U-Pb and K-Ar Geochronological Constraints on the Tectonothermal Evolution of the Precambrian Terranes of the SE São Paulo State, Brazil

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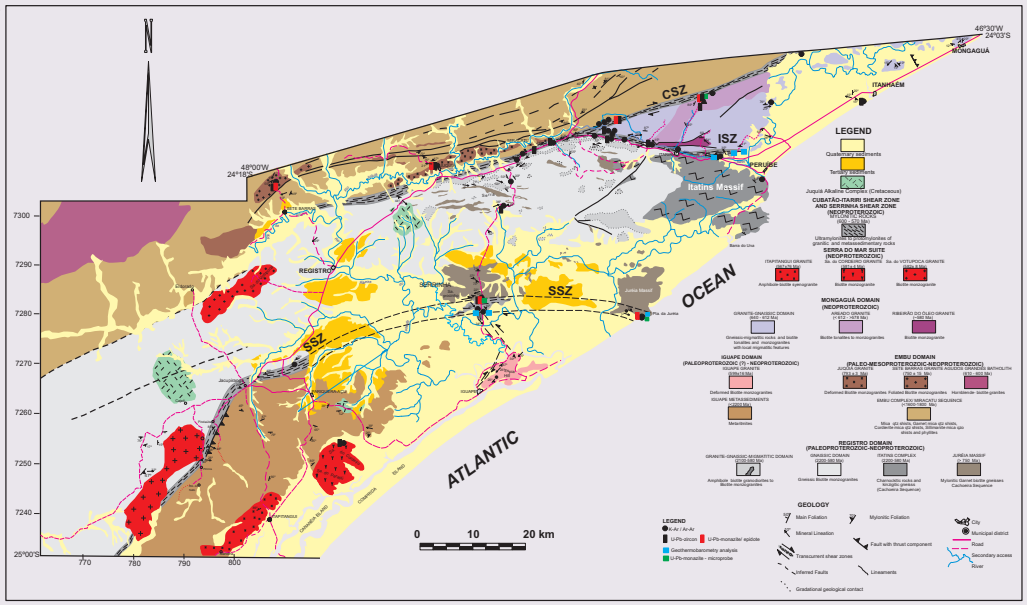
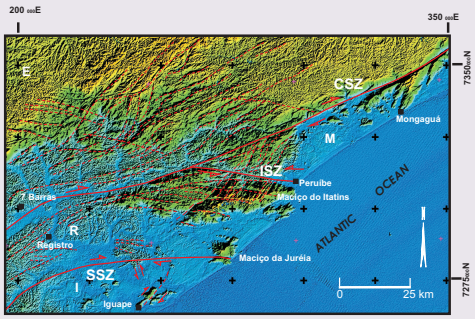
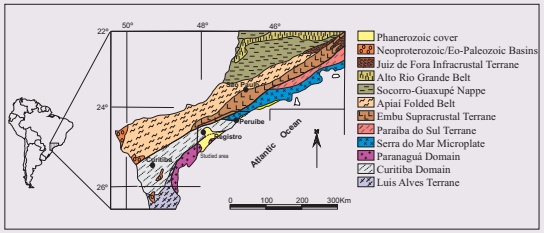
T23C - 2051

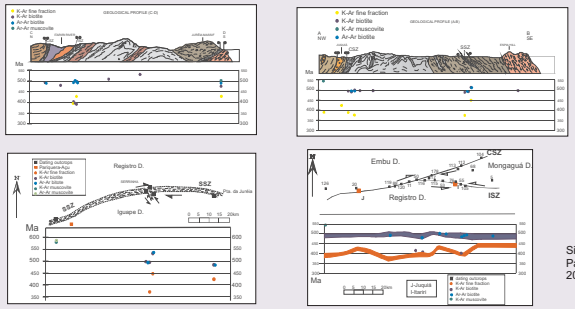
2008 AGU FALL MEETING 15-19 DECEMBER • SAN FRANCISCO





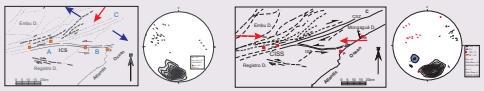


Tectonic sketch of SE of the SP State and NE of the PR State. (Mod. Campos Neto & Figueiredo, 1995).



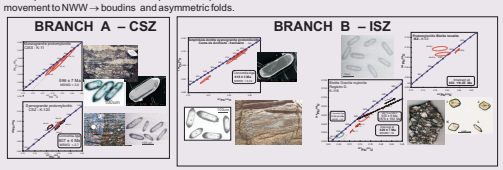
Siga Jr. et al. 1993; Machado et al., 1996; Schmitt 2000; Janasi et al., 2001; Vlach, 2001; Passarelli, 2001; Cordani et al., 2002; Leite, 2003; Heilbron & Machado, 2003; Silva et al., 2003; Hackspacher et al., 2004; Tassinari et al. 2006; Passarelli et al. 2008.

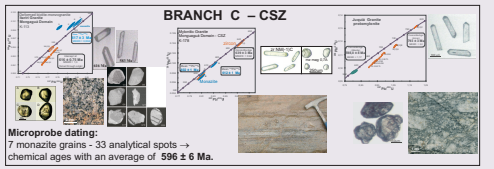
CUBATÃO - ITARIRI SHEAR SYSTEM



Deformation phase I, branch A-B: σ1 NNE → sinistral shear, top-to-the SWW thrust component, associated to an expressive extensional component, top-down movement to NWW → boudins and asymmetric folds.

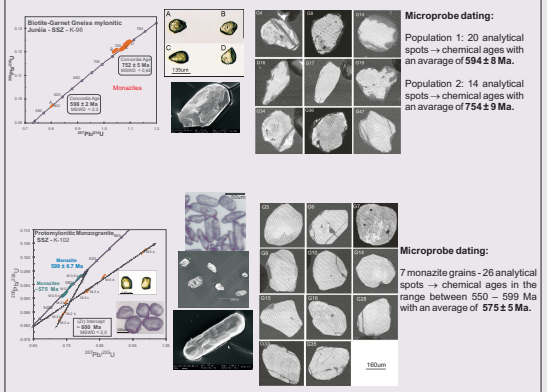
Deformation phase II: σ1 ~ E-W →dextral movement in the A-C branch and sinistral in the branch B.





Microprobe dating:
7 monazite grains - 33 analytical spots → chemical ages with an average of **596 ± 6 Ma.**

SERRINHA SHEAR ZONE

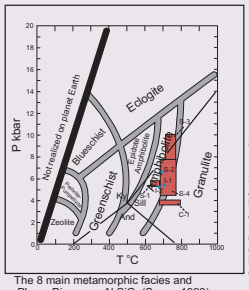


Microprobe dating:
Population 1: 20 analytical spots → chemical ages with an average of **594 ± 8 Ma.**

Population 2: 14 analytical spots → chemical ages with an average of **754 ± 9 Ma.**

Microprobe dating:
7 monazite grains - 26 analytical spots → chemical ages in the range between 550 – 599 Ma with an average of **575 ± 5 Ma.**

P-T Diagram CISS and SSZ



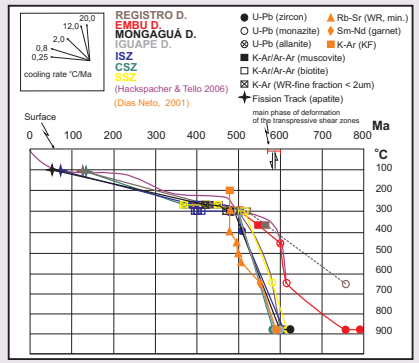
The 8 main metamorphic facies and Phase Diagram - Al_2SiO_5 (Spear, 1993).

CISS:
1)Gar-monzogranite protomylonite (ISZ)
SHEAR : gar+plag + bio
Amphibolite facies (I-1)

2) Gar-bio-monzogranite ultramyl. (ISZ)
SHEAR: gar+KF+plag + bio + ser.
Amphibolite facies (I-2)

SSZ and Cachoeira Sequence
1)Garnet- bio gneiss mylonite (Juréia and Serrinha) – Cachoeira Seq.
SHEAR: plag+ ser+ gar
Amphibolite facies (S1 + S-3 fields, S-2).
Metamorphic peak: gar + bio + pla +musc
Amph/Granulite facies (S4 field).

Cachoeira Sequence:
Cordierite garnet biotite gneiss
Metamorphic peak: cord +gar+bio+pla+KF
Granulite facies (field C1).



CISS : max. movement age **~ 598 Ma** (U-Pb zr γ protomylonite; U-Pb ep ages Embu D. γ peraluminous)
Embu D. (SP), N Taxaquara Fault, compressive tectonic-associated γ yield ages ≈ ages **610-595 Ma**.
Além Paraíba SZ (RJ) max. age of **590 ± 8 Ma** (U-Pb titanite and monazite) for the WNW thrust.
Mongaguá D. (SP) - gneissic-γ rocks: U-Pb zr ages of **620- 640 Ma**, intensely deformed during the juxtaposition of the Embu and Registro D. → generation of intrusive γ **~ 580 Ma.**
Costeiro Domain (SE Além Paraíba SZ - RJ), rocks of magmatic arcs, correlate with gneissic rocks and Itariri-type rocks of the Mongaguá D., yield ages of ca. 630 Ma
Paraíba do Sul/Costeiro Domains: metamorphic peak → **580 Ma,** syn-collision γ empl. **~ 590-550 Ma**
SSZ: major movement at **575 Ma** (U-Pb monazite). Juxtaposition of Registro and Iguape D.
Syn-collisional granites (South APSZ - RJ): 580-560 Ma. Metamorphic peak → monazite and titanite dating.

The juxtaposition of tectonic blocks (CISS and SSZ): very close periods during the Neoproterozoic .
The present tectonic scenario of SE SP State results from collages associated with the formation of the Western Gondwanaland by the end of the Neoproterozoic.
K-Ar ~ 500 Ma: cooling age associated to vertical dislocations.
K-Ar fine fractions (450-370 Ma): brittle deformations at very low metamorphic grade.
After ~350 Ma, faster cooling rates occurred up to the Cretaceous (**~120 Ma**).
From the Cretaceous to the Paleocene/Eocene (**~55 Ma**), very slow cooling rates took place again.
Apatite FT dating indicate that the terranes involved cooled from 110° C to 60° C isotherms in distinct periods.
Apatite FT ~120 Ma: uplift → opening of Atlantic Oc.,→ border **E** of the Paraná Basin
Apatite FT ~74 Ma: important alkaline manifestations and uplift areas
Apatite FT ~55 Ma: acceleration in the exhumation and denudation proc. → extensional tectonics → Continental Rift System of the Serra do Mar

Acknowledgements

FAPESP (grants 03/13246-6; 04/07837-4) for financial support (fieldwork and isotopic analyses).

References:
Almeida de, F.F.M. et al. 1981. Brazilian structural provinces: an introduction. Earth Sci. Rev, 17: 129.
Almeida de, F.F.M. et al. 2000. The origin and evolution of the South Americaan Plataform, Earth Science Reviews, 50: 77-111.
Basei, M.A.S. et al. 1999. Paleoproterozoic granulitic belts of the Brazilian Southern Region (PR-SC). II South-American Symposium on Isotope Geology, CD-Rom and Extended Abstracts: 291-294. Cordoba, Argentina.
Campos Neto, M.C. and Figueiredo, M.C.H., 1995. The Rio Doce Orogeny, southeastern Brazil. Journal of South American Earth Sciences, 8(2): 143-162.
Dias Neto, C. M. et al. 2002. Evolução Tectonotermal do Complexo Costeiro (Faixa de Dobramentos Ribeira) em São Paulo. XLI Congresso Brasileiro de Geologia, Anais p. 305, João Pessoa, Brasil.
Hackspacher, P.C.; Tello, S.C., 2006. Thermal history at the Mantiqueira Province, southeastern Brasil: modeling with fission track on zircon. V South American Symposium on Isotope Geology, CD-Rom and Extended Abstracts: 218-220. Punta del Este, Uruguay.
Hackspacher, P.C et al. 2004. Consolidation and Break-up of the South American Platform in Southeastern Brazil: Tectonothermal and Denudation Histories. Gond Res, 7 (1); 91-101.
Heilbron, M.; Machado, N., 2005. Timing of terrane accretion in the Neoproterozoic-Eopaleozoic Ribeira Orogen (SE Brazil). In: IV South American Symposium on Isotope Geology, Salvador, 2005. Short Papers, p. 182-185.
Kaul P.F.T.; Cordani U.G., 2000. Geochemistry of the Serra do Mar (southern Brasil) granitoid magmatism and tectonic implications. Revista Brasileira de Geociências, 30: 115119.
Machado, N et al. 1996. U-Pb geochronology of the central Ribeira belt (Brazil) and implications for the evolution of the Brazilian Orogeny. Precambrian Research, 79: 347-361.
Passarelli, C. R. 2001. Caracterização estrutural e geocronológica dos domínios tectônicos da porção sul-oriental do Estado de São Paulo. PhD Thesis Instituto de Geociências, Universidade de São Paulo, 254pp. [Unpublished].
Passarelli C.R. et al. 2004. Geocronologia e geologia isotópica dos terrenos Pré-Cambrianos da porção sul-oriental do Estado de São Paulo. Geologia USP Ser Cient, 4 (1): 55-74.
Siga Jr O. et al. 1995. O Complexo Atuba: um cinturão Paleoproterozóico intensamente retrabalhado no Neoproterozóico. Bol IG-USP Série Científica, 26: 6998.
Silva, L. C. et al. 2003. Zircon U-Pb Shrimp dating of The Serra dos Órgãos and Rio de Janeiro Gneissic Granitic Suites: implications for the (560 Ma) Brasiliano/Pan-African Collage". Revista Brasileira de Geociências, 33(2): 237-244.
Silva, L. C. et al. 2005. The neoproterozoic Mantiqueira Province and its African connections: a zircon-based UPb geochronologic subdivision for the Brasiliano/Pan-African systems of orogens. Precambrian Research, 136: 203240.
Tupinambá M. et al. 2000. Neoproterozoic Western Gondwana assembly and subduction-related plutonism: the role of the Rio Negro Complex in the Ribeira Belt, Southeastern Brazil. Revista Brasileira de Geociências, 30: 7-11.
Vlach, S., 2001. Micropobe Monazite Constraints for an early (ca. 790 Ma) Brasiliano Orogeny: the Embu Terrane, Southeastern Brazil. In: III South-American Symposium on Isotope Geology. Pucon, 2001. Extended Abstracts, p. 265-268.