



IRP BuCoMO

Building Continents - From Mantle to Ore

Outcomes and activities 2019-2023



BuCoMO at a glimpse

- **31** persons involved in various capacities, from **6** institutions (3 in France, 3 in S.A.) + external partners
- **20** papers (published or in revision)
- **> 50** conference communications
- **15** students (graduated/ongoing):
 - M2: 3/1
 - MSc: 2/2
 - PhD 2/5
- **16** trips between France and South Africa for joint activities (dominantly field work), involving a total of ca. 40 travelers (some several times)
- Total budget ca. **206 k€**
 - 60 k€ (French side) and 725k ZAR (South African side) directly attributed to BuCoMO
 - Leveraged funds from other sources: ca. 86 k€ and 500k ZAR





People and institutions:

31 persons from **6 institutions** have been involved, more or less intensely, in BuCoMO activities. Several international collaborators are routinely participating to our research activities.

South Africa:

- **Stellenbosch University:** G. Stevens; A. Kisters; B. von der Heyden; M. Mayne (faculty). K. Wassenaar; M. Santos Leandro; A. Ferreira; T. Otto; S. Hoffman; M. Werle;
- **University of Cape Town:** C. Harris; J. Diener (faculty)
- **University of Johannesburg:** J. Lehmann (faculty); B. Mapingere

France:

- **LMV/Université Clermont Auvergne:** J.-F. Moyen ; B. Moine ; M. Boyet ; E. Médard ; E. Bruand (faculty) L. Maulny ; T. Chaptal
- **GET / Université Toulouse III** O. Laurent; D. Baratoux (faculty)
- **GM / Université de Montpellier:** A. Chauvet ; D. Arcay (faculty)

Students enrolled in joint degrees, double affiliation (France + South Africa):

- M. Mühlberg; J.-B. Combaz; H. Fest; L. Travers ; S. Kitoga; H. Dominguez-Carranza

Collaborators in other universities:

- J. Marin-Carbonne (Lausanne); C. Heubeck (Jena); P. Lanari (Berne); V. Janoušek (Prague); C. Lana (Ouro Preto); ...

Publications

20 articles in peer-reviewed journals can be directly linked to BuCoMO (many more are indirectly related), including one in Nature Geosciences and one in Geology.

> 50 conference presentations in international and domestic (on both sides) meetings

Papers

- Couzinié, S., Laurent, O., Chelle-Michou, C., Bouilhol, P., Paquette, J.L., Gannoun, A. & Moyen, J.F. 2019. Detrital zircon U–Pb–Hf systematics of Ediacaran metasediments from the French Massif Central: Consequences for the crustal evolution of the north Gondwana margin. *Precambrian Research*, 324, 269-284, <http://doi.org/https://doi.org/10.1016/j.precamres.2019.01.016>.
- Radu, I.B., Harris, C., Moine, B.N., Costin, G., Cottin, J.-Y. Subduction relics in the subcontinental lithospheric mantle evidence from variation in the $\delta^{18}O$ value of eclogite xenoliths from the Kaapvaal craton. *Contributions to Mineralogy and Petrology* 174:19, <https://doi.org/10.1007/s00410-019-1552-z>
- Laurent, O., Zeh, A., Brandl, G., Vézinet, A. & Wilson, A. Granitoids and Greenstone Belts of the Pietersburg Block—Witnesses of an Archaean Accretionary Orogen Along the Northern Edge of the Kaapvaal Craton. In *The Archaean Geology of the Kaapvaal Craton, Southern Africa*, Kröner A. & Hofmann, A., eds. P. 83-107, https://doi.org/10.1007/978-3-319-78652-0_4
- Mayne, M.J., Stevens, G. & Moyen, J.-F., 2019, A phase equilibrium investigation of selected source controls on the composition of melt batches generated by sequential melting of an average metapelite. Geological Society, London, Special Publications 491, SP491-2018-121, <https://doi.org/10.1144/SP491-2018-121>



- Mayne, M.J., Stevens, G., Moyen, J.F., & Johnson, T.E., 2019, Performing process-oriented investigations involving mass transfer using Rcrust: a new phase equilibrium modelling tool. Geological Society, London, Special Publications 491, SP491-2018-85, <https://doi.org/10.1144/SP491-2018-85>
- Moyen, J.-F., Zeh, A., Cuney, M., Dziggel, A. & Carrouée, S. 2020. The multiple ways of recycling Archaean crust : a case study from the ca. 3.1 Ga granitoids from the Barberton Greenstone Belt, South Africa. Precambrian Research. <https://doi.org/10.1016/j.precamres.2020.105998>
- Couzinié, S., Bouilhol, P., Laurent, O., Marko, L., Moyen, J.-F., 2021. When zircon drowns: elusive geochronological 1 record of water-fluxed orthogneiss melting in the Velay dome (Massif Central, France). Lithos 384-385, 105938. <https://doi.org/10.1016/j.lithos.2020.105938>
- Laurent, O., Björnsen, J., Wotzlaw, J.-F., Bretscher, S., Pimenta Silva, M., Moyen, J.F., Ulmer, P. & Bachmann, O. 2020. Earth's earliest granitoids are crystal-rich magma reservoirs tapped by silicic eruptions. Nature Geoscience, <http://doi.org/10.1038/s41561-019-0520-6>.
- Laurent O, Moyen JF, Wotzlaw JF, Bjoernsen J, Bachmann O, 2021. Early Earth zircons formed in residual granitic melts produced by tonalite differentiation. Geology 50(4), 437-441
- Moyen, J.F., Cuney, M., Baratoux, D., Sardini, P. Carrouée, S., 2021. Multi-scale spatial distribution of K, Th and U in an Archaean potassic granite: a case study from the Heerenveen batholith, Barberton Granite-Greenstone Terrain, South Africa. South African Journal of Geology, 124:53-86, <https://doi.org/10.25131/sajg.124.0005>
- Fall, M., Baratoux, D., Jessell, M., Moussa Ndiaye, P., Vanderhaeghe, O., Moyen, J.-F., Baratoux, L. & Bonzi, W.M.E. 2020. The redistribution of thorium, uranium, potassium by magmatic and hydrothermal processes versus surface processes in the Saraya Batholith (Eastern Senegal): insights from airborne radiometrics data and topographic roughness. Journal of Geochemical Exploration, vol 219 article 106633. <https://doi.org/10.1016/j.gexplo.2020.106633>
- Poujol, M., Jaguin, J., Moyen JF, Boulvais, P. Paquette, JL., 2021. Archean S-Type granites: petrology, geochemistry and geochronology of the Lekkersmaak and Willie plutons, Kaapvaal Craton, South Africa. South African Journal of Geology, 124:87-110, <https://doi.org/10.25131/sajg.124.0004>
- Mühlberg, M., Stevens, G., Moyen, J.-F., Kisters, A.F.M., Lana, C., 2021. Thermal evolution of the Stolzburg Block, Barberton granitoid-greenstone terrain, South Africa: Implications for Paleoarchean tectonic processes. Precambrian Research 359 article 106082, <https://doi.org/10.1016/j.precamres.2020.106082>
- Werle, M., Stevens, G., Moyen, J.-F., Laurent, O., Harris, C., Lana, C. and Janney, P.E. in revision. Cryptic crustal growth identified through Variscan post-collisional lamprophyre-granite composite dykes, French Massif Central. Lithos.
- Van Schijndel, V., Stevens, G., Lana, C., Zack, T. and Frei, D. 2021. De Kraalen and Witrivier Greenstone Belts, Kaapvaal Craton, South Africa: Characterisation of the Palaeo-Mesoarchean evolution by rutile and zircon U-Pb geochronology combined with Hf isotopes. South African Journal of Geology, 124, 17-36.
- Vielzeuf, D., Paquette, J-L., Clemens, J.D., Stevens, G., Gannoun, A., Suchorski, K. and Saúl, A. 2021. Age, duration and mineral markers of magma interactions in the deep crust: an example from the Pyrenees. Contributions to Mineralogy and Petrology, 176, 39.
- Cutts, K., Maneiro, K.A., Stevens, G. and Baxter, E. 2021. Metamorphic evolution for the Inyoni shear zone: Investigating the geodynamic evolution of a 3.20 G terrane boundary in the Barberton granitoid greenstone terrane, South Africa. South African Journal of Geology, 124, 163-180.
- Otto, T., Stevens, G., Mayne, M.J. and Moyen, J.-F. 2023. Phase equilibrium modelling of partial melting in the upper mantle: A comparison between different modelling methodologies and experimental results. Lithos 444–445, 107111, <https://doi.org/10.1016/j.lithos.2023.107111>.
- Hoffman, S., Mayne, M., Stevens, G., and Moyen, J.-F., in review. Applying phase equilibria modelling to igneous systems by coupling trace element partitioning and accessory phase saturation to compositionally variable thermodynamic modelling in Rcrust

Conference publications

- Not listed in details – include international conferences such as Goldschmidt (every year), IMA, International Platinum symposium, Hutton Symposium on Granites and Related Rocks and domestic conferences (RST in France; GeoCongress, IMSG in South Africa).



Students and joint degrees

15 students graduated (or are working) as part of the BuCoMO program. A majority of them were co-supervised by French and South African researchers, with various degrees of officiality ranging from proper “cotutelle” with inter-university agreement, to informal collaboration.

M2 (France)

- L. Maulny (Clermont, 2019). Géochronologie des gneiss gris de la région du Limpopo.
- H. Dominguez-Carranza (Lyon/Stellenbosch, 2020). Study of amphibolite-facies metapelites from the hydrated zone of the Southern Marginal Zone, Limpopo.
- L. Travers (Montpellier, 2020). Caractérisation et distribution de l'évènement « Or » dans la ceinture de roches vertes de Barberton (Afrique du Sud).
- T. Chaptal (Clermont, 2023)

MSc (South Africa)

- H. Fest (Stellenbosch, 2020-2022).
- M. Werle (Stellenbosch, 2020-2022). Mantle and crust interaction in post-collisional setting, a case study of lamprophyric-granitic composite dykes of northern Aigoual pluton, French Massif Central.
- S. Hoffman (Stellenbosch, 2021-2023). Applying phase equilibria modelling to igneous systems by coupling trace element partitioning and accessory phase saturation to compositionally variable thermodynamic modelling in Rcrust.
- K. Wassenaar (Stellenbosch, 2023-). An investigation of the migmatitic terrain near Berg-en-Dal, southern Krüger National Park.

PhD

- T. Otto (Stellenbosch, 2019- 2023).
- M. Mühlberg (Stellenbosch, 2017-2023). Metamorphism of the Stolzberg Block, Barberton Granitoid-Greenstone Terrain: Implications for the evolution of the Archean continental crust
- M. Santos Leandro (Stellenbosch, 2021-). Petrology and geochemistry of the ca. 3.1 Ga syenites of the Barberton granite- greenstone terrain.
- H. Fest (Stellenbosch/Clermont, 2022-). Origin of potassic granites in the Southern French Massif Central.
- J.-B. Combaz (Stellenbosch/Toulouse, 2022-). The detrital record of Archaean crustal evolution in the Kaavaal craton.
- L Travers (Montpellier/Johannesburg, 2020-23). Structural context of gold mineralization in the Barberton Greenstone belt.
- S Kitoga (Clermont/Stellenbosch, 2021-). The geochemical signature of alteration in the Barberton greenstone belt and its transfer to Archaean granitoids



Trips and joint research activities

At least **16 trips** between France and South Africa, mostly for field work but also for coordination, defenses and so on. **40 travelers**, many of them several times.

- 2019. T. Otto to Saint Etienne (research visit, 3 month)
- 2019. H. Dominguez-Carranza, J.-F. Moyen, G. Stevens, J. Diener to Limpopo (field work, 10 days) 2019. G. Stevens, J.-F. Moyen to southern Massif Central (field work, 3 days)

- 2020. A. Chauvet, L. Travers to Barberton (field work, 3 weeks)

- 2021. S. Kitoga, M. Santos Leandro, J.-F. Moyen, G. Stevens, A. Kisters, M. Werle, H. Fest, T. Otto to Barberton (field work, 3 weeks + mini workshop)
- 2021. A. Chauvet, L. Travers, J. Lehmann to Barberton (field work, 1 month + mini workshop)

- 2022. H. Fest, O. Laurent, J.-F. Moyen to Southern Massif Central (field work, 3 weeks + participation to workshop in Orléans)
- 2022. T. Otto to Lyon (IMA conference + scientific discussions, 10 days)
- 2022. A. Chauvet, L. Travers, J. Lehmann to Barberton (field work, 2 weeks)
- 2022. M. Santos Leandro, J.-B. Combaz to Barberton (field work, 10 days)

- 2023. J. Lehmann to Montpellier (scientific discussions, 1 week)
- 2023. A. Chauvet, J.-F. Moyen to Stellenbosch (Geocongress + scientific discussions + BuCoMO meeting, 10 days)
- 2023. T. Chaptal to Cape Town (research visit, 2 weeks)
- 2023. J.-F. Moyen, A. Chauvet, M. Mayne, K. Wassenaar to Barberton/Kruger Park/Swaziland (3 weeks, field work).
- 2023. H. Fest to Clermont (3 month, part of PhD program)
- 2023. T. Otto, M. Mayne to Lyon (10 days, Goldschmidt conference and scientific discussions)
- 2023. (planned). J. Lehmann, J.-F. Moyen to Montpellier (scientific discussion + PhD defense L. Travers, 4 days)



Budget and financial information

Total budget of ca. **206 k€** (146 k€ in France and 1.25 M ZAR in South Africa), including **66 k€ + 725k ZAR** directly attributed to BuCoMO and an estimated amount of 80 k€ and 500 k ZAR leveraged from other sources.

These figures are approximative, because of fluctuating exchange rate and the indirect nature of some support.

Also note that the reporting (and the date of fund availability) is different between France and South Africa.

French budget (in k€)

	From BuCoMO sources			From other sources
	Travel for joint research activities (field mostly)	Other travel (domestic and conferences)	Equipment	
2019	3	1.5	1.7	
2020*	5	3.5	5.4	PhD grant to L. Travers from U. Montpellier + some support from Montpellier
2021	9.7**	0.5	0.4	PhD grant to L. Travers from U. Montpellier + some support from Montpellier; PhD grant to S. Kitoga from CNRS
2022	11.2	2.0	0.9	PhD grant to L. Travers from U. Montpellier + some support from Montpellier; PhD grant to S. Kitoga from CNRS
2023 (as of 1/05/2023)	3.2 (+ 3 k€ field expenses, planned)	0.1	0.7	PhD grant to L. Travers from U. Montpellier + some support from Montpellier; PhD grant to S. Kitoga from CNRS UCA "Emergence" program contributing to H. Fest's project. ½ PhD grant to H. Fest from UCA (3 months in 2023)

* Covid year. International travel was seriously affected, a larger portion of the budget was used to invest in equipment.

** plus 1.8 k€ for cancelled flights (Covid), notionally available with the travel agent.

PhD grants: estimated at 30 k€ for a full PhD

South African budget (in ZAR)

	Travel, conferences etc	Analytical costs	Bursaries	Origin of the funds	
				BuCoMO	Other
2021	95k	175k	220k	Running costs: 325k Bursaries: 400k	350k from NRF to G. Stevens 100k from UJ to J. Lehmann 50k – misc. sources
2022	155k	240k	340k	Total: 725k	

South African budget was paid in two installments in 2021 and 2022.