Are there any correlations between West African Craton and Rio de la Plata Craton?

Tahar Aïfa[1,*], Henri Masquelin[2], Fernando Scaglia[3]
[1]Univ. Rennes, Géosciences-Rennes, CNRS UMR 6118, Bat.15, Campus de Beaulieu, 35042 Rennes cedex, France ; [2]Instituto de Ciencias Geológicas, Universidad de la República, Montevideo, 11400, Uruguay; [3]PEDECIBA Geociencias, Universidad de la República, Montevideo, 11400, Uruguay
[*]E-mail: tahar.aifa@univ-rennes1.fr

The difficult reconstruction of "Atlantica" Paleocontinent may remain in the game of irreconcilable ideas of tectonic evolution, which are permanently controversial, if there is not enough geological (Hartmann et al., 2002) and paleomagnetic (Franceschinis et al., 2019) data of good quality. However, since correlations between cratons are based on paleogeographic hypotheses only valid for relatively small-time intervals, some far-field relationships between cratons can be established. They allow to reconcile the available information by simply establishing a temporal link between rocks of the same nature, age, and coherent lithotectonic units. This includes the roots of large igneous provinces (dyke swarms) but also granitic magmatism of specific characteristics. For example, post-orogenic high-K rapakivi granitic magmatism, Statherian in age (ca. 1.8-1.7 Ga), could be used as a valid argument to correlate cratons.
The lithospheric architecture of Africa and the Brazilian Shield in South America consist of several Archean cratons and small juxtaposed craton fragments, differentially transformed into mylonitic belts, and faulted blocks tectonically interspersed with younger folded belts. The similarities of ages, tectonic styles and mineralizations suggest a connection between the structure and the Eburnean tectonic evolution of the West African Craton (WAC) with respect to the Paleoproterozoic terranes of the Rio de la Plata Craton (RPC) from Argentina and Uruguay, as well as its tectonic evolution.
The WAC is made up of two Paleoproterozoic-Archean shields that seem to belong to the same and only great pre-Panafrican craton: (i) Reguibat Shield, in Northern Mauritania, Southern Algeria and Mali, (ii) Man-Leo Shield, in Ivory Coast, Sierra Leone, Liberia and Togo. The Taoudeni Basin comprises Neoproterozoic and Paleozoic formations unconformably deposited on both shields, in its center. The Man-Leo shield contains a central Archean domain unaffected by the Eburnean tectonics (Man Craton) but well deformed in its periphery. In the Reguibat shield, even if the intense Eburnean deformation occurred, some preserved Archean terranes outcrop (Jessell and Liégeois, 2015).
Archean migmatitic orthogneisses (~3.5 Ga) as well as metabasalts (3.3-3.1 Ga) in the western part of the WAC are affected by granulite facies metamorphism at 2.9-2.7 Ga. Above these migmatites and metabasalts, the Birimian Supergroup were deposited, folded and injected by Rhyacian granites (2.1-2.0 Ga) during the Eburnean Orogenesis. Furthermore, the evolution of Paleoproterozoic magmatism of the most affected Archean regions by Eburnean tectonics (eg, Yetti and Eglab; Leo-Rise and Burkina Faso) indicates the presence of high-K post-orogenic granites, whose ages are consistent with ca. 1.8-1.7 Ga (Peucat et al., 2005).
On the other hand, the RPC is an 850,000 km^2 craton, small compared to the WAC. It is made up of a western block, i.e. Buenos Aires-Piedra Alta (BAPA), separated by Paleozoic faults from pre-Andean terranes, and an eastern block made of multiple pieces of an Archean craton, shredded and recycled by Paleoproterozoic tectonics, the Nico Pérez Terrane (NPT) Uruguay (Oriolo et al., 2016).
Since both blocks are geologically different, some models consider that they were newly docked in the Neoproterozoic, during the Brasiliano Orogenesis. However, given the recent geophysical findings (gravimetry, magnetotelluric survey) it is likely that the RPC already had a common inherited structure between them, since there are no differences in the lithosphere thickness (200 km) (Dragone et al., 2017; Bologna et al., 2019). The nature of the discontinuity that separates them would be misleading, since it was considered as a very long ductile strike-slip shear zone. However, structural evidence suggests that there exists an edge of conjugate faults of brittle-ductile behaviour, which reactivate an ancient dextral strike-slip shear zone, during the Neoproterozoic and causing a sinistral strike-slip inversion with drag folds.
The RPC geology in the BAPA block, westward to this strike-slip shear zone, consists of migmatitic orthogneisses, in amphibolite facies, and late-orogenic juvenile granites, dated at 2.1-2.0 Ga. The

Rhyacian fold-belts contain metavolcano-sedimentary rocks, reaching the amphibolite facies, with rather the same ages. The PAT is cross-cut by the Florida dyke swarm, which yields an age of ~1.79 Ga (U-Pb on baddeleyite) (Halls et al., 1999). On the other hand, the NPT contains ortho- and para-derived granulitic gneisses older than ~2.2 Ga and a granulite metamorphism with a thermal peak dated at ca. 2.0 Ga. This domain is subdivided into five sub-domains, each of which has its own tectonic history and geological framework. For example, the Pavas Block stands out for the presence of Archean TTG suites (~3.4-3.1 Ga) but with an amphibolite facies at 2.7 Ga. The Rivera and Valentines blocks contain older metavolcano-sedimentary successions that reached the granulite facies during the Rhyacian Orogenic event (ca. 2.0-1.9 Ga). The high-K Statherian granites of Illescas (rapakivi) and Campanero of the NPT are post-orogenic and yield ages U-Pb LA-ICPMS in zircon of 1768 ± 11 Ma and 1754 ± 7 Ma, respectively (Oriolo et al., 2016 and references therein).
Finally, the intrusion of tholeiitic metagabbros yielded 1479 ± 4 and 1482 ± 6 Ma ages. They could have emplaced during a pre-Panafrican extensional event that produced an intracontinental rift.
Excellent exposition in mineralized old terranes are located around Minas de Corrales, northern Uruguay, Isla Cristalina Belt, where metavolcanic-sedimentary sequences are associated to granite and gneiss bodies and gold was mined during the last century. Mineralization is restricted to dextral shear zones or granite borders and the main mineral assemblages are gold, pyrite, galena, and chalcopyrite associated to quartz veins. Other mineralization examples exist in southern Uruguay, and especially near Minas, Lavalleja, where the main mineral assemblages are sphalerite, pyrite, chalcopyrite, galena but no longer mining.

Keywords: Terranes, geochronology, shear zones, mineralization

Acknowledgements: We acknowledge ECOS-Sud Conicyt (project n°U17U01) for providing support in Uruguay, DINAMIGE for providing airborne geophysical data. This is a contribution of UNESCO-IGCP638 program.

References

Bologna, M.S., Dragone, G.N., Muzio, R., Peel, E., Nuñez-Demarco, P., Ussami, N., 2019. Electrical structure of the lithosphere from Rio de la Plata craton to Paraná basin: Amalgamation of cratonic and refertilized lithospheres in SW Gondwanaland. Tectonics, 38, 77-94.

Dragone, G.N., Ussami, N., Gimenez, M.E., Klinger, F.G.L., Chaves, C.A.M., 2017. Western Parana suture/shear zone and the limits of Rio Apa, Rio Tebicuary and Rio de la Plata cratons from gravity data. *Precambrian Research*, 291, 162-177.

Franceschinis P.R., A.E. Rapalini, L. Sánchez Bettucci, C. Martínez Dopico, F.N. Milanese, 2019. Paleomagnetic confirmation of the "unorthodox" configuration of Atlantica between 2.1-2.0 Ga, *Precambrian Research*, doi: https://doi.org/10.1016/j.precamres.2019.105447

Halls, H., Campal, N., Davis, D.W., Bossi, J., 2001. Magnetic studies and U-Pb geochronology of the Uruguayan dyke swarm, Rio de la Plata Craton, Uruguay: paleomagnetic and economic implications. *Journal of South American Earth Sciences*, 14, 349-361.

Hartmann, L.A., 2002. The Mesoproterozoic supercontinent Atlantica in the Brazilian shield-review of geological and U-Pb zircon and Sm-Nd isotopic evidence. *Gondwana Research*, *5*(1), 157-163.

Jessell, M., Liégeois, J.-P., 2015. 100 years of research on the West African Craton. *Journal of African Earth Sciences*, 112, 377-381.

Oriolo, S., Oyhantçabal, P., Basei, M.; Wemmer, K., Siegesmund, S., 2016. The Nico Pérez Terrane (Uruguay): From Archean crustal growth and connections with the Congo Craton to late Neoproterozoic accretion to the Río de la Plata Craton. *Precambrian Research*, 280, 147-160.

Peucat, J., Capdevila, R., Drareni, A., Mahdjoub, Y., Kahoui, M., 2005. The Eglab massif in the West African Craton (Algeria), an original segment of the Eburnean orogenic belt: petrology, geochemistry and geochronology. *Precambrian Research*, 136, 309-352.