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Zircon U-Pb ages and Hf isotopes tracking the origin of Permian Paraná Basin ash-fall layers: are they coming from Choiyoi formation?

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Geological Setting

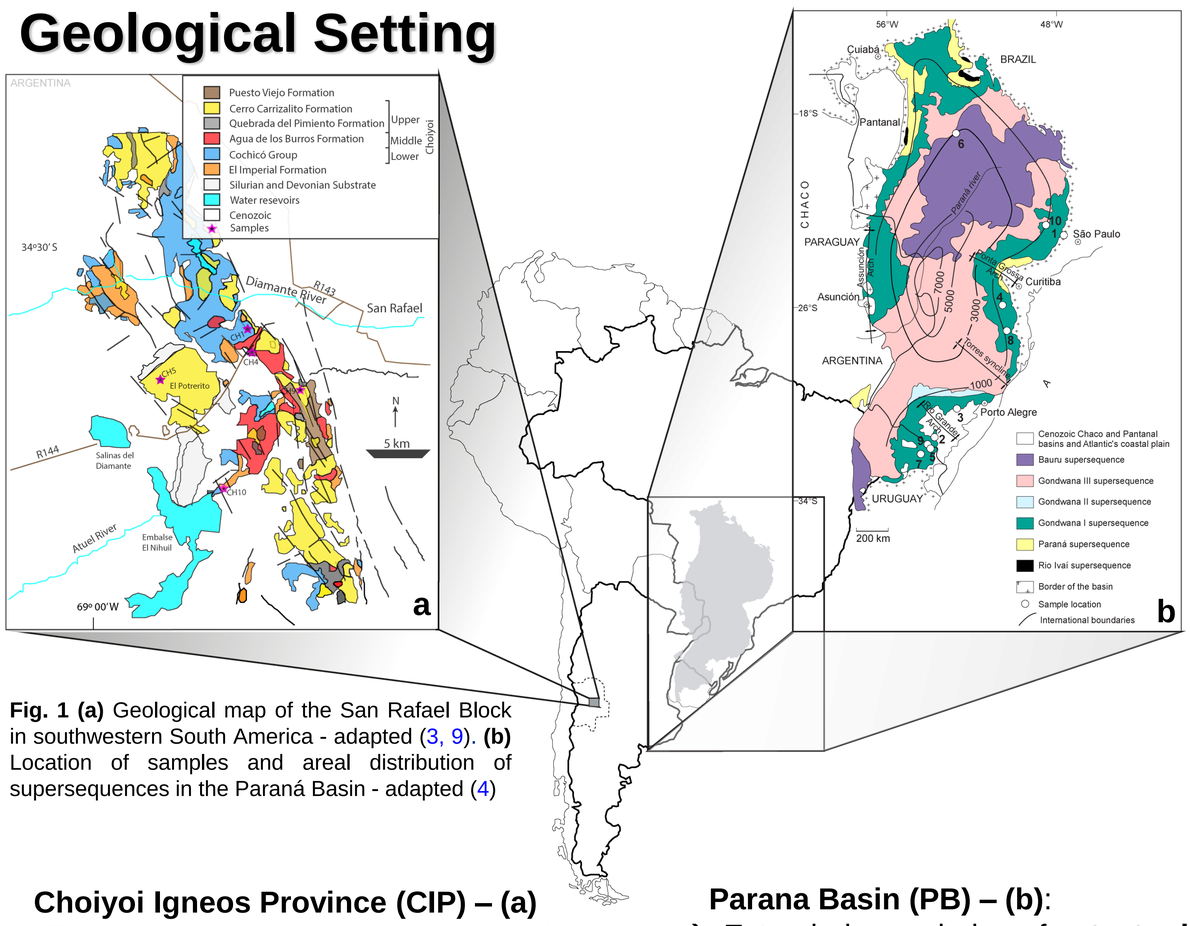


Fig. 1 (a) Geological map of the San Rafael Block in southwestern South America - adapted (3, 9). **(b)** Location of samples and areal distribution of supersequences in the Paraná Basin - adapted (4)

Choiyoi Igneos Province (CIP) – (a)

- → The largest silicic magmatic event of western Gondwana
- → Located in western Argentina and eastern Chile (5, 6, 7)
- → Felsic volcanic rocks and subsidiary intrusions (area of ~ 500,000 km2) and thickness ~ 2000 m (8)

Parana Basin (PB) – (b):

- → Extended period of **tectonic stability in Brazilian territory** (Paleozoic);
- → Influenced by tectonics and orogeny SW portion of Gondwana - compressional efforts between continental block and the oceanic lithosphere of Panthalassa.

In Brazil and Uruguay, volcanic ash and volcanic glass fragments (1, 2, 3) were found in several formations of PB (Rio Bonito, Irati, Rio do Rasto, and Estrada Nova/Teresina) ↔ Permian Plinian and Ultraplinian eruptions of the CIP over 2000 km away (3, 4)

U-Pb Zircon

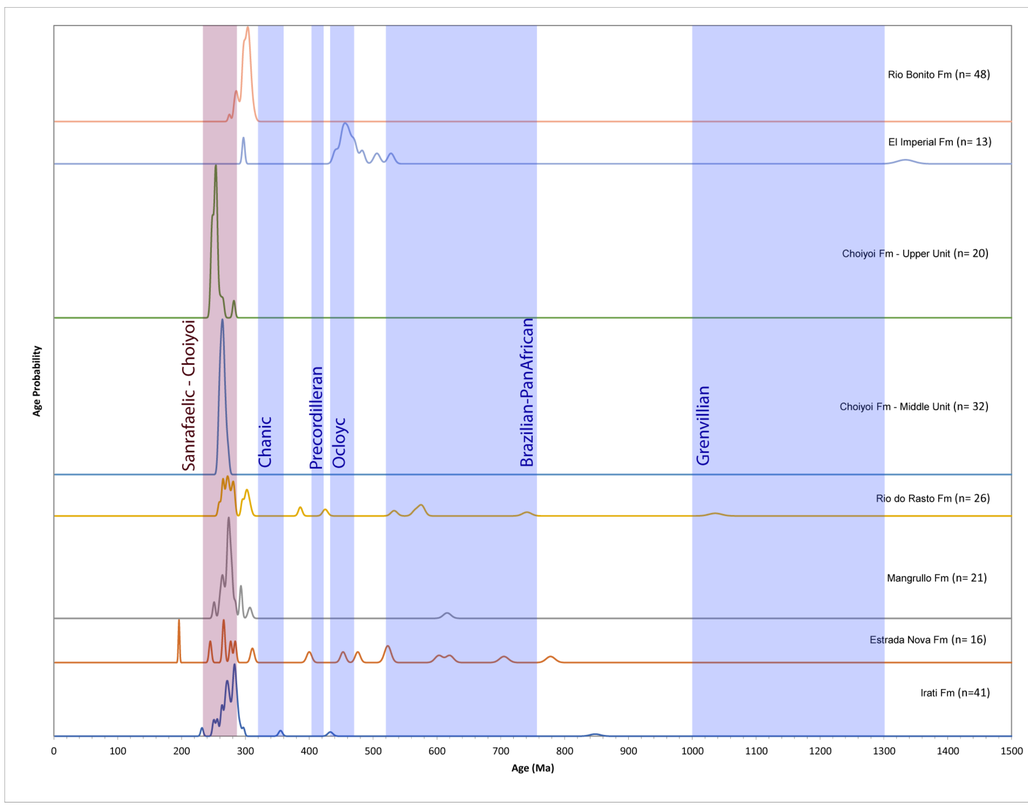


Fig. 2 Age spectra of Volcanogenic zircon U–Pb dating (including detrital zircon) from the PB and CIP Permian formations.

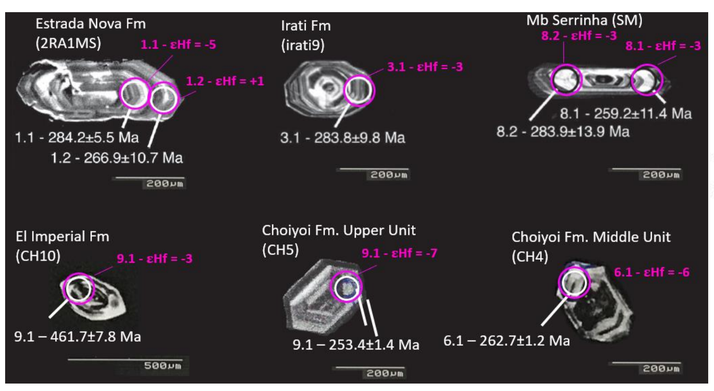


Fig. 3: Cathodoluminescence images of representative volcanogenic zircons analyzed from CIP and BP Permian Fm. Zircon pop. with transparent, euhedral, biterminated with sharp corners and internal oscillatory magmatic zonation. (4)

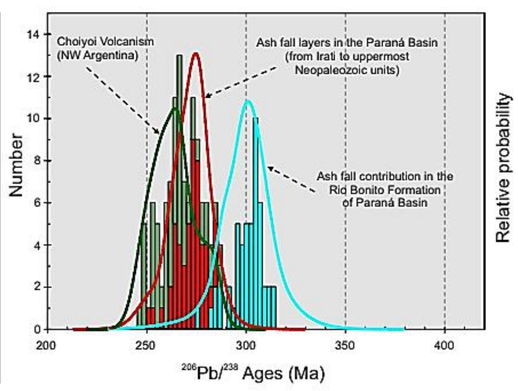


Fig. 4: Histogram of zircon ages from CIP and BP (3). Ages of the CIP can be correlated with ash fall layers (BP). Except Rio Bonito Fm. (4)

Hf Zircon

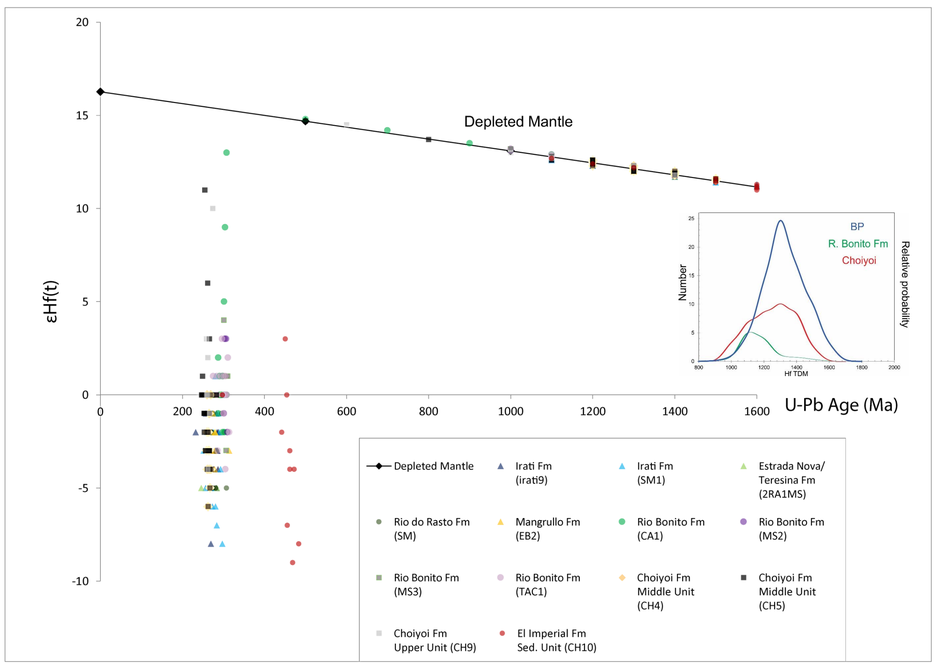


Fig. 5 U-Pb ages versus εHf(t) diagram for the zircons from Permian formations of BP and CIP

Permian Zircons:

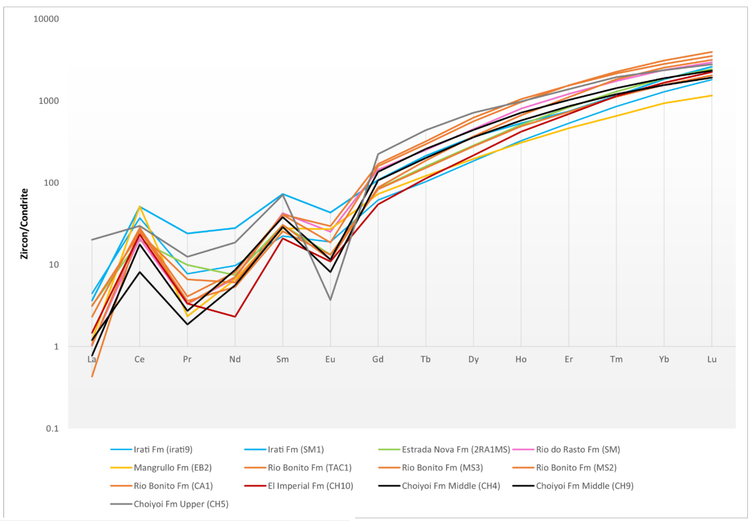
- **CIP**: εHf(t) +3 ↔ -6; very rarely ≅ εHf(t) +10
- **Irati**: εHf(t) 0 ↔ -6; rarely -8
- **Teresina**: εHf(t) -5
- **R. Rasto**: εHf(t) 0 ↔ -5; rarely -10
- **R. Bonito**: εHf(t) +1 ↔ -3

Carboniferous Zircons:

- **R. Bonito**: εHf(t) +5 ↔ -4; rarely ≅ εHf(t) +10

Geochemistry Zircon

Fig. 6 Chondrite-normalized mean REE patterns for the zircons from Permian formations of BP and CIP. Possible to notice that the profile of zircon is typically magmatic.



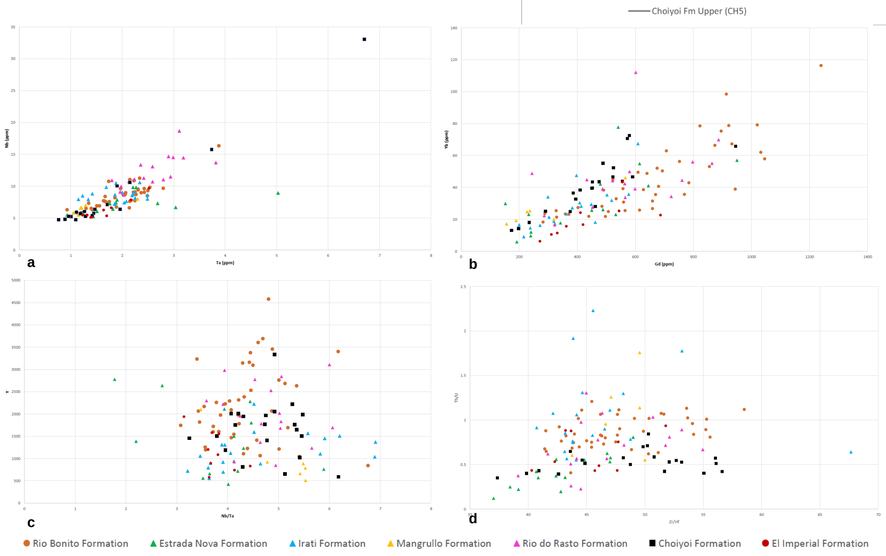


Fig. 7 Trace elements correlation for zircons from BP and CIP
(a) Nb/Ta
(b) Yb/Gd
(c) Y x Nb/Ta
(d) Th/U x Zr/Hf
As the concentration in all are relatively close without significant dispersion (specially between BP and CIP) it can indicate the possibility of the zircons being part of the same volcanic system.

Conclusions

- **U-Pb Zircon Age**
  - Volcanogenic Zircons from Irati/Mangrullo, Estrada Nova and Rio do Rasto Fm. have similar age of Choiyoi volcanism (286 – 247 Ma)
- **Hf isotopic and geochemistry signature in zircon**
  - εHf, Hf-T_{DM} and trace elements in zircon of Fm above are similar with the geochemistry-isotopic signature of ignimbrites from Middle/Upper Choiyoi Units.
- **The obtained data:** strongly suggest that the ash-fall zircons of BP Permian Fm. are from CIP.
- **Rio Bonito Fm.** Volcanogenic contribution is related to a pre-Choiyoi volcanism (314 – 296 Ma) with few contribution of the Lower Choiyoi Unit (286 – 275 Ma).

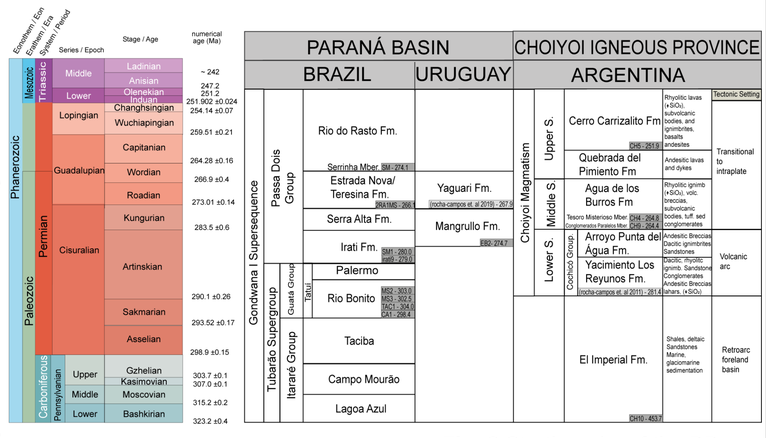


Fig. 8 Stratigraphy of the BP and CIP succession compiled (6-19), modified from (3). These results and studies (3, 4) reinforce the correlation between Permian zircon ages from BP and CIP.

Further analysis are in progress to test this hypothesis.

Main references

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(7) Llambías and Sato, 1995
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(9) Kleiman et al., 2002, 2005, 2009
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Acknowledgments

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