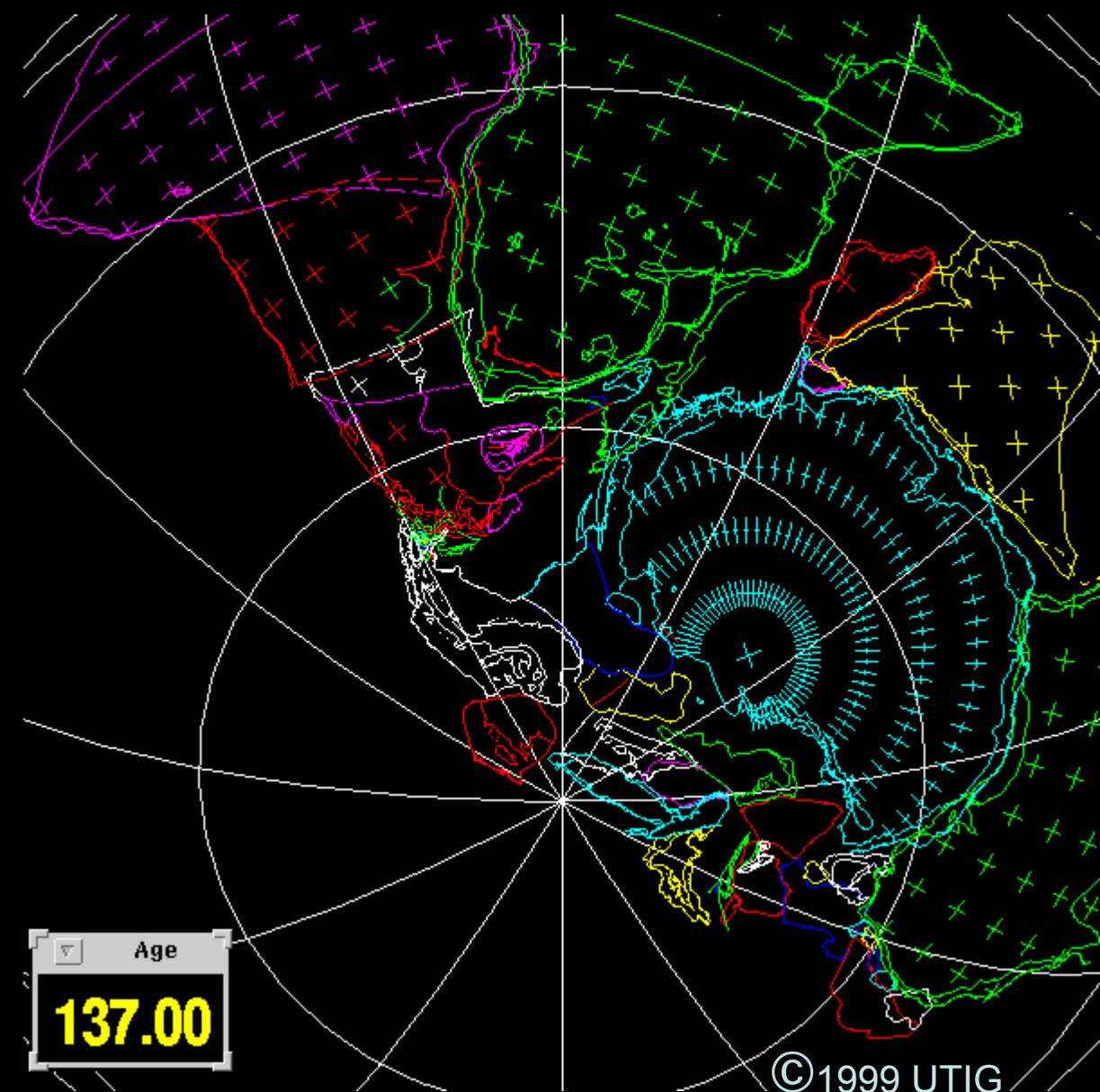


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Age

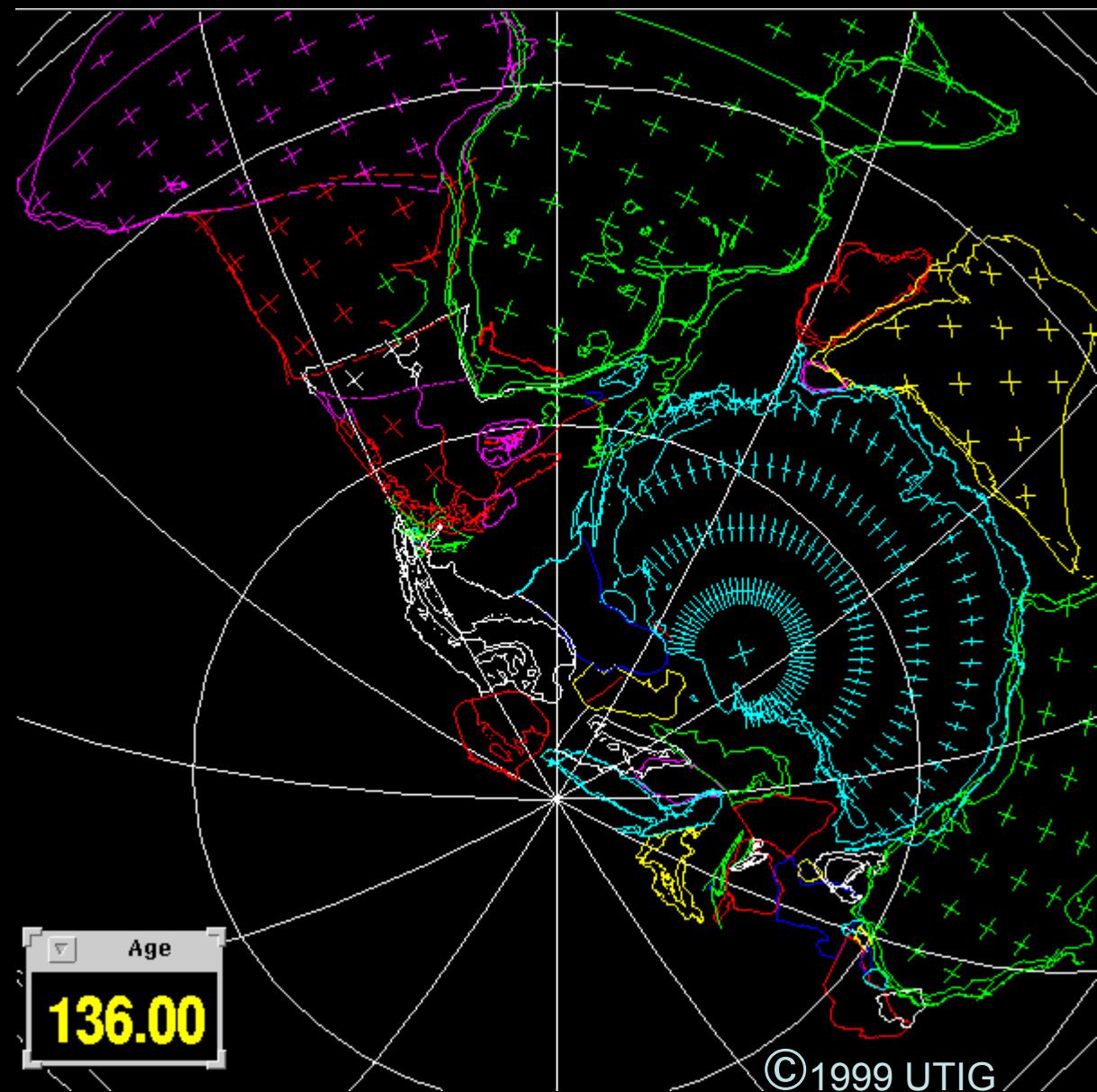
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136.00

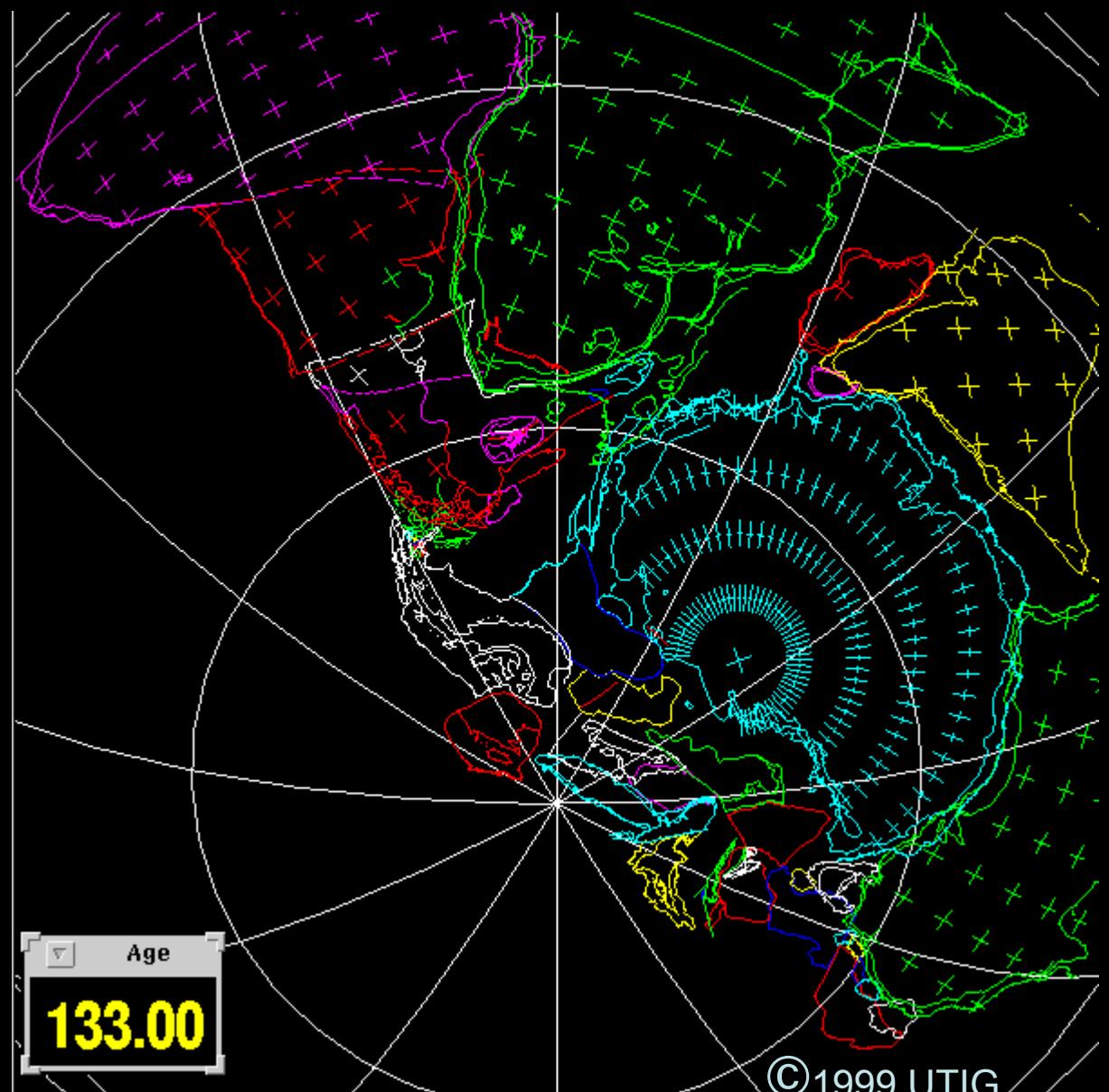


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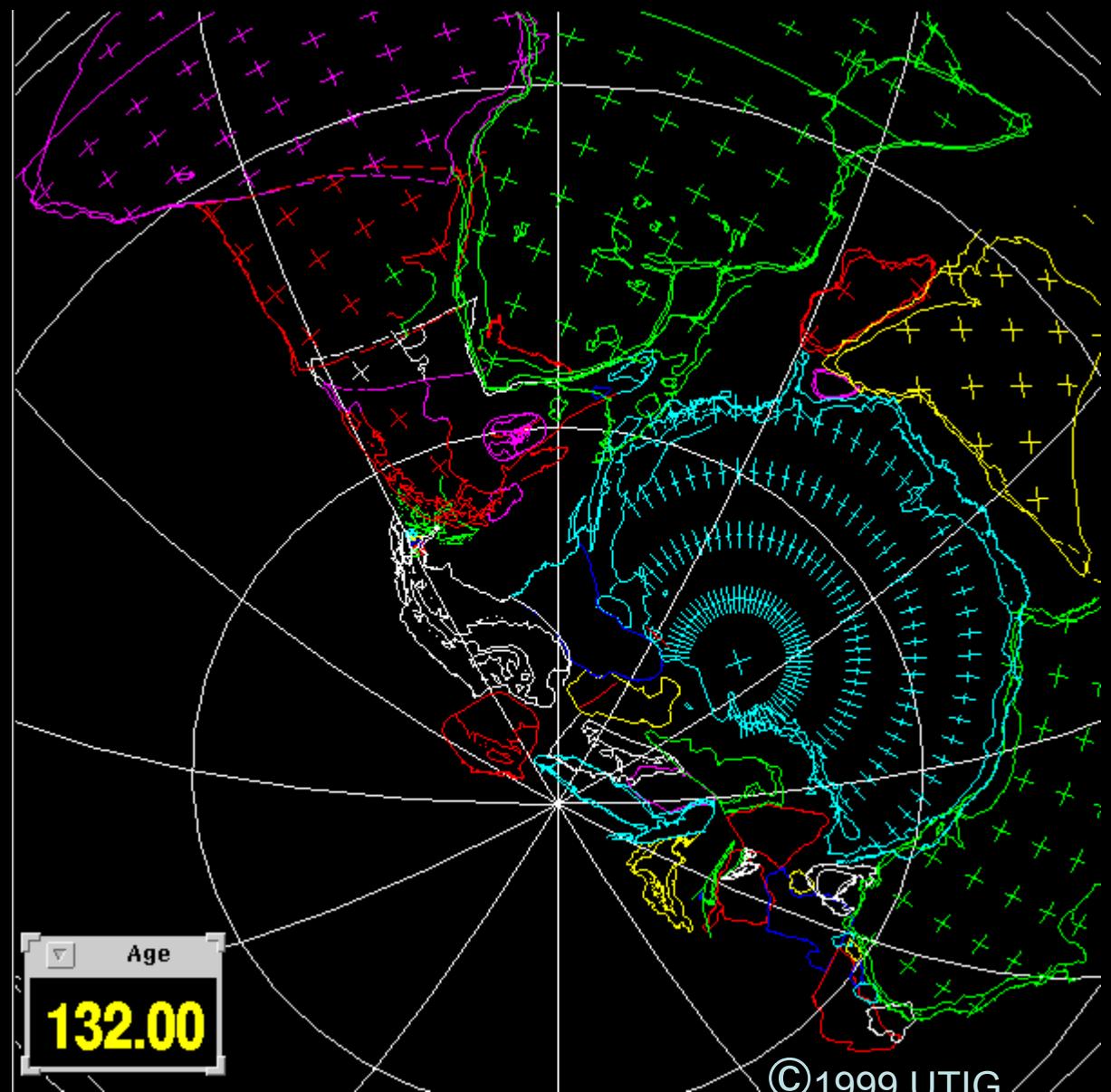
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Age
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Age

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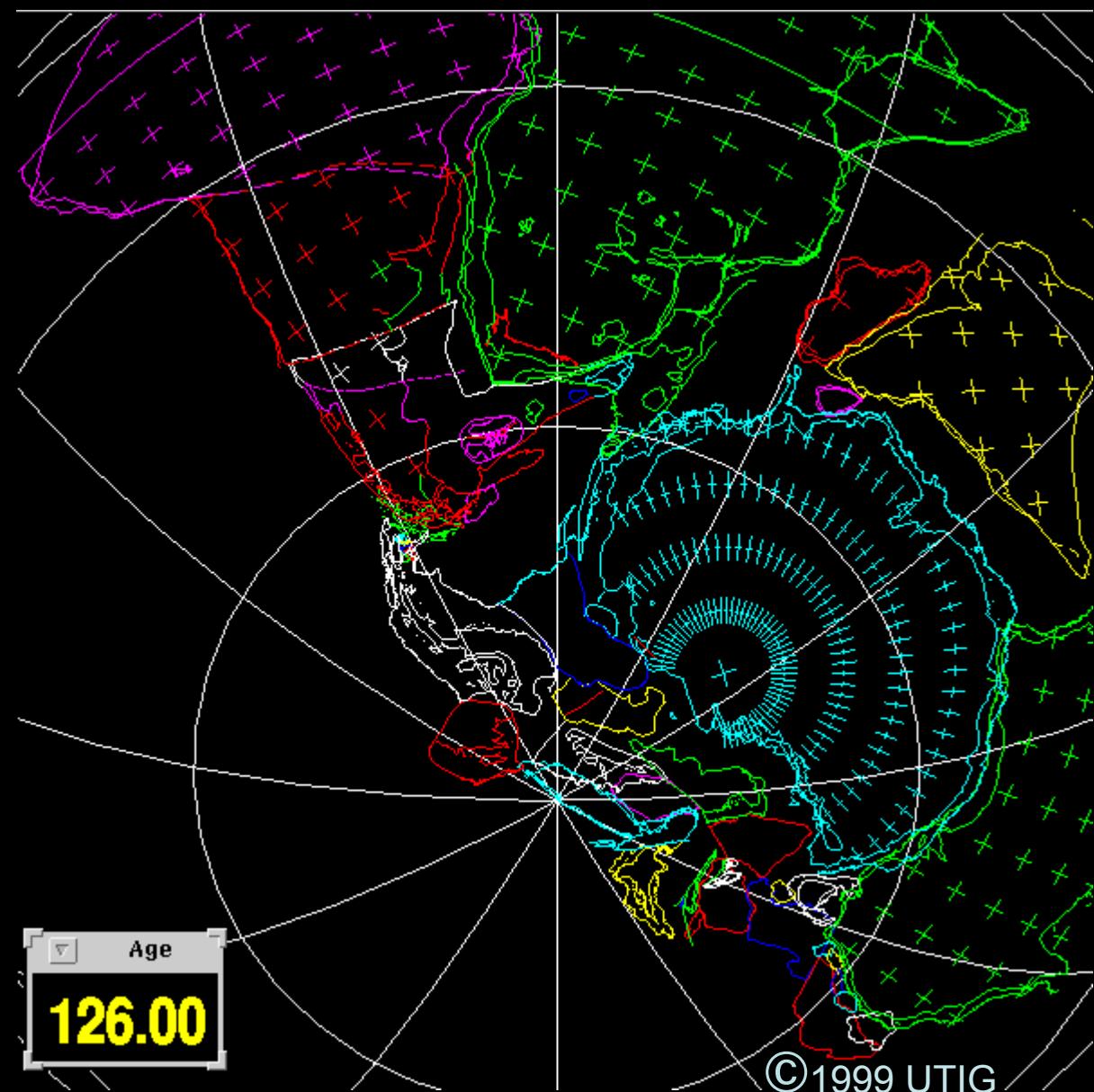
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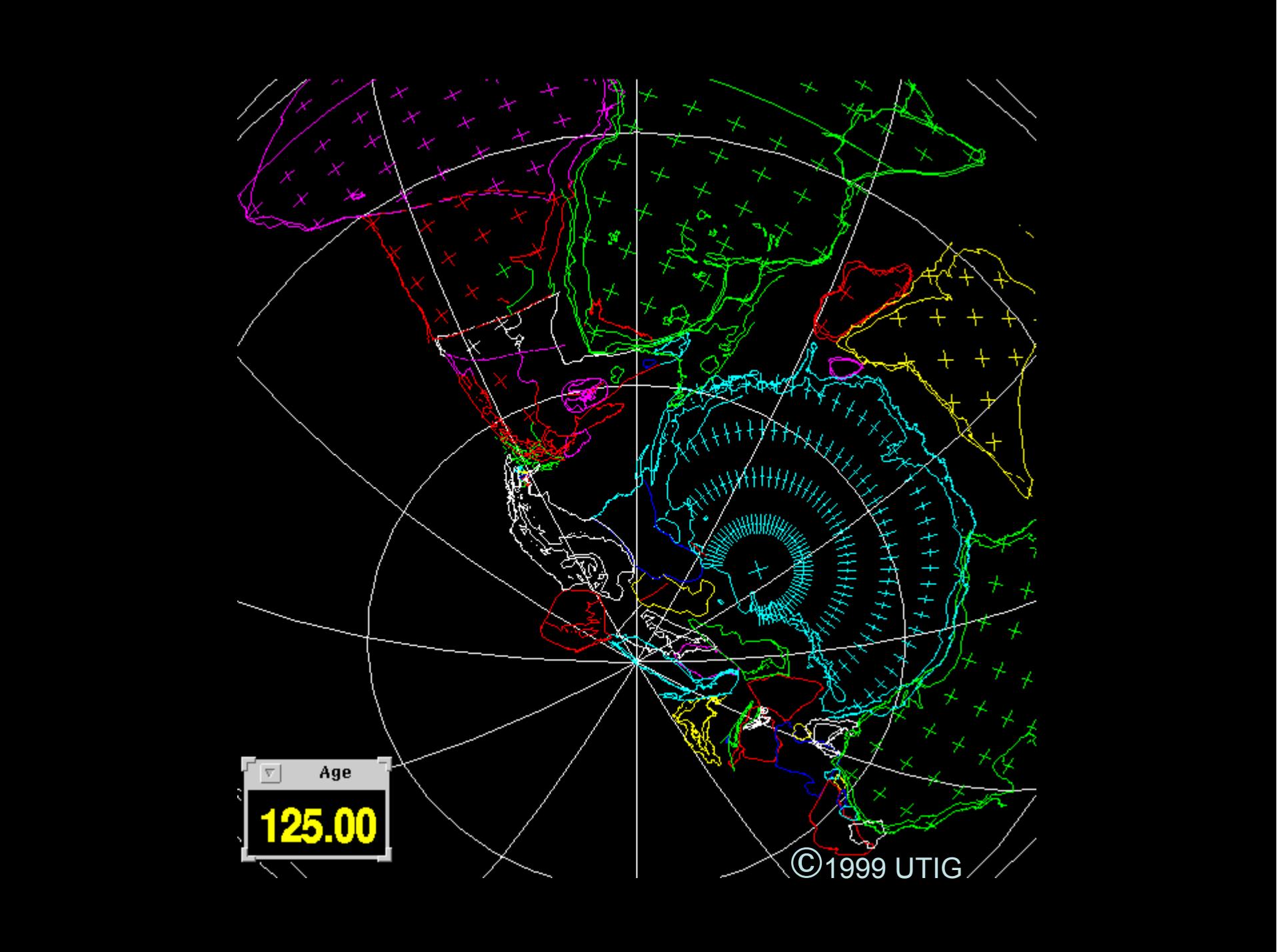
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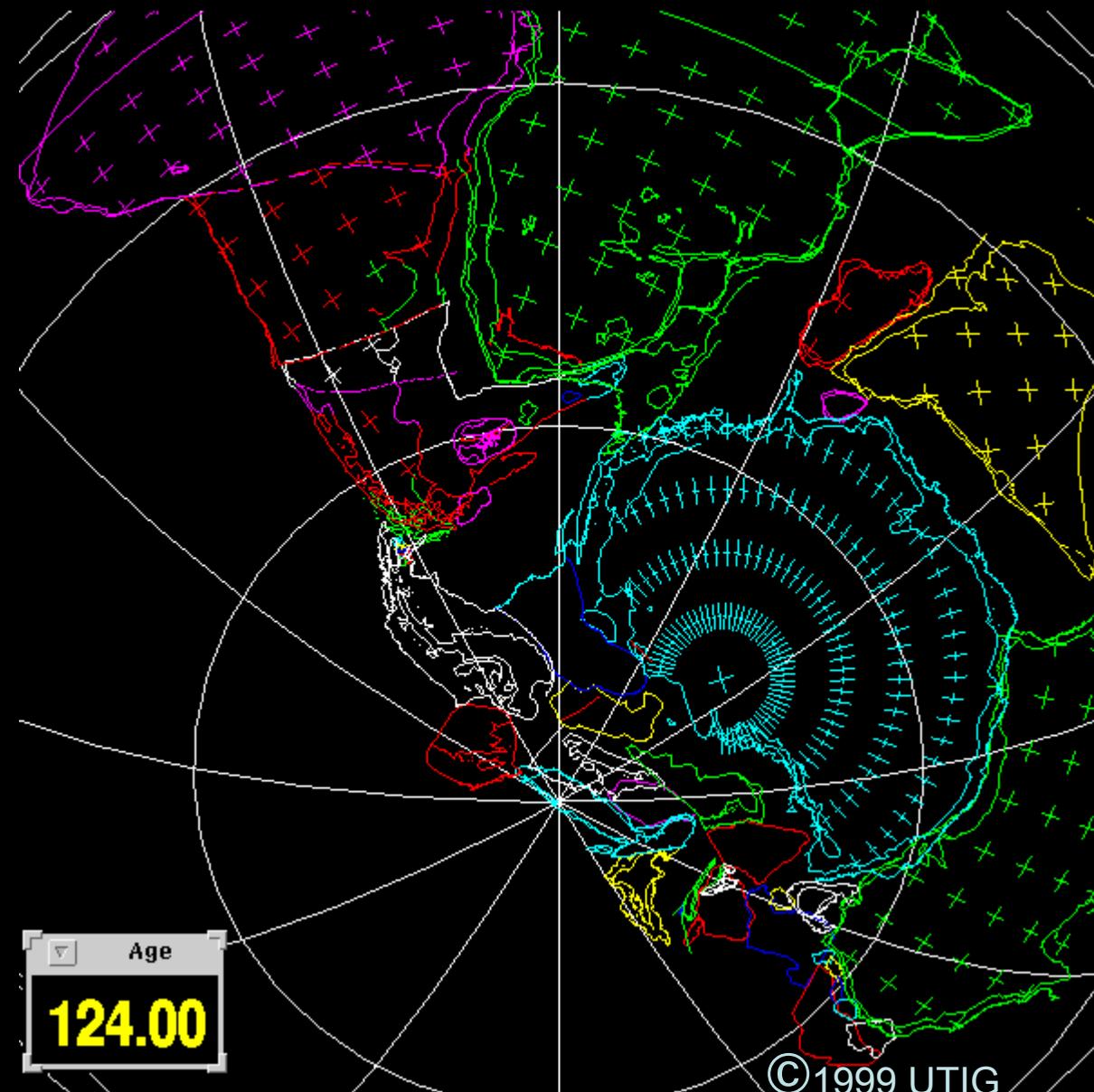


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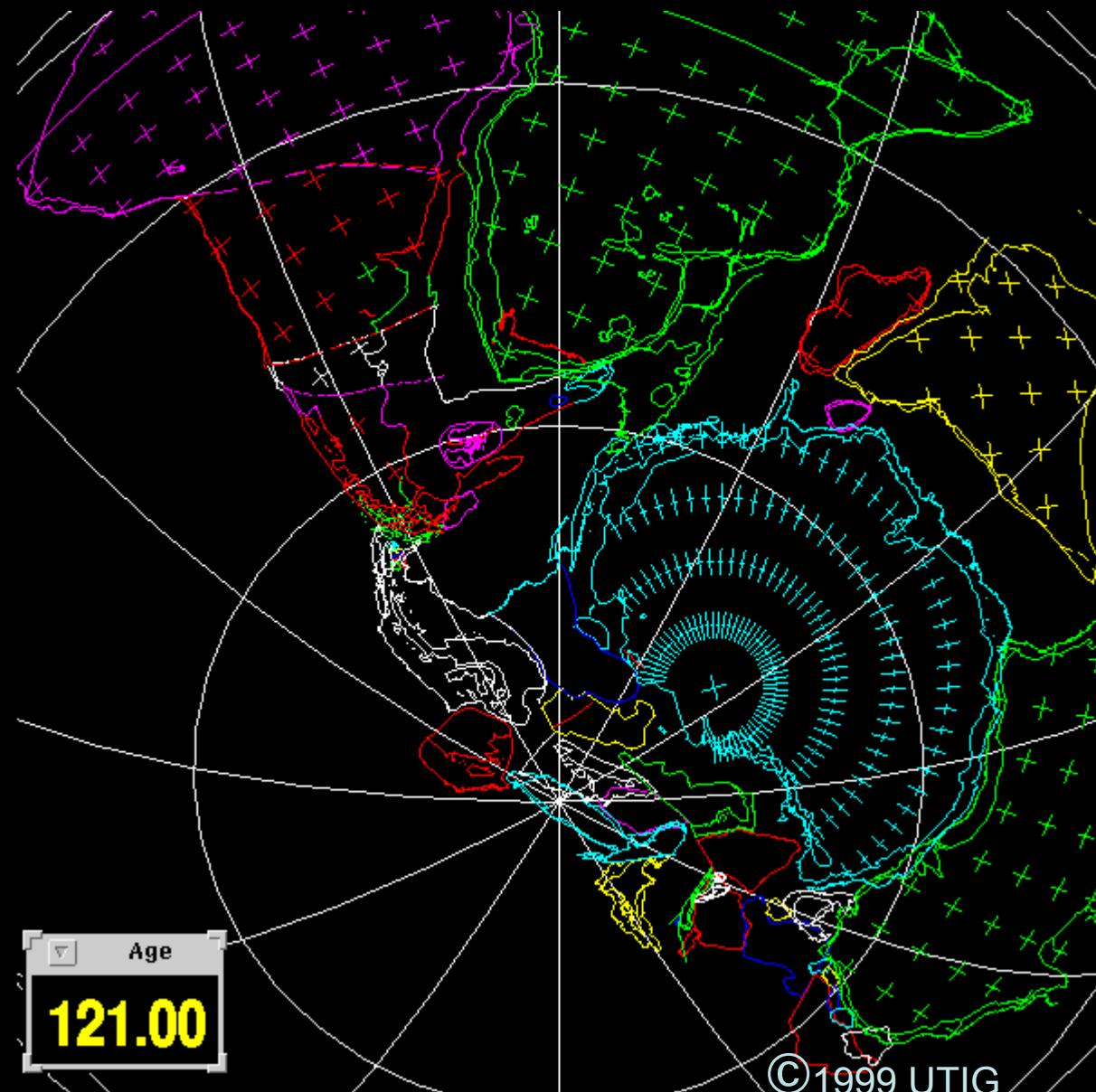
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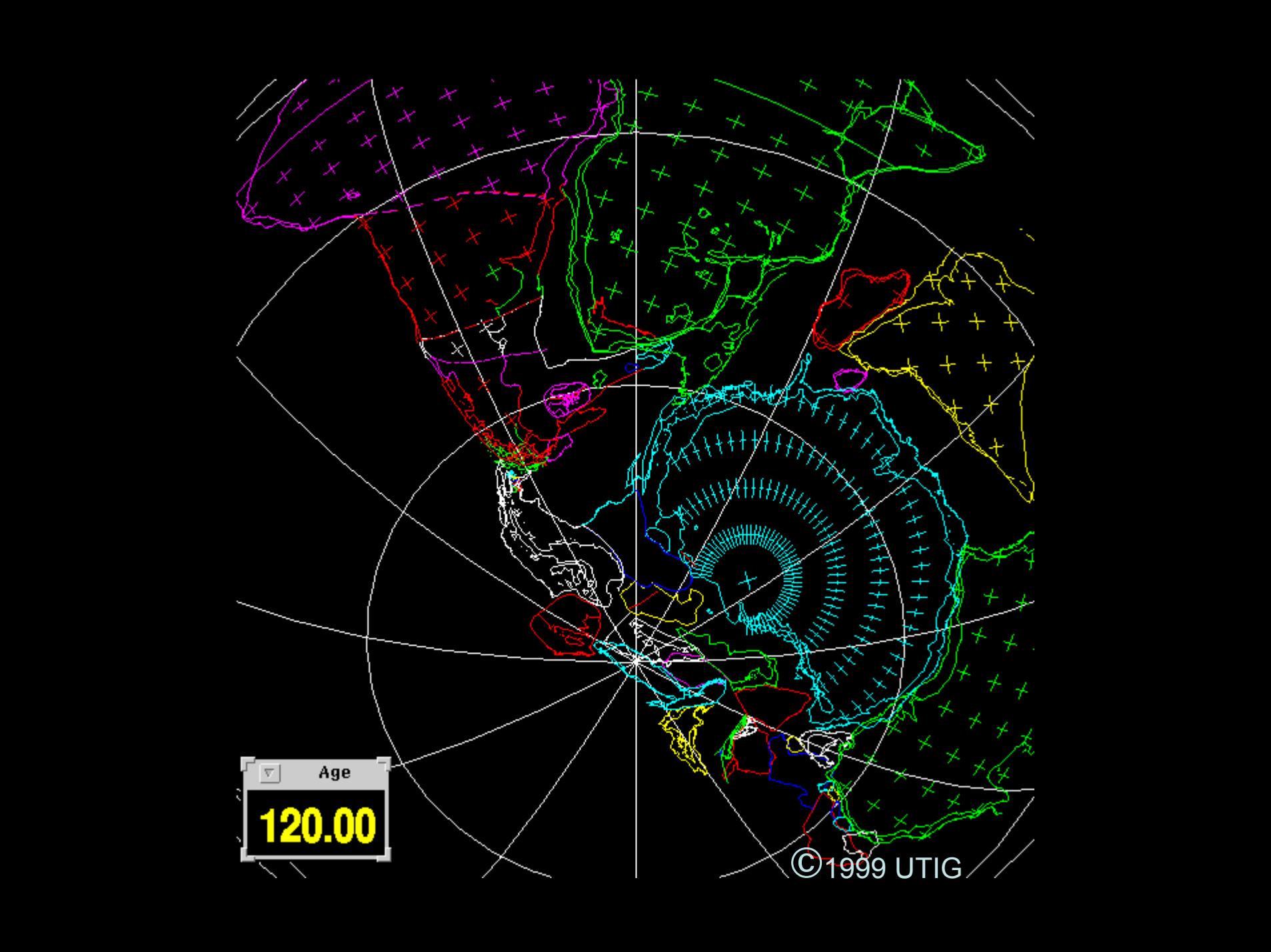
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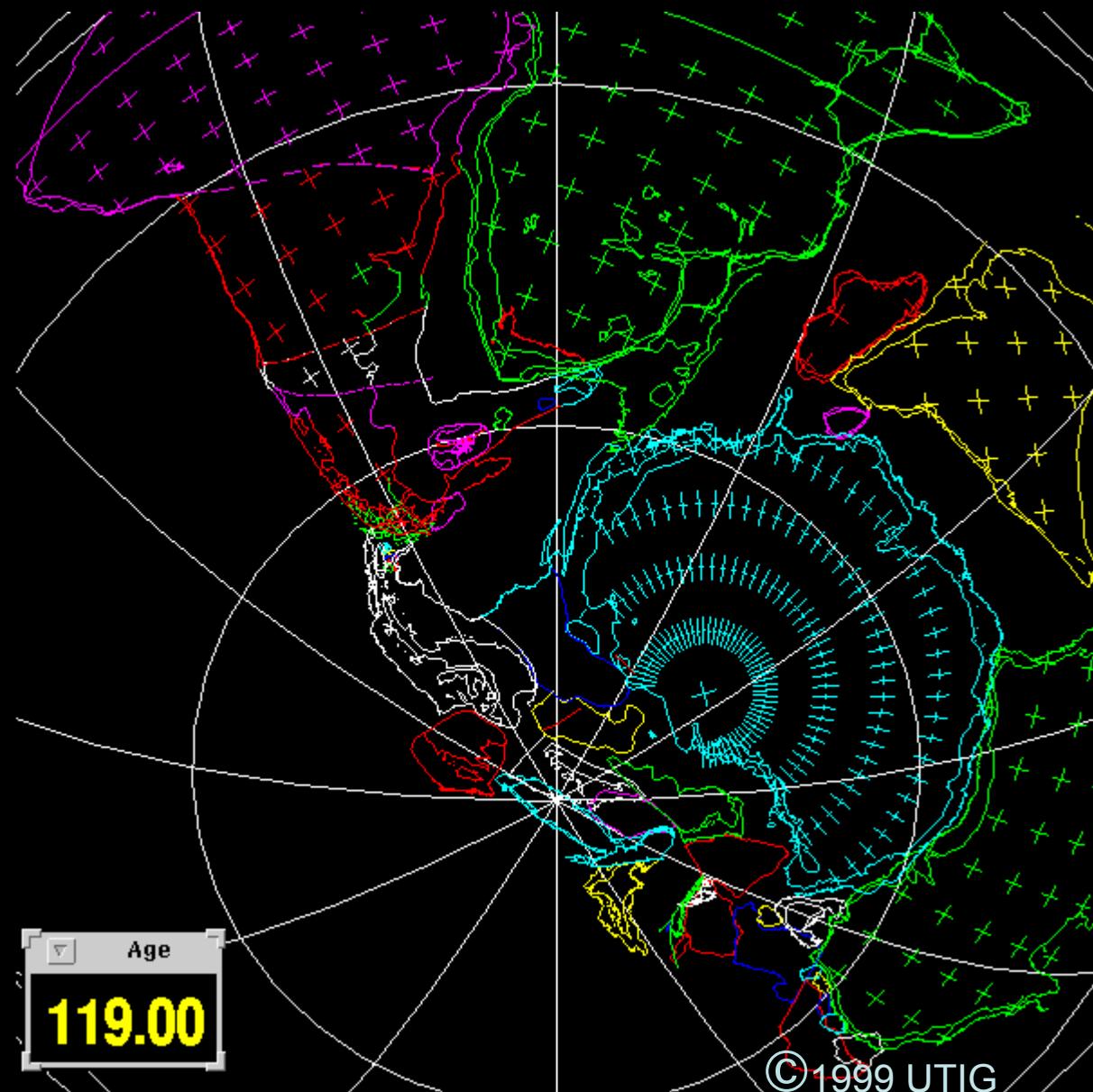


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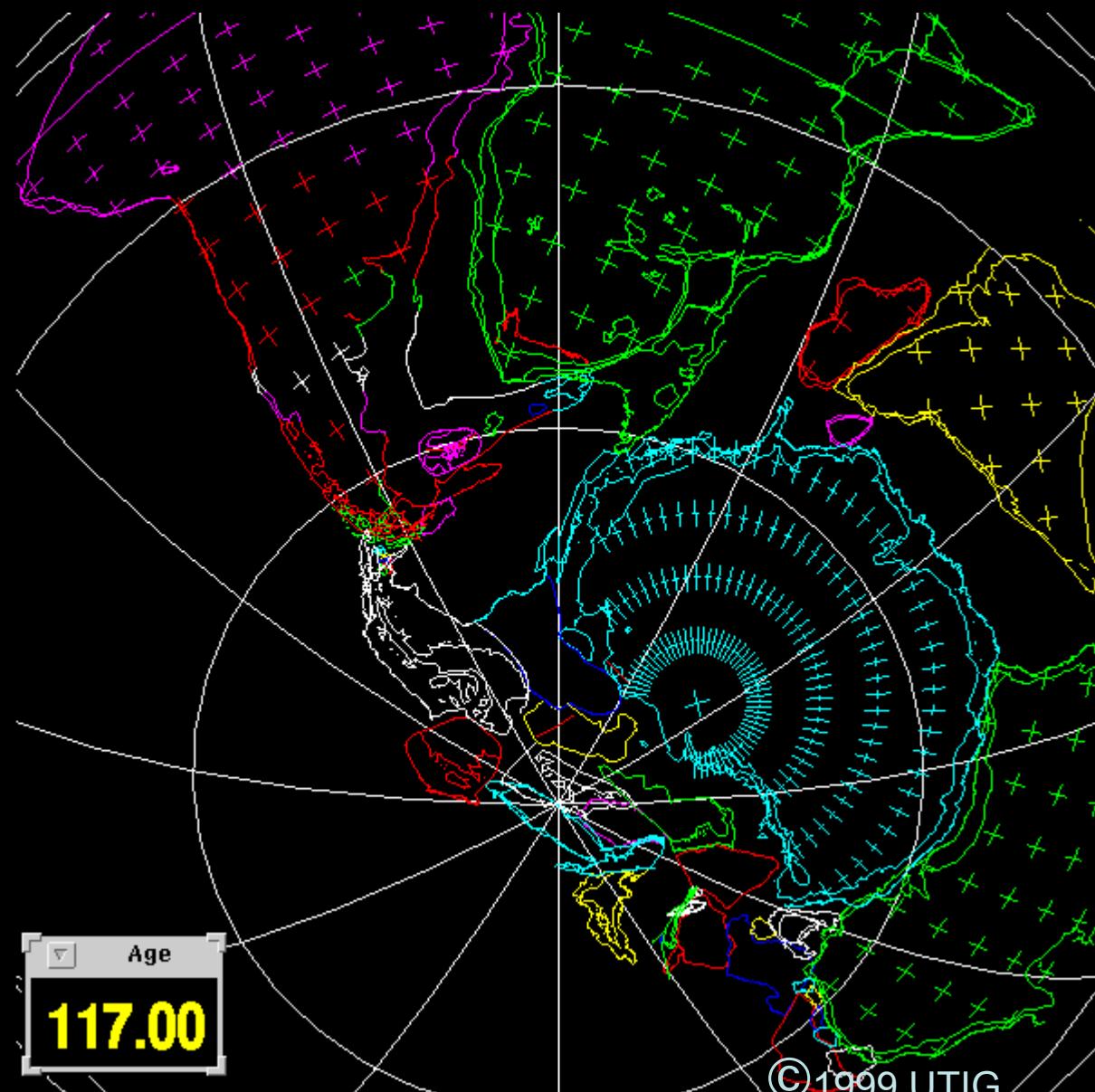


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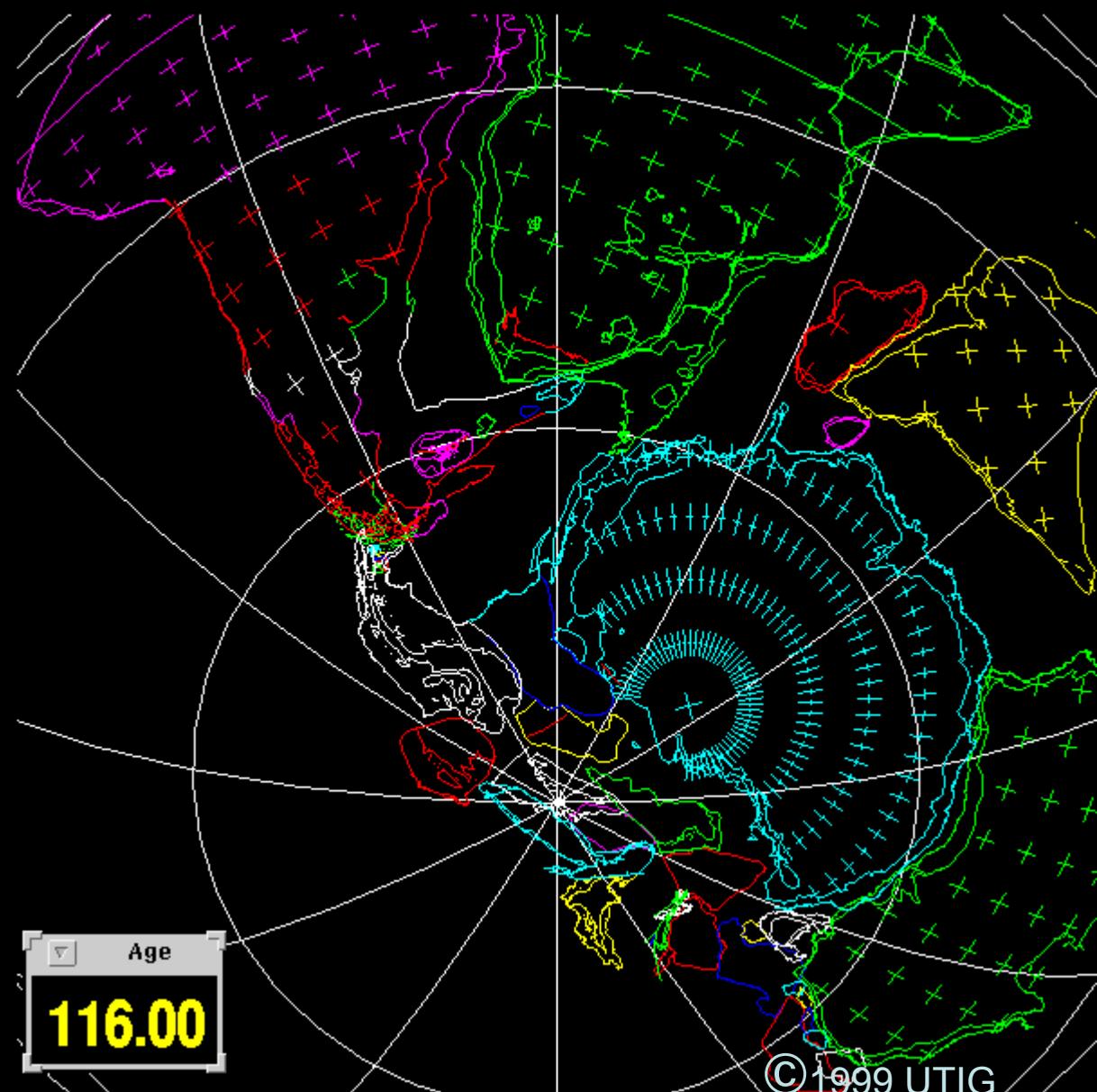
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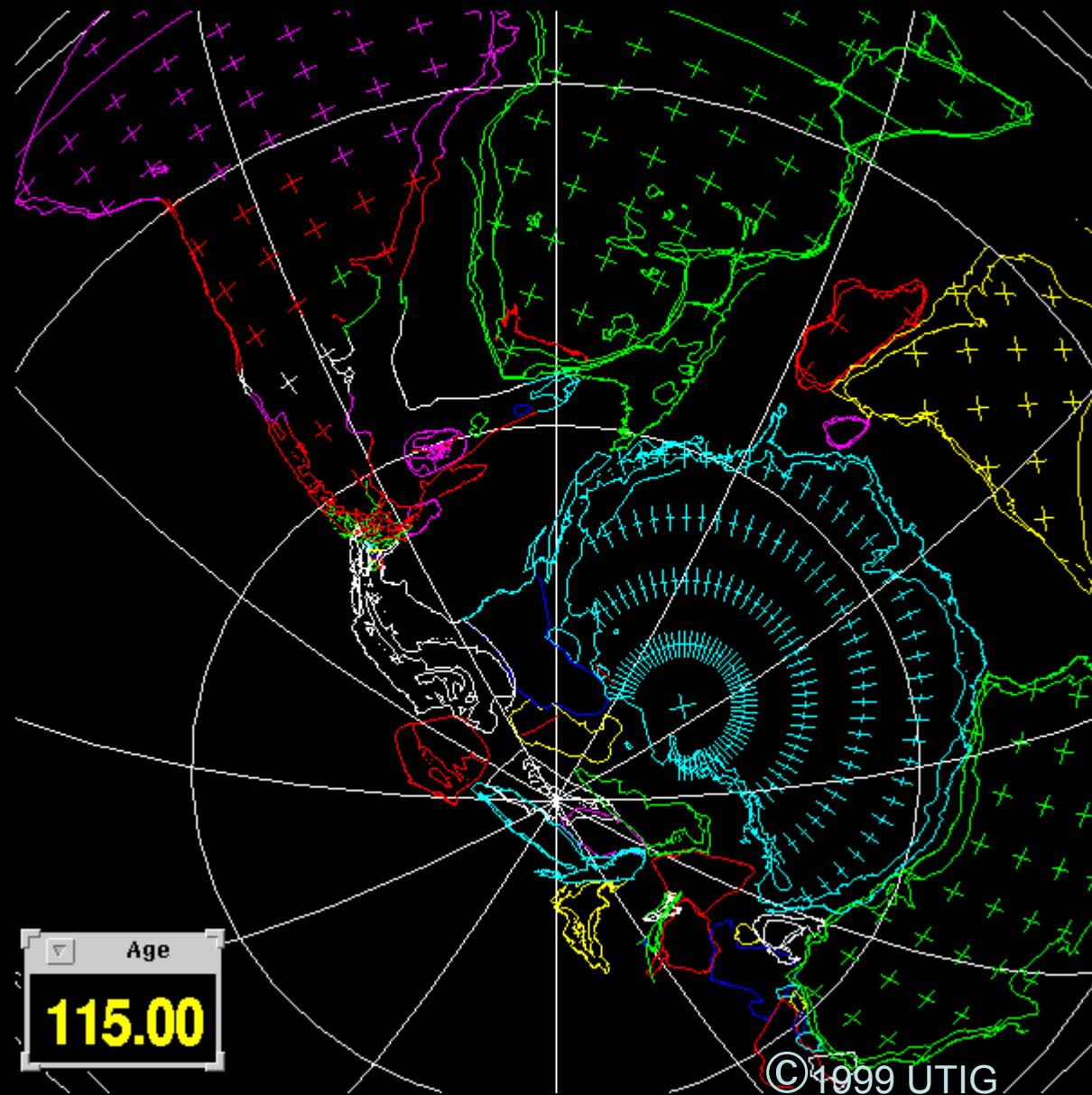
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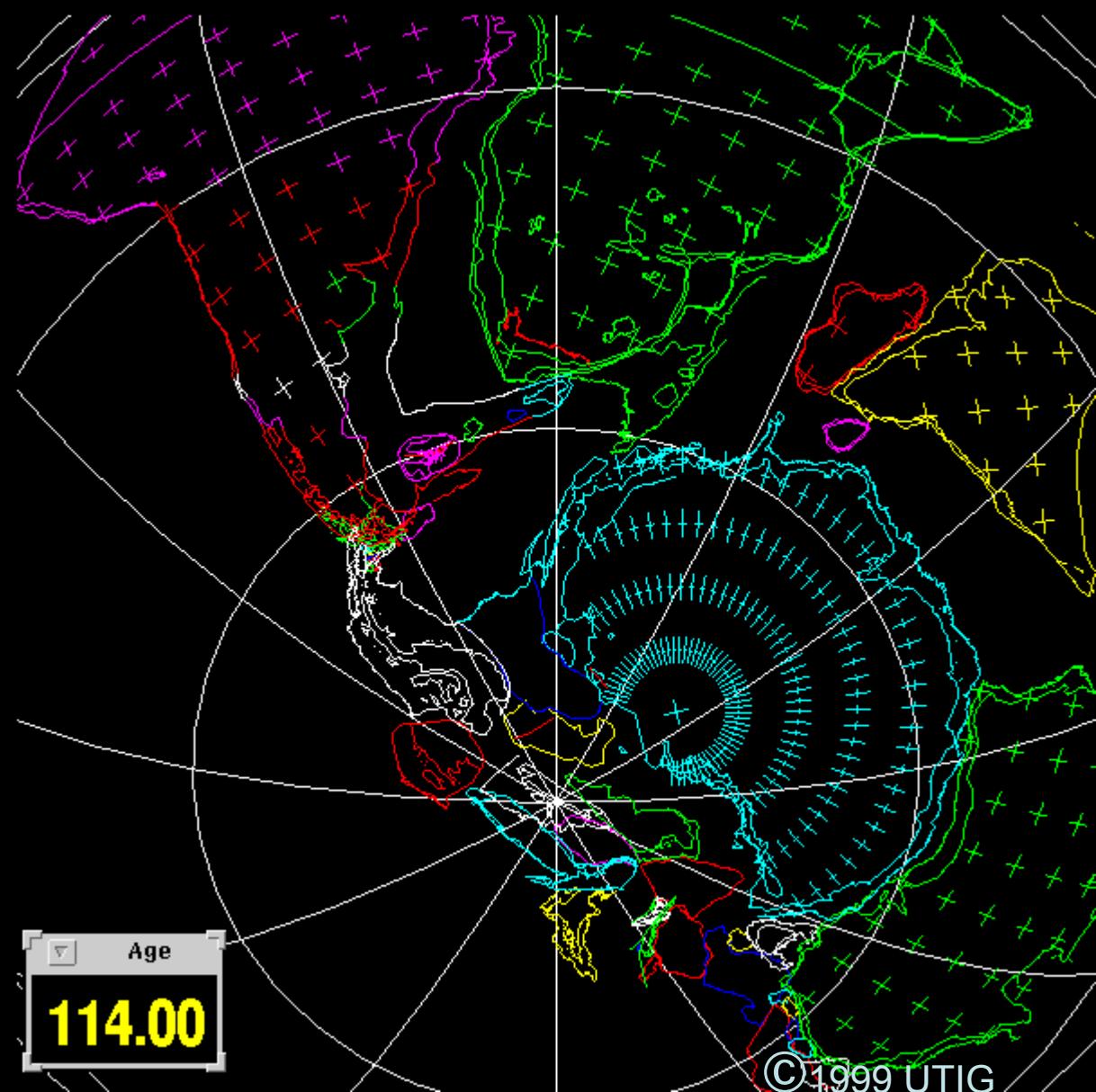


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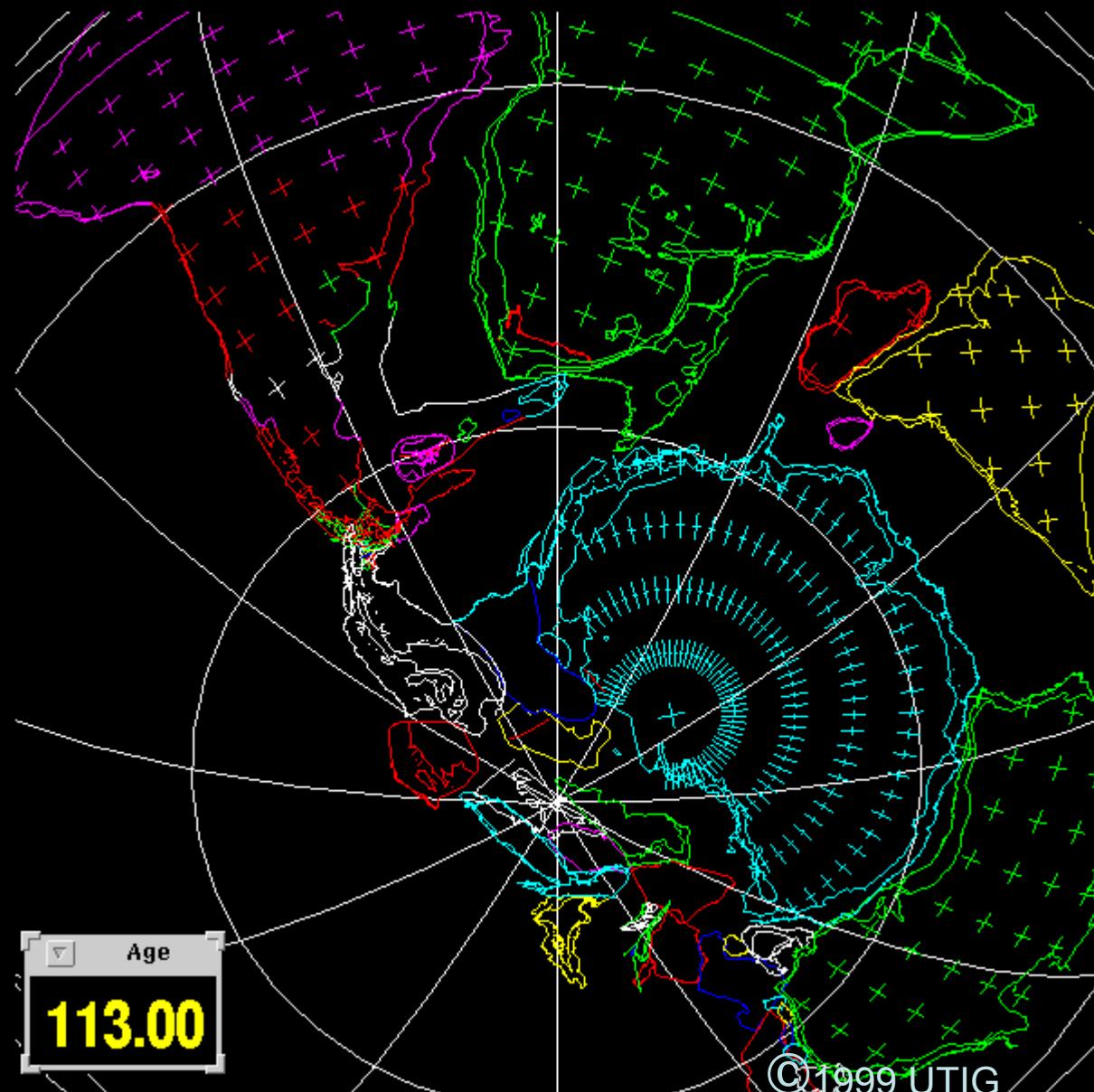
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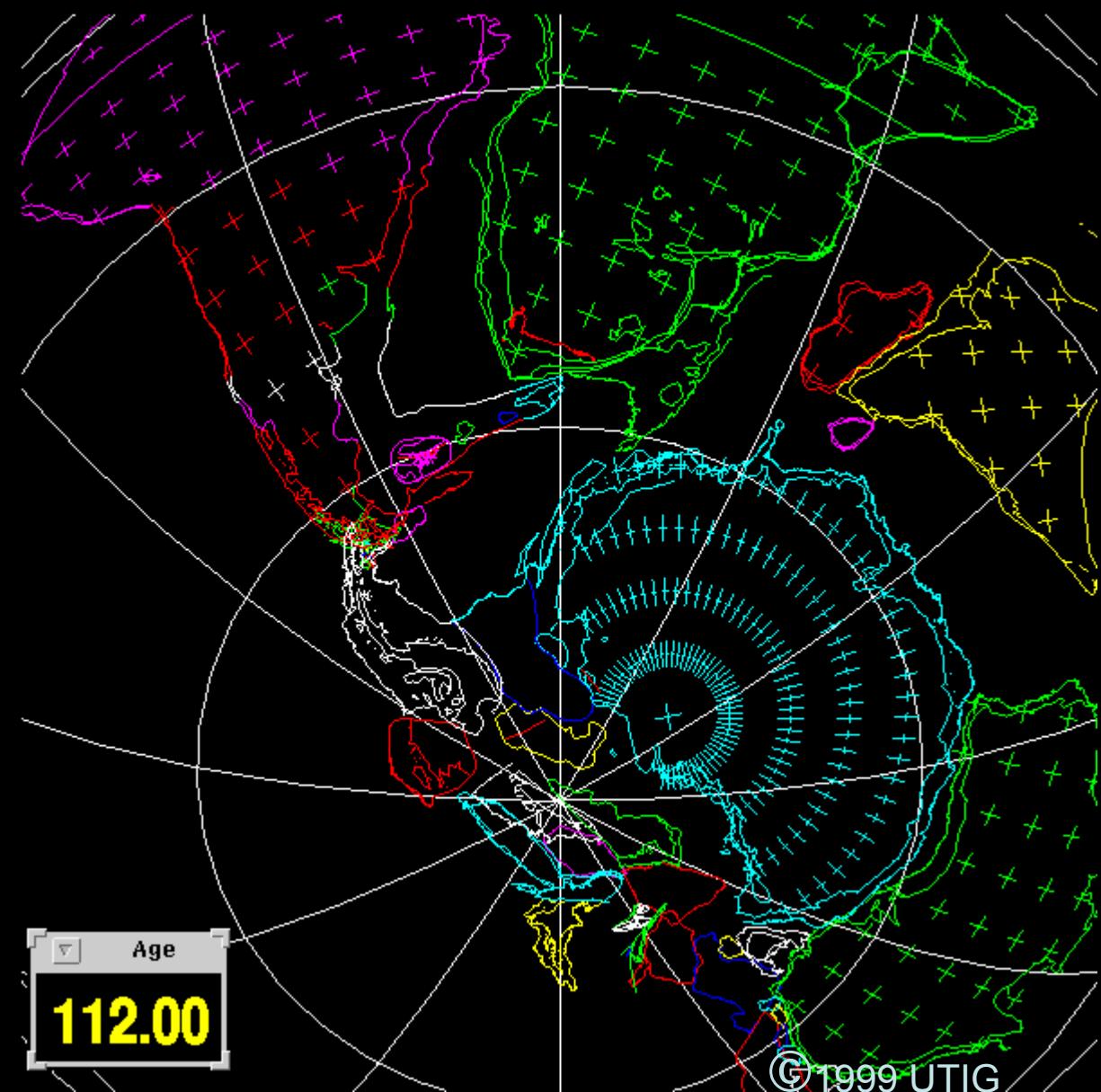
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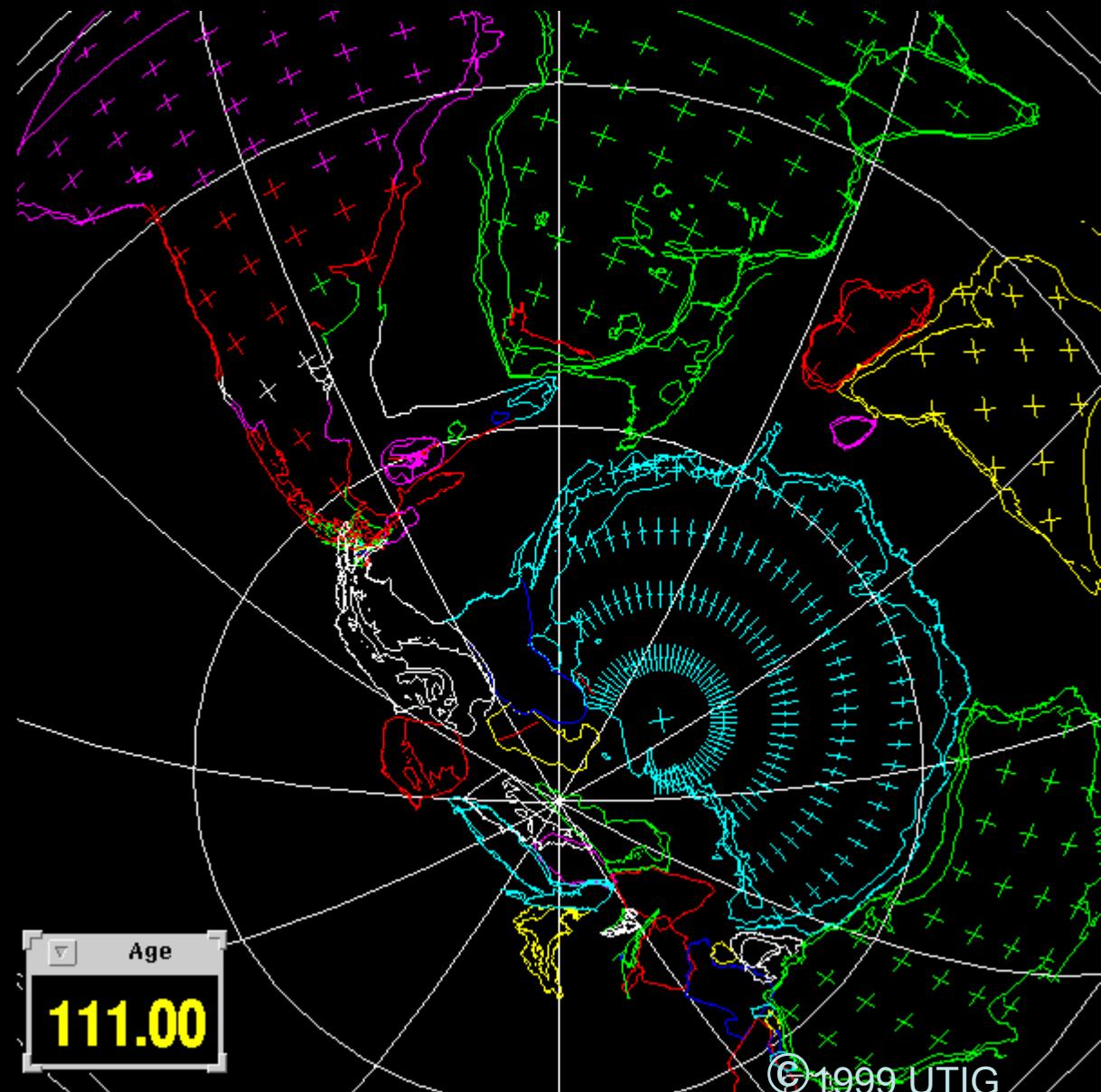
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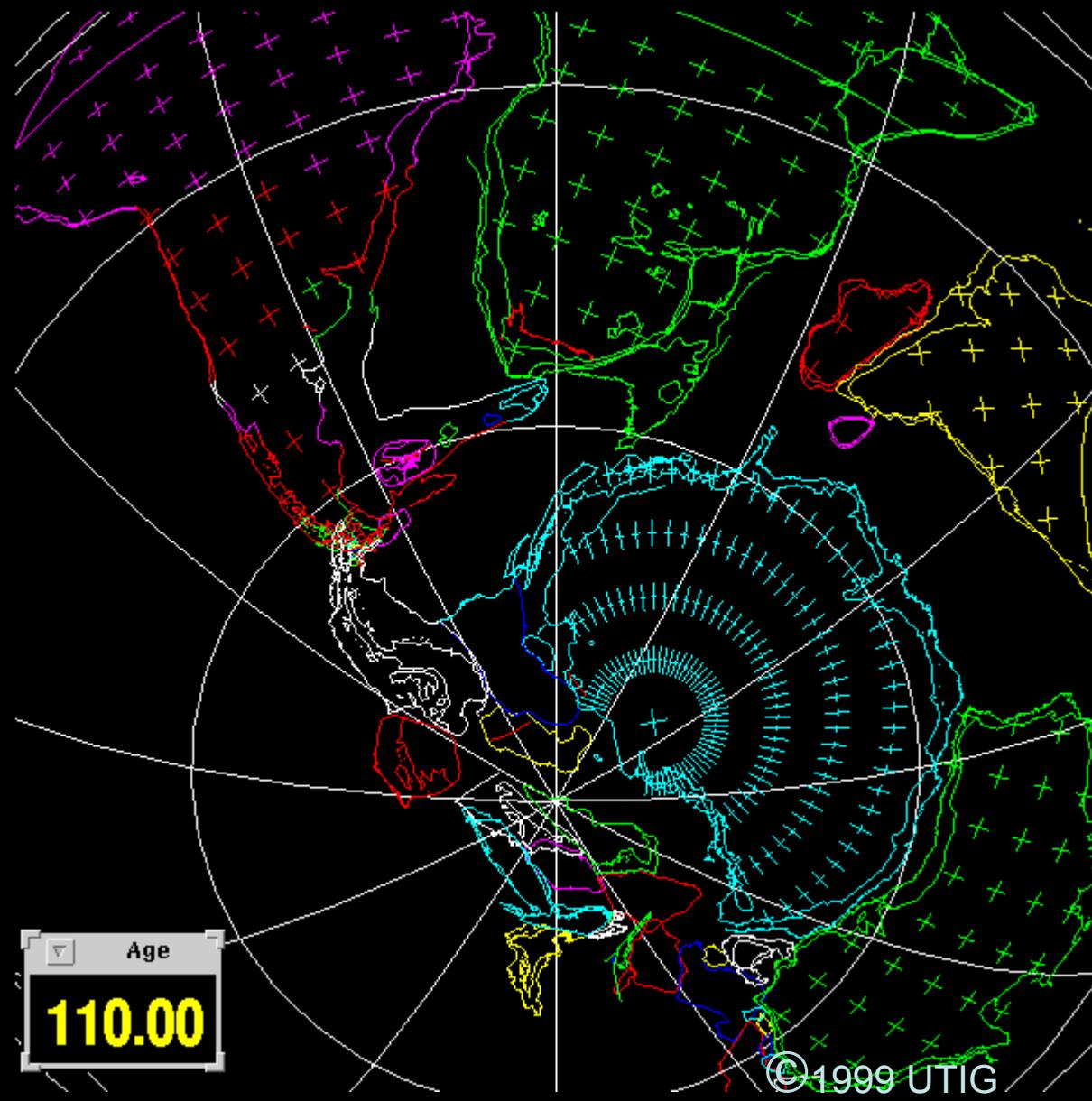
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111.00

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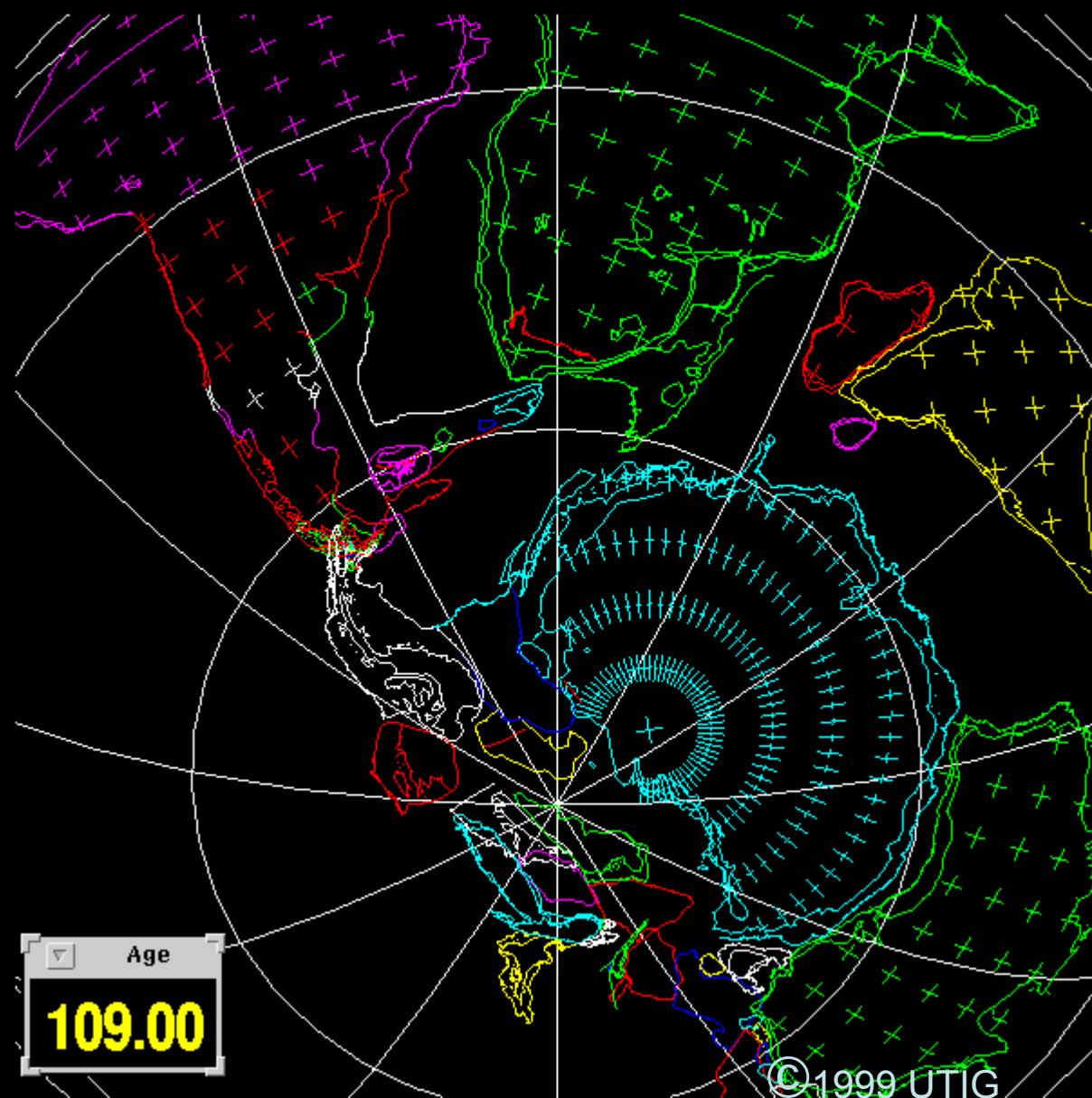
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110.00

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 Age
109.00

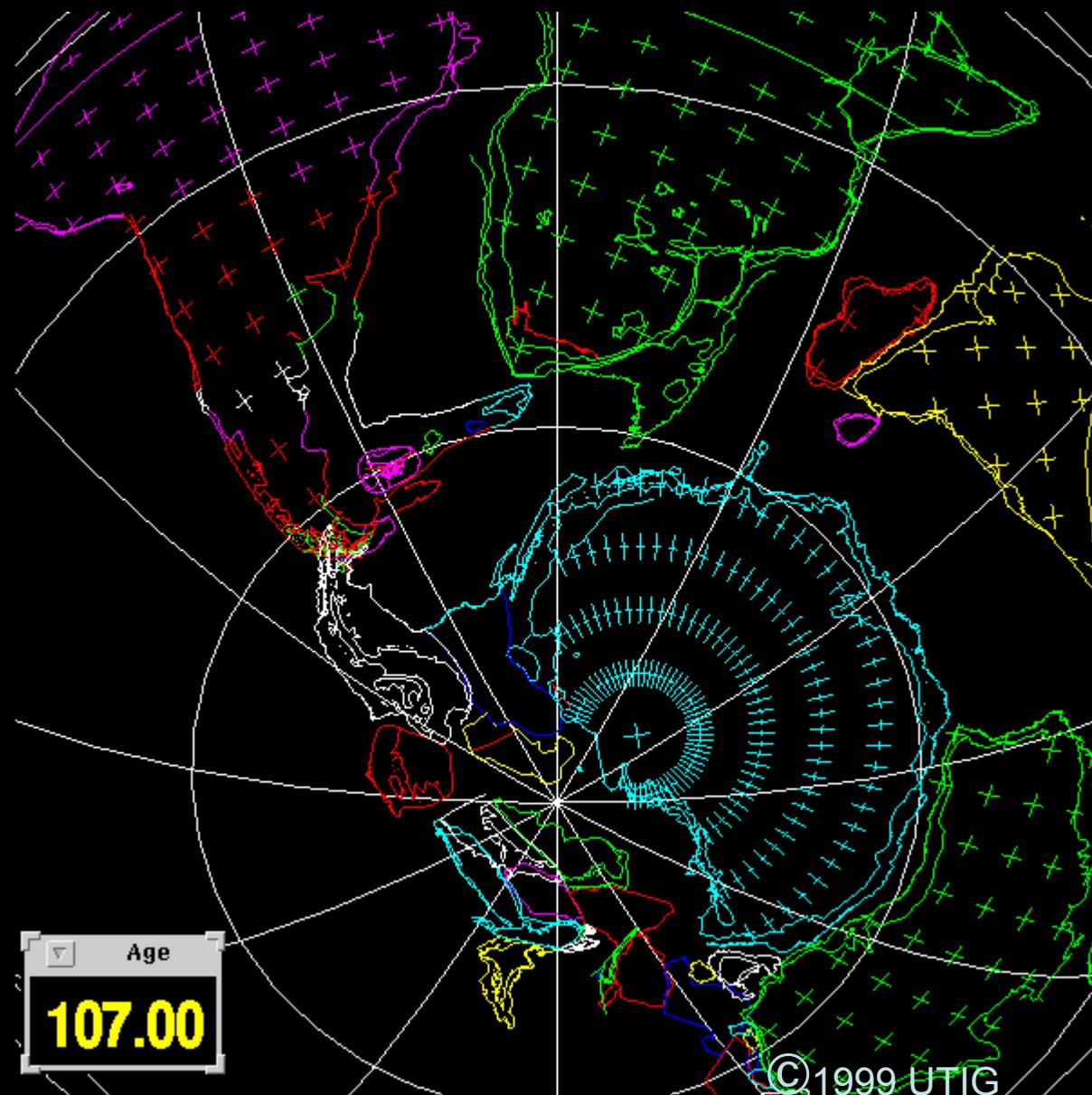
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 Age
109.00

©1999 UTIG

 Age
107.00

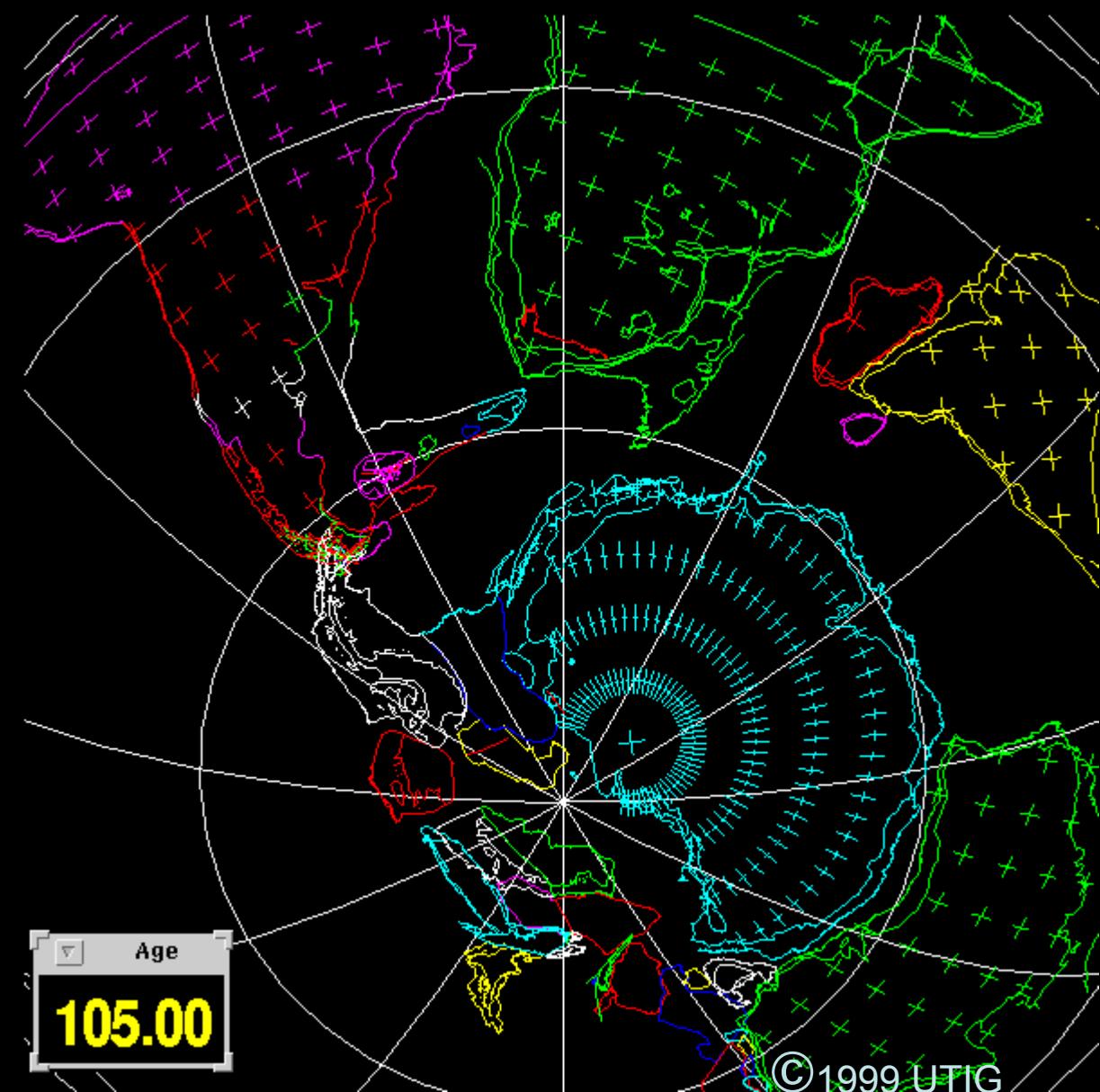


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Age

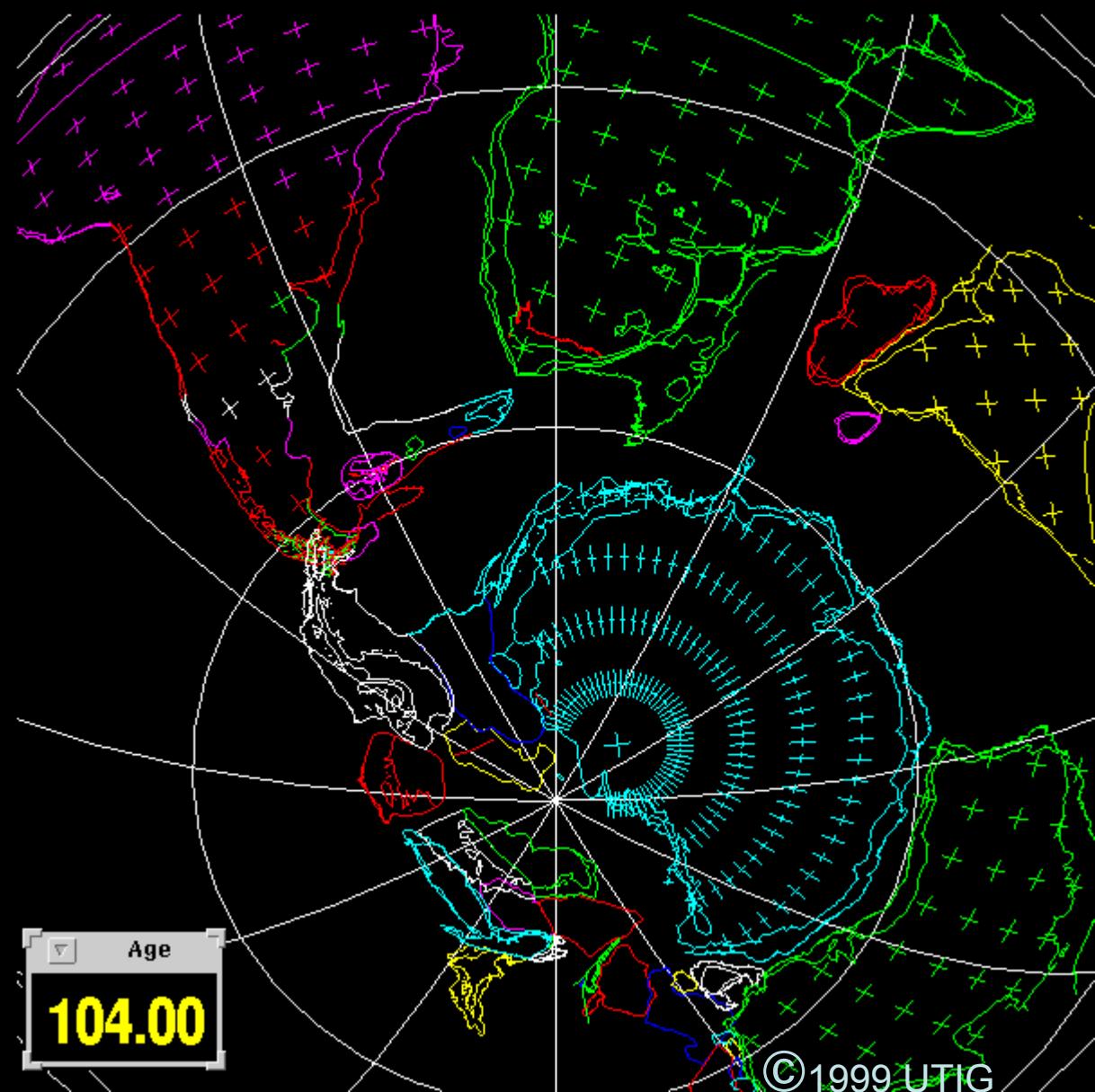
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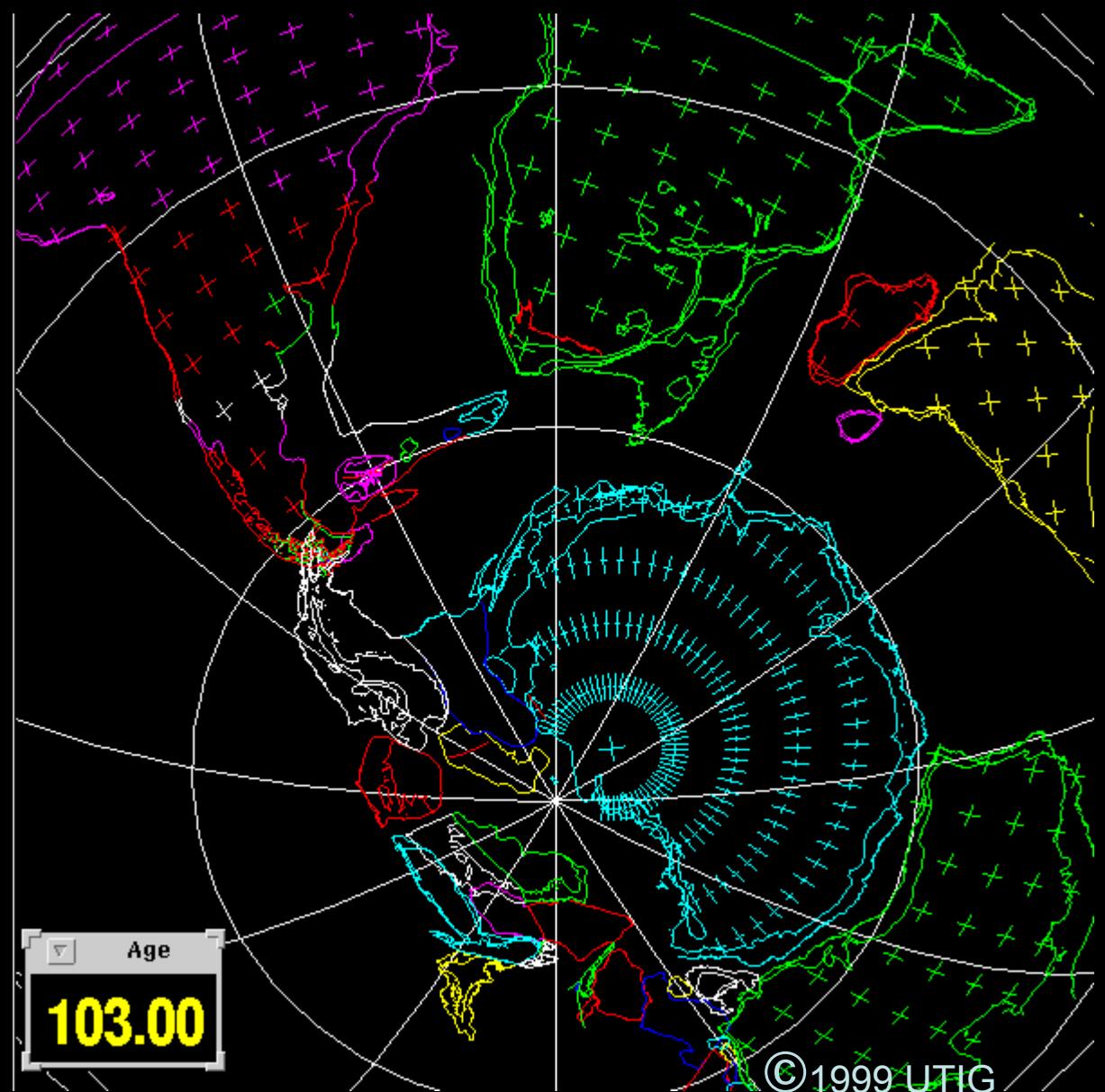
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104.00

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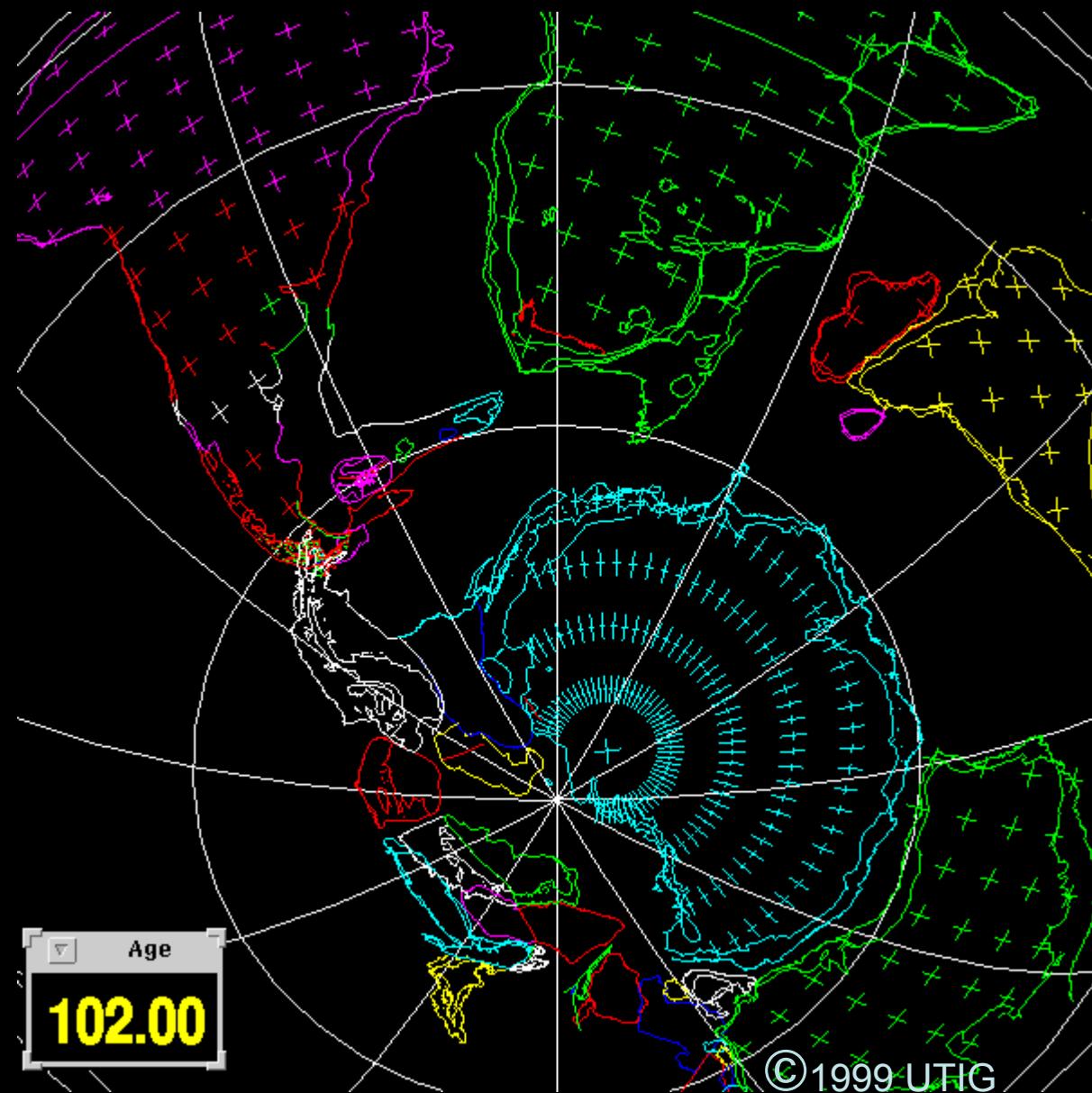




Age
103.00

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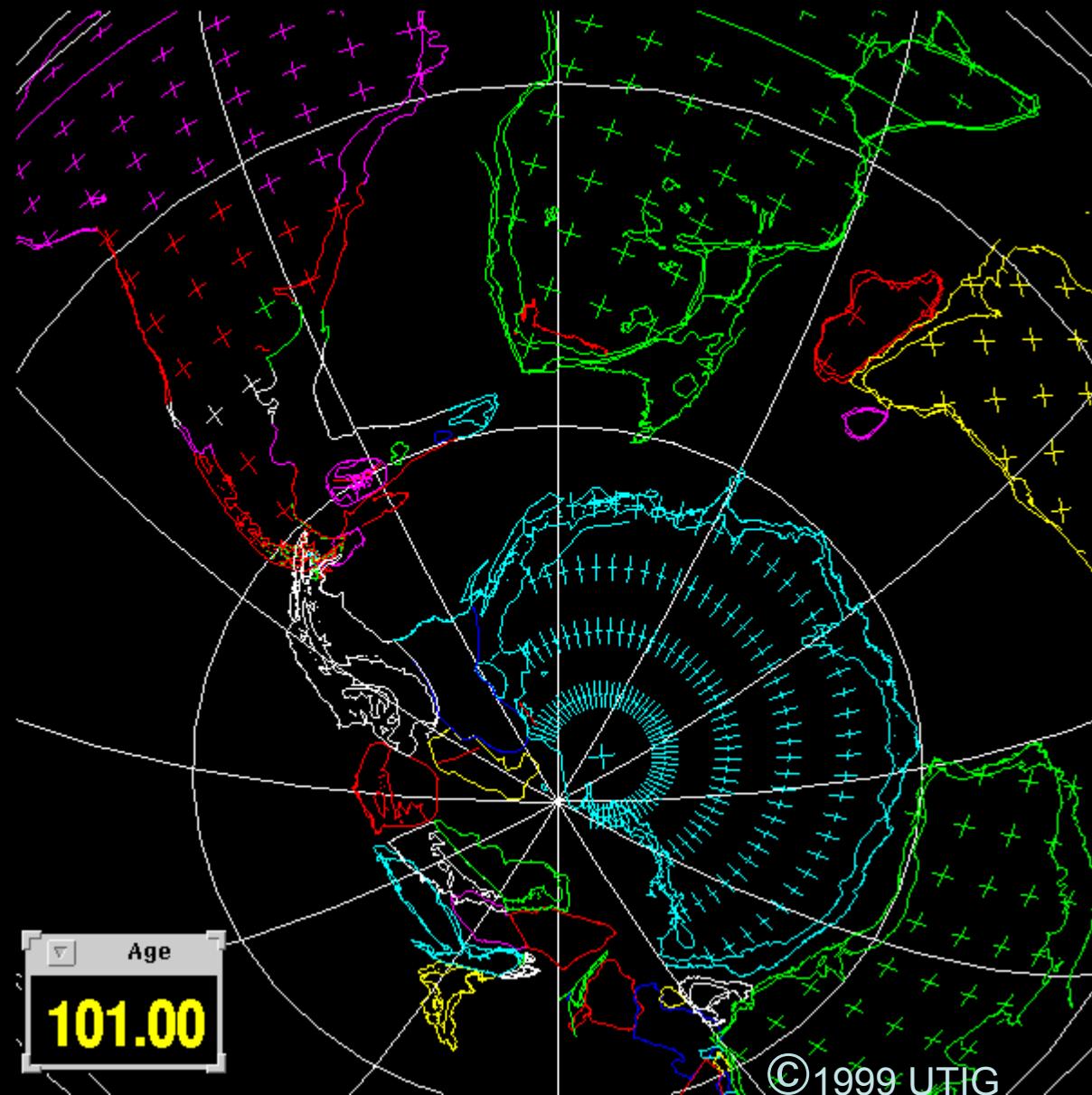
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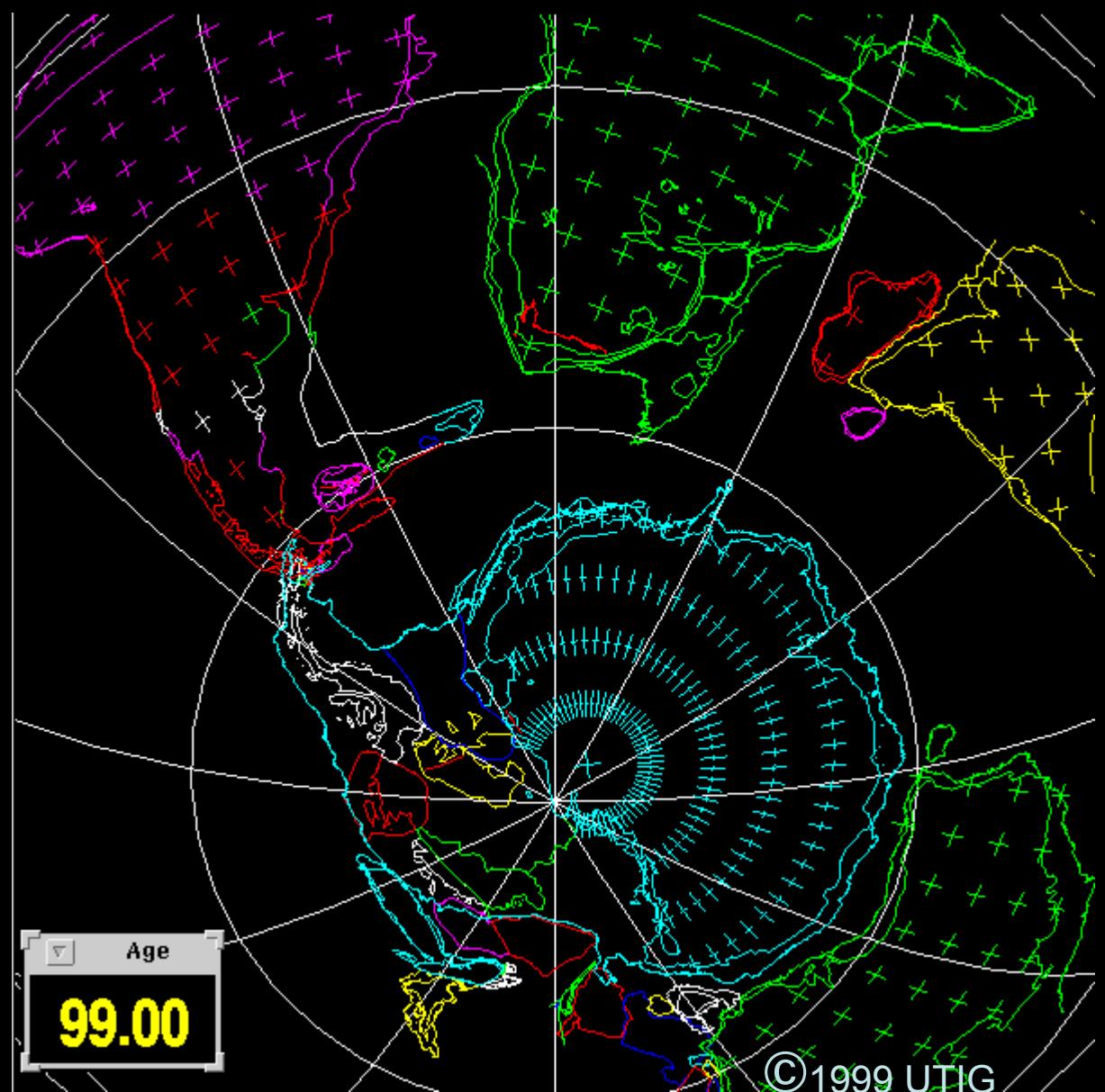
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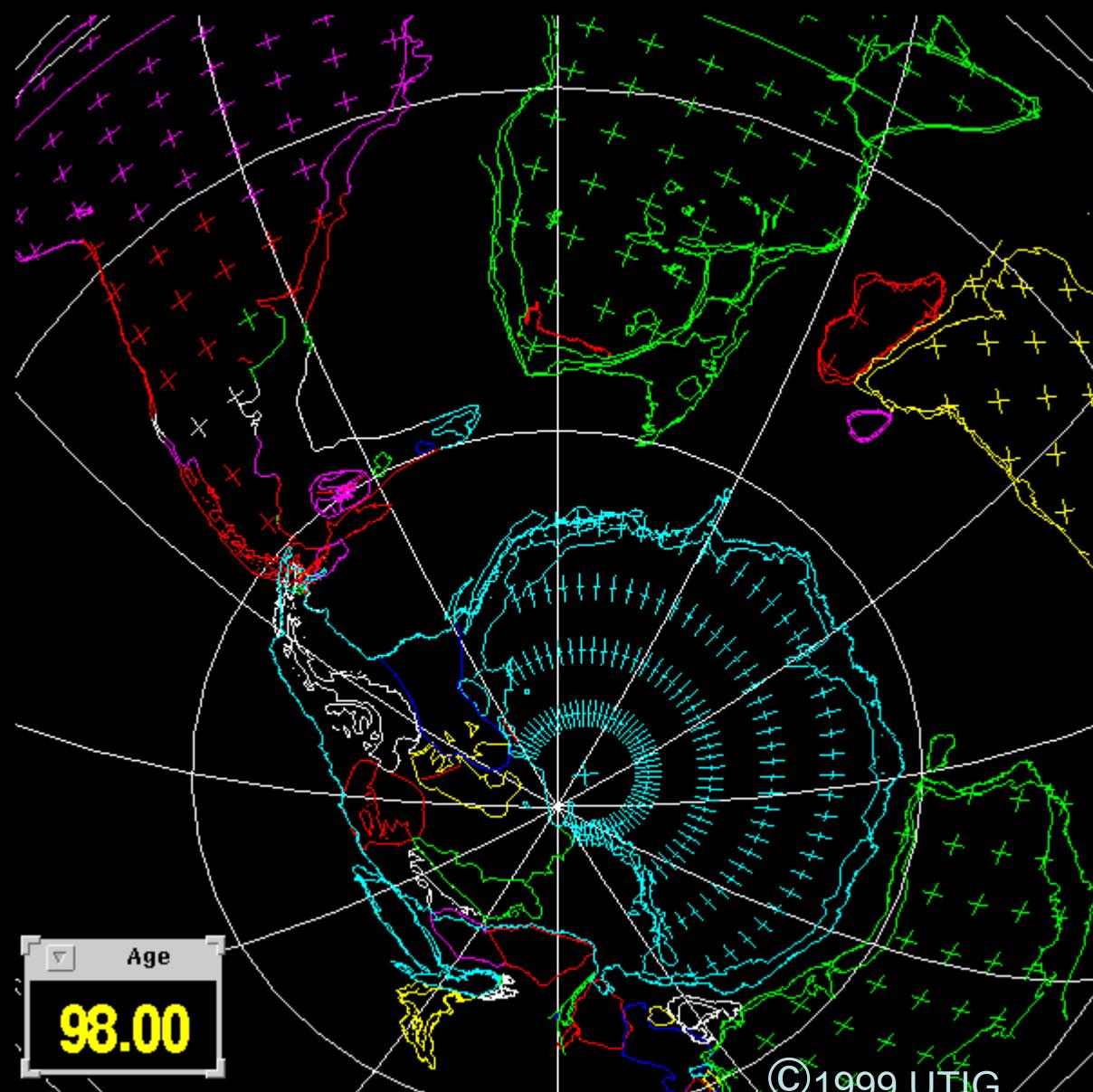
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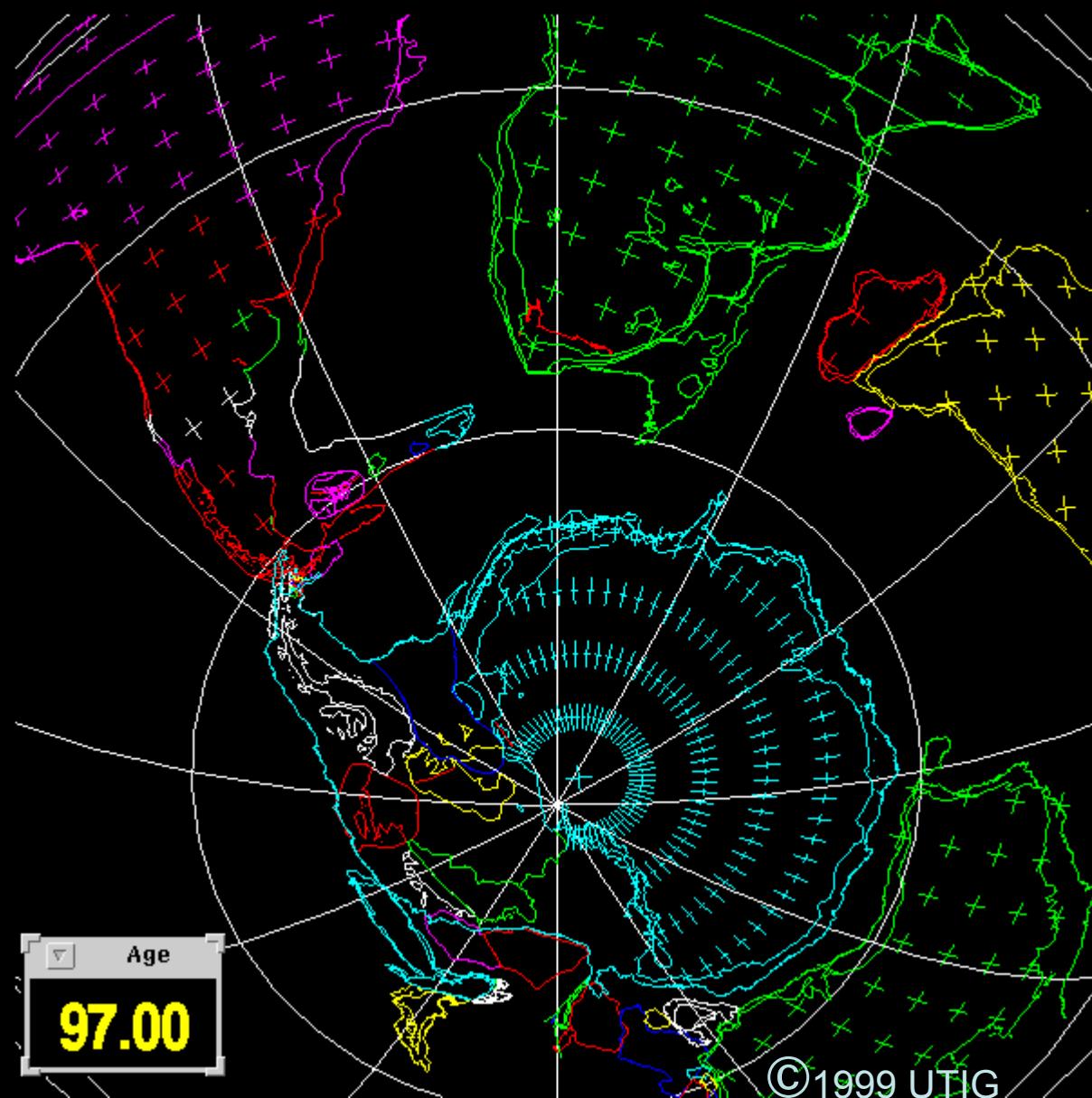
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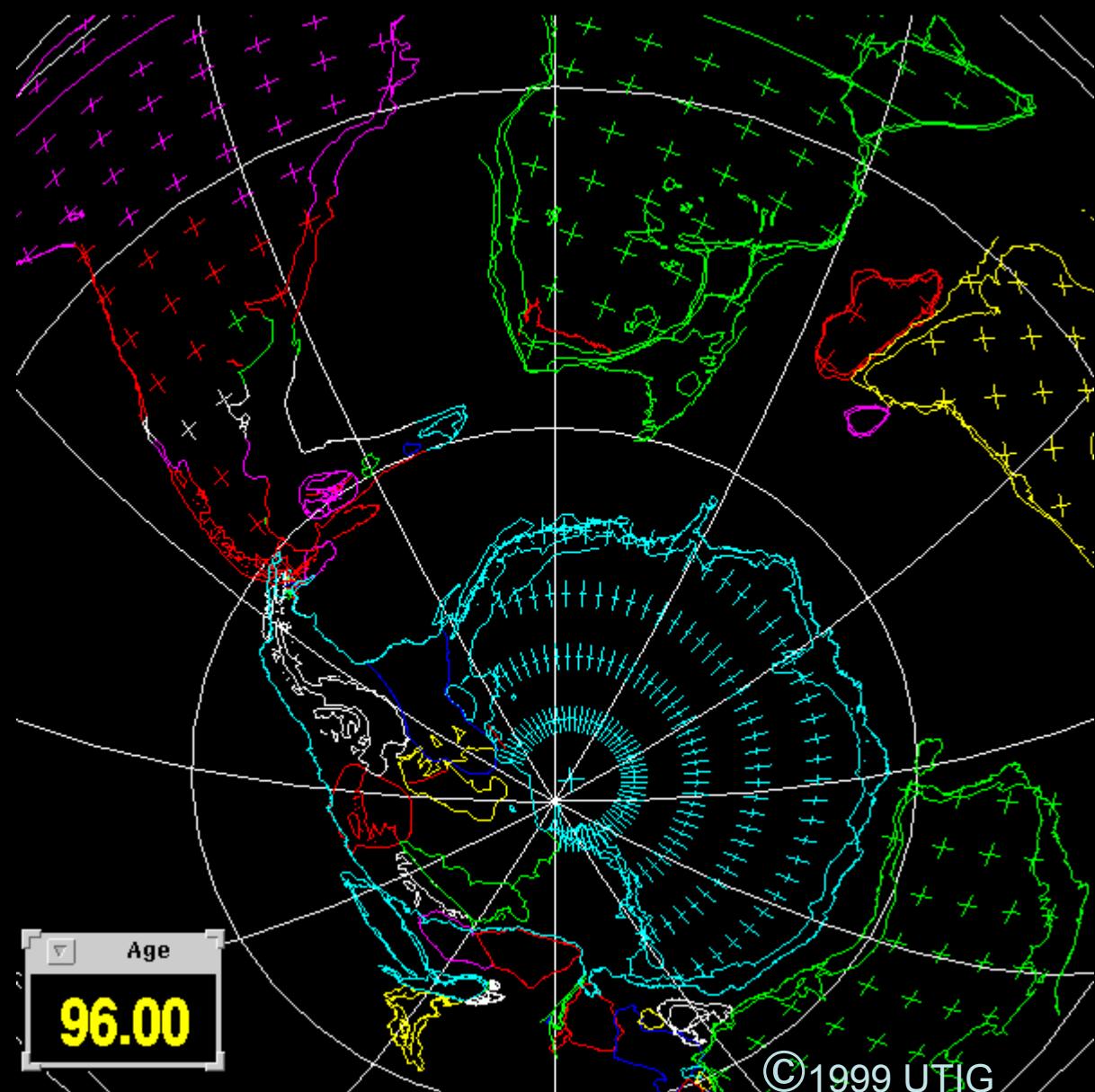


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97.00

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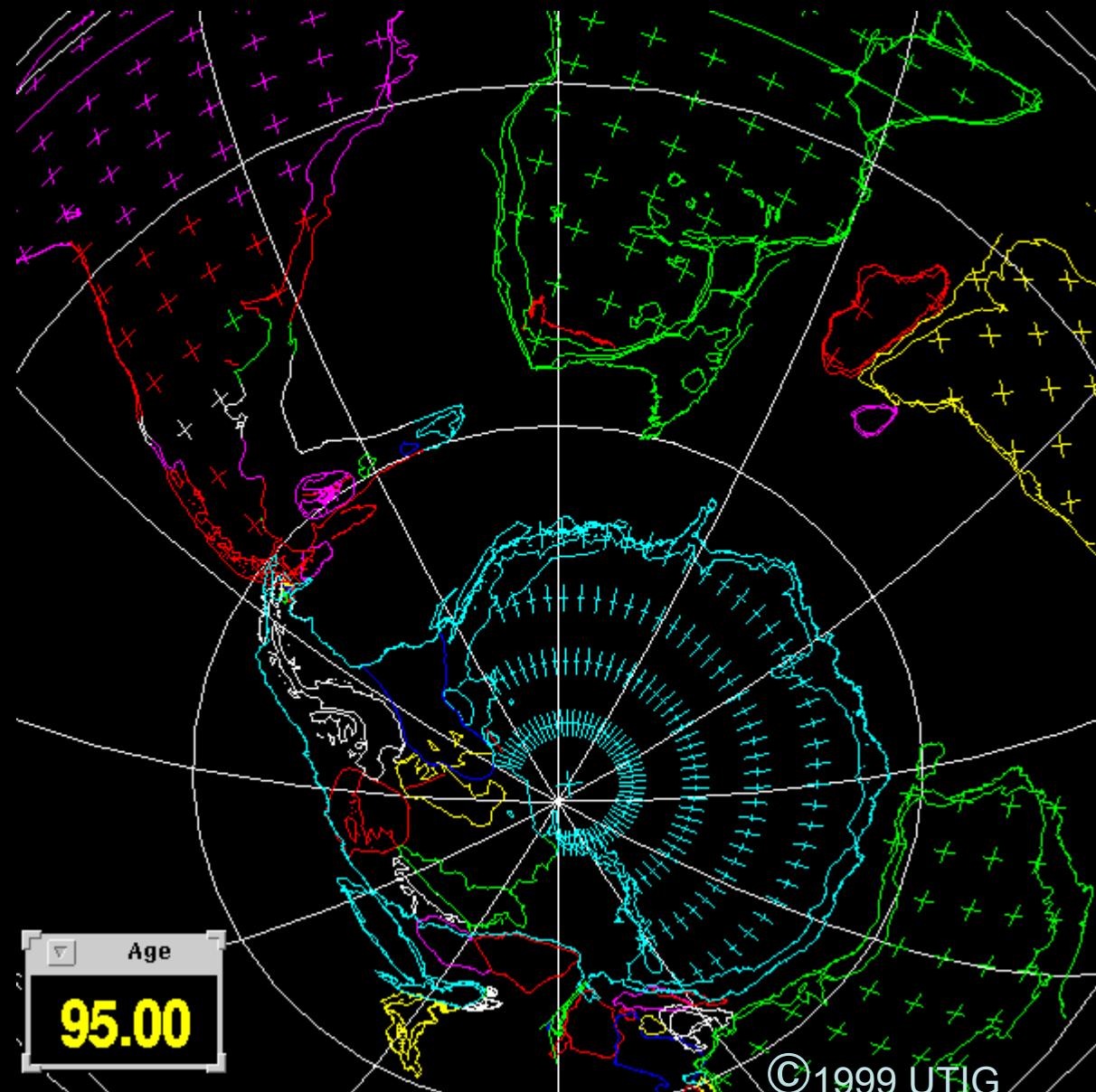


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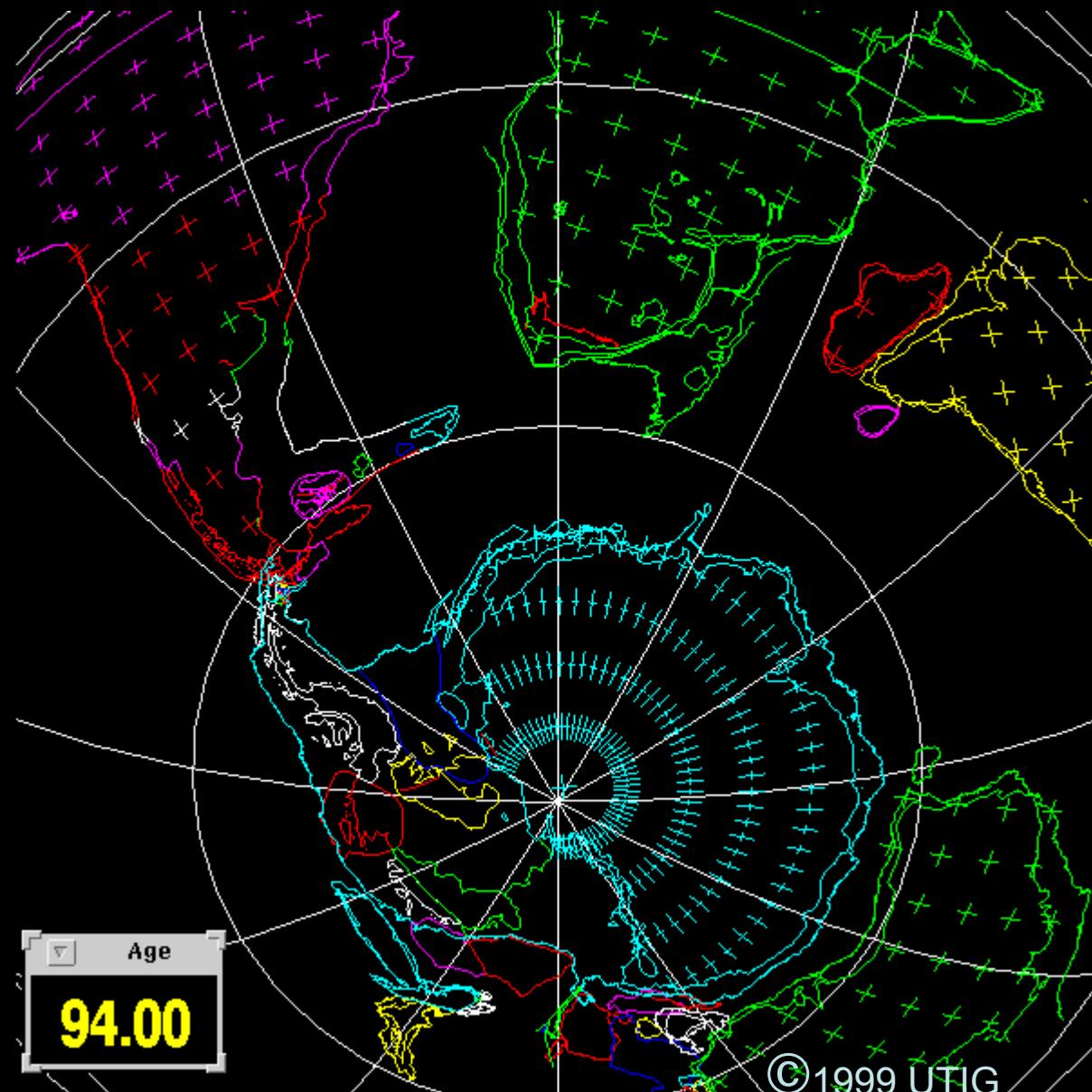
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95.00

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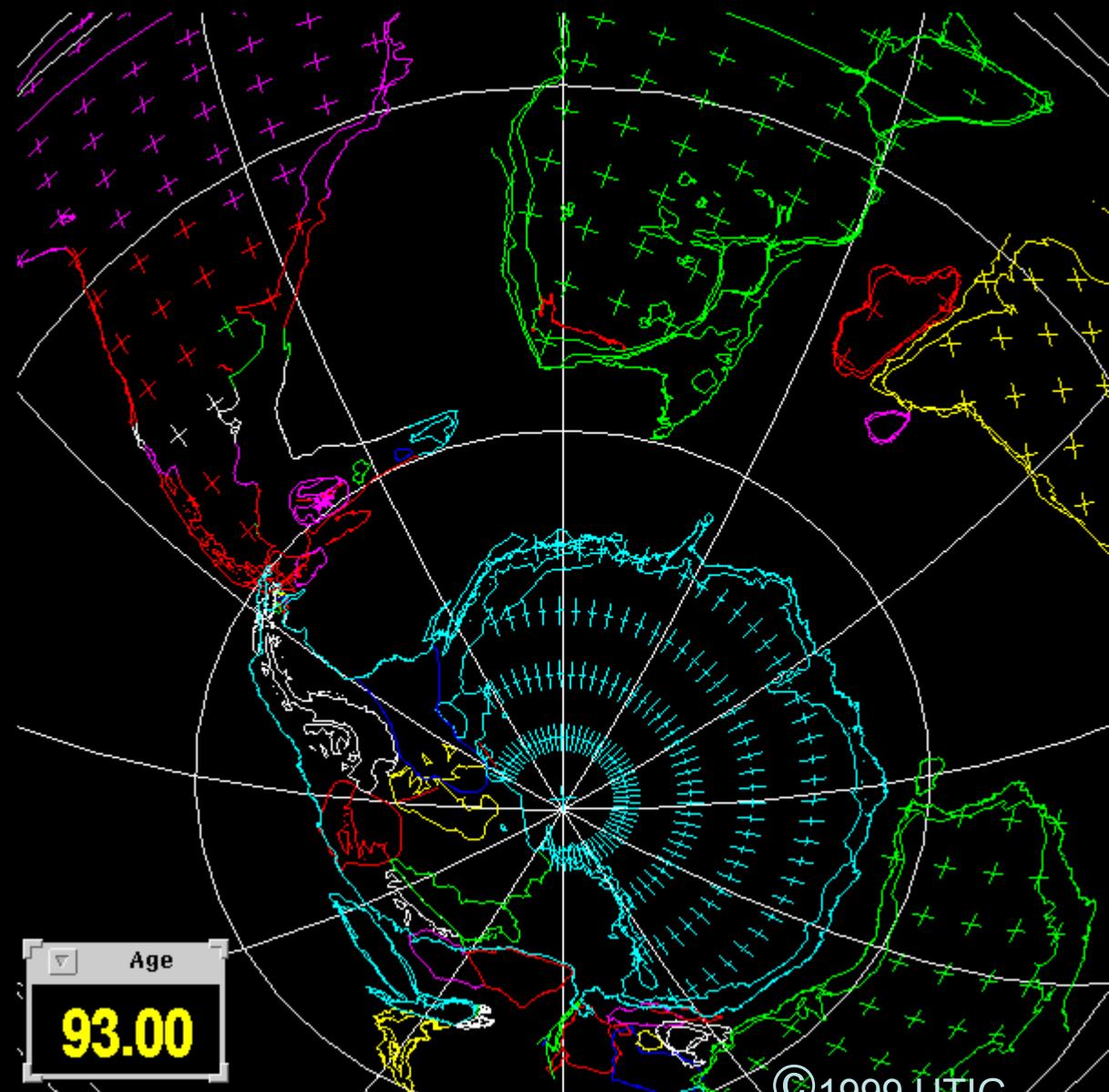
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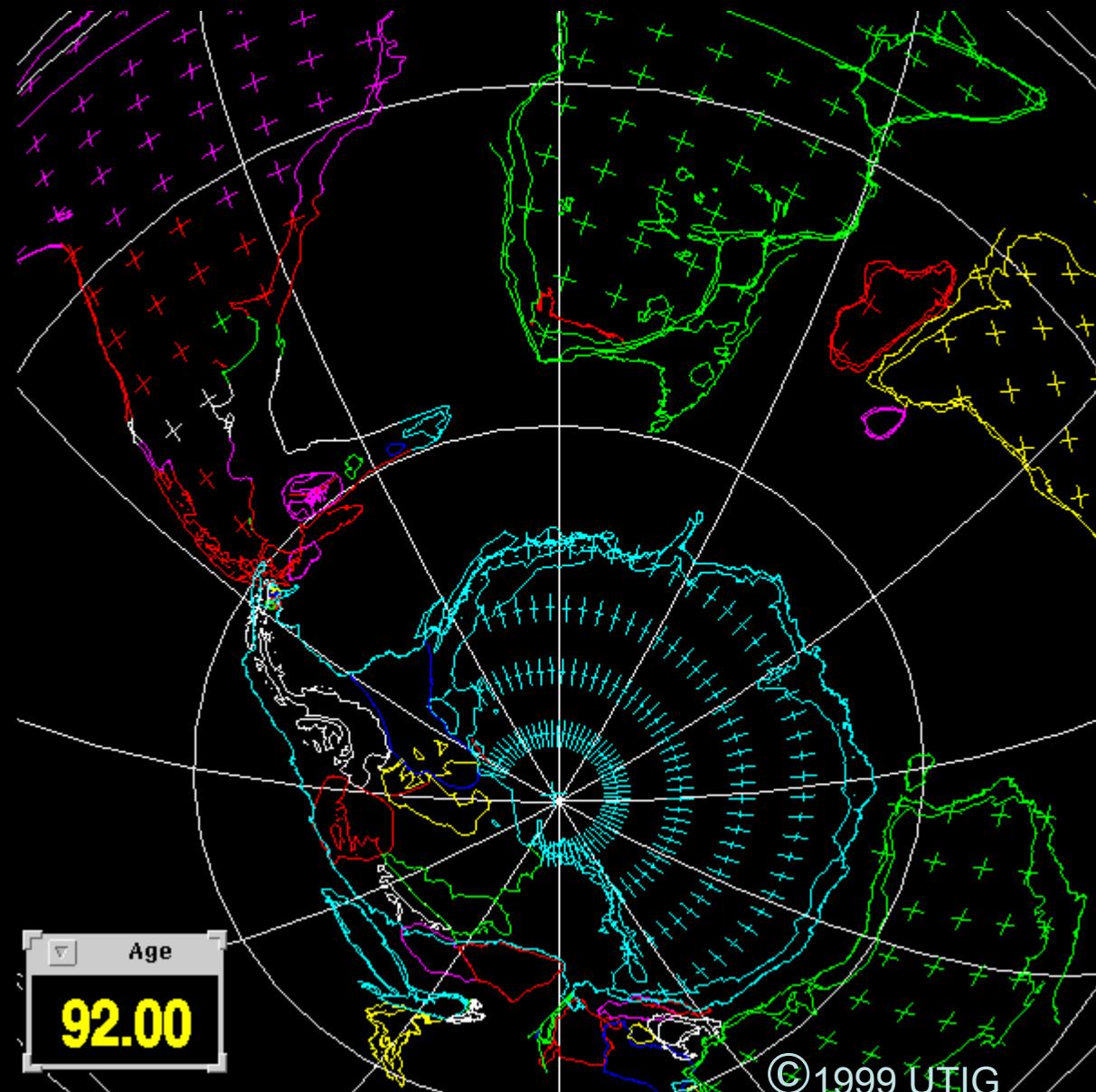
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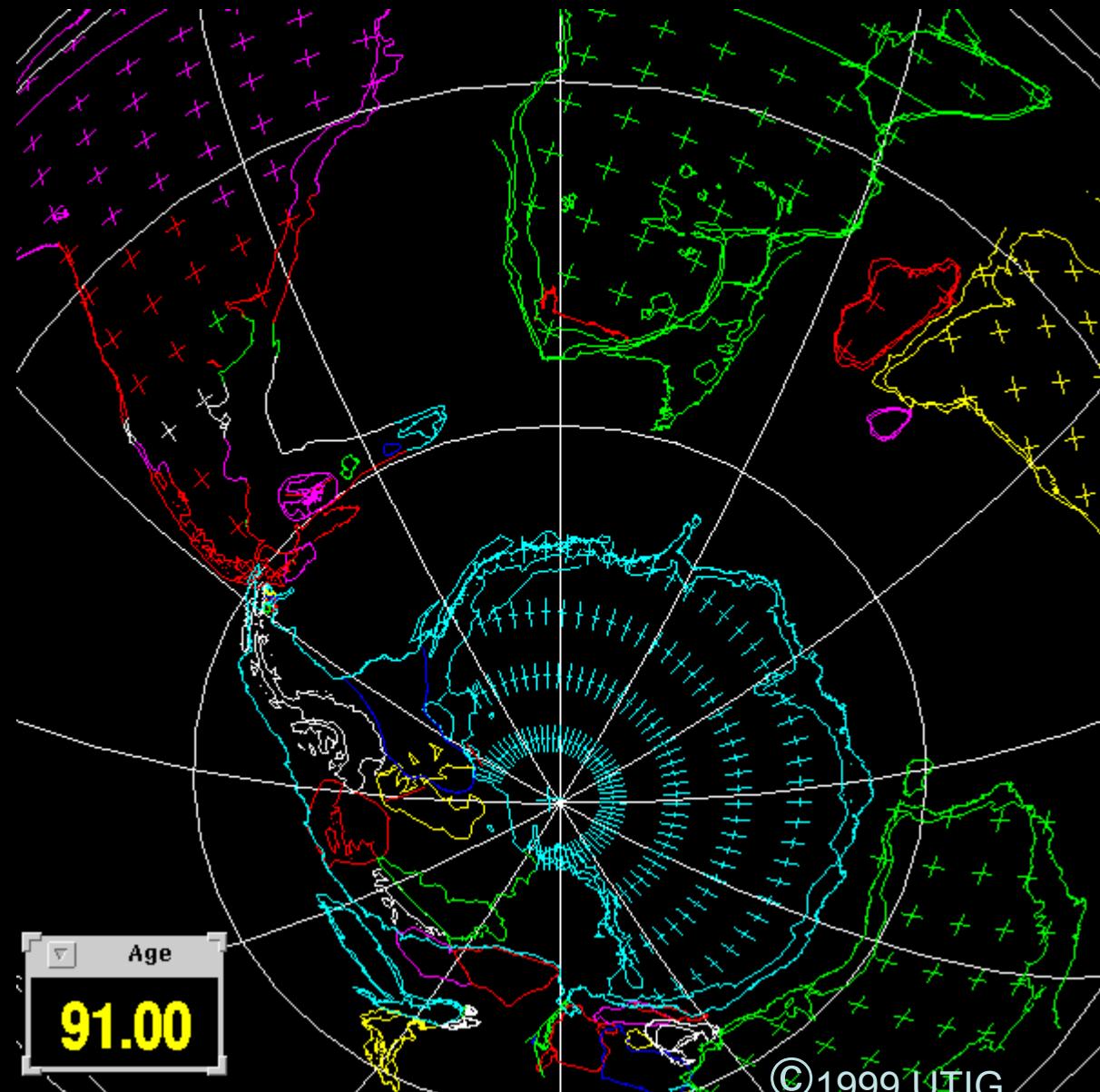
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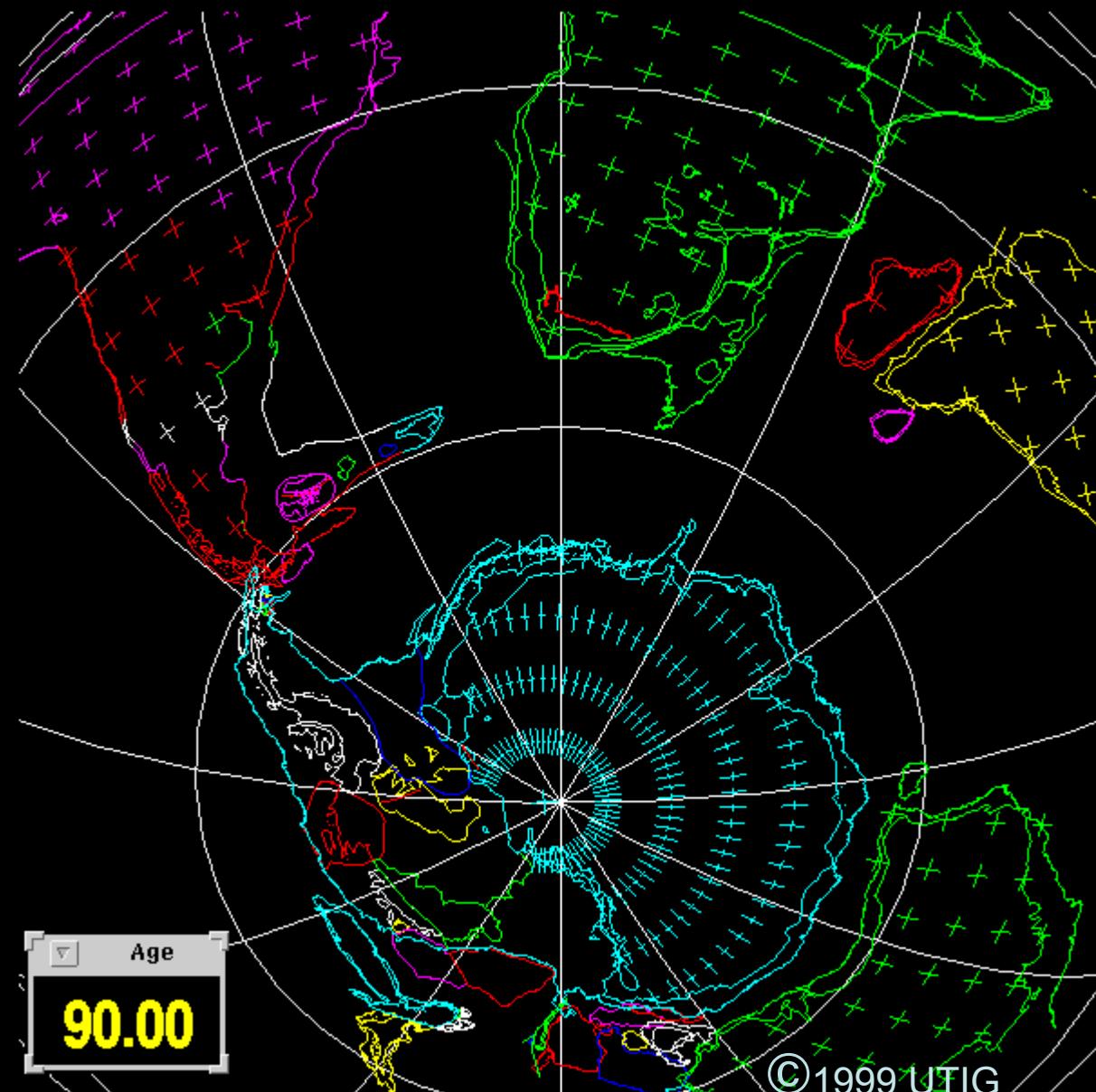
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91.00

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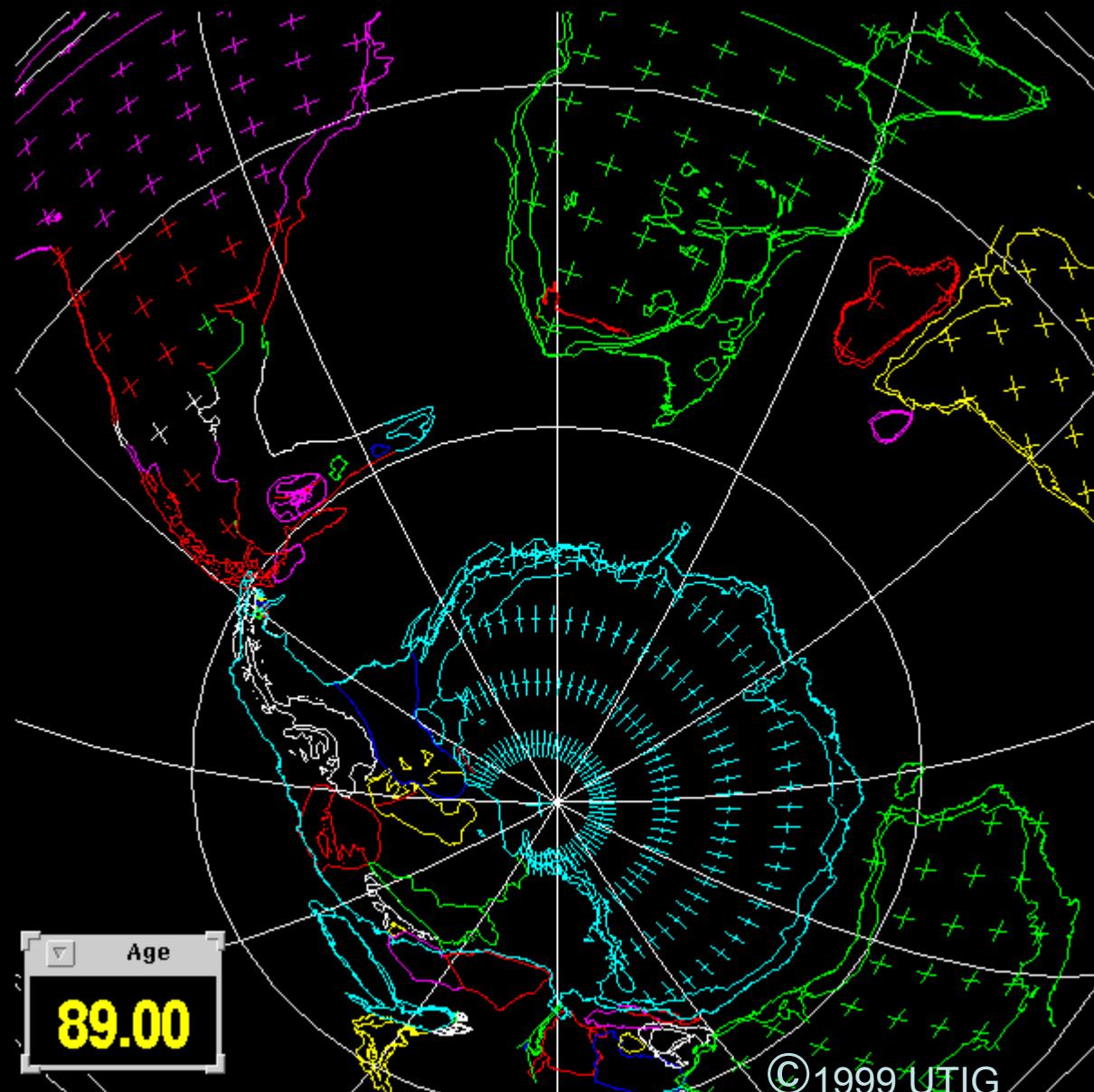
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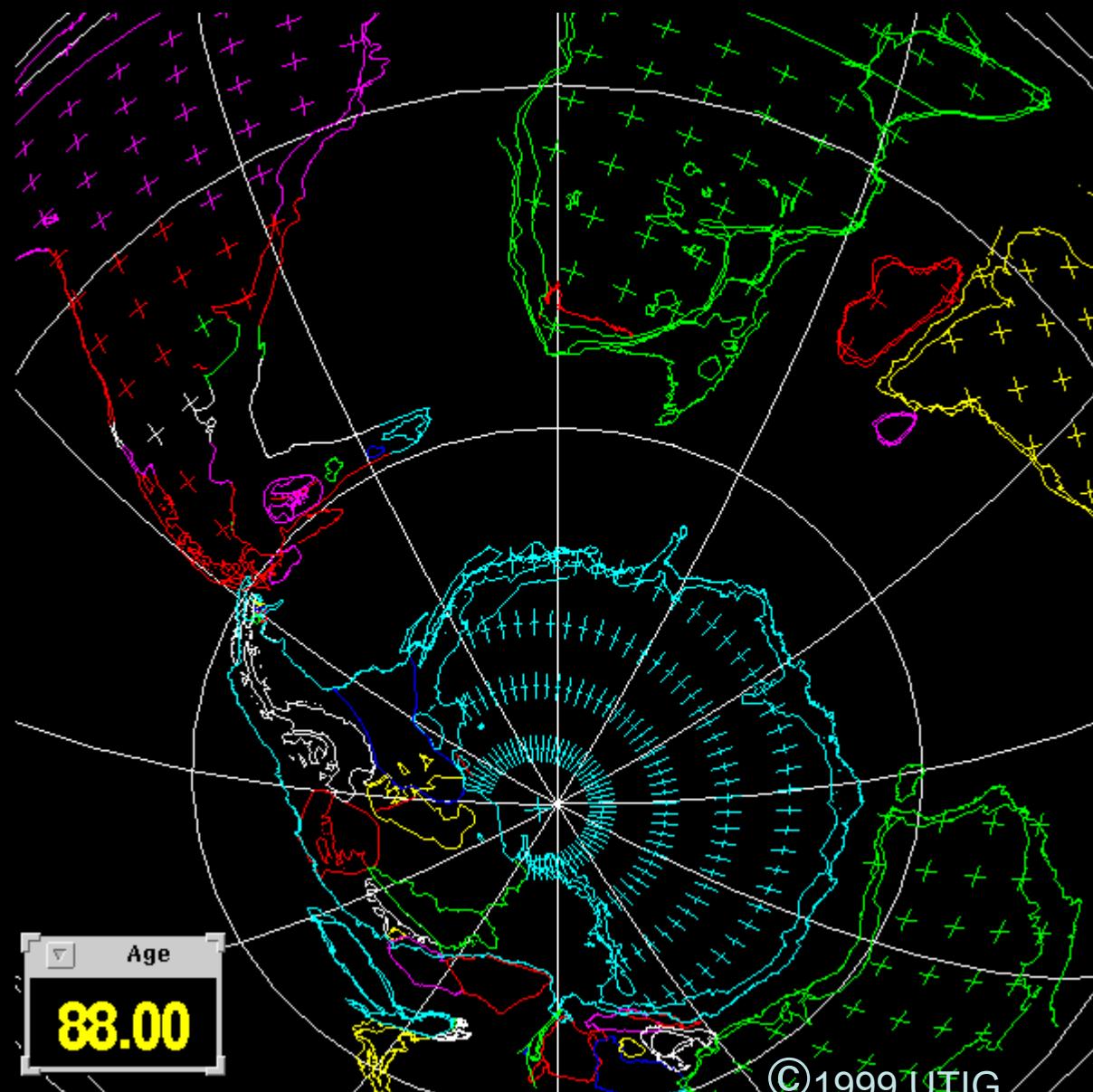
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89.00

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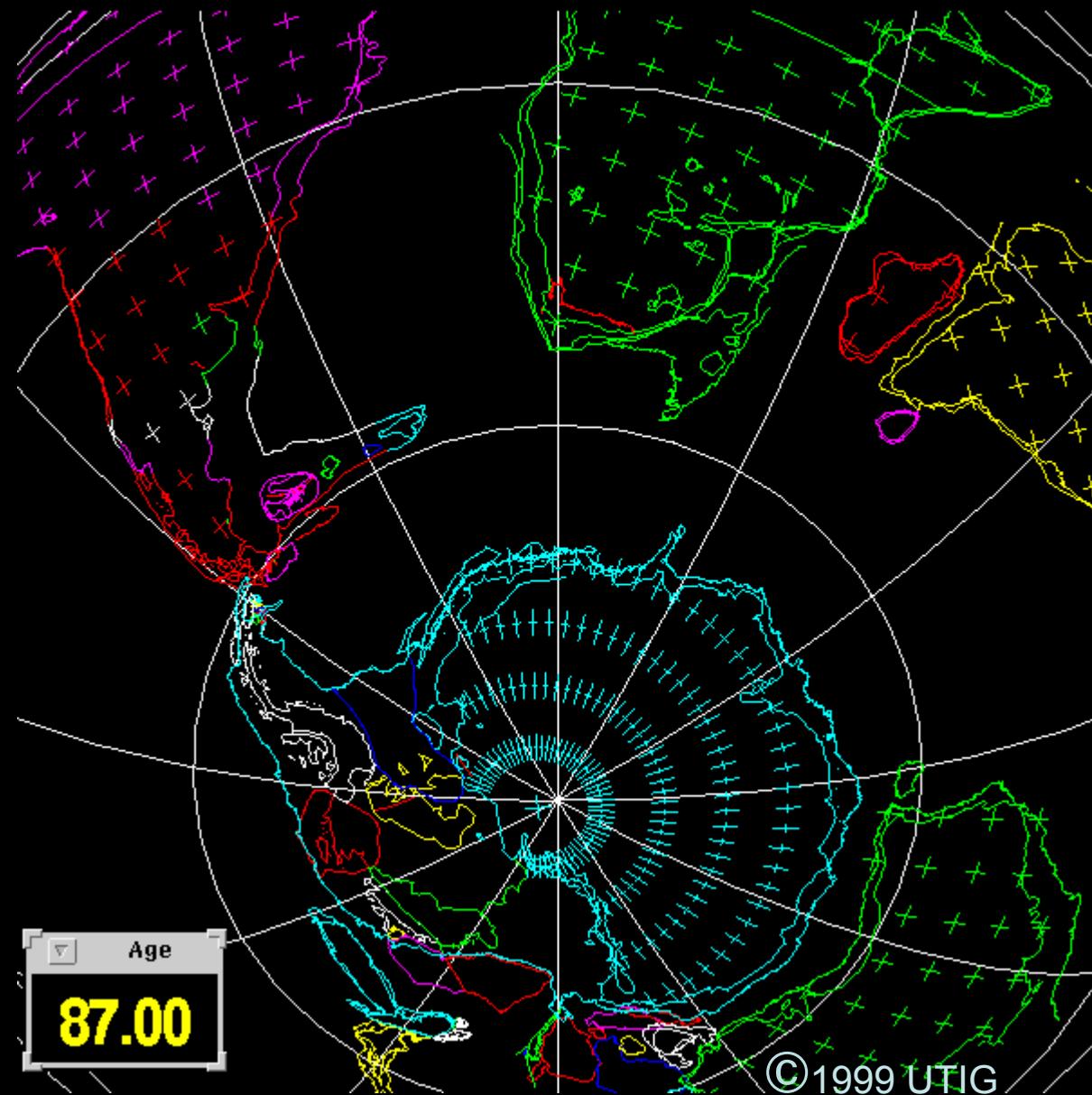
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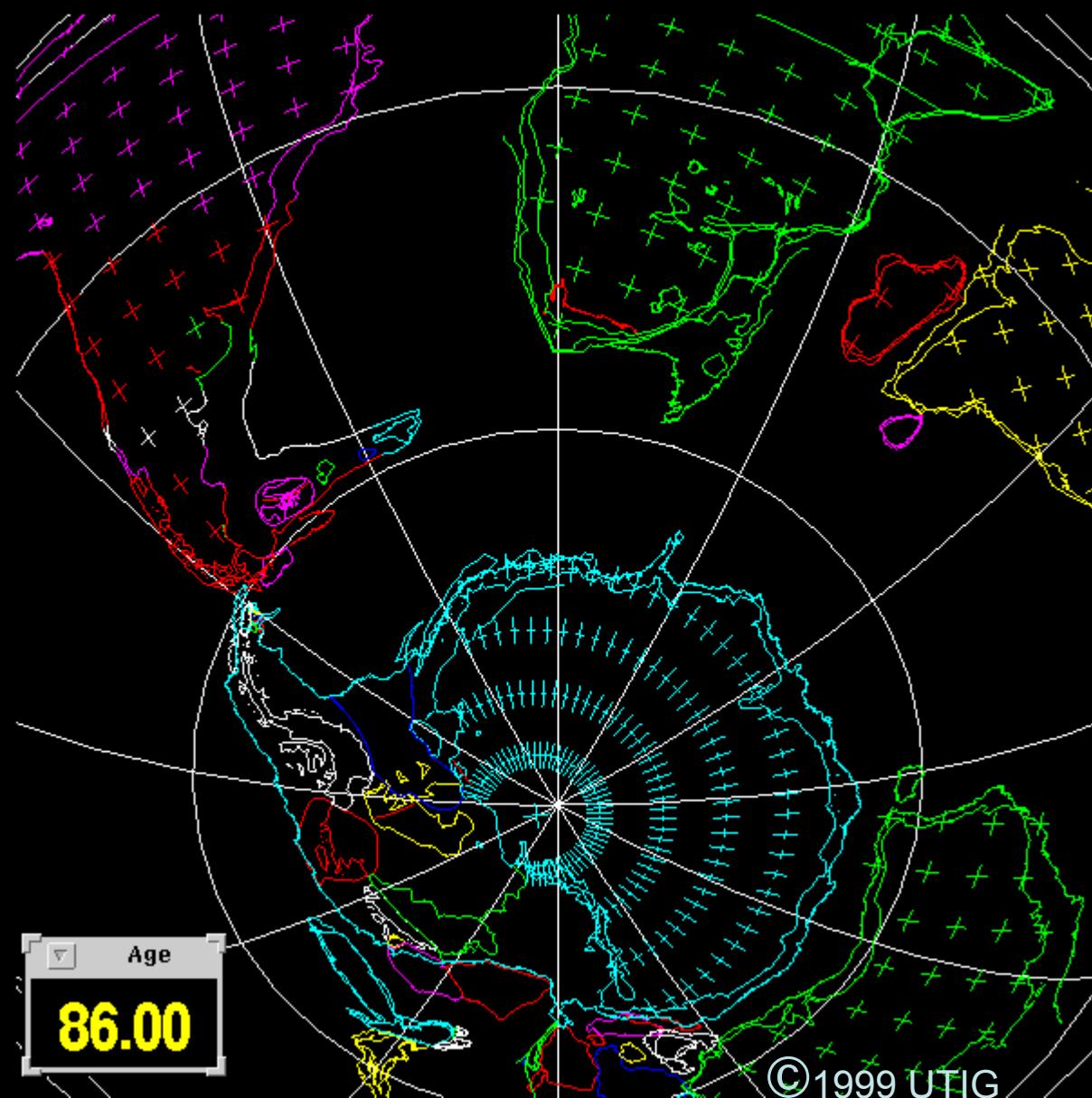


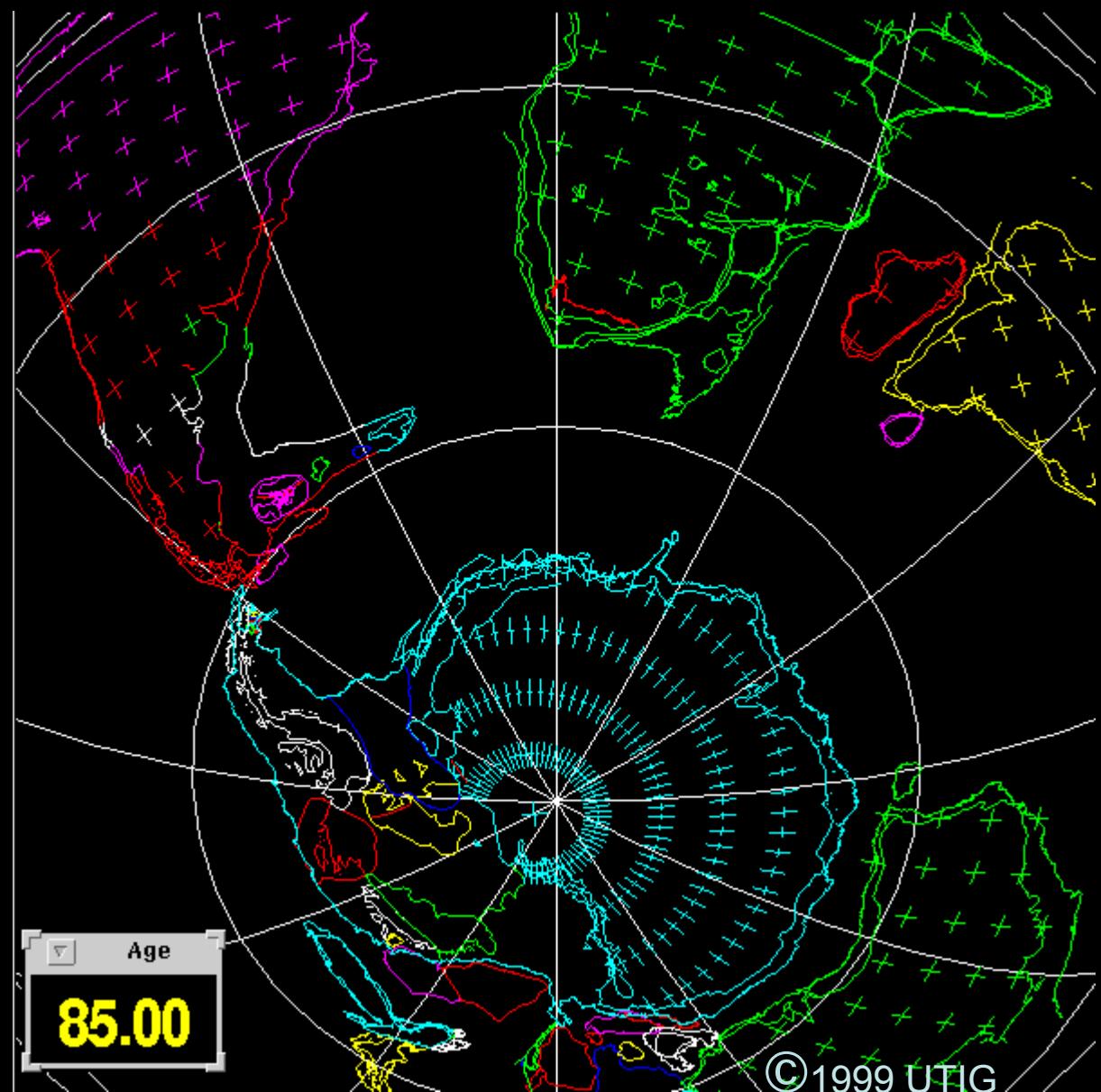
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87.00

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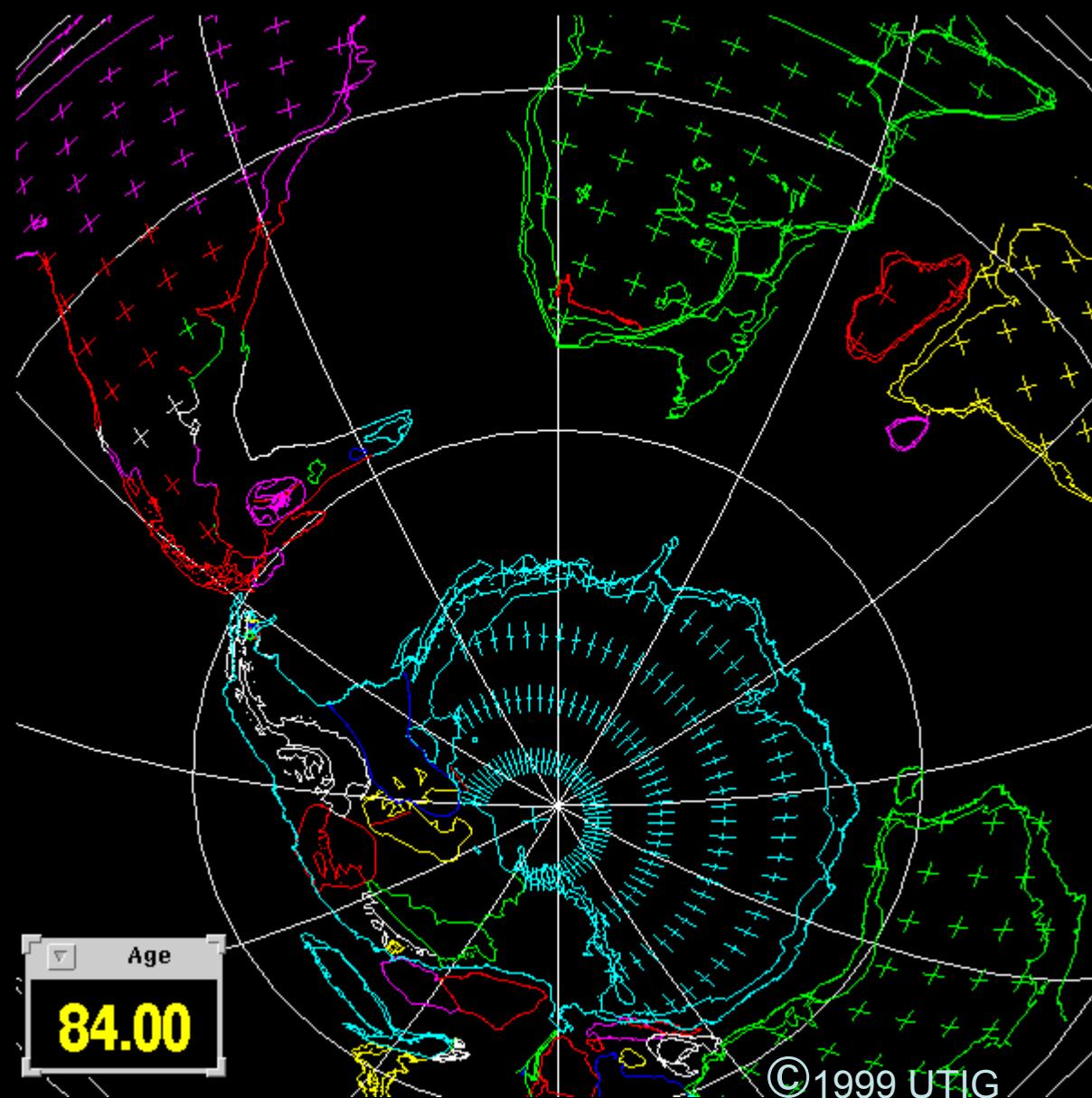


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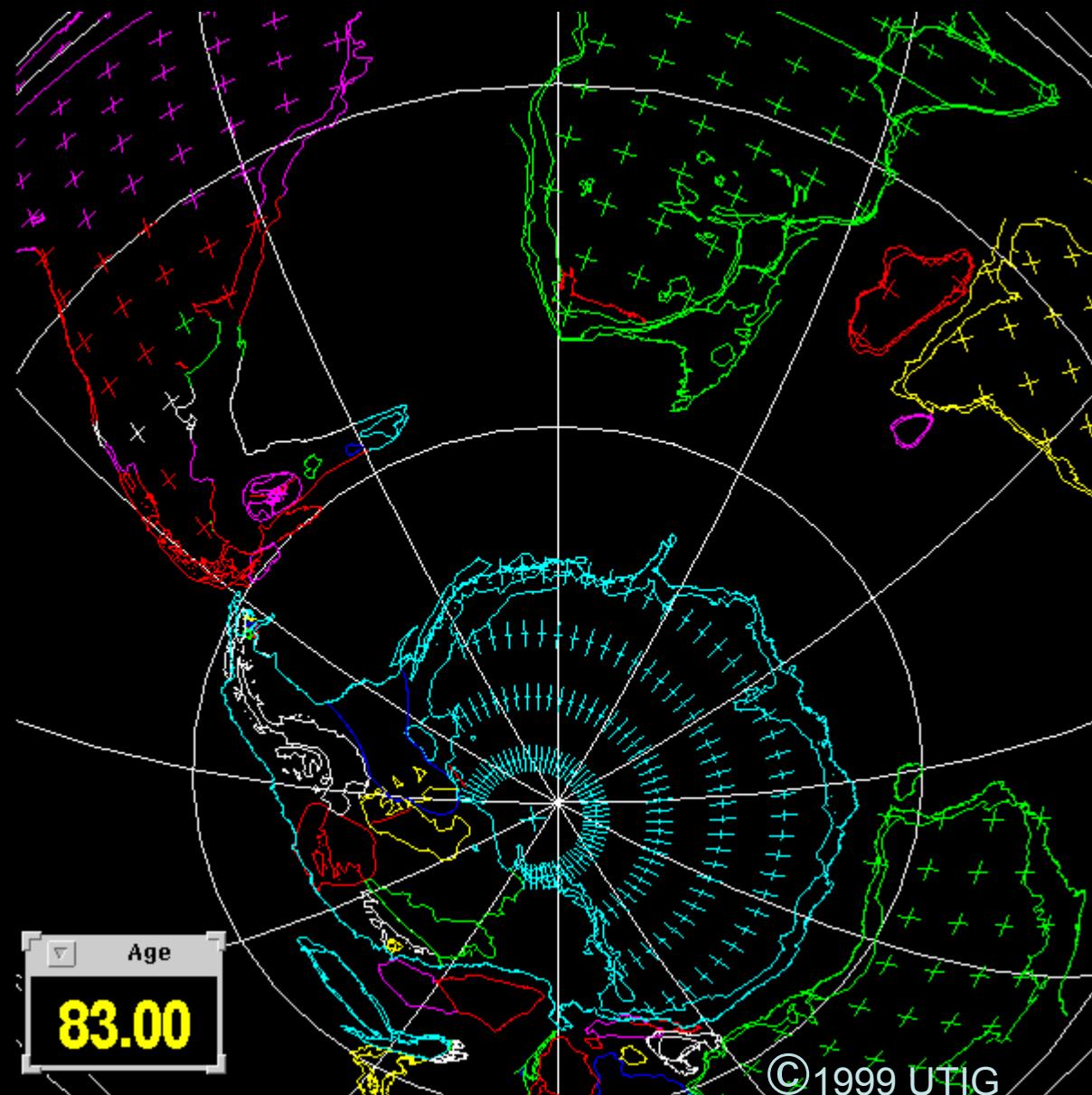


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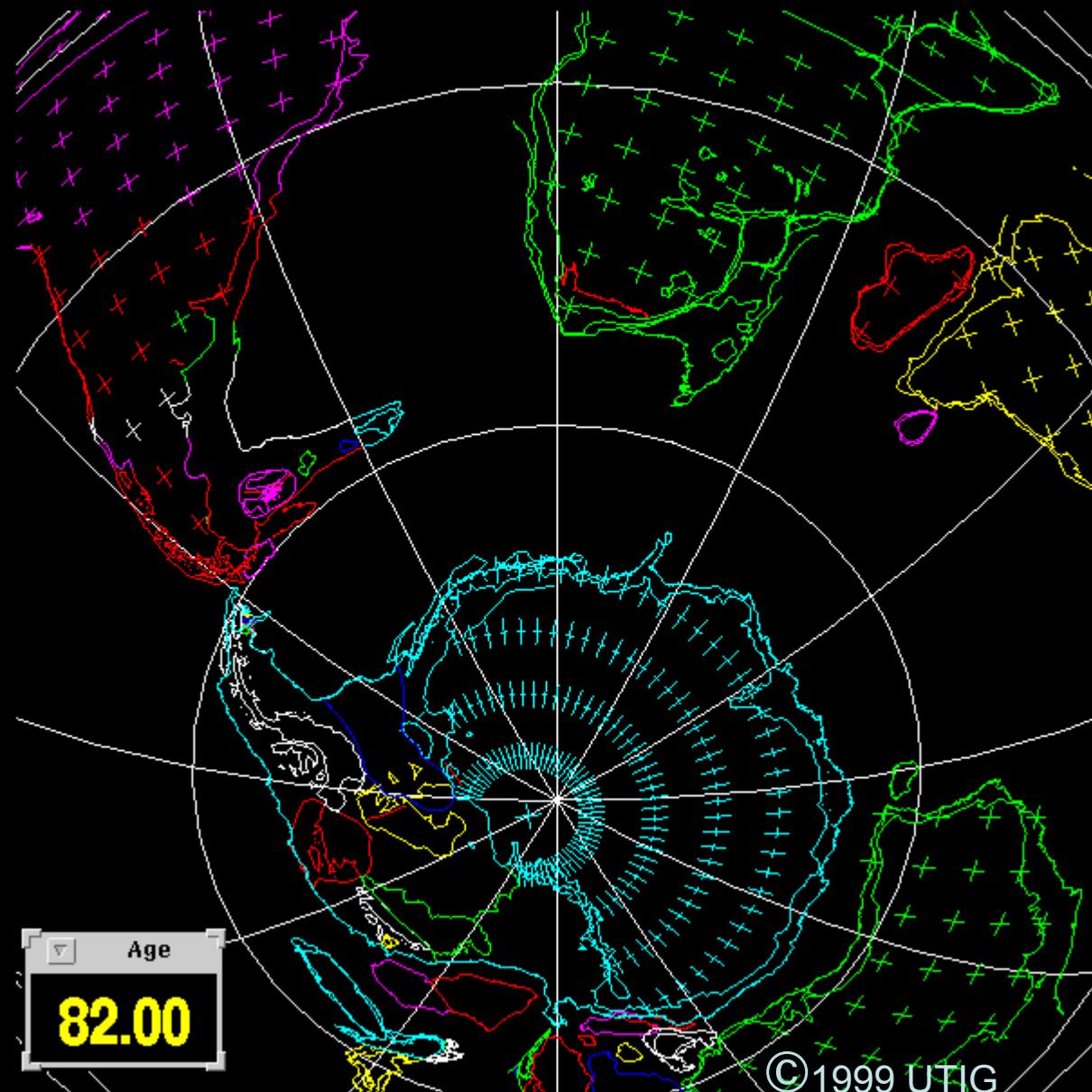
83.00

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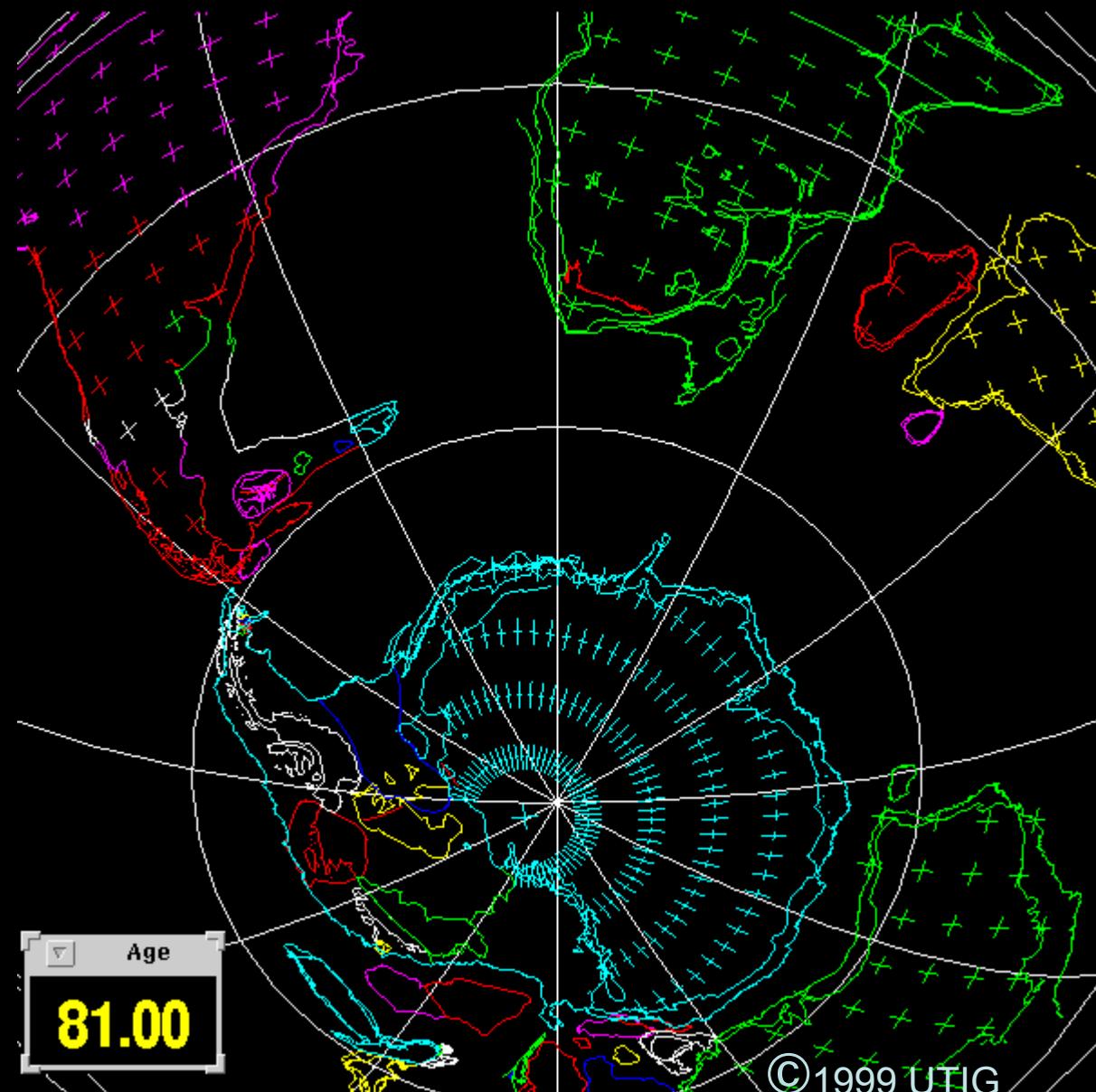
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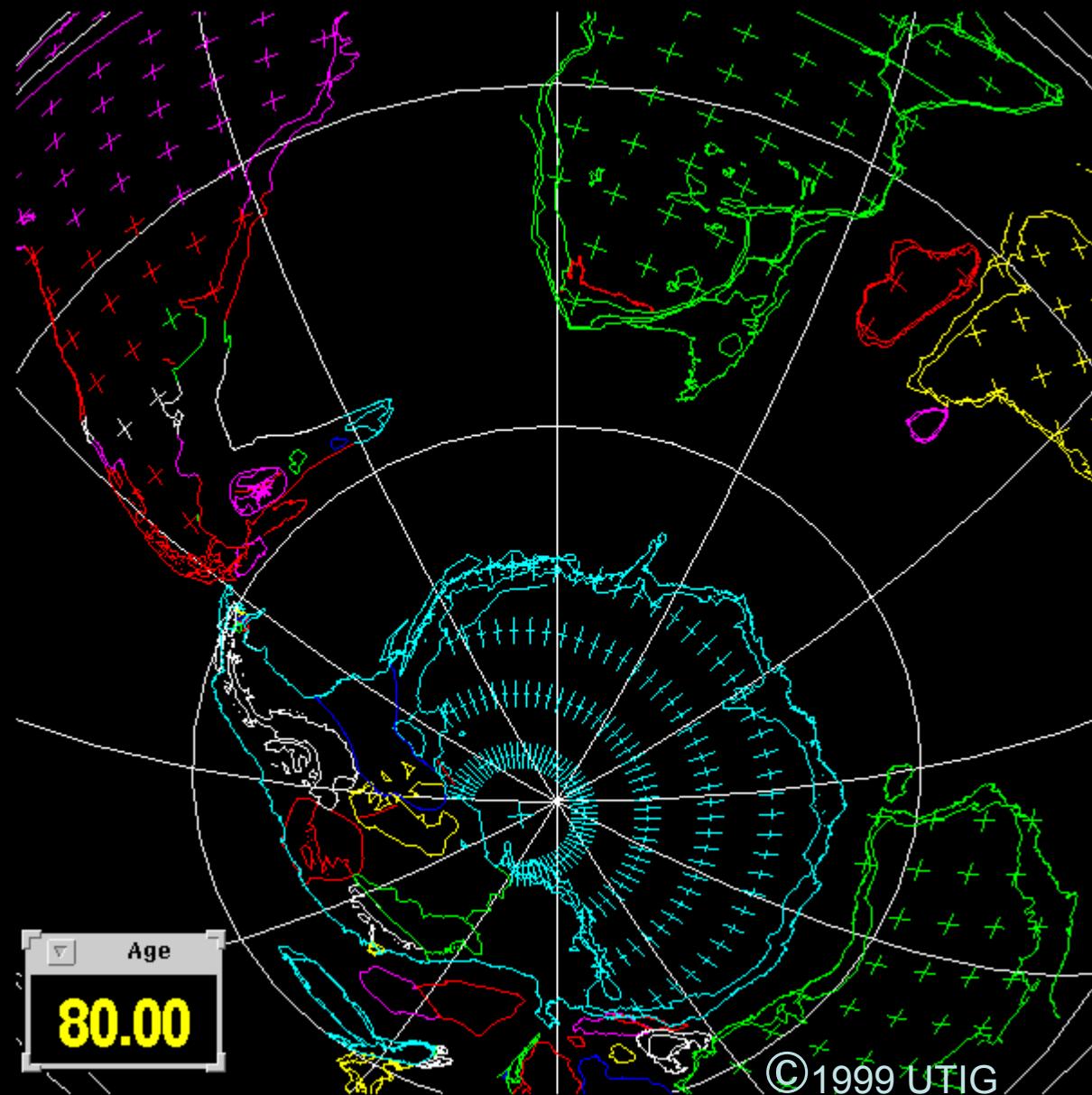
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81.00

©1999 UTIG



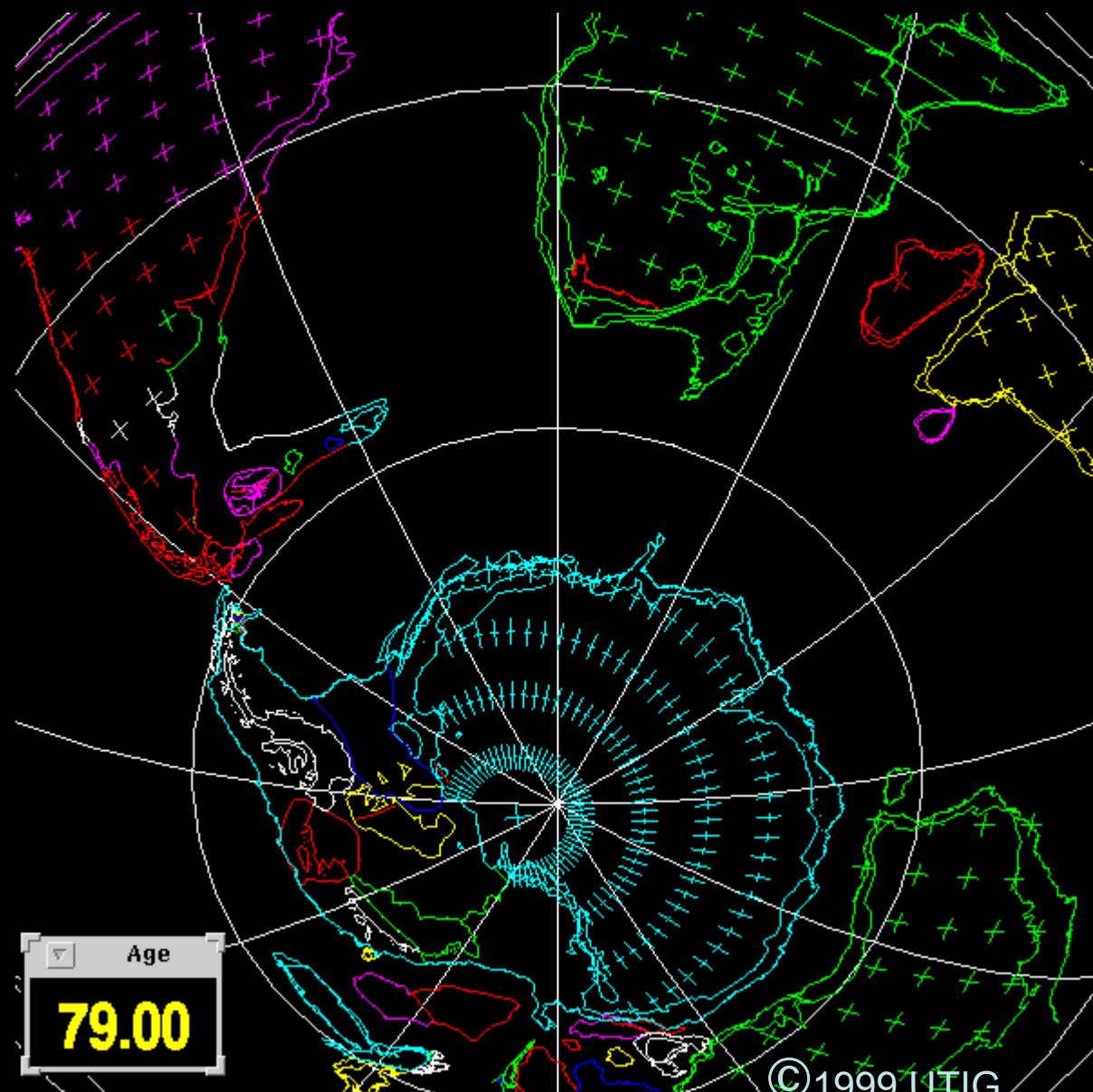
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80.00

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 Age
79.00

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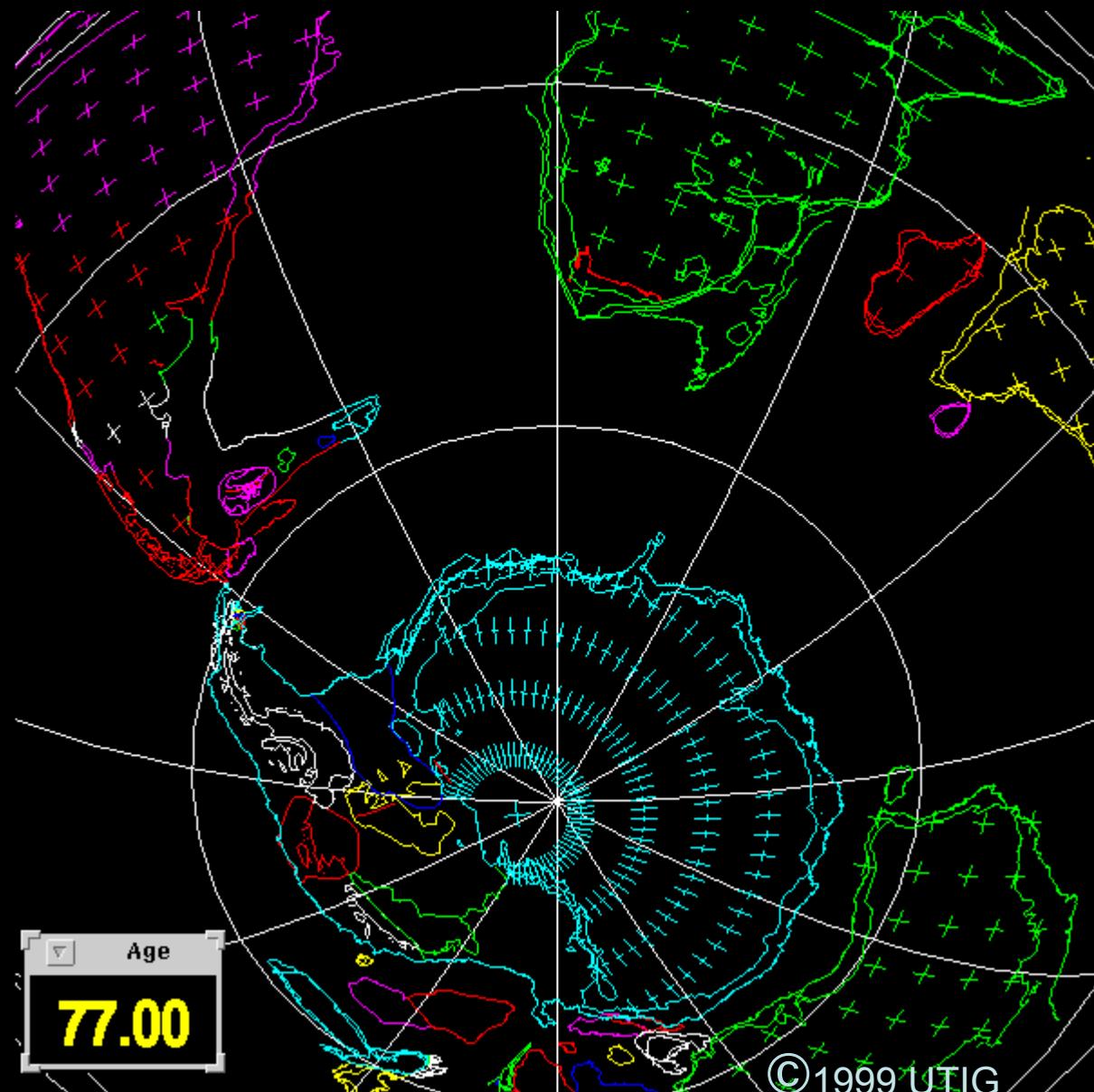
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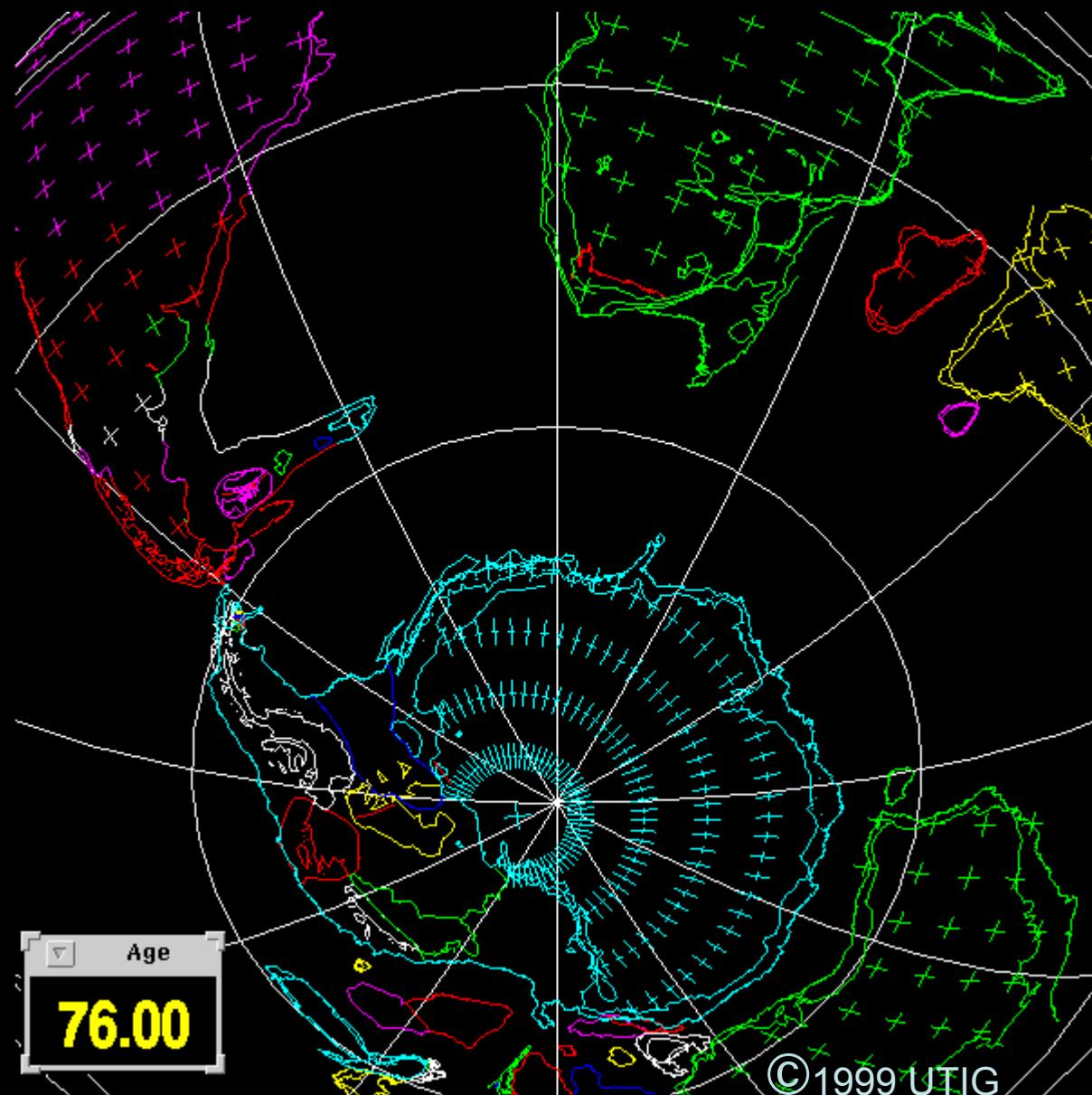
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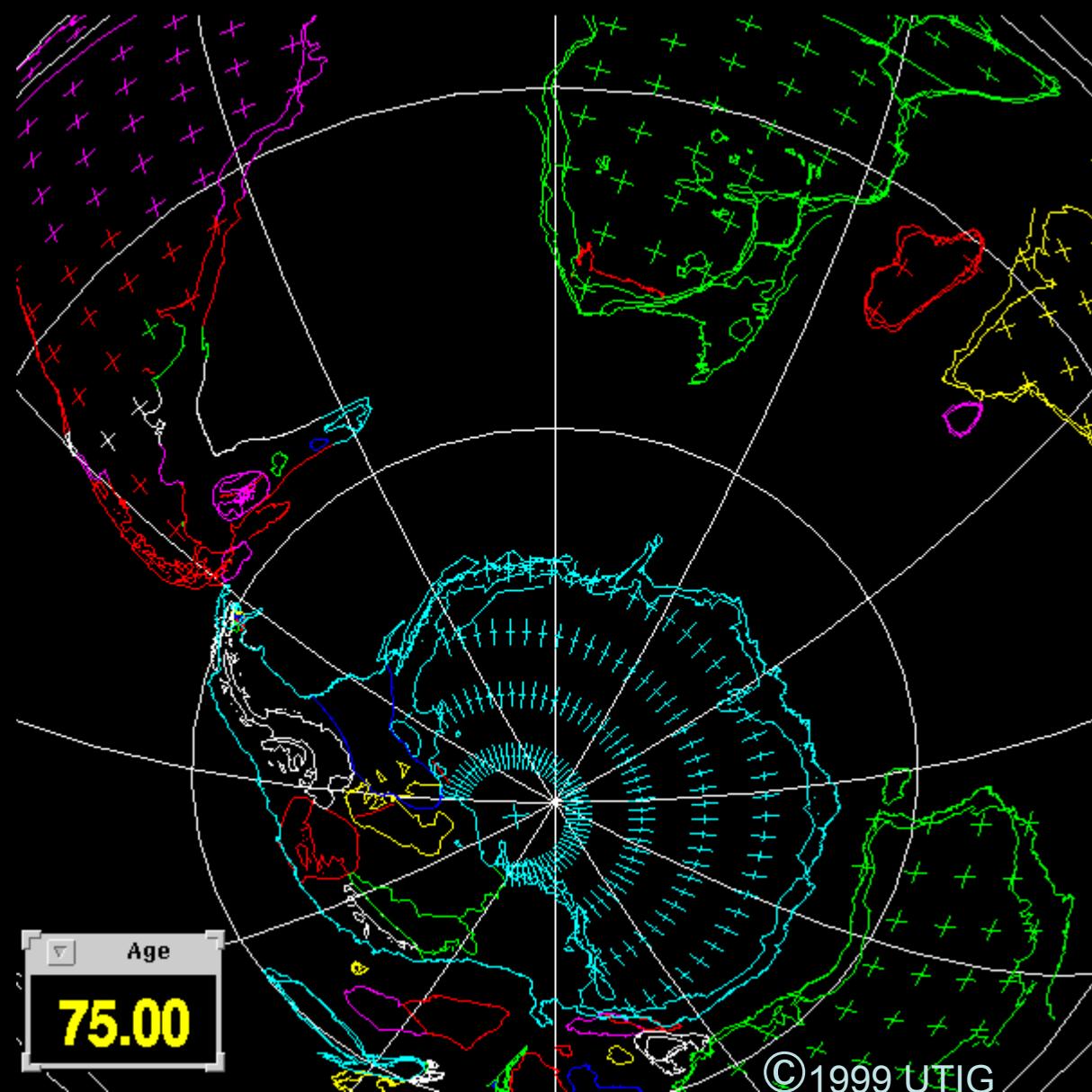
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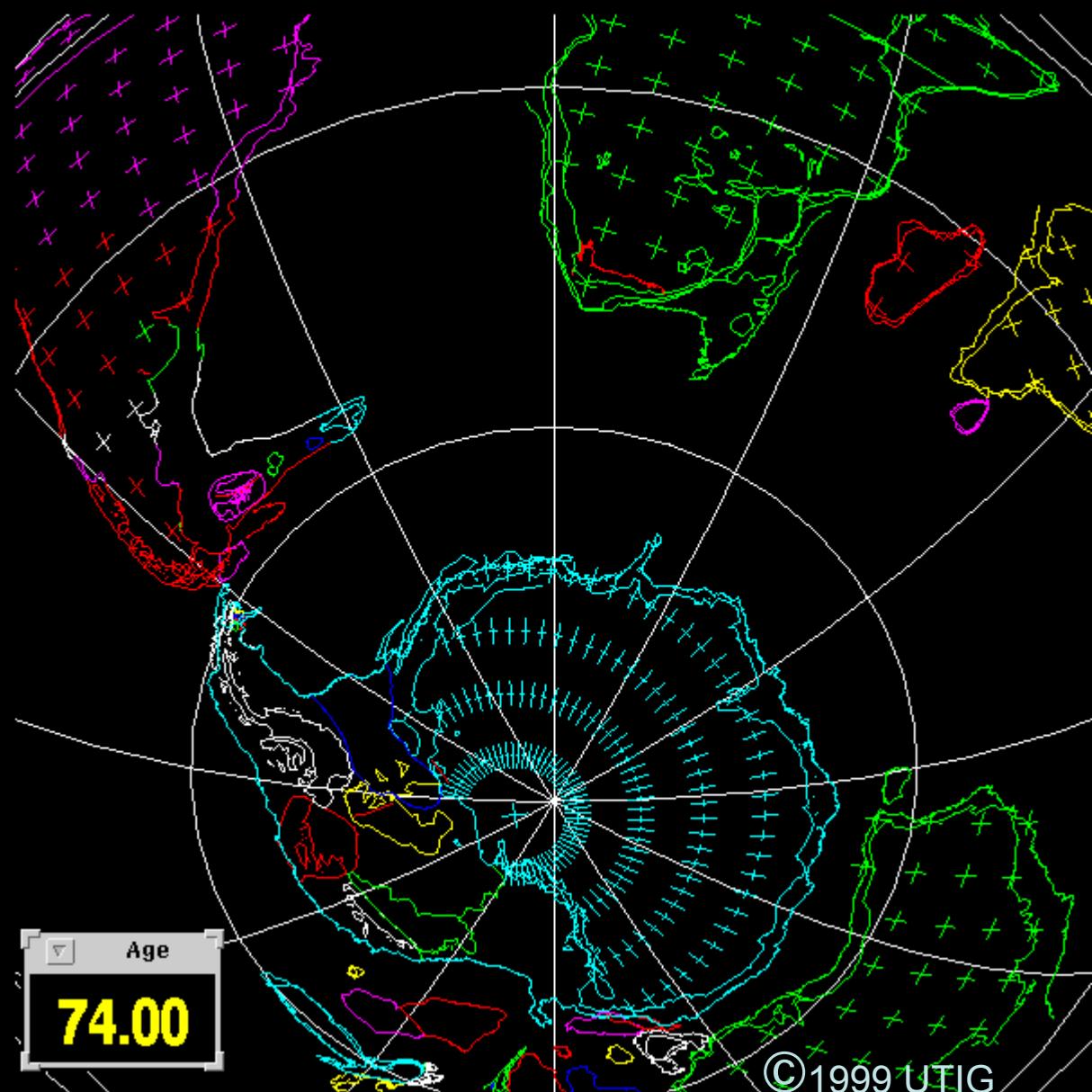


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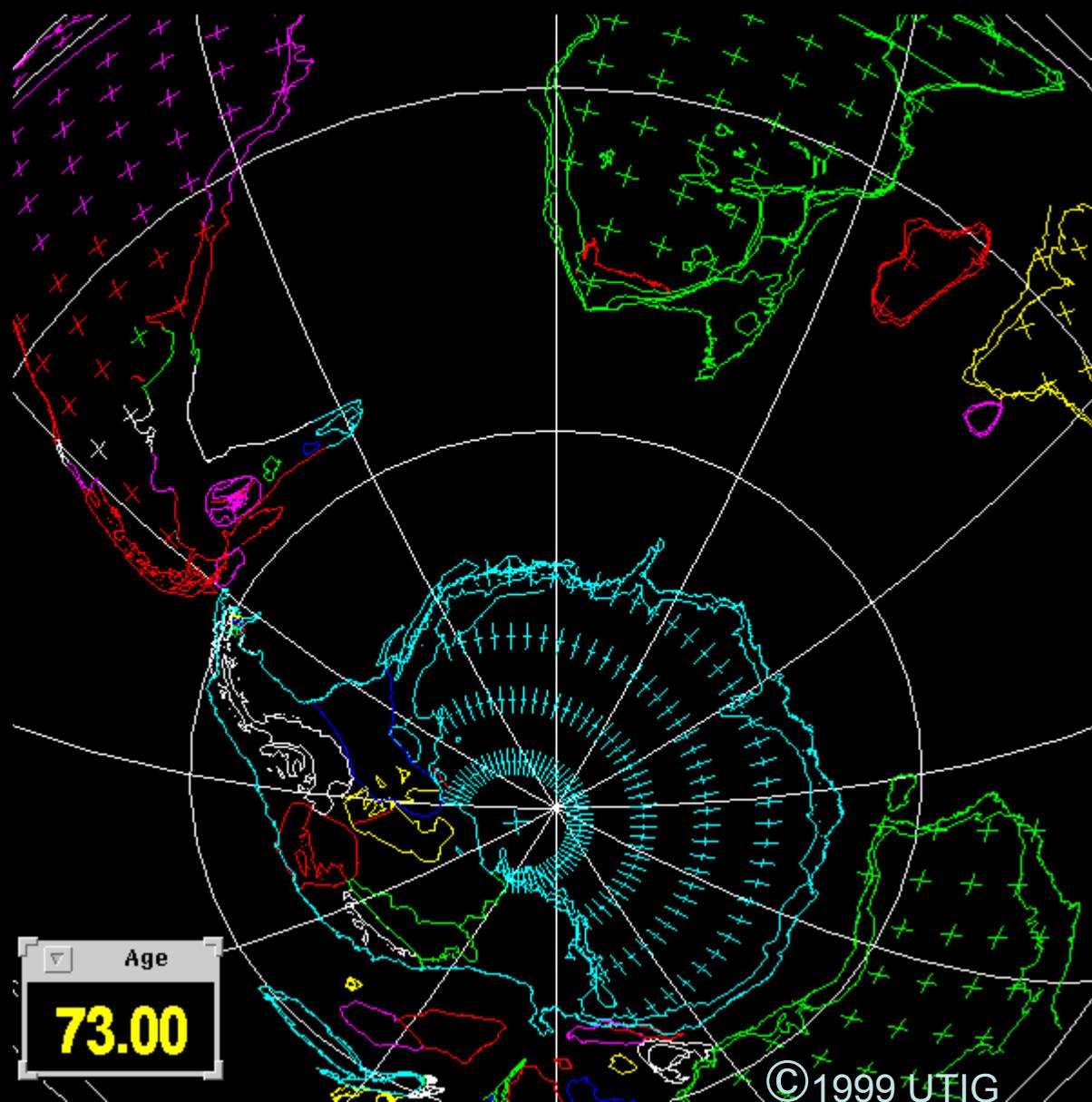
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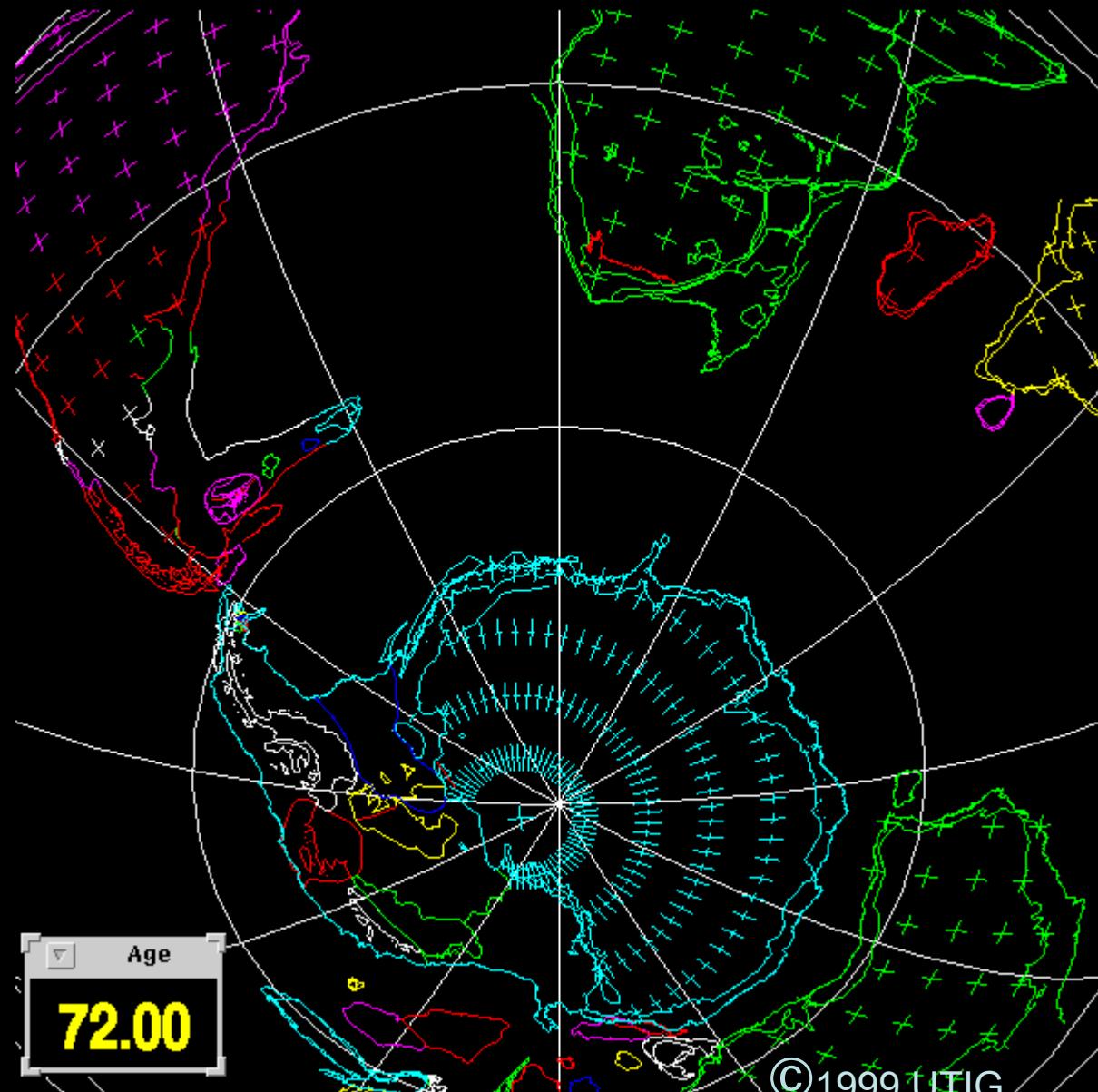


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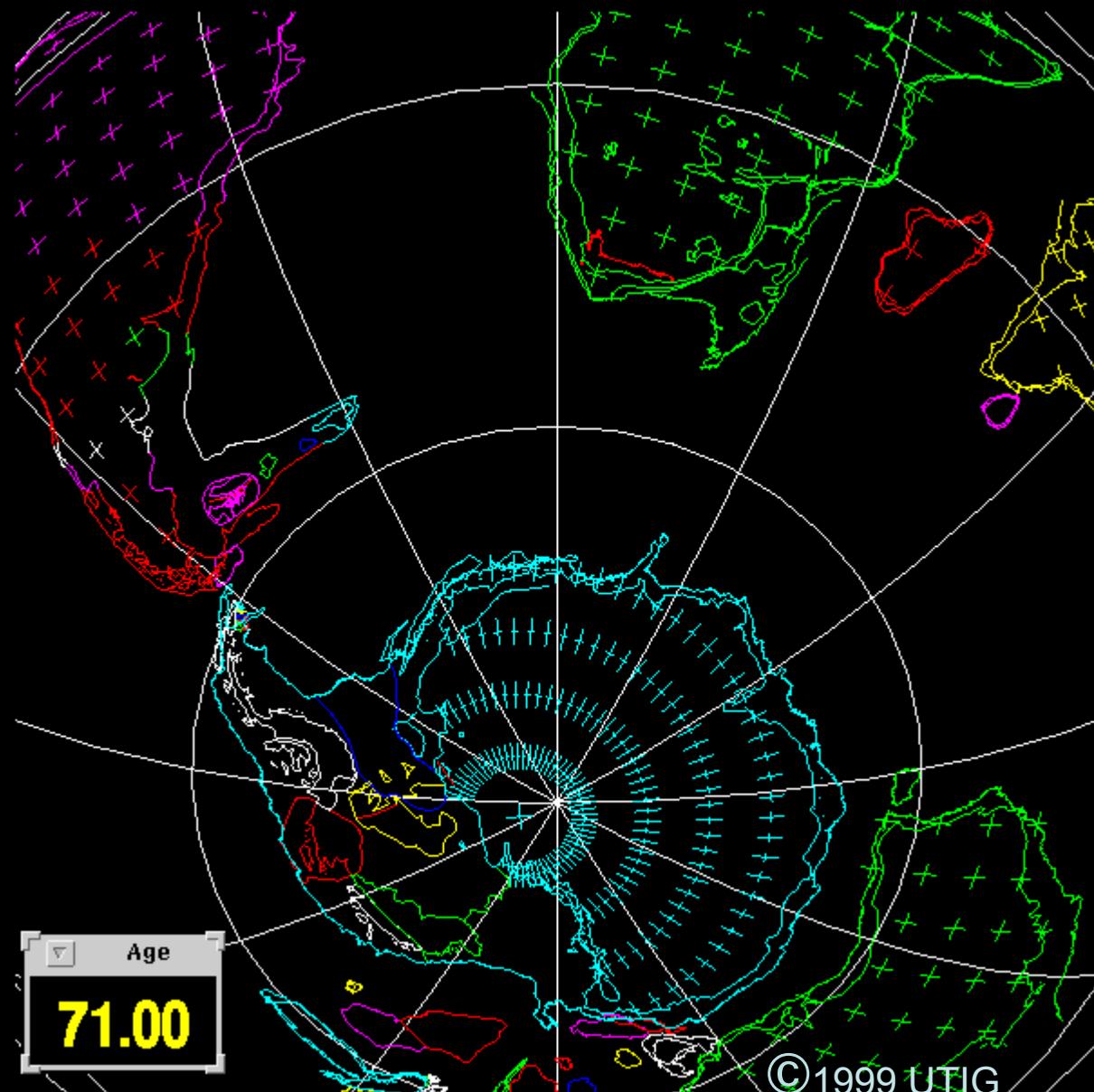
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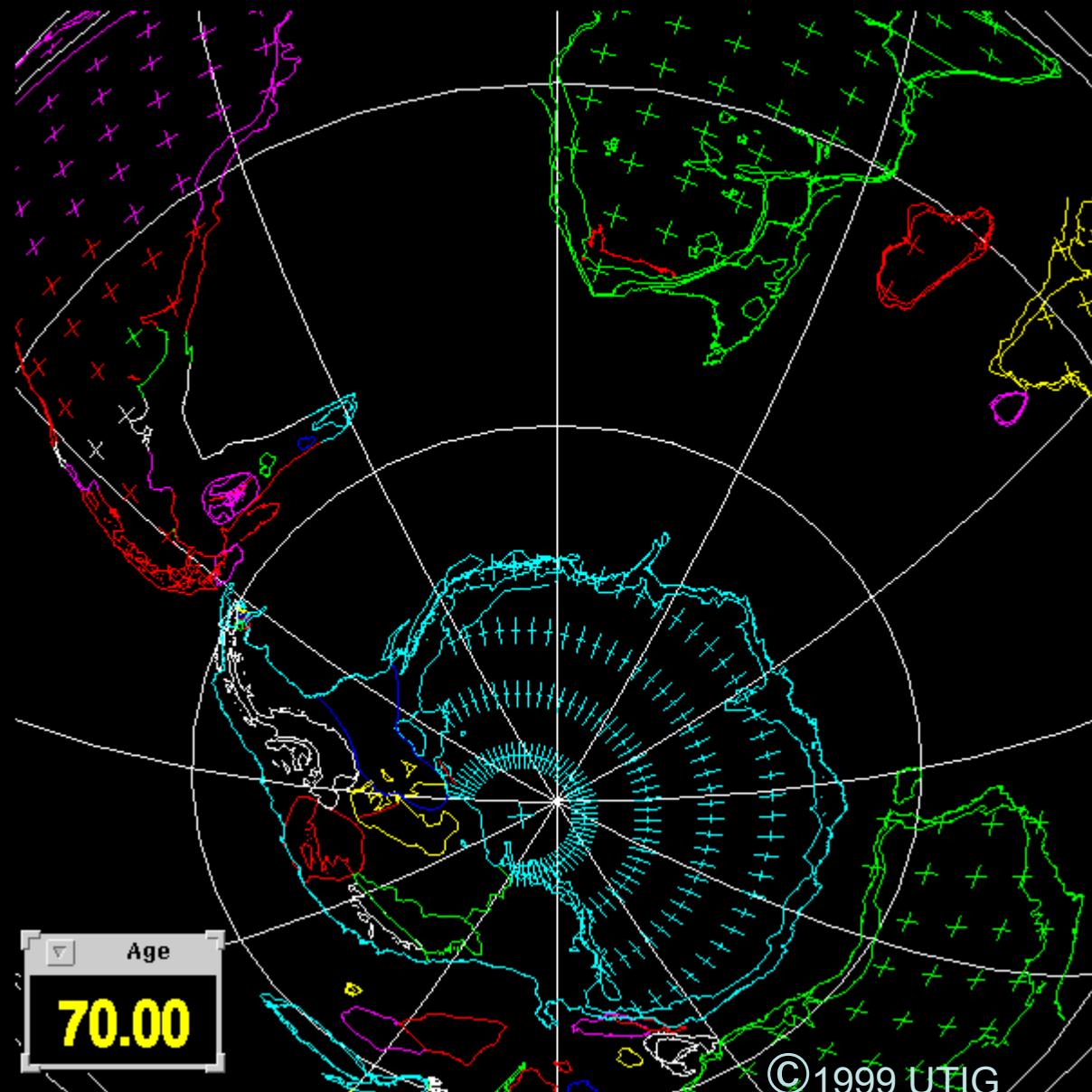
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71.00

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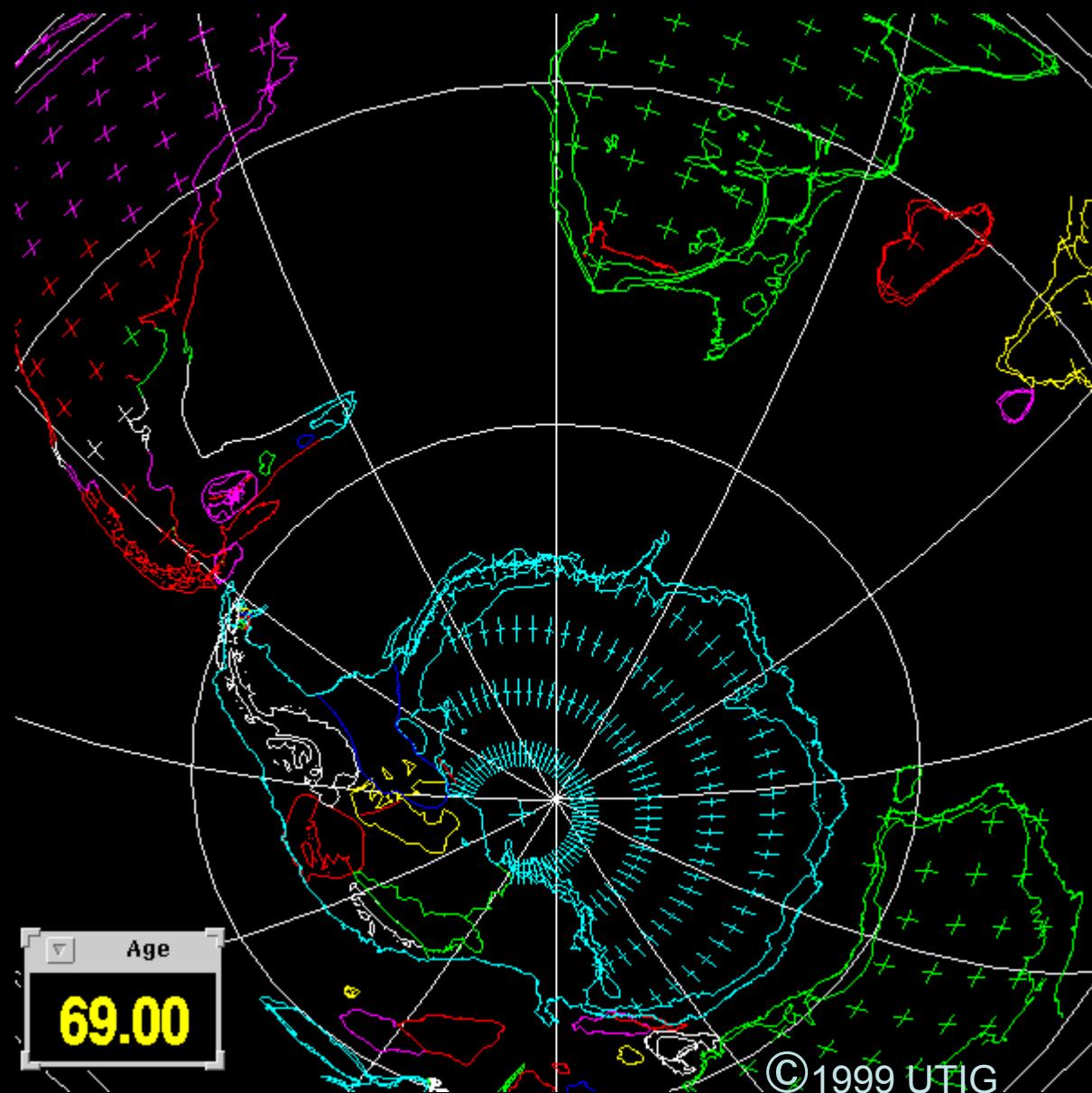
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70.00

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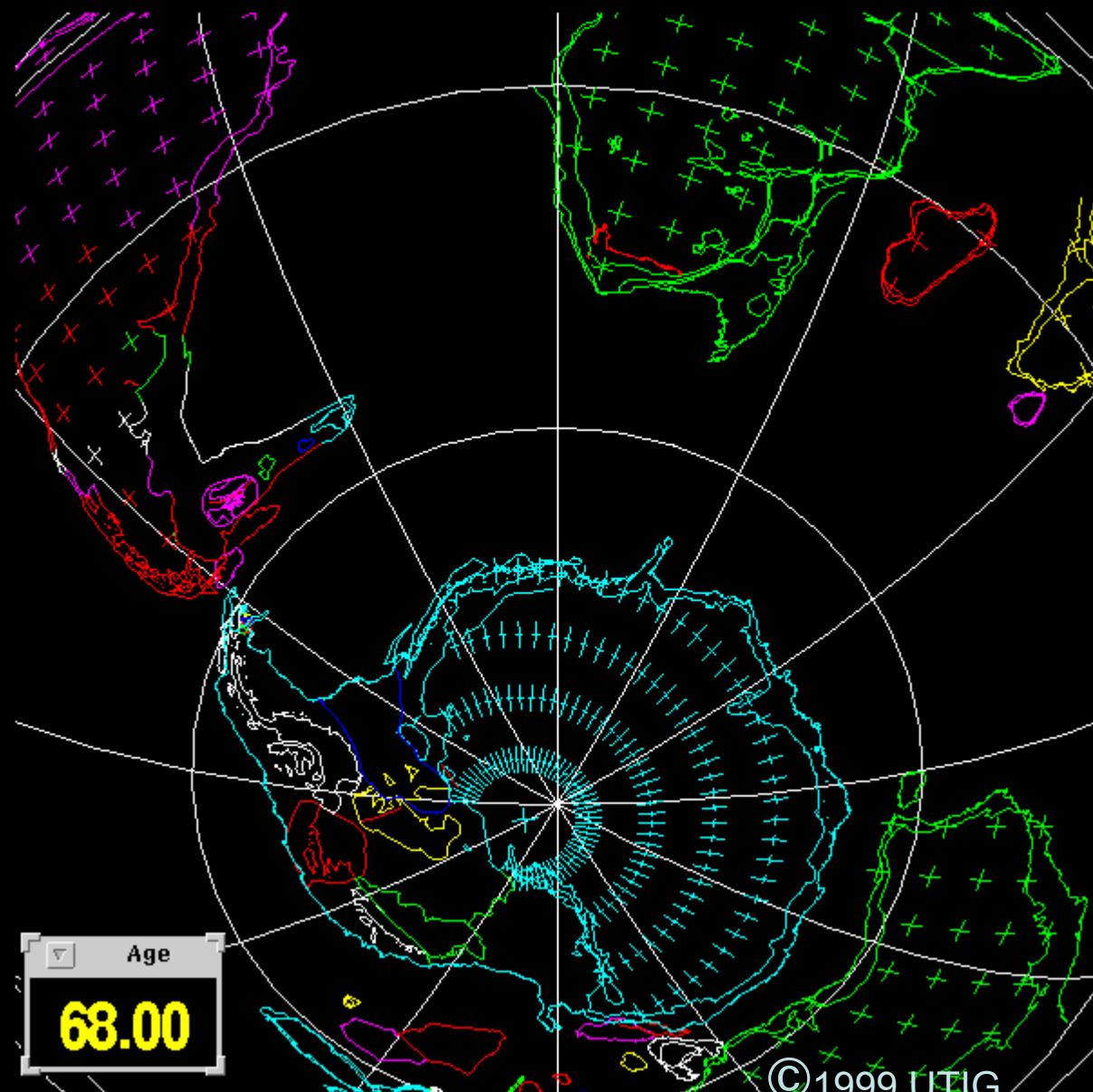
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69.00

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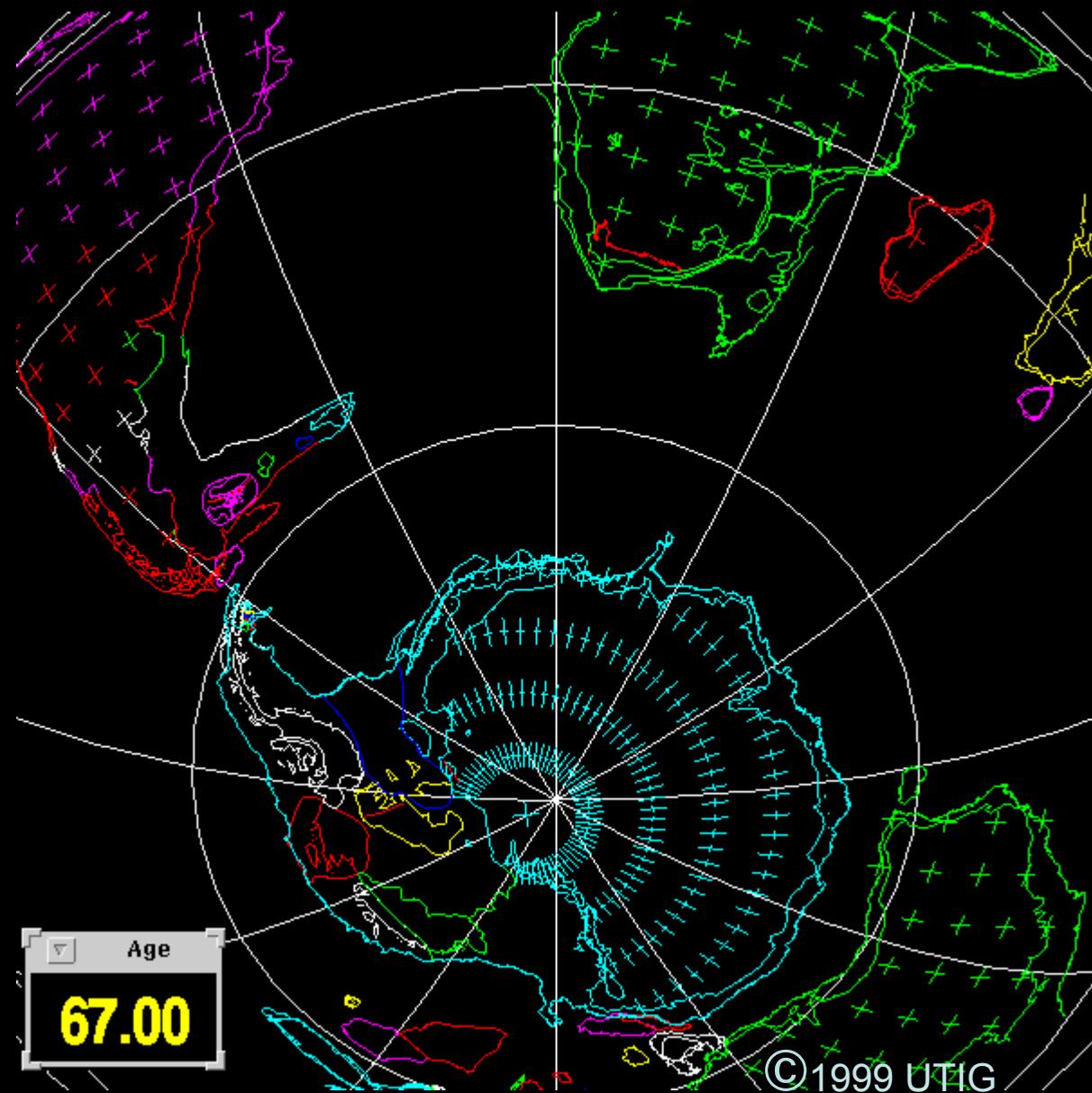


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68.00

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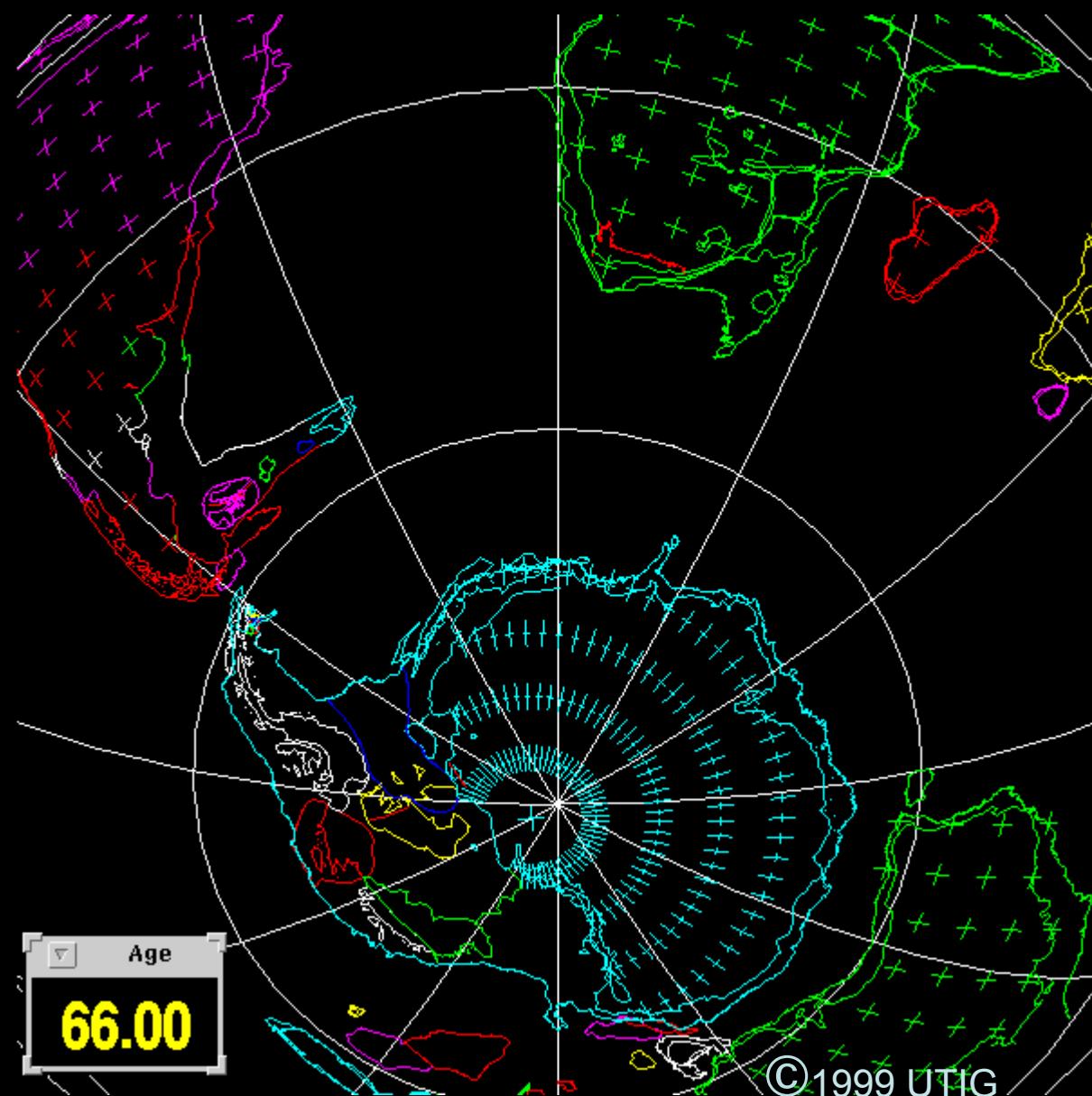


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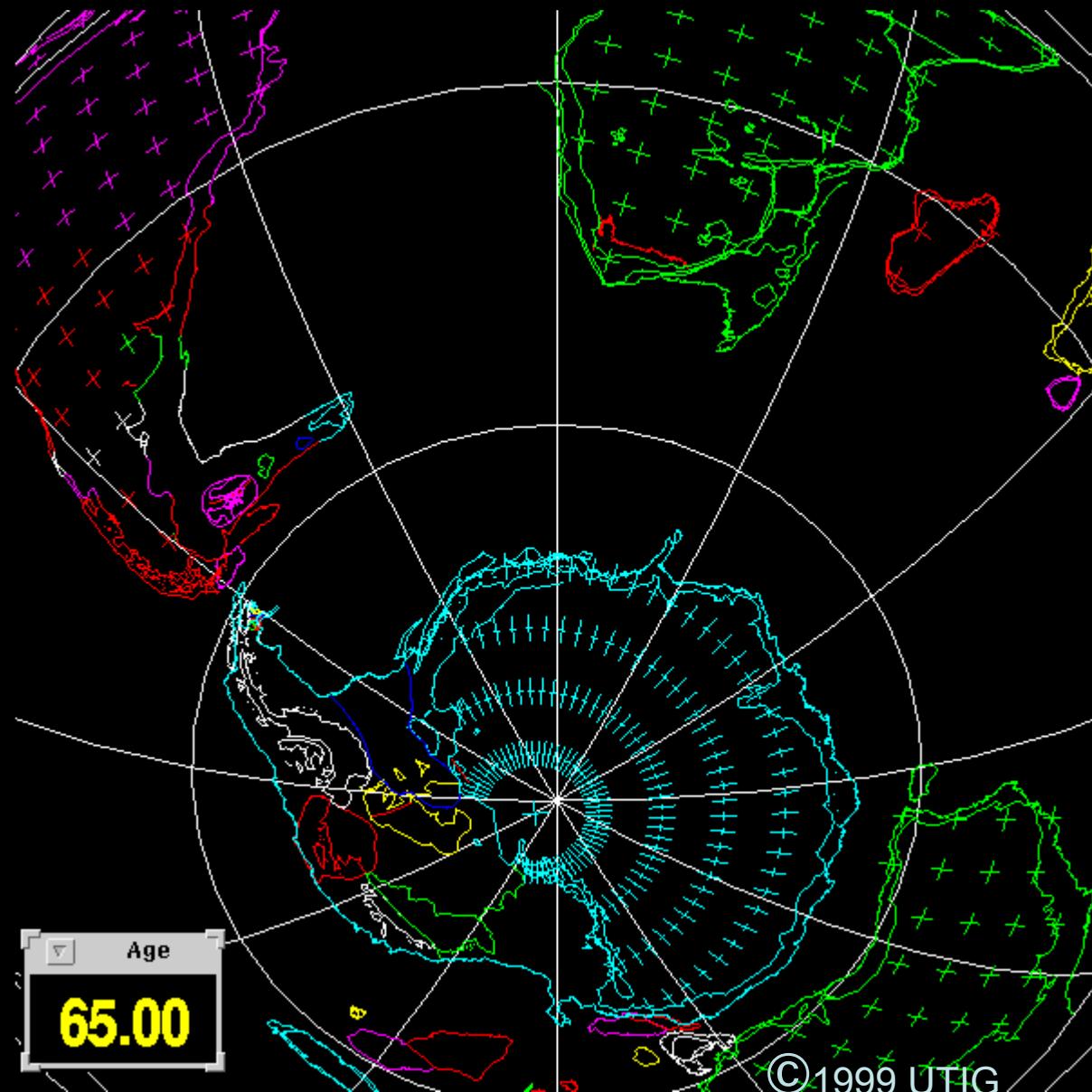


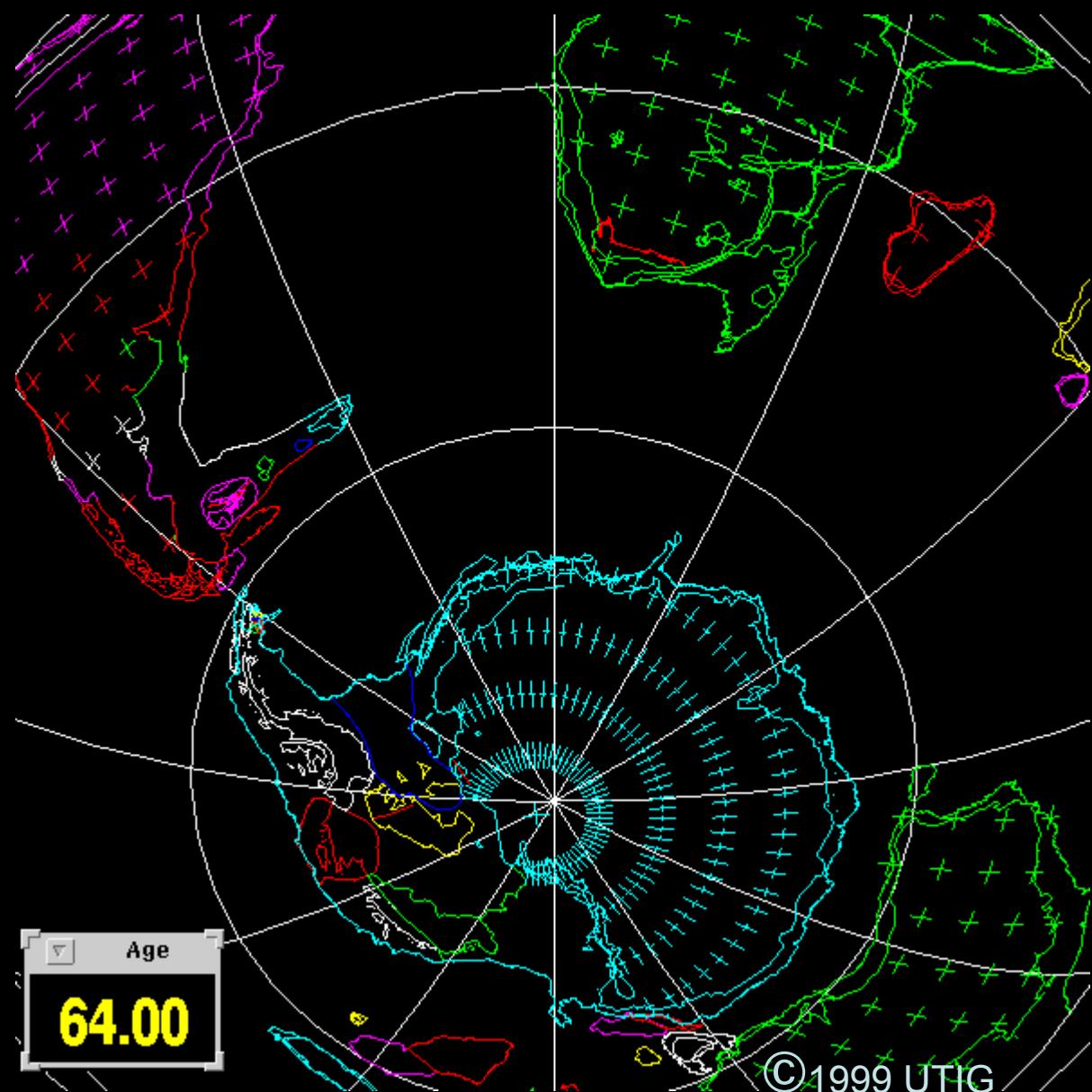
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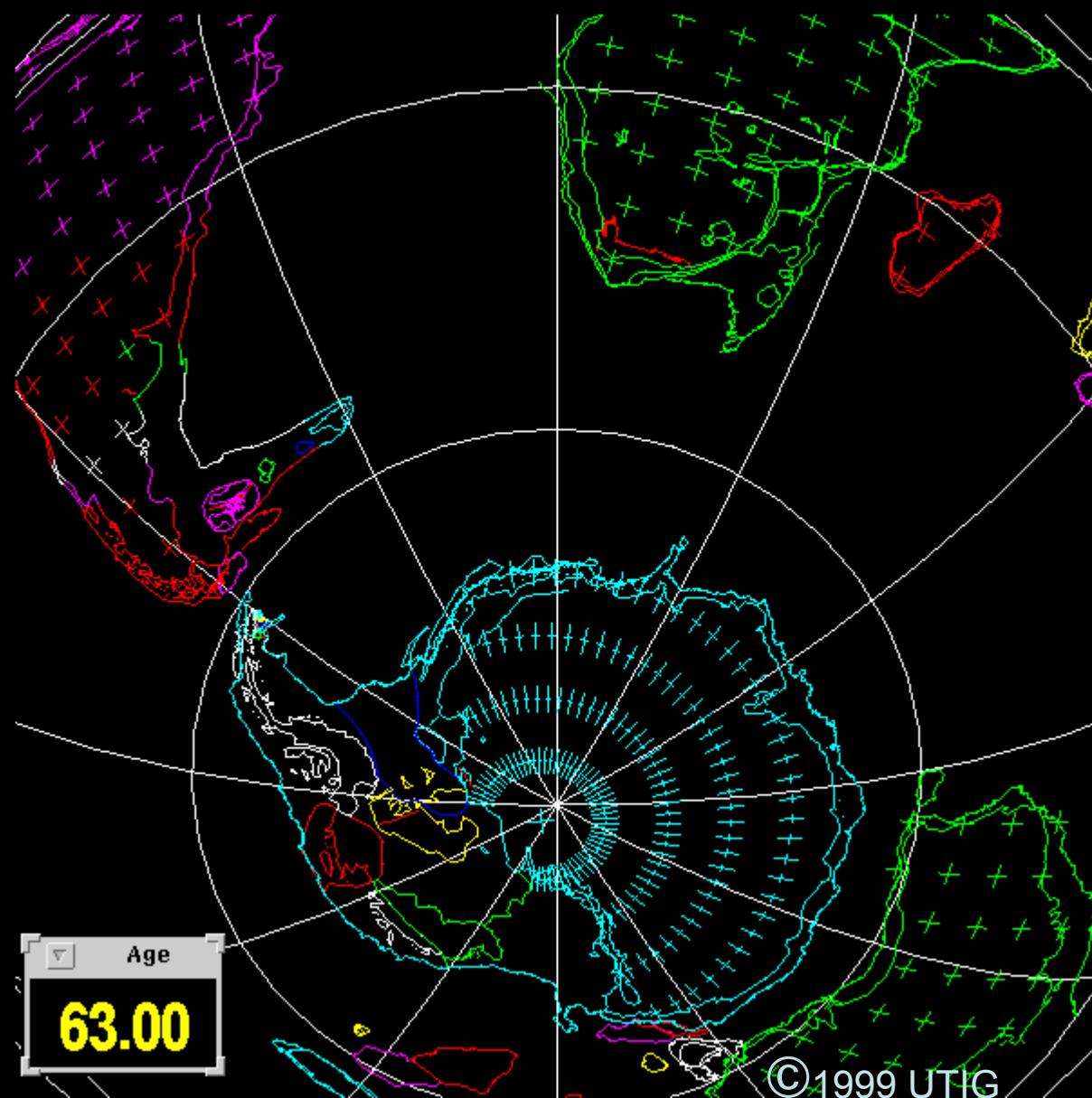


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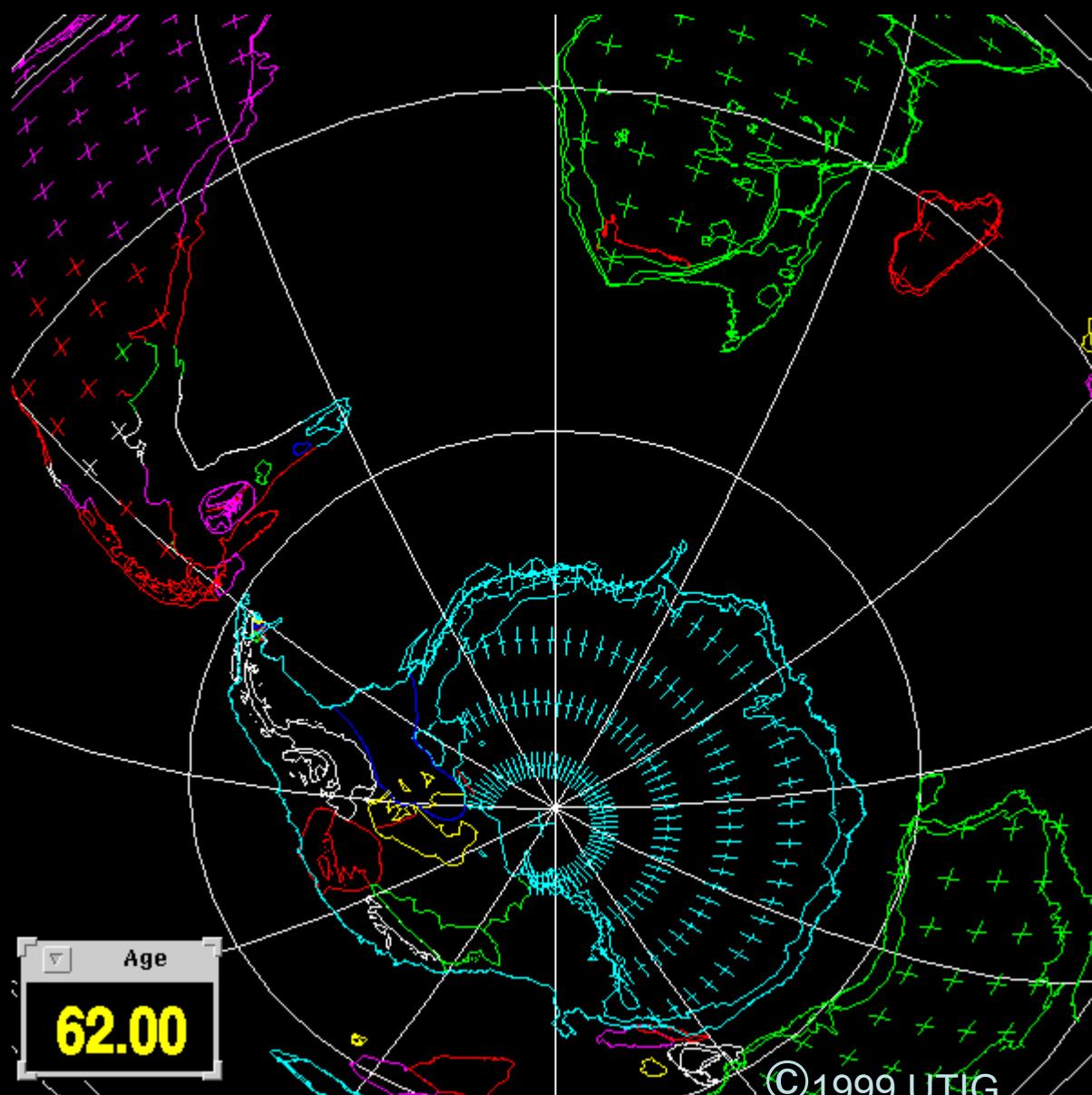




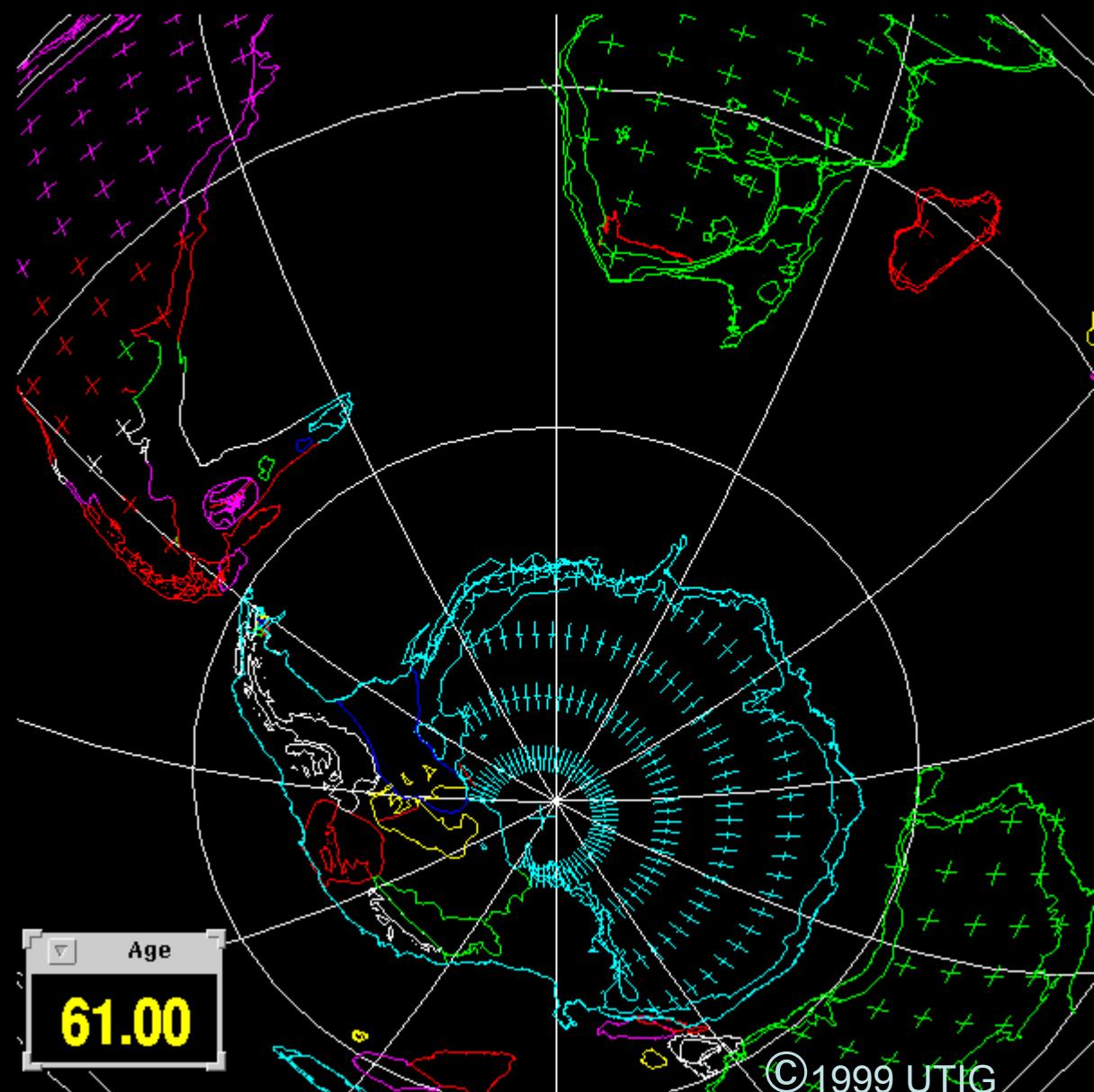
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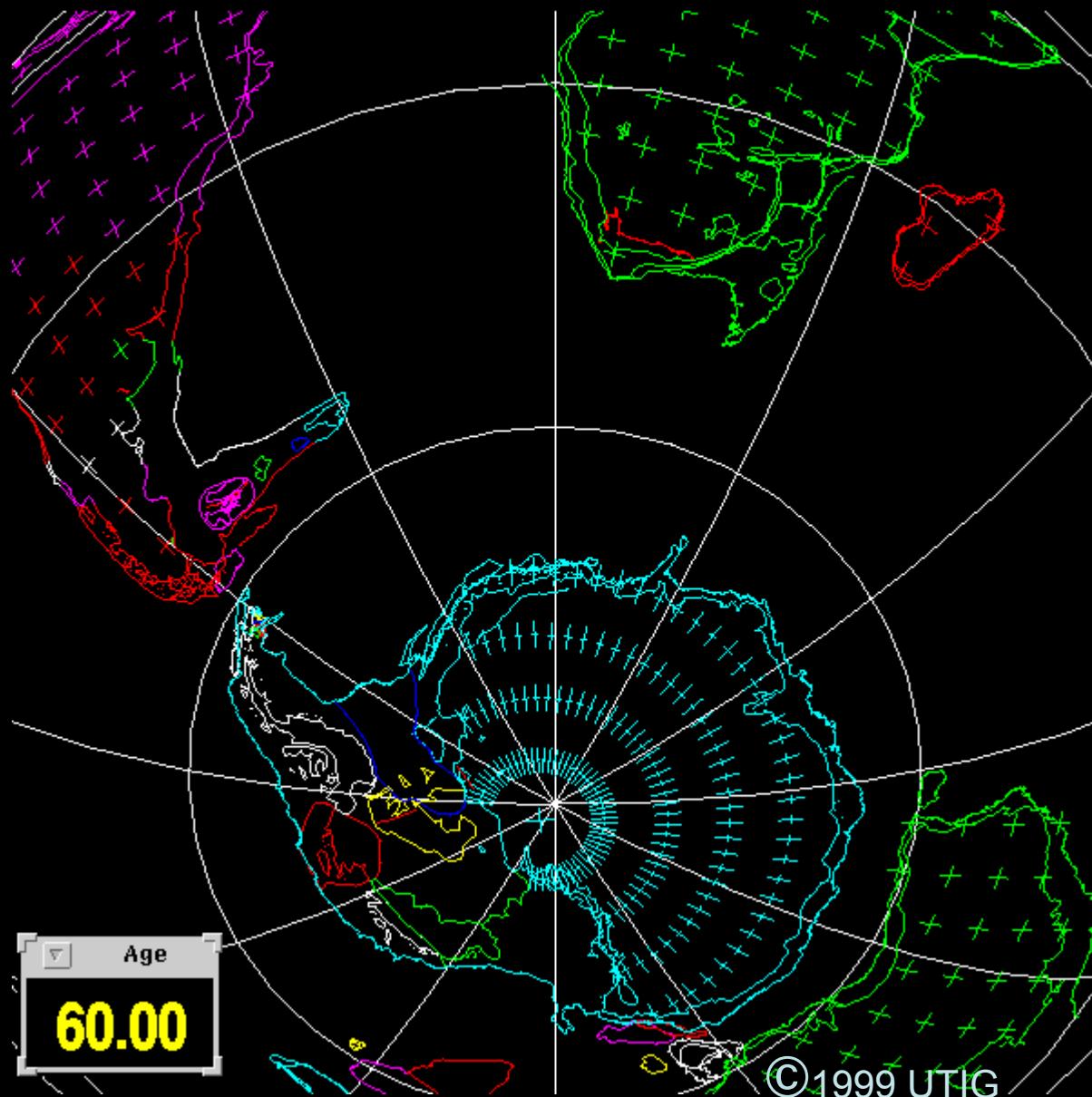
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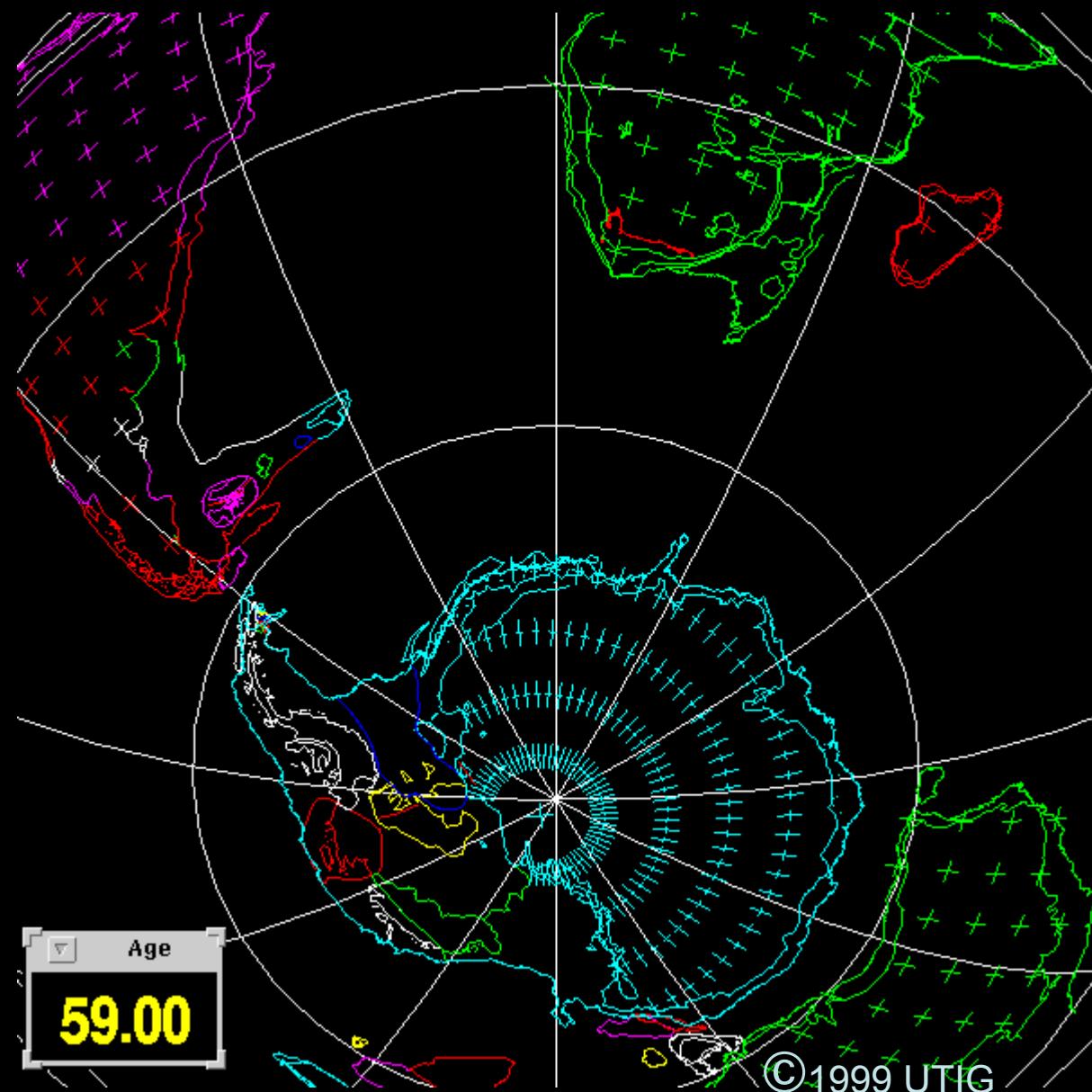


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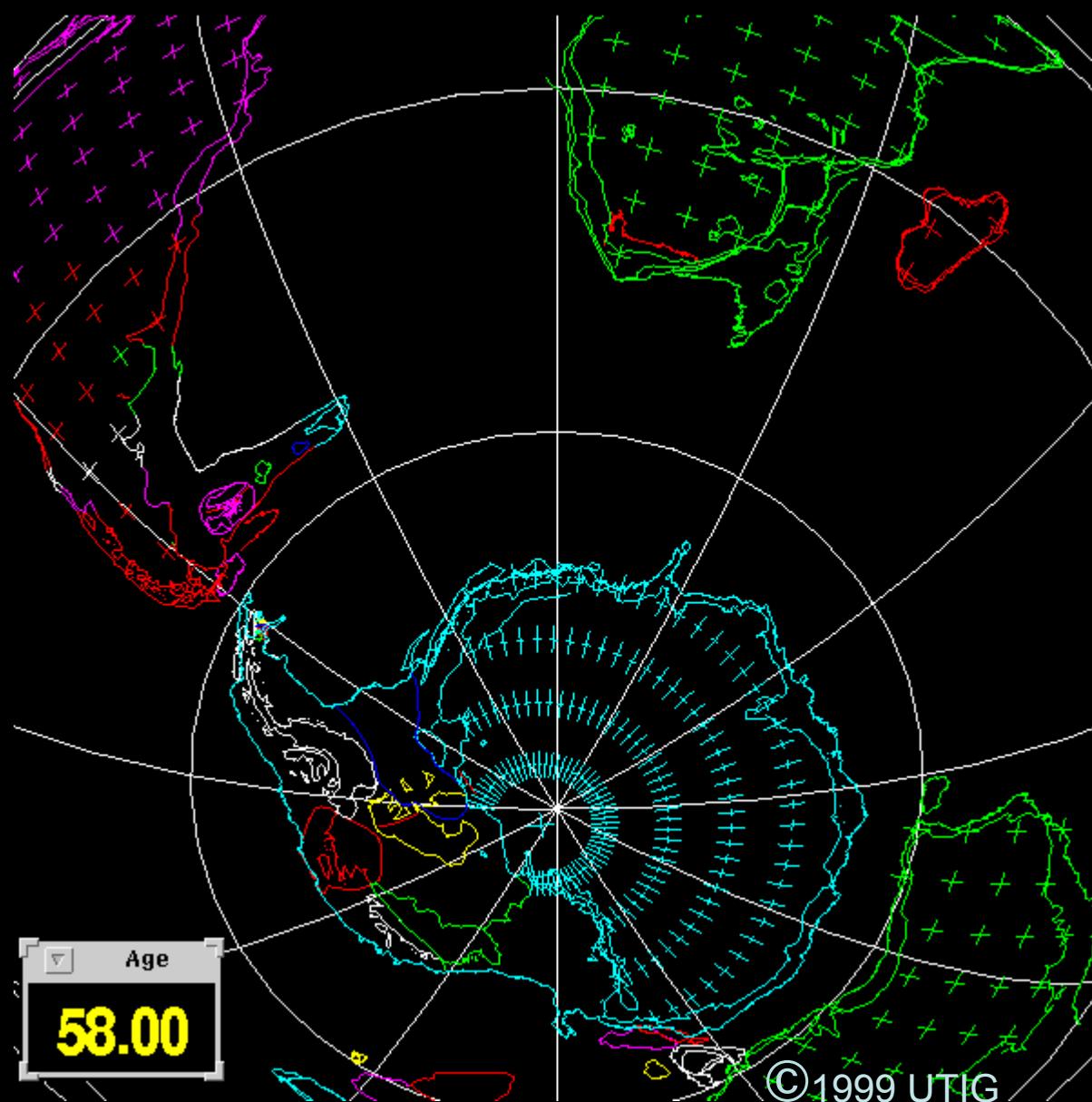


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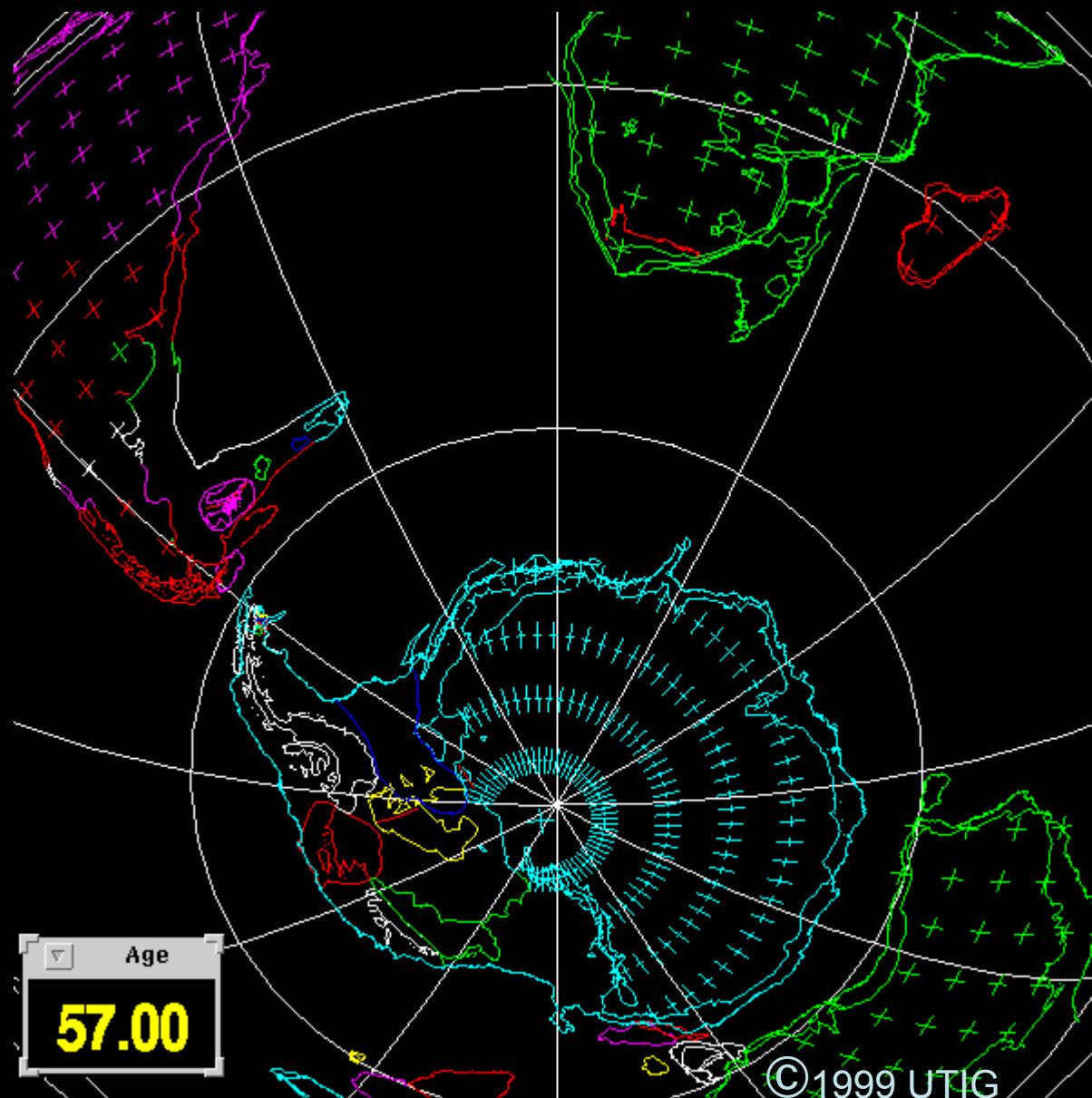




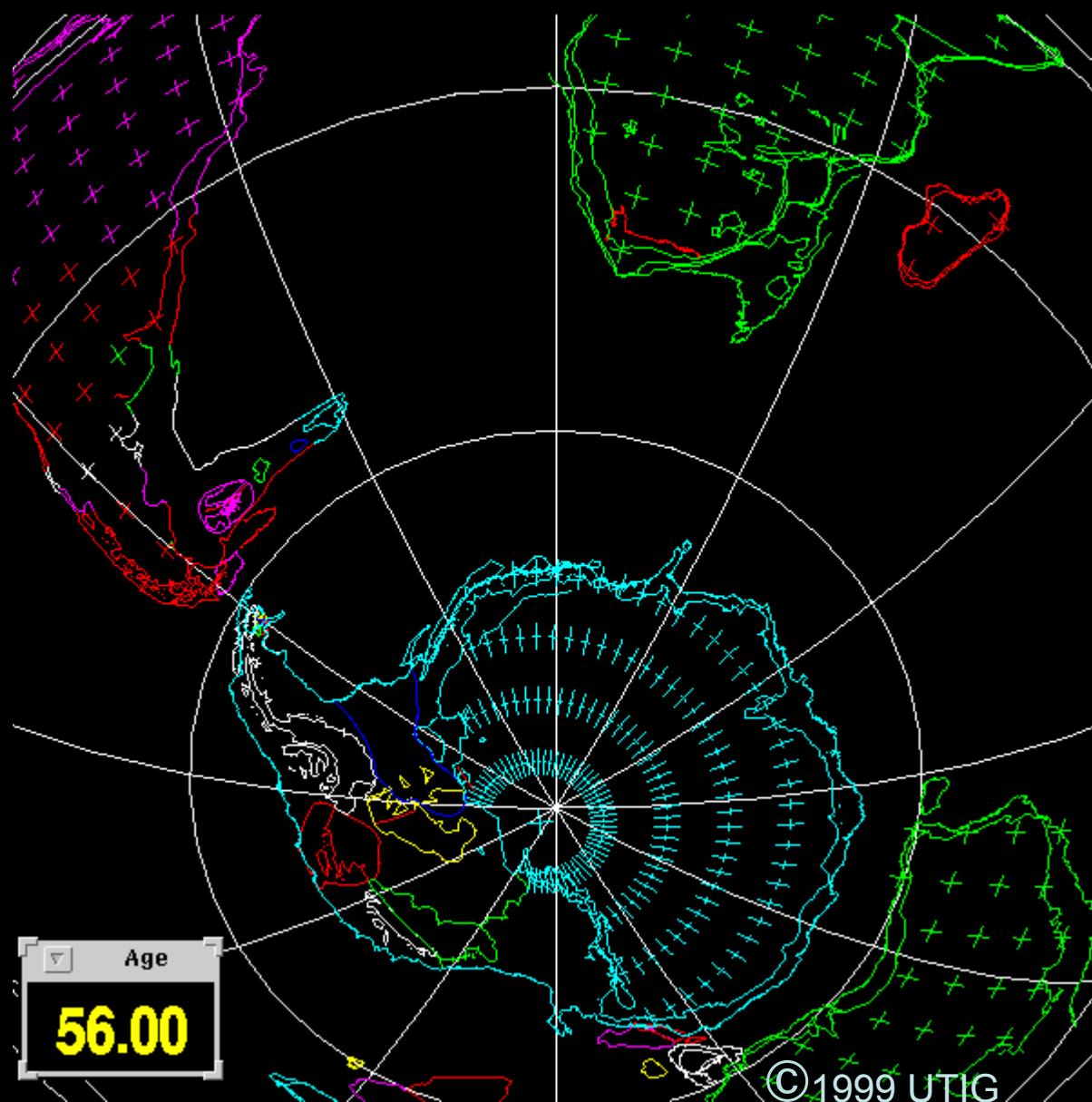
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58.00



 Age
57.00



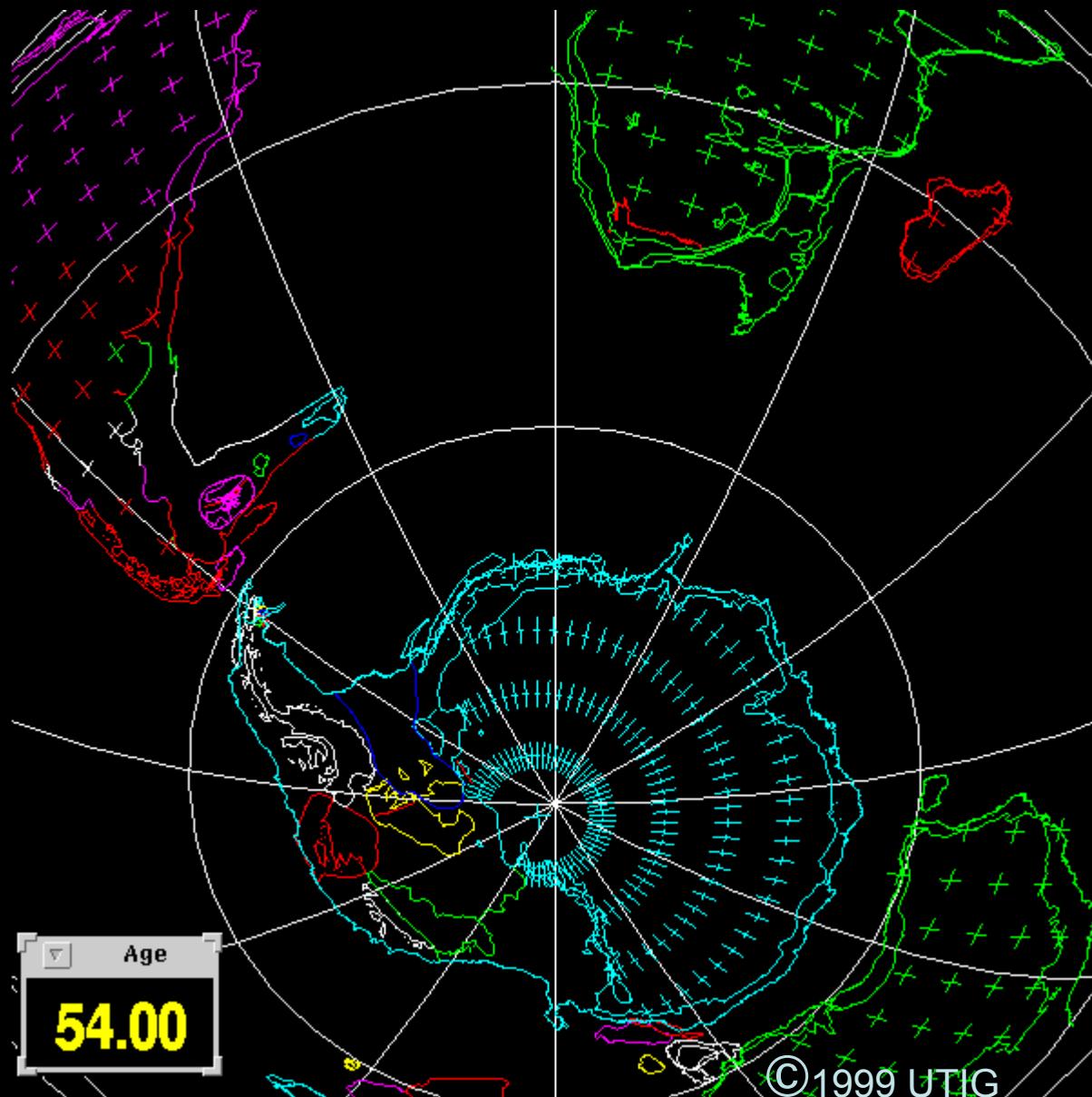
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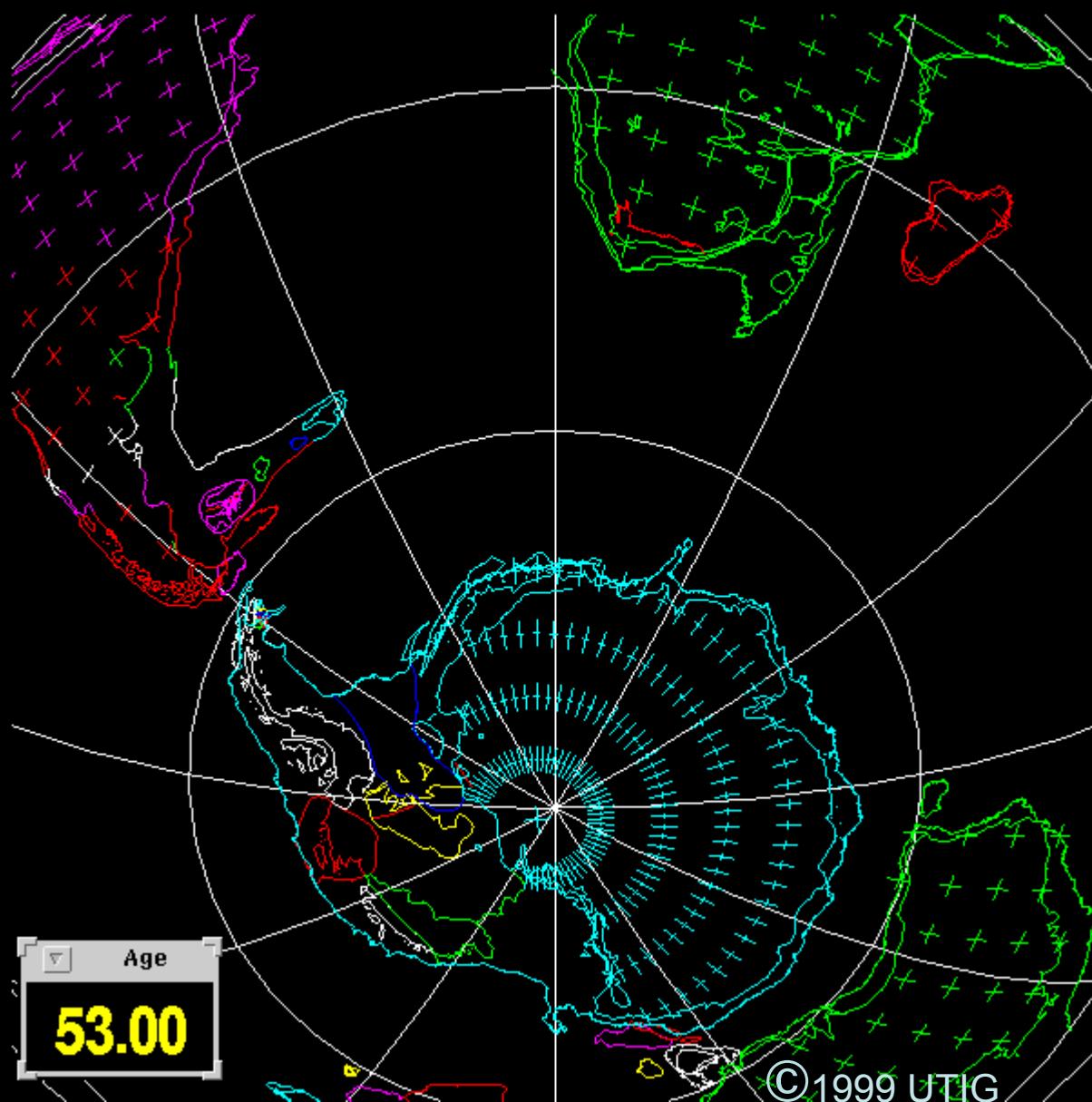
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55.00

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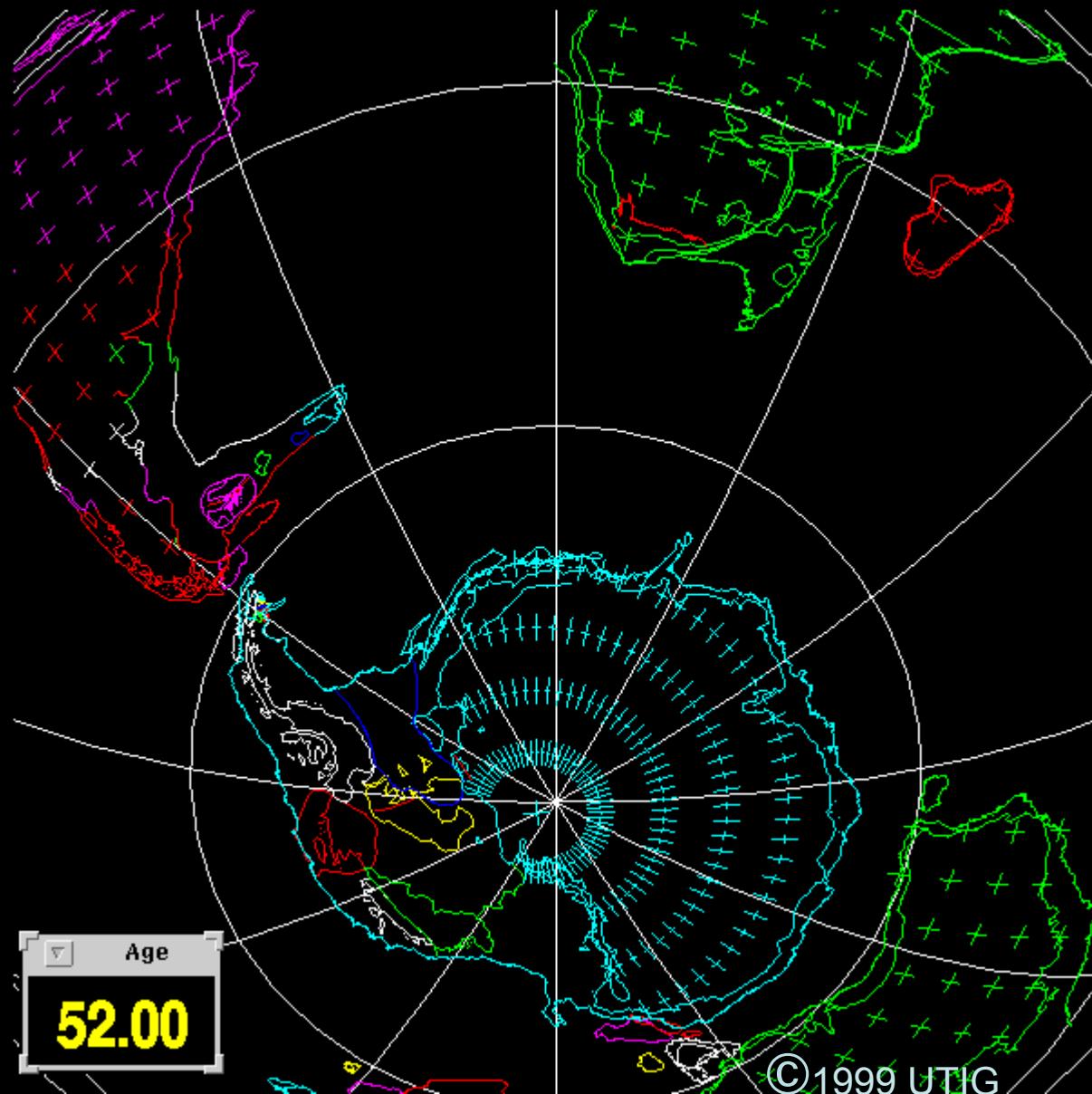
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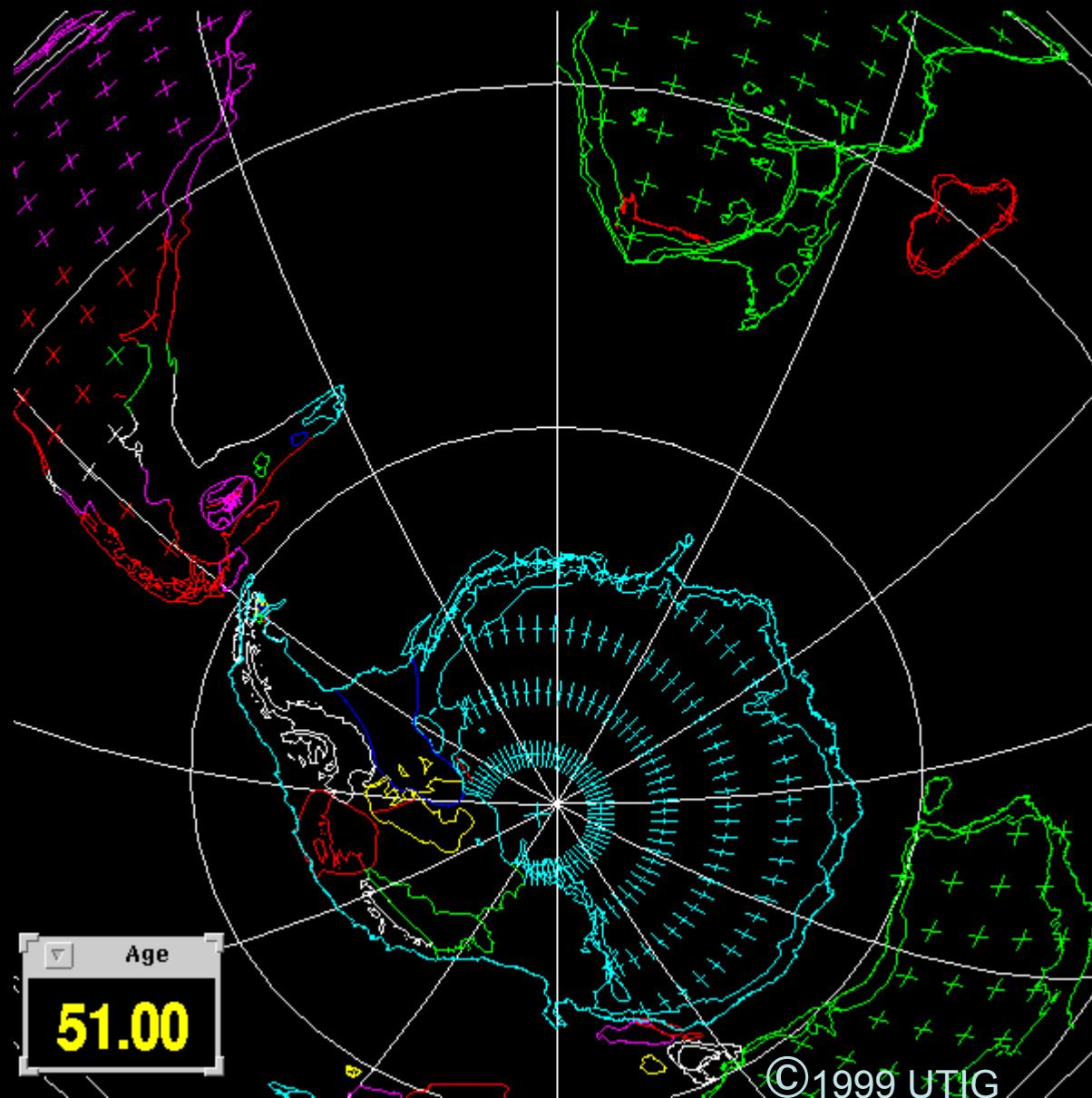
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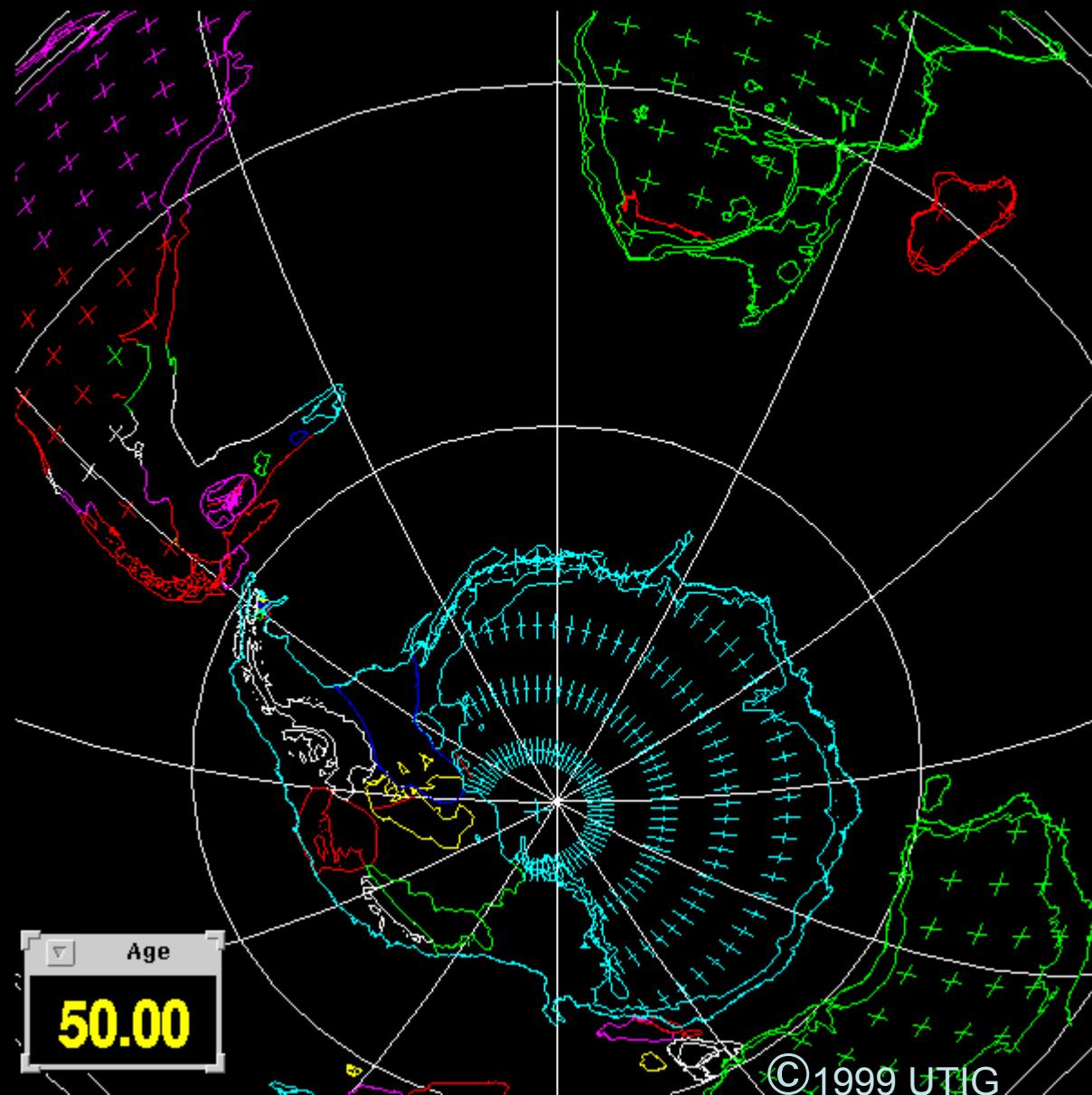
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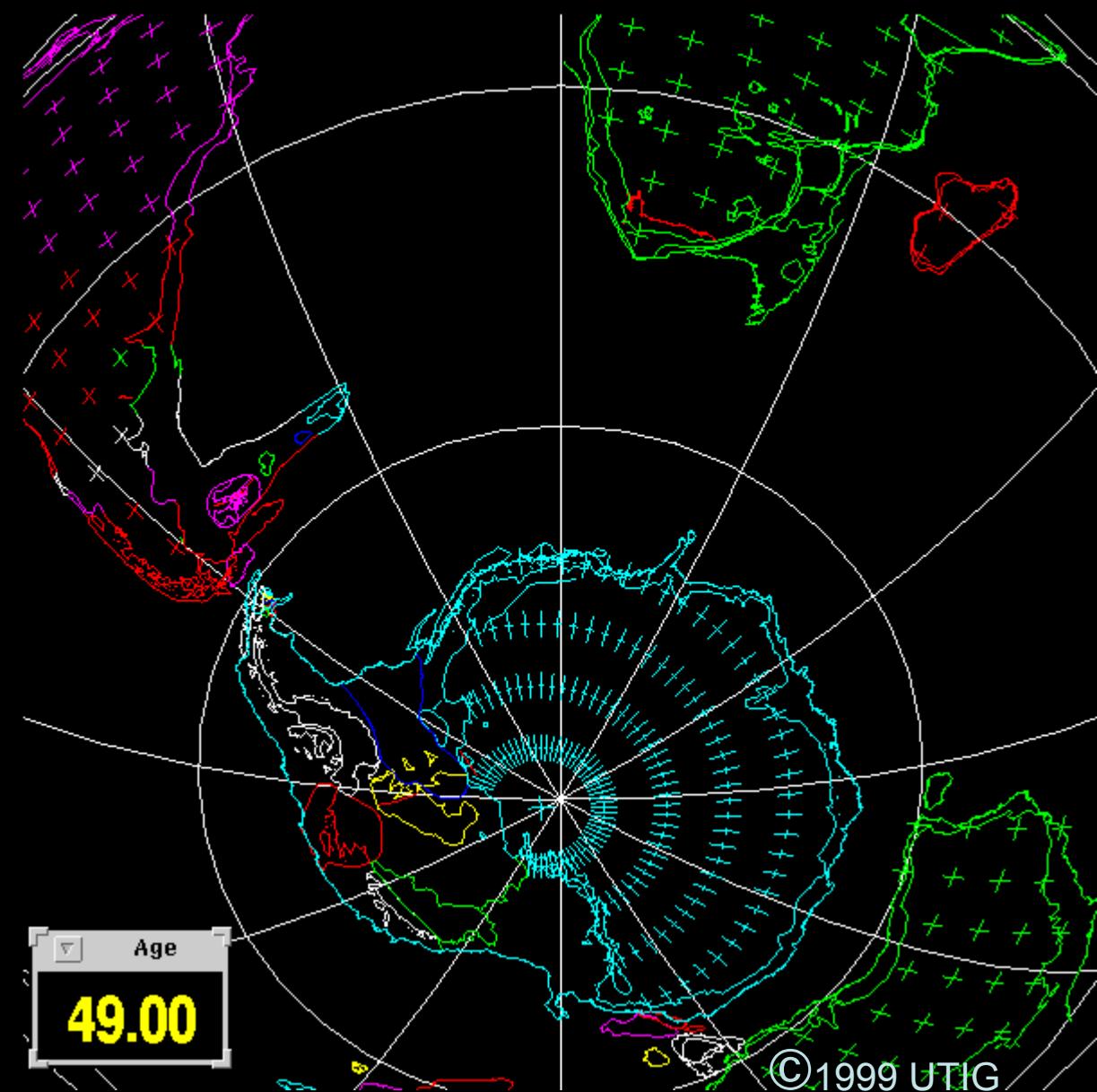


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51.00

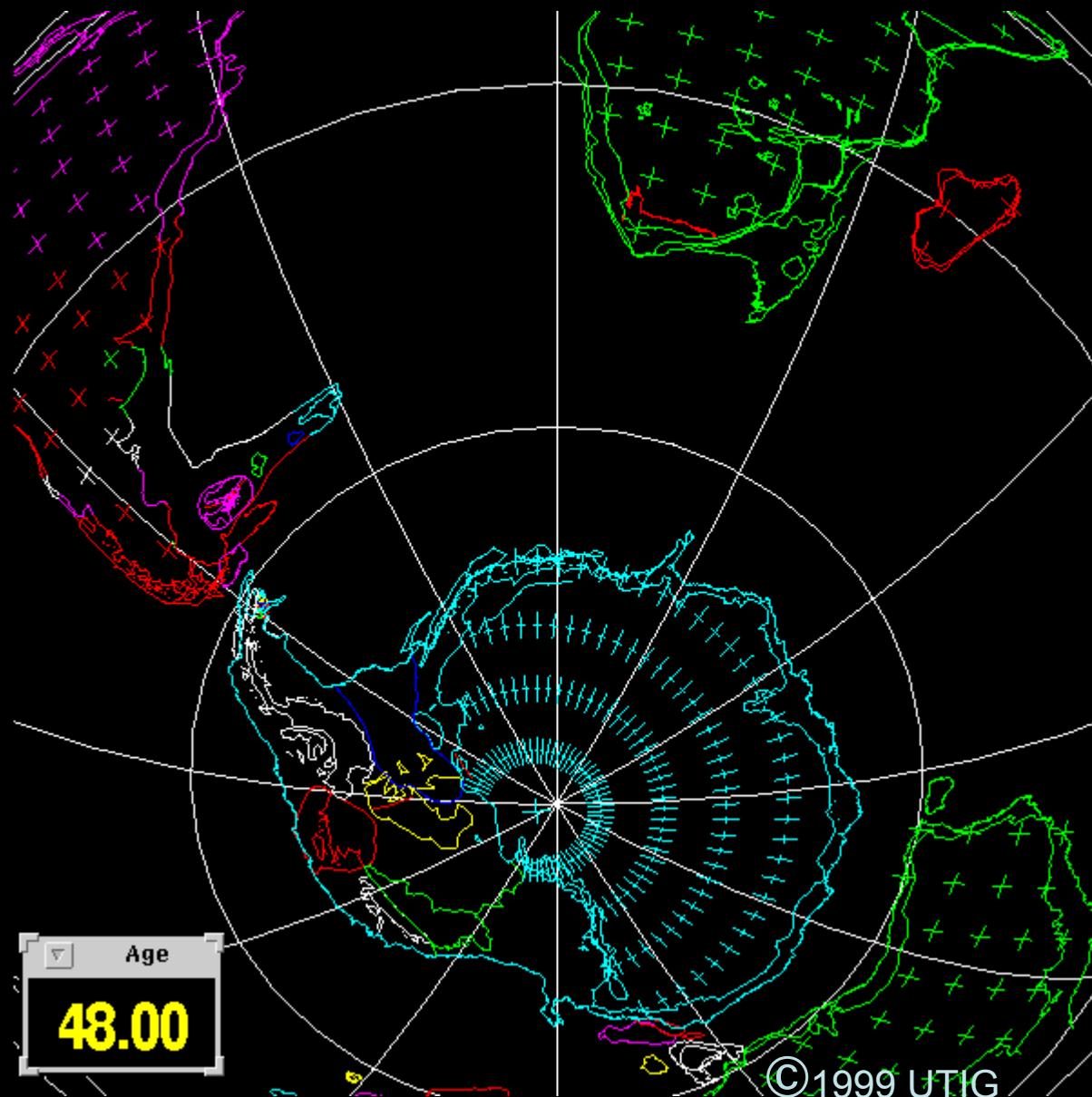


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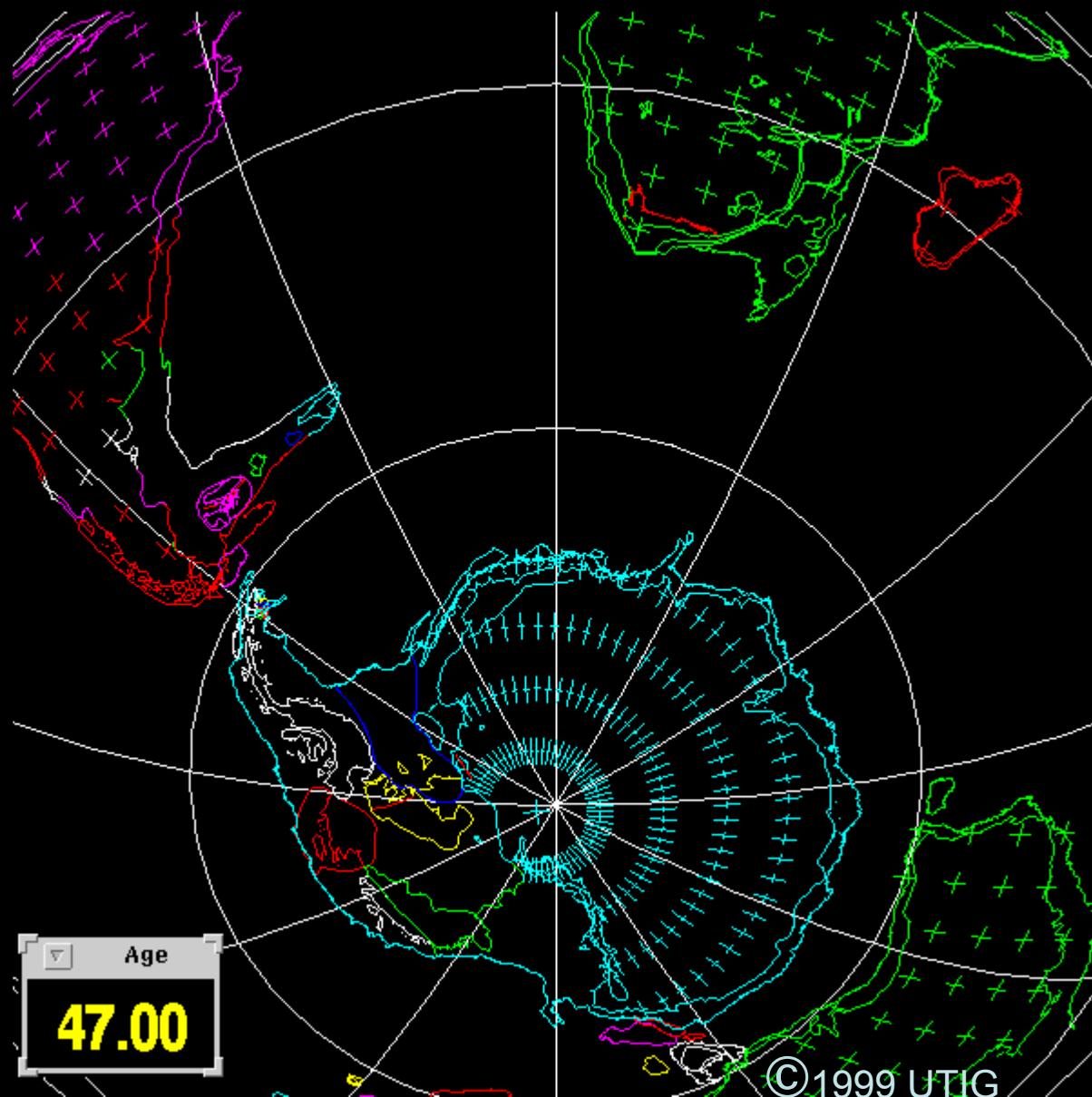


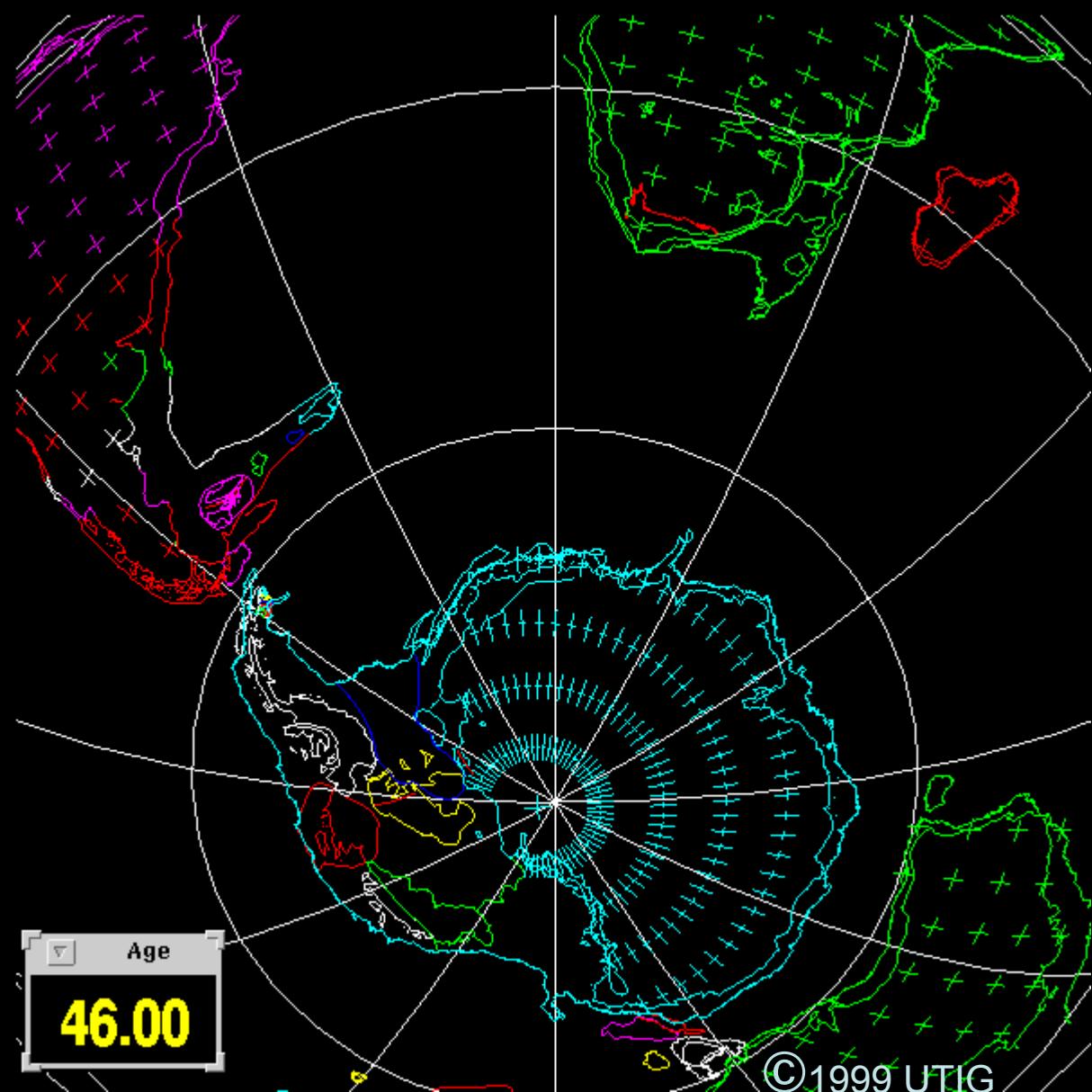
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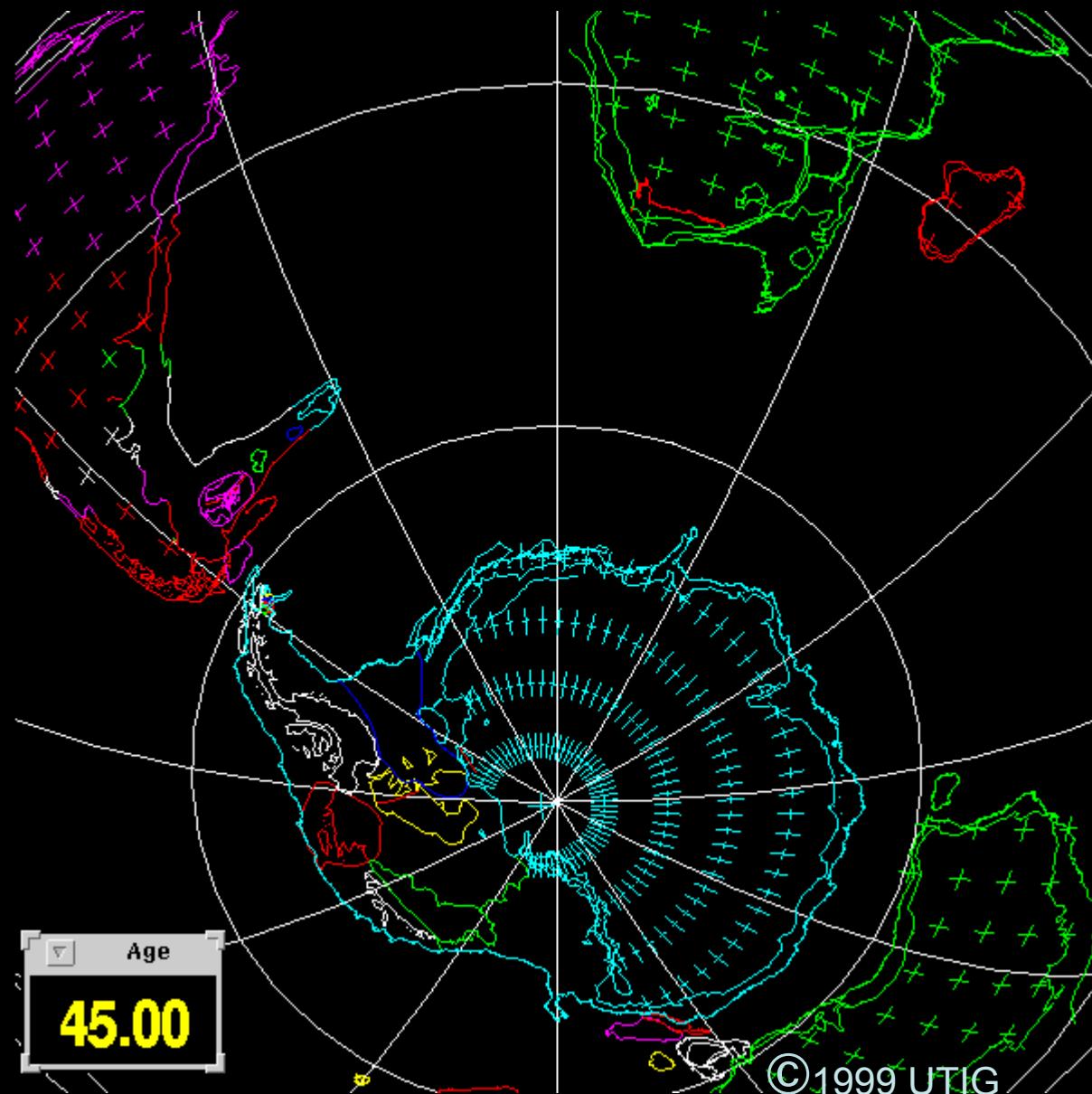
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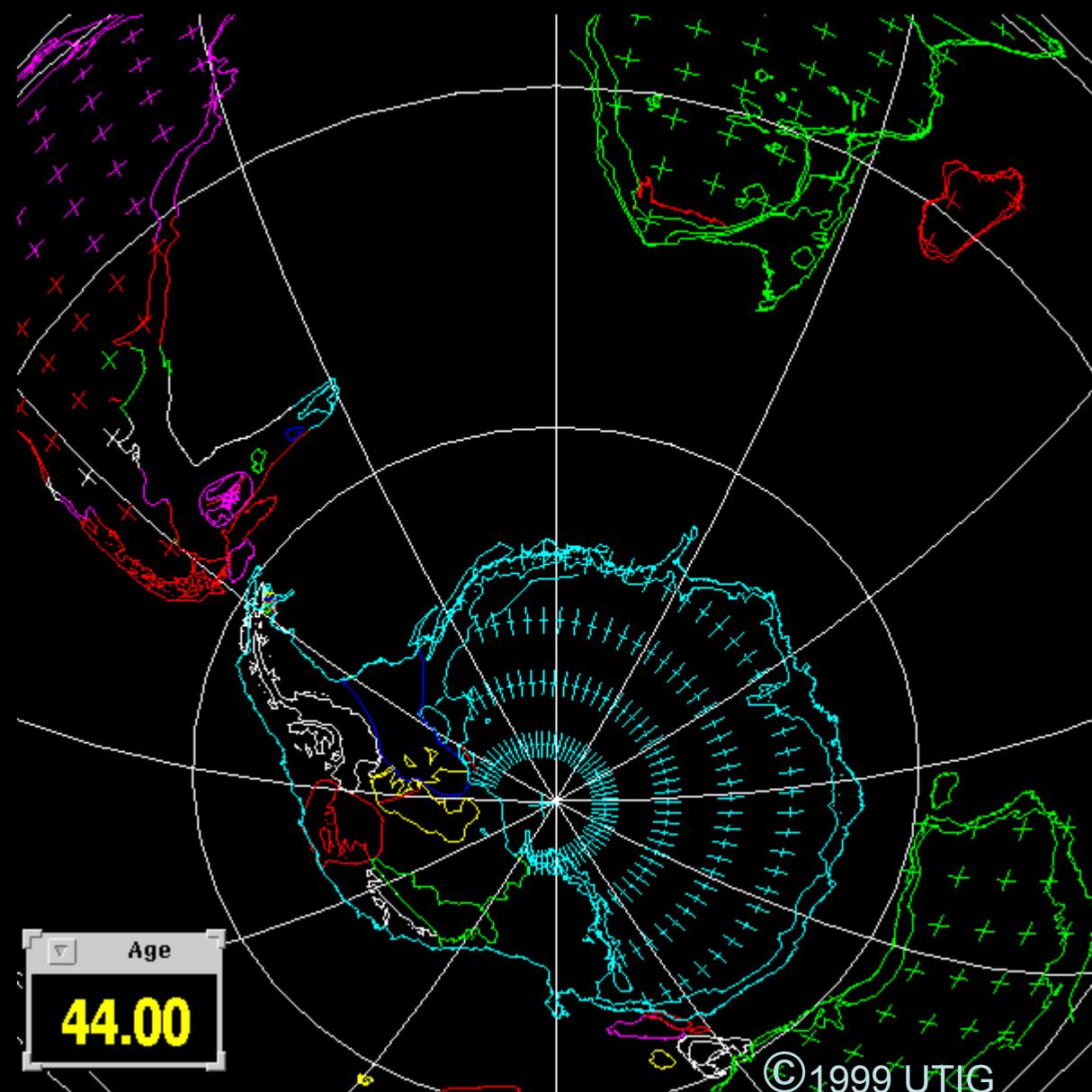
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47.00





 Age
45.00



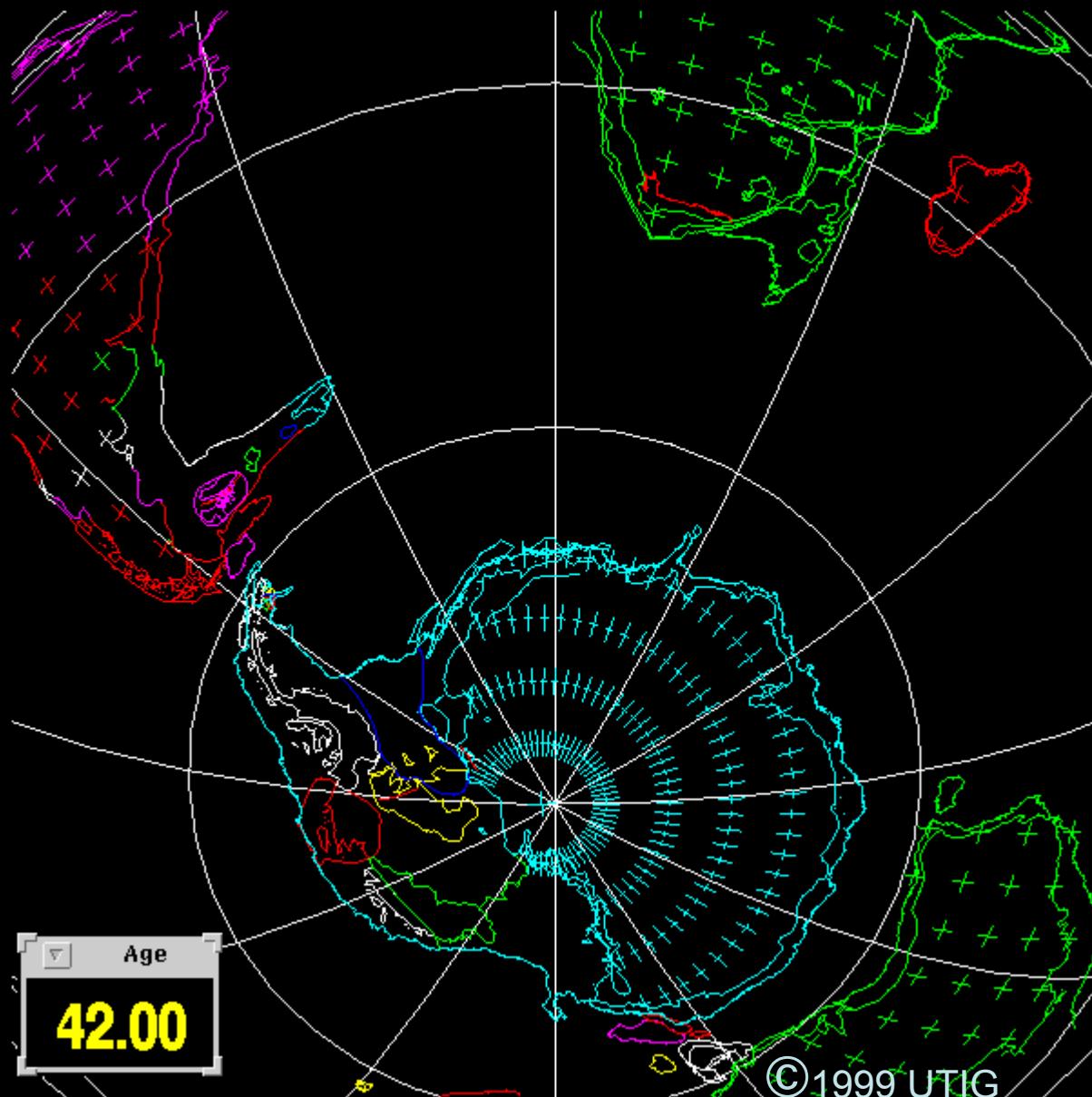


Age

43.00

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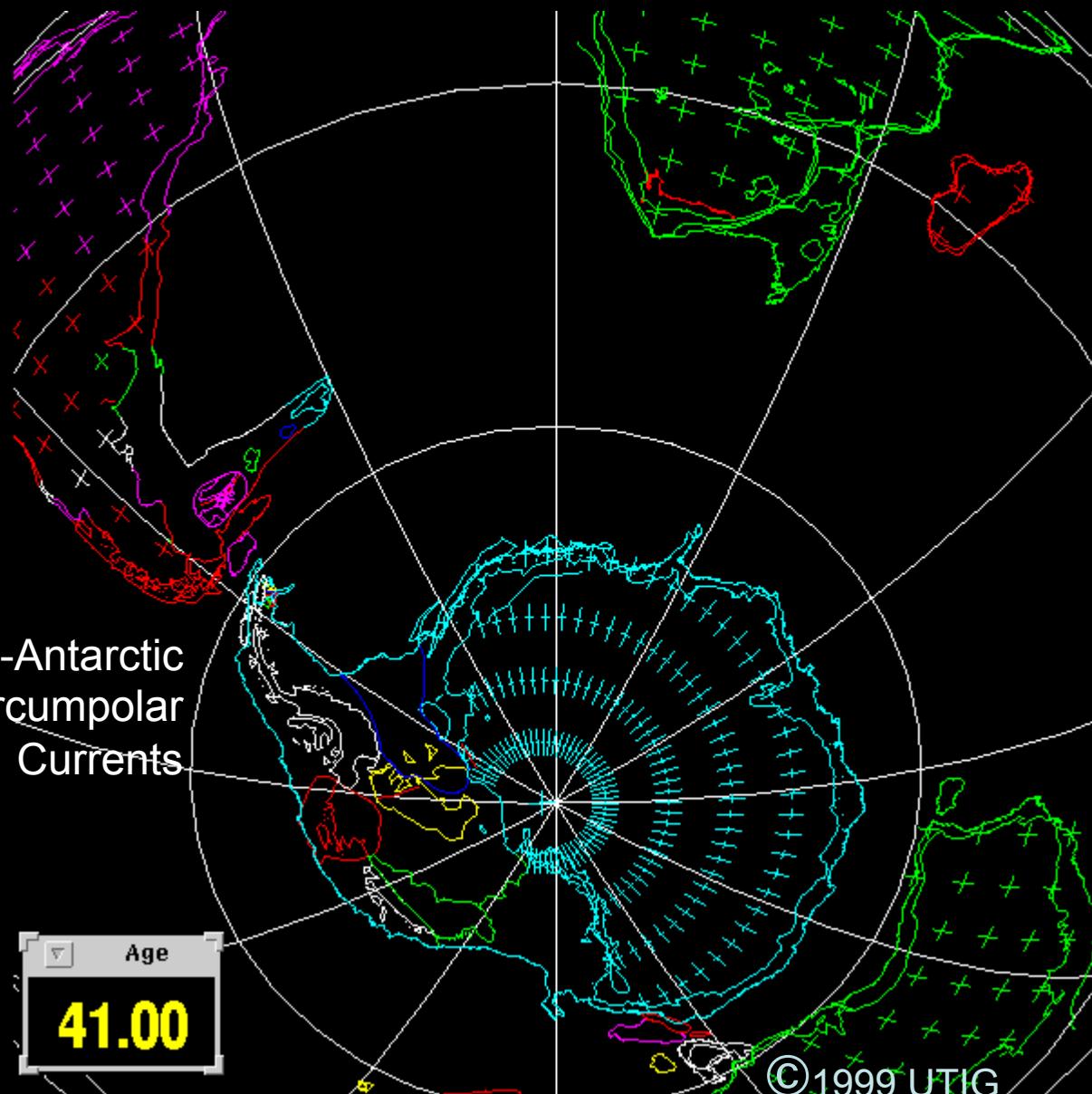
42.00



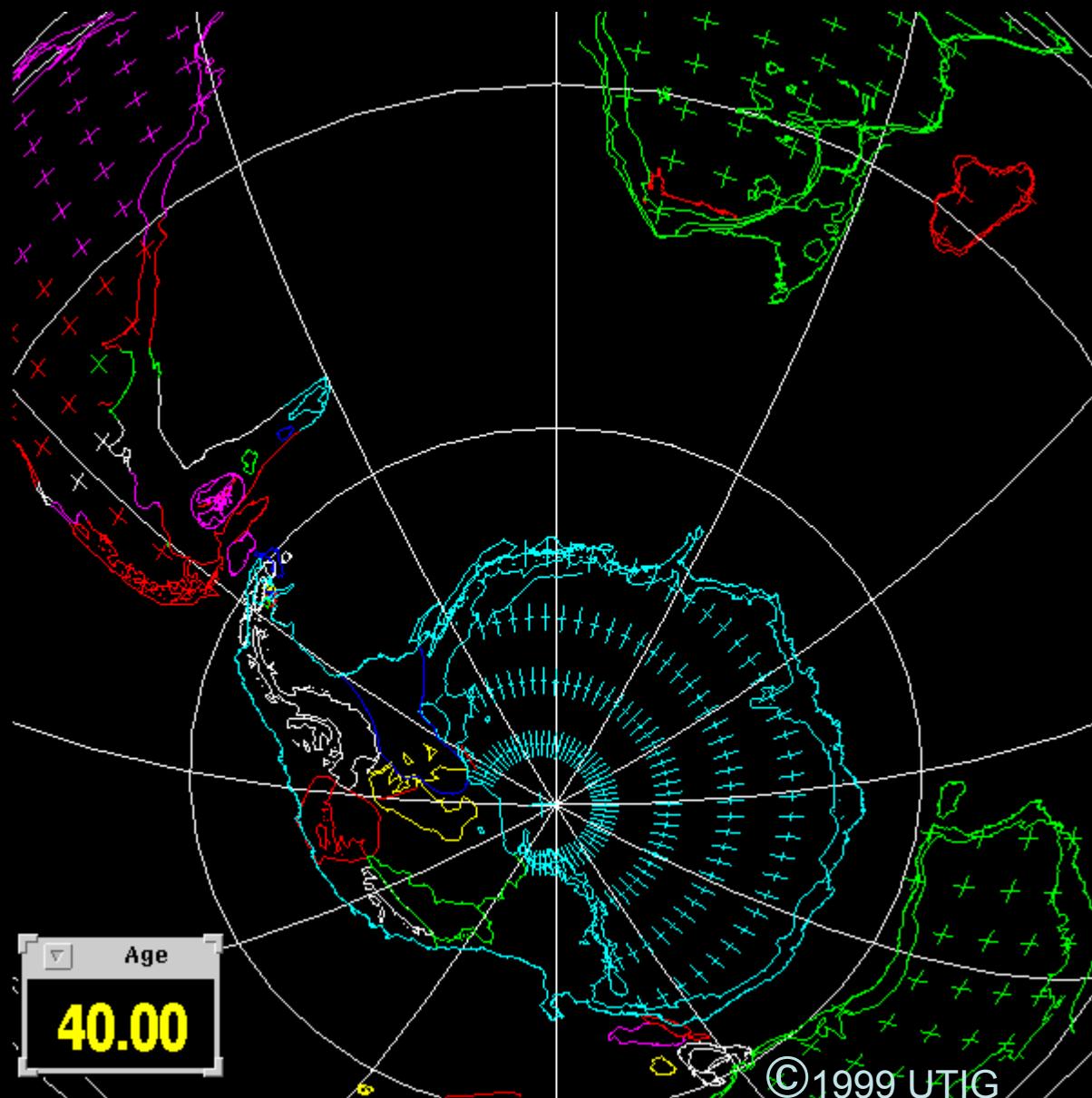
Proto-Antarctic
Circumpolar
Currents

Age
41.00

©1999 UTIG



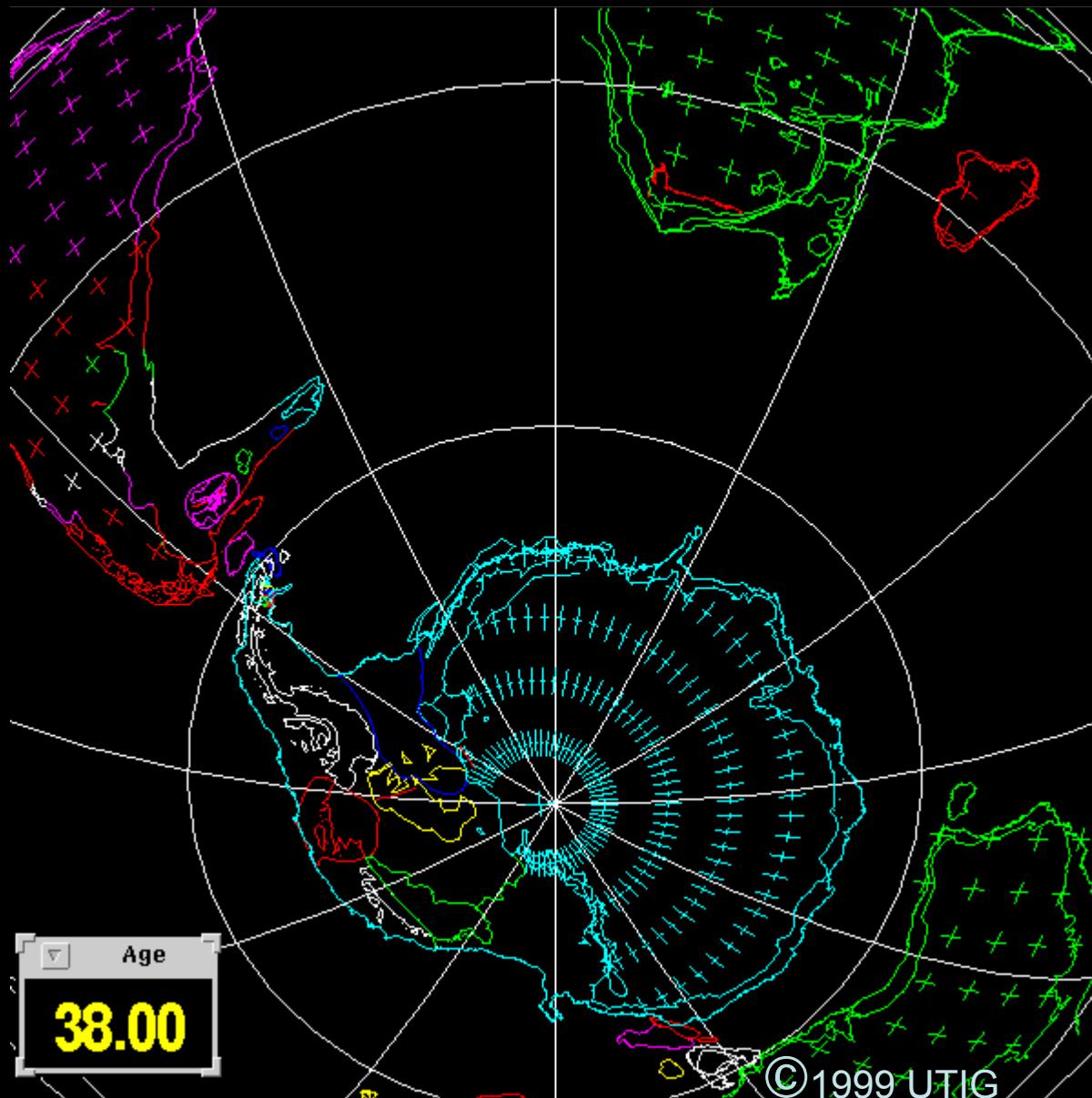
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40.00



Age
39.00

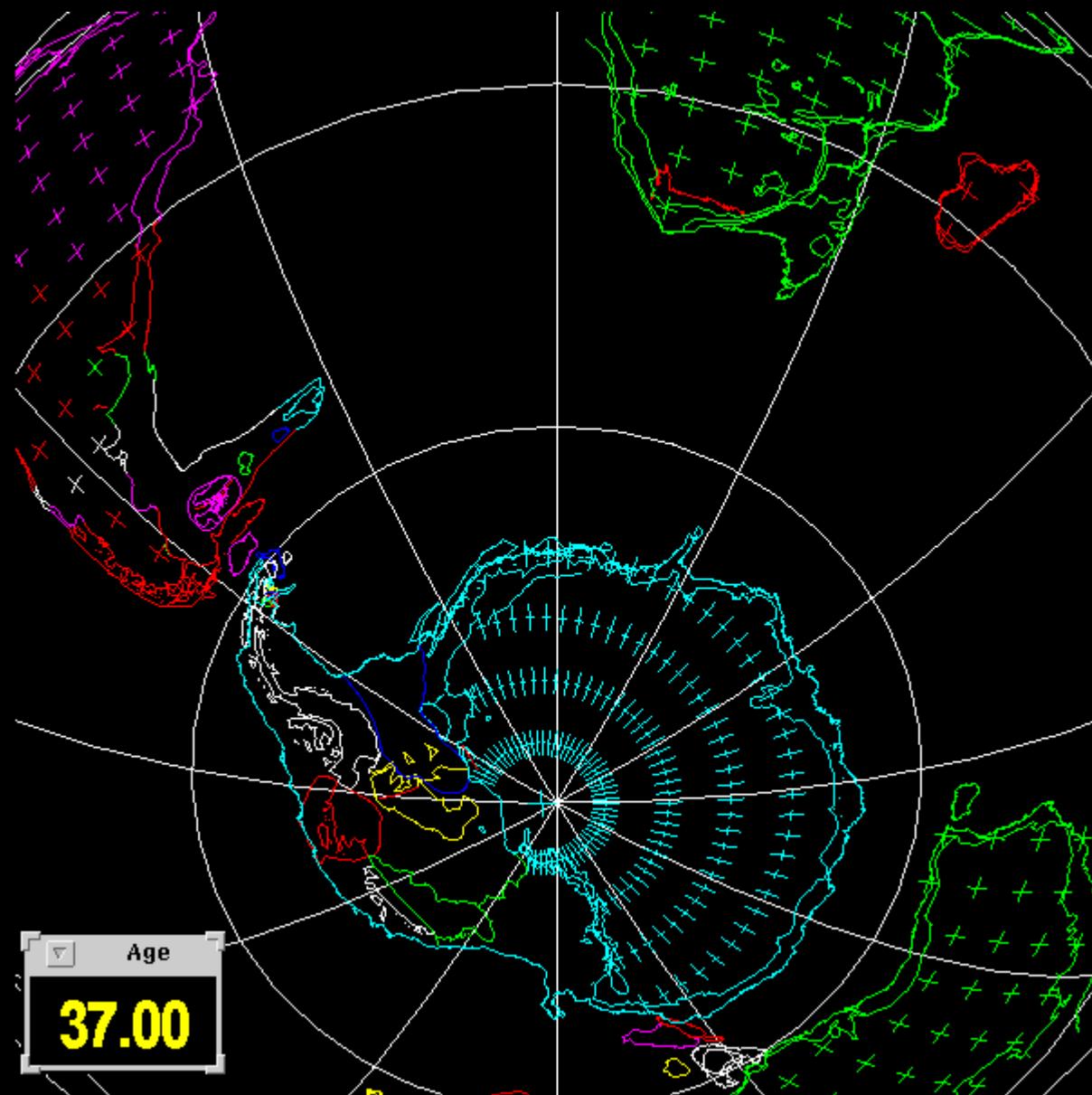
©1999 UTIG

 Age
38.00

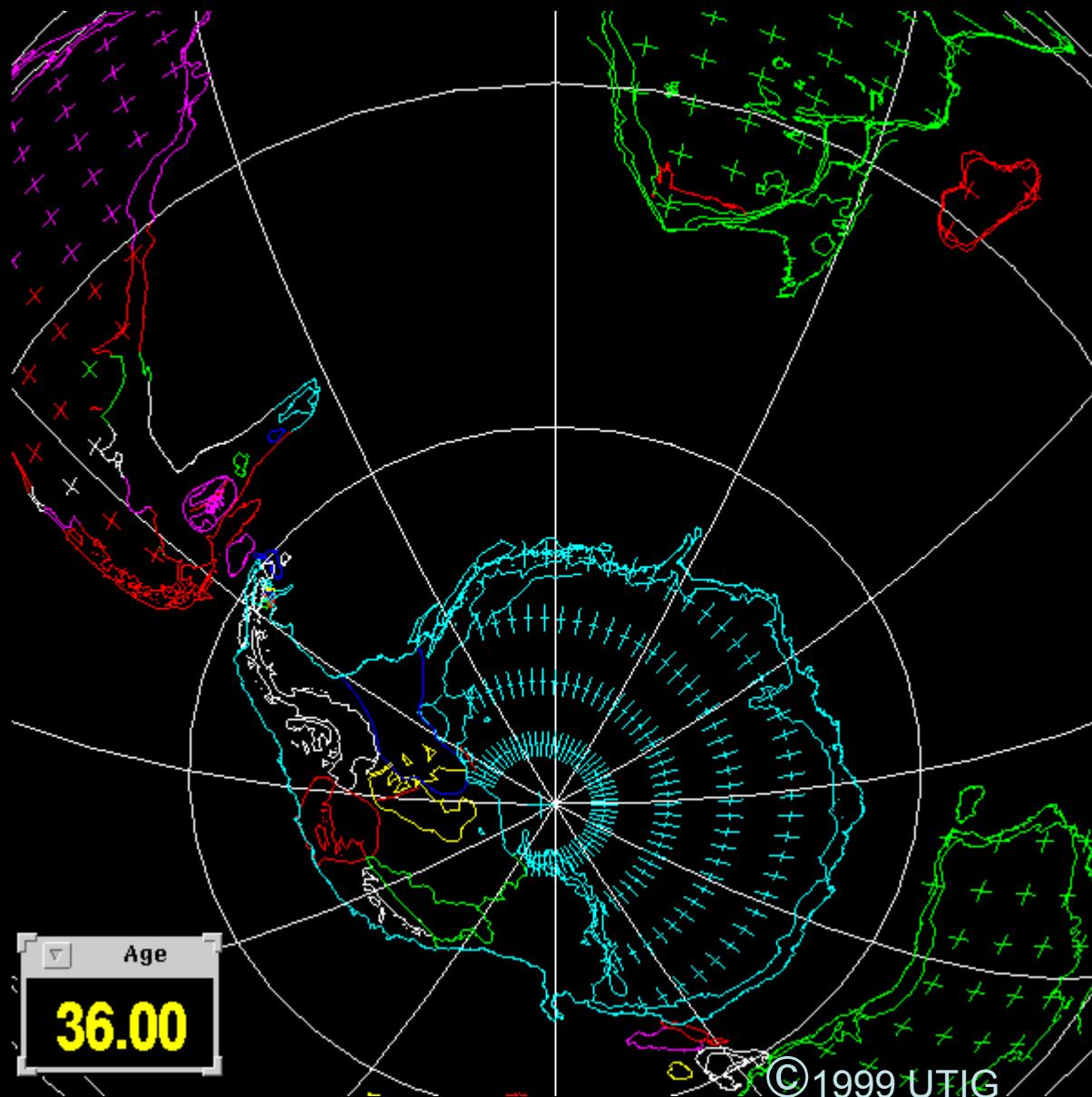


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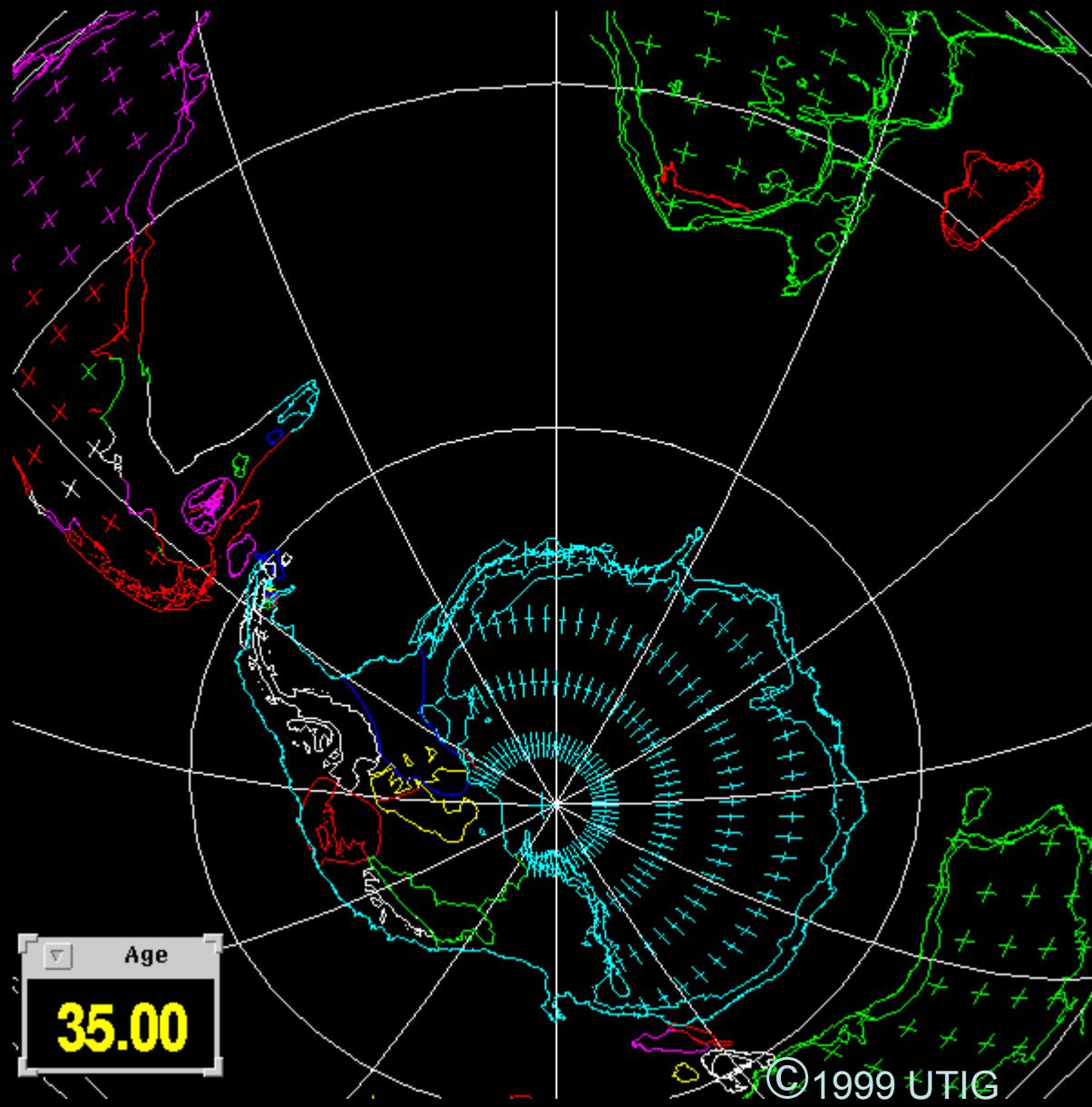
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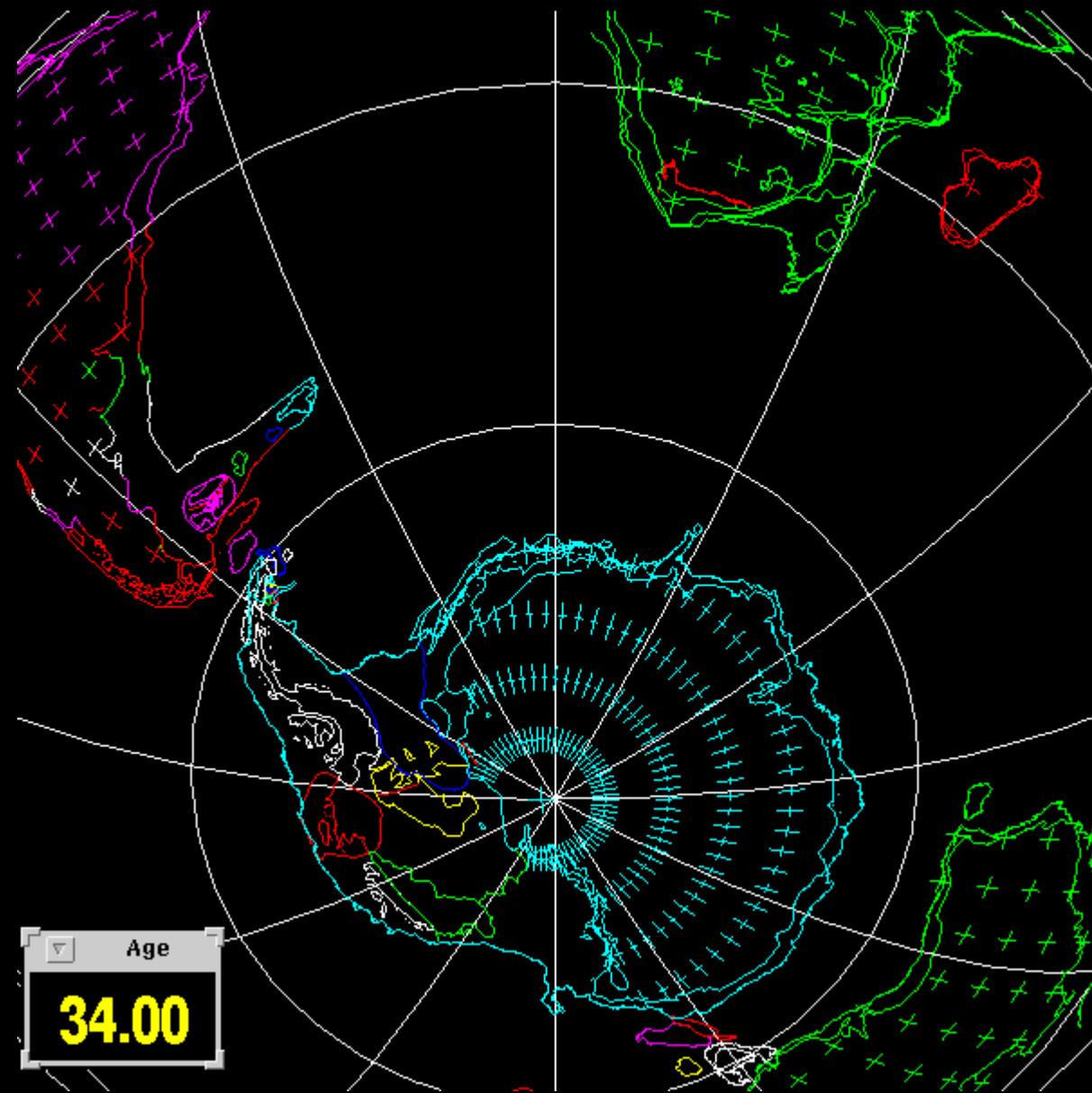
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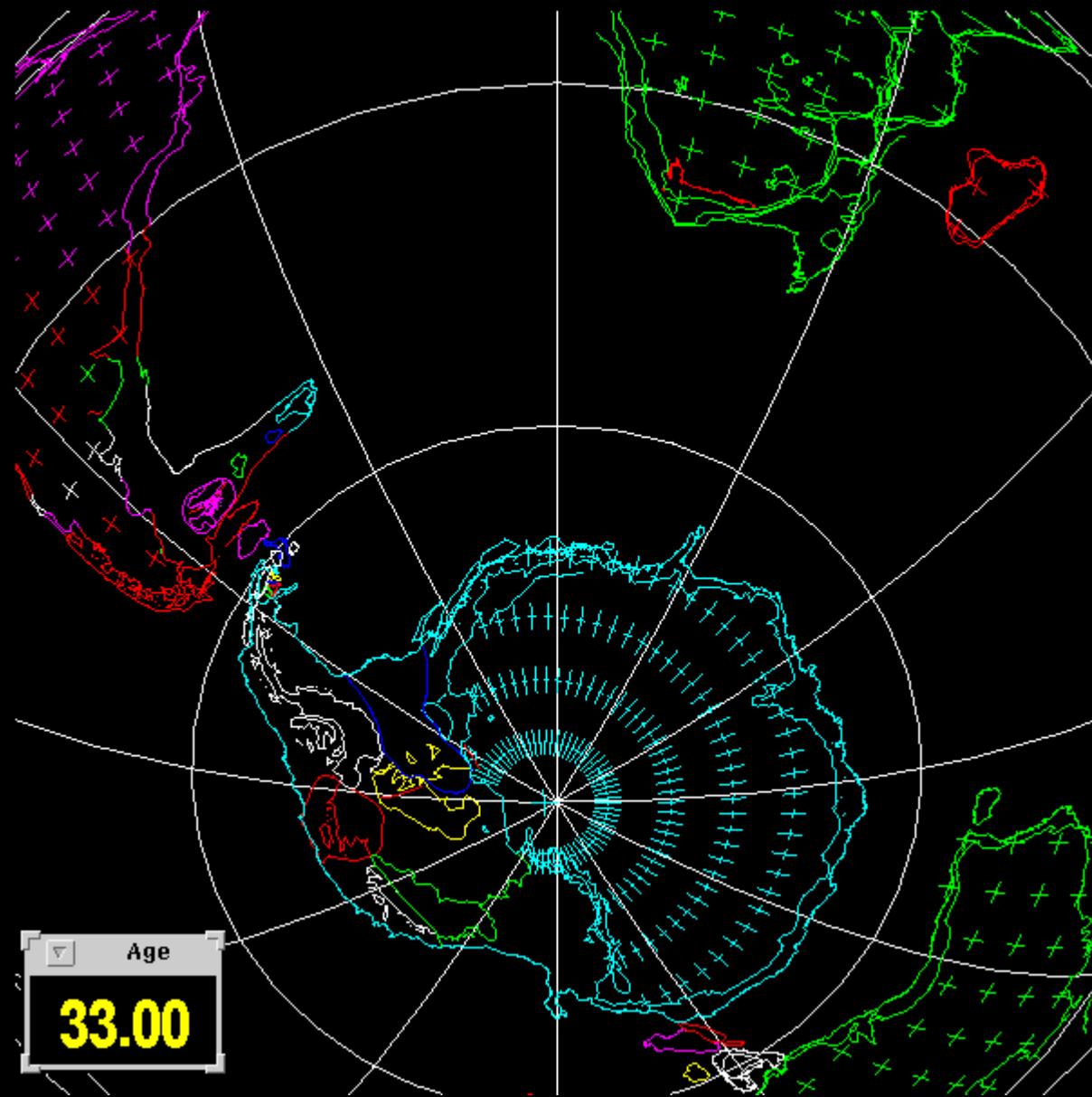
 Age
35.00



34.00



33.00



Age
32.00

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Age
31.00

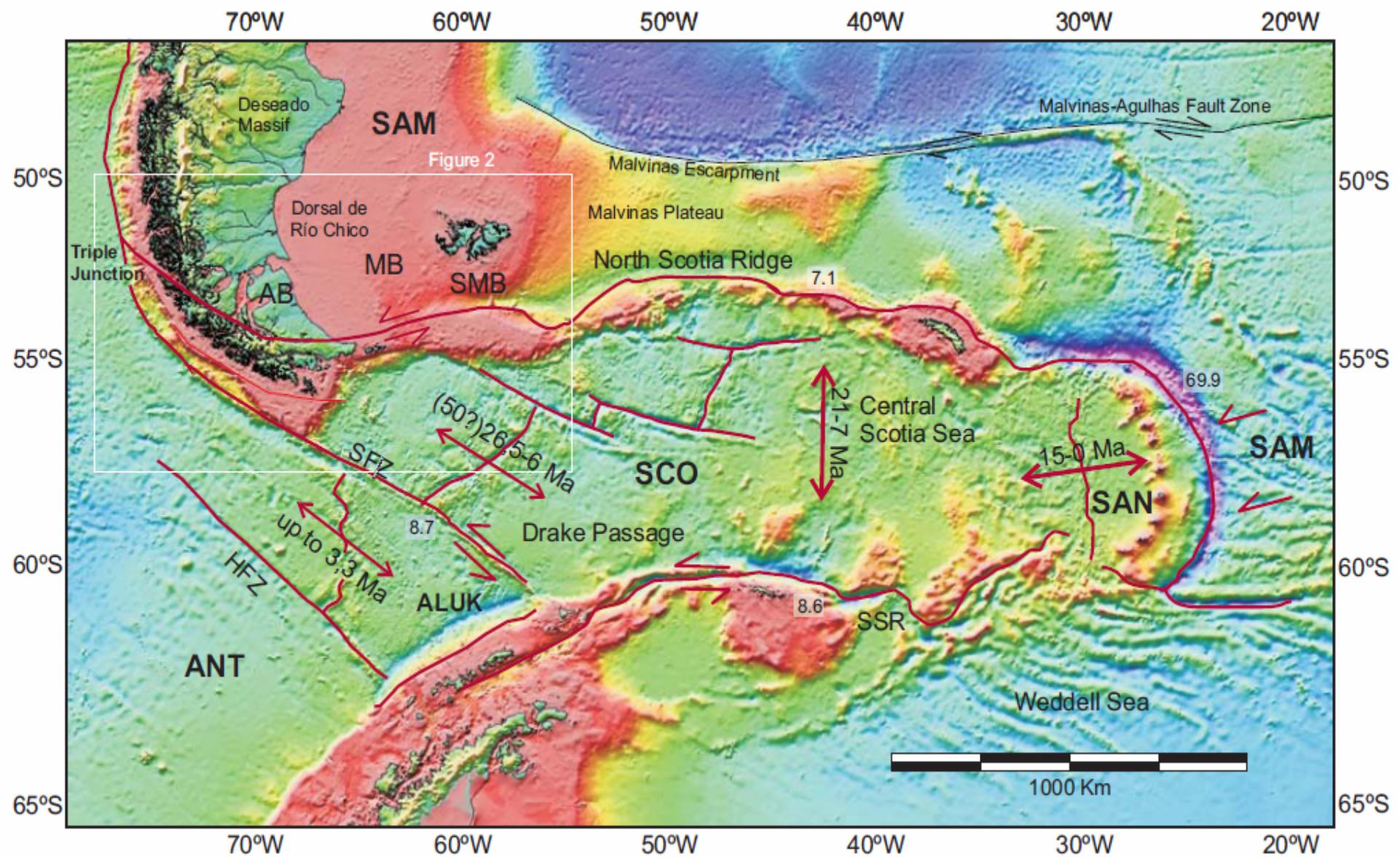
©1999 UTIG

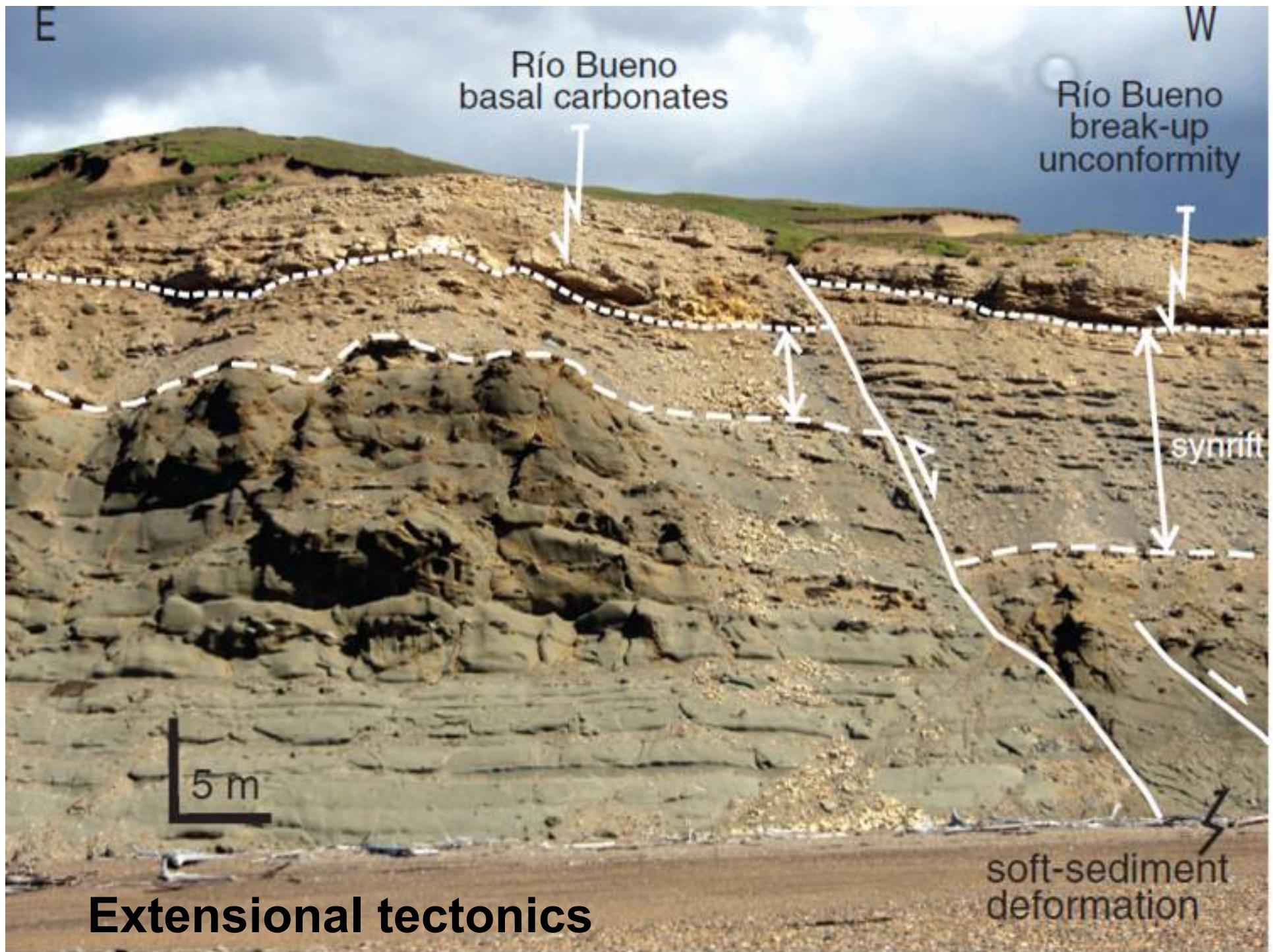
Antarctic
Circumpolar
Currents

Age
30.00

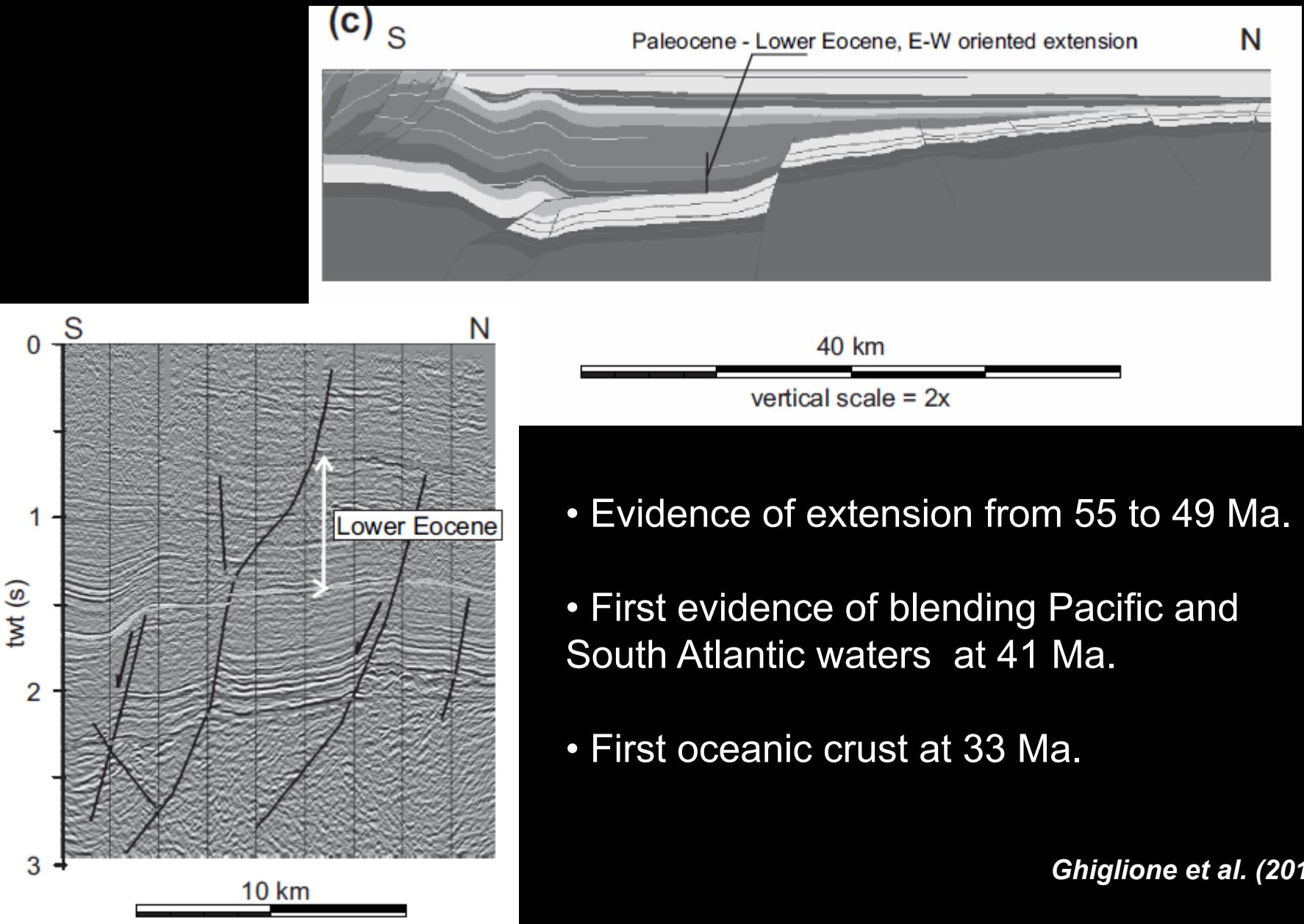
©1999 UTIG

THE SCOTIA PLATE

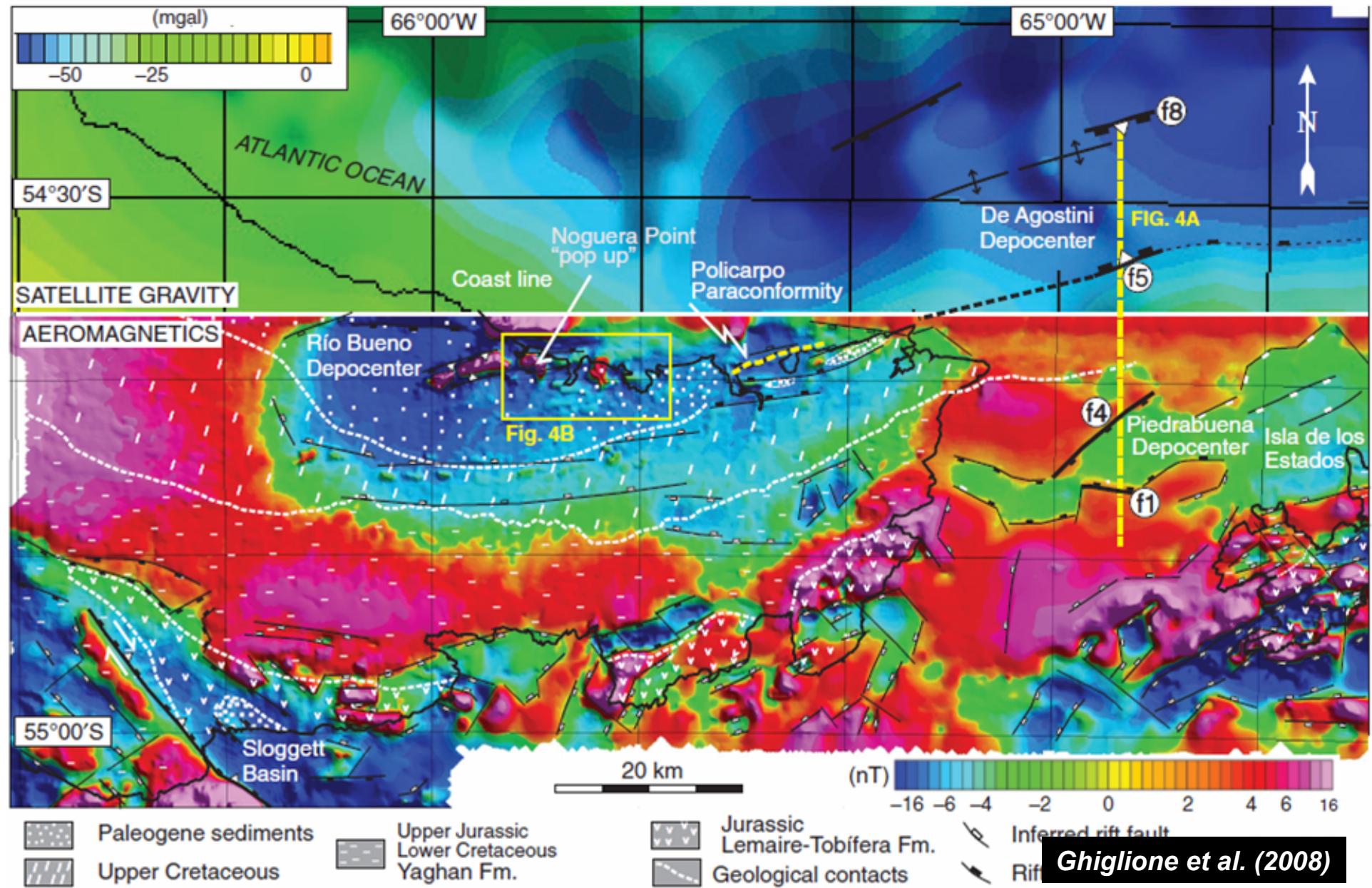




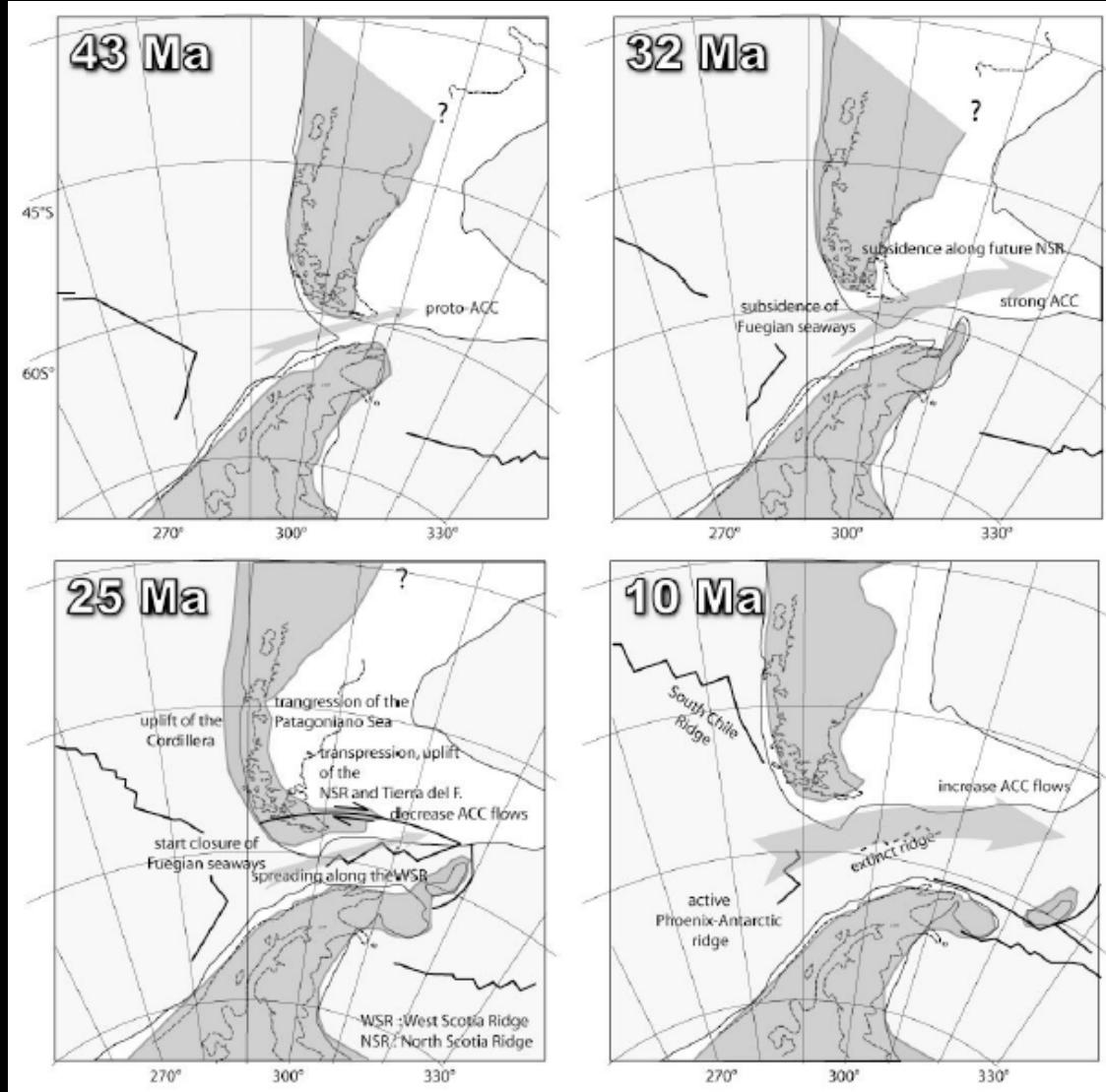
EOCENE EXTENSIONAL BASINS



EOCENE EXTENSIONAL BASINS



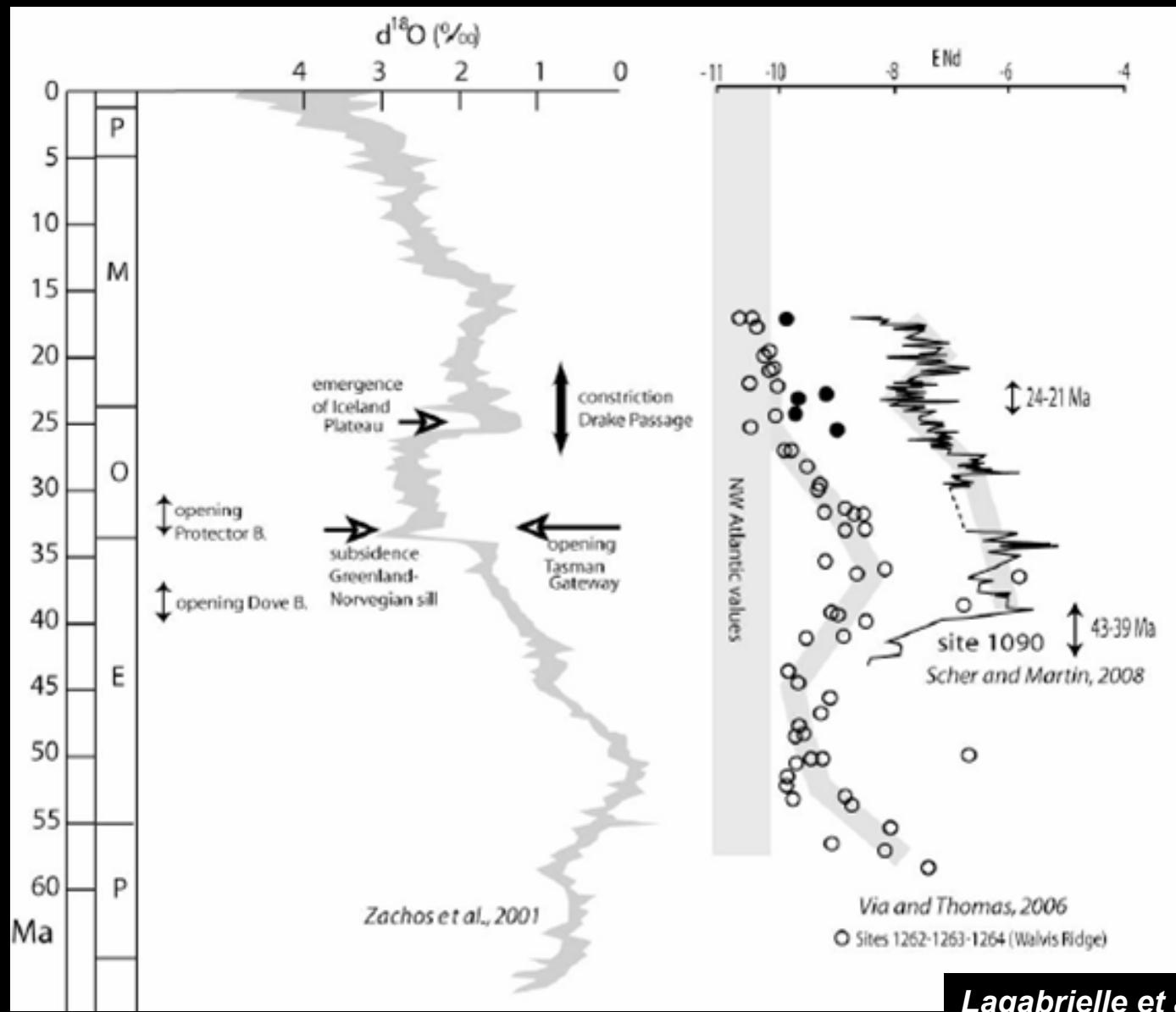
OPENING OF THE DRAKE PASSAGE



- Proto Antarctic Circumpolar Currents during Eocene-Oligocene (\pm 43-41 Ma).
- Closing Fuegian seaways at 26-14 Ma as a consequence of Scotia ridge spreading.
- These restrictions in the ACC produced a global warming.
- Present condition are dominant since 14 Ma.

Lagabrielle et al. (2008)

DRAKE PASSAGE CONSTRICTION AND GLOBAL WARMING



CONCLUSIONS

- The geological history of Patagonia shows important differences with the rest of the South American basement.
- Patagonia has been in the Transantarctic Mountains in the early Paleozoic, as part of the Eastern Gondwana.
- Patagonia has been in the Transantarctic Mountains in the early Paleozoic, as part of the Eastern Gondwana.
- It shows important links with the southern continents until the Eocene-Oligocene boundary (~ 33 Ma).
- Present settings since the Middle Miocene (< 14 Ma)



MUCHAS GRACIAS!!



MUCHAS GRACIAS!!