NICOLAS RIEL

Curriculum Vitae

Institute of Geosciences
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Research Experience

Johannes Gutenberg University, Mainz, Germany

Mar 2024 – present **Modelling of CHROMium Enrichment in the mantle and the crust (CHROME)**.
Use models of reactive-multiphase flow in order to model chromium ore-forming process
Advisor : **Pr. Evangelos Moulas**, *Professor of Metamorphic Geology, Institute of Geosciences* (*Web-page*)

Oct 2023 – Feb 2024 **W2 professorship (fixed term)**.
Teaching activity: Geophysics (introduction to geodynamic modeling) and Geostatistics (introduction to geosciences numerical modelling)

Dec 2018 – Sep 2023 **Melting And Geodynamic Models of Ascent (MAGMA)**.
Developing an efficient Gibbs free energy minimizer to model stable phase equilibrium with the objective to couple it with geodynamic models of magma transfer.
Advisor : **Pr. Boris Kaus**, *Professor of Geodynamics and Geophysics, Institute of Geosciences* (*Web-page*)

University of Bergen, Bergen, Norway

Feb 2017 – Aug 2018 **Lithosphere defORmation and Stratigraphy (COLORS)**.
Coupling surface processes (FastScape) with 3D geodynamic models (pTatin3D).
Advisor : **Pr. Ritske Huismans**, *Professor, Head of Geodynamics and Basin studies Group* (*Web-page*)

Durham University, Durham, United-Kingdom

Sep 2014 – Dec 2017 **Modelling the Archaean Subduction Environment (MASE)**.
Development of a coupled petrological two-phase flow code to explore magma differentiation in the deep hot crust of volcanic systems
Advisor : **Pr. Jeroen van Hunen**, *Professor, Dept Director of Research* (*Web-page*)

Monash University, Melbourne, Australia

Sep 2012 – Jul 2013 **2D and 3D thermomechanical modelling of subduction systems: implications for the Cenozoic evolution of the Andean system**.
Development of 2D-3D thermomechanical subduction models, including free surface, to explore the control of the subduction plate age on subduction dynamics.
Advisor : **Pr. Fabio Capitanio**, *Associate Professor* (*Web-page*)

Education

2008–2012 **PhD in Geosciences**, *University of Grenoble, Grenoble*, France, « Thermal anomaly and underplating in a forearc region: an example from the El Oro Complex from SW Ecuador » with S. Guillot, E. Jaillard and J-E Martelas).

2007–2008 **Master in Geosciences**, *University of Grenoble, Grenoble*, France, « Pressure-Temperature-Time characterization of a new Eclogitic Complex in Himalaya » with S. Guillot and K.H. Hattori.

Computer skills

Numerical modelling	2D-3D tectonic/geodynamic modelling: LaMEM, Underworld, pTatin3D, Citcom, FastScape
Programming Languages	C, Julia, Python, Matlab
Computational Fluid Dynamics	Finite difference and finite volume methods. Development of reactive two-phase flow code in complex chemical systems.
Computational thermodynamics	Main developer of MAGEMin and MAGEMinApp (*Github*): Mineral Assemblage Gibbs Energy Minimization.
Optimization algorithms	Ability to implement and apply optimization algorithms: Conjugate-Gradient, Newton-Raphson, Levenberg-Marquardt, BFGS, Simplex, Interior Point Method.
Software	ArcGis, Adobe suite, LaTeX, Blender

Structural and petrological skills

Petrology	Macroscopic and microscopic identification of rocks and minerals. Modelling of pressure-temperature evolution of geological units using thermobarometry coupled with X-ray imaging and thermodynamic modelling (Perple_X, Therial-Domino and MAGEMin softwares).
Tectonics	Identification and mapping of geological structures, in 2D and 3D. Characterization of finite deformation field with kinematic indicators in brittle, ductile and partially molten domains.
Geochronology	In situ U-Th/Pb dating of zircon and monazite crystals with SHRIMP (Ottawa, Perth) and with LA-ICPMS (Clermont-Ferrand). Dating on separated crystal grains and thin-sections. Ar/Ar dating on amphibole and muscovite (VG3600 mass spectrometer).

Teaching experience

2024–2025 : **Geophysical modeling: introduction to LaMEM (60h)**, *Undergraduate students*, University of Mainz.

2023–2024 : **Geophysical modeling: introduction to LaMEM (30h)**, *Undergraduate students*, University of Mainz.

Geostatistic: introduction to programming applied to geosciences problems (24h), *Undergraduate students*, University of Mainz.

Introduction to geodynamic modelling using LaMEM (1 week), *Undergraduate students*, University of Heidelberg.

2020–2022 : **Geophysical modeling: introduction to LaMEM (60h)**, *Undergraduate students*, University of Mainz.

2016 : **Introduction to long-term tectonic modeling using Underworld (1 week)**, *Undergraduate to PhD student*, University of Lisbon.

2013–2014 : **Basin and Resources (70h)**, *Undergraduate students*, Monash University.

2008–2012 : **Geological mapping (24h)**, University of Grenoble, Master students.

optical microscopy (6h), University of Grenoble, Master students.

French Massif Central fieldwork (24h), University of Grenoble, Master students.

Italian Alps fieldwork (24h), University of Grenoble, Master students.

2008–2012 : **Water resources and environment (25h)**, University of Grenoble, Undergraduate students.

Geological mapping (25h), University of Grenoble, Undergraduate students.

Petrology (15h), University of Grenoble, Master students.

Structural geology fieldtrip (35h), University of Grenoble, Undergraduate students.

Post-graduate student supervision

2023–2027 **N. Miguel Ferreira**, *University of Lisbon*, Portugal, «3D numerical geodynamic modelling of continental collision ».
PhD student

2024–2026 **J. Assunção**, *University of São Paulo*, Brazil, « 2D/3D long term geodynamic modelling of subduction: the control of phase change and rheology ».
PhD student

2021–2022 **M. Bensing**, *Johannes Gutenberg University*, Germany, « Geodynamic modelling of the Mediterranean: implications for Ionian's plate magmatism ».
Master student

2020–2024 **H. Domingez**, *University of Bern*, Switzerland, « Quantification and simulation of reactive fluid flows in medium to high-grade metamorphic terranes ».
PhD student

2020–2024 **A. Gomes**, *University of Lisbon*, Portugal, « Geodynamic modelling of obduction: a new contribution towards a fully buoyancy-driven plate tectonics theory ».
PhD student

2017–2022 **J. Almeida**, *University of Lisbon*, Portugal, « Modeling subduction invasion of the Atlantic Ocean ».
PhD student

2016 **J. Cornet**, *Durham University*, England, « Implementation of trace element behaviour in the numerical modelling of magmatic processes ».
MsC student

2016 **V. Grigorova**, *Durham University*, England, « The flavor of slab fluids ».
MsC student

2011 **T. Putois**, *University of Grenoble*, France, « Characterization of eclogitic metasediments of the Stak massif, Himalaya ».
Master student

Field experience

2022 **South-west Ecuador (30 days)**, Structural mapping in variably metamorphozed units in the El Oro metamorphic complex.

2012–2014 **Italian Alps (7 days)**, Co-organizer with C. Cordier and N. Arndt of the Ivrea fieldtrip: volcanology and petrography.

French Massif Central (7 days), Co-organizer with E. Janots of the Montagne Noire fieldtrip for Master students: mapping and structural geology in the low to medium-grade unit.

2011–2012 **French Massif Central (7 days)**, Structural study of the emplacement of the Velay granitic complex.

South-west Ecuador (22 days), Structural mapping in variably metamorphozed units in the El Oro metamorphic complex.

2009–2010 **Elbe Island (7 days)**, Structural and metamorphic study in high-temperature and ophiolitic units in the island of Elbe.

Northern Pakistan (21 days), Geodesy and structural mapping in high grade metamorphic rocks at the suture zone between India and Asia.

South-west Ecuador (15 days), Structural mapping in variably metamorphozed units in the El Oro metamorphic complex.

2008–2009 **French Alps (8 days)**, Study of highly strained ophiolitic units in the Mont Viso.

French Alps (8 days), Sedimentology, structural geology and metamorphic study across the Alps belt.

Referees

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Publications

Green, E. C. R., Holland, T. J. B., Powell, R., Weller, O. M., & **Riel, Nicolas**. (2025). Corrigendum to: Melting of peridotites through to granites: A simple thermodynamic model in the system kncfmashtocr, and, a thermodynamic model for the subsolidus evolution and melting of peridotite. *Journal of Petrology*, *66*(1), egae079. https://doi.org/10.1093/petrology/egae079

Liu, J.-H., Kaempf, J., Huang, M., **Riel, Nicolas**, Guo, J., Huang, G., Chen, L., Jiao, S., Mao, M., Clark, C., et al. (2025). Thermal structure of a paleoproterozoic orogen: A case study from the wutai–fuping crustal section. *Journal of Petrology*, *66*(5), egaf043.

Schuler, C., Kaus, B. J., Le Breton, E., **Riel, Nicolas**, & Popov, A. A. (2025). Mantle dynamics in the mediterranean and plate motion of the adriatic microplate: Insights from 3d thermomechanical modeling. *Geochemistry, Geophysics, Geosystems*, *26*(3), e2024GC011996.

Soderman, C. R., Weller, O. M., Beard, C. D., **Riel, Nicolas**, Green, E. C., & Holland, T. J. (2025). A mid-crustal tipping point between silica-undersaturated and silica-oversaturated magmas. *Nature Geoscience*, 1–8.

Dominguez, H., **Riel, Nicolas**, & Lanari, P. (2024). Modelling chemical advection during magma ascent. *Geoscientific Model Development Discussions*, *2024*, 1–30.

Duarte, J. C., **Riel, Nicolas**, Rosas, F. M., Popov, A., Schuler, C., & Kaus, B. J. (2024). Gibraltar subduction zone is invading the atlantic. *Geology*.

Forshaw, J. B., Dominguez, H., Markmann, T. A., Tamblyn, R., Hermann, J., **Riel, Nicolas**, & Lanari, P. (2024). Major-element geochemistry and fe3+/Σfe of metabasites. *Journal of Petrology*, egae120.

Ganade, C. E., **Nicolas Riel**, Manatschal, G., Tesser, L. R., Hermann, J., Rubatto, D., Weinberg, R. F., Lanari, P., & Kaus, B. J. (2024). Exhumation of ultra-high pressure (uhp) rocks modulated by rifted margin-subduction feedback: Implications for their preservation in old collisional orogens. *Earth and Planetary Science Letters*, *643*, 118893. https://doi.org/https://doi.org/10.1016/j.epsl.2024.118893

Kaus, B. J., Thielmann, M., Aellig, P., de Montserrat, A., de Siena, L., Frasukiewicz, J., Fuchs, L., Piccolo, A., Ranocha, H., **Riel, Nicolas**, et al. (2024). Geophysicalmodelgenerator. jl: A julia package to visualise geoscientific data and create numerical model setups. *Journal of Open Source Software*, *9*(103), 6763.

Markmann, T. A., Lanari, P., Piccoli, F., Pettke, T., Tamblyn, R., Tedeschi, M., Lueder, M., Kunz, B. E., **Riel, Nicolas**, & Laughton, J. (2024). Multi-phase quantitative compositional mapping by la-icp-ms: Analytical approach and data reduction protocol implemented in xmaptools. *Chemical Geology*, *646*, 121895.

Weller, O. M., Holland, T. J., Soderman, C. R., Green, E. C., Powell, R., Beard, C. D., & **Riel, Nicolas**. (2024). New thermodynamic models for anhydrous alkaline-silicate magmatic systems. *Journal of Petrology*, egae098.

Schmitt, A., Sliwinski, J., Caricchi, L., Bachmann, O., **Riel, N**, Kaus, B., de Léon, A. C., Cornet, J., Friedrichs, B., Lovera, O., et al. (2023). Zircon age spectra to quantify magma evolution. *Geosphere*, *19*(4), 1006–1031.

Riel Nicolas, Duarte, J. C., Almeida, J., Kaus, B. J., Rosas, F., Rojas-Agramonte, Y., & Popov, A. (2023). Subduction initiation triggered the caribbean large igneous province. *Nature Communications*, *14*(1), 786.

Almeida, J., **Riel N**, Rosas, F., Duarte, J., & Schellart, W. (2022). Polarity-reversal subduction zone initiation triggered by buoyant plateau obstruction. *Earth and Planetary Science Letters*, *577*, 117–195.

Almeida, J., **Riel N**, Rosas, F. M., Duarte, J. C., & Kaus, B. (2022). Self-replicating subduction zone initiation by polarity reversal. *Communications Earth & Environment*, *3*(1), 55.

Husson, L., **Riel Nicolas**, Aribowo, S., Authemayou, C., de Gelder, G., Kaus, B., Mallard, C., Natawidjaja, D., Pedoja, K., & Sarr, A. (2022). Slow geodynamics and fast morphotectonics in the far east tethys. *Geochemistry, Geophysics, Geosystems*, *23*(1), e2021GC010167.

Riel Nicolas, Kaus, B. J., Green, E., & Berlie, N. (2022). MAGEMin, an efficient gibbs energy minimizer: Application to igneous systems. *Geochemistry, Geophysics, Geosystems*, *23*(7), e2022GC010427.

Theunissen, T., Huismans, R. S., Lu, G., & **Riel Nicolas**. (2022). Relative continent/mid-ocean ridge elevation: A reference case for isostasy in geodynamics. *Earth-Science Reviews*, 104153.

Goussin, F., **Riel Nicolas**, Cordier, C., Guillot, S., Boulvais, P., Roperch, P., Replumaz, A., Schulmann, K., Dupont-Nivet, G., Rosas, F., et al. (2020). Carbonated inheritance in the eastern tibetan lithospheric mantle: Petrological evidences and geodynamic implications. *Geochemistry, Geophysics, Geosystems*, *21*(2), e2019GC008495.

Rummel, L., Kaus, B. J., Baumann, T. S., White, R. W., & **Riel Nicolas**. (2020). Insights into the compositional evolution of crustal magmatic systems from coupled petrological-geodynamical models. *Journal of Petrology*, *61*(2), egaa029.

Schwartz, S., Gautheron, C., Ketcham, R. A., Brunet, F., Corre, M., Agranier, A., Pinna-Jamme, R., Haurine, F., Monvoin, G., & **Riel Nicolas**. (2020). Unraveling the exhumation history of high-pressure ophiolites using magnetite (u-th-sm)/he thermochronometry. *Earth and Planetary Science Letters*, *543*, 116359.

Riel Nicolas, Bouilhol, P., van Hunen, J., Cornet, J., Magni, V., Grigorova, V., & Velic, M. (2019). Interaction between mantle-derived magma and lower arc crust: Quantitative reactive melt flow modelling using styx. *Geological Society, London, Special Publications*, *478*(1), 65–87.

Loury, C., Rolland, Y., Lanari, P., Guillot, S., Bosch, D., Ganino, C., Jourdon, A., Petit, C., Gallet, S., Monié, P., & **Riel Nicolas**. (2018). Permian charnockites in the pobeda area: Implications for tarim mantle plume activity and ht metamorphism in the south tien shan range. *Lithos*, *304*, 135–154.

Riel Nicolas, Capitanio, F. A., & Velic, M. (2018). Numerical modeling of stress and topography coupling during subduction: Inferences on global vs. regional observables interpretation. *Tectonophysics*, *746*, 239–250.

Riel Nicolas, Jaillard, E., Martelat, J.-E., Guillot, S., & Braun, J. (2018). Permian-triassic tethyan realm reorganization: Implications for the outward pangea margin. *Journal of South American Earth Sciences*, *81*, 78–86.

Rosas, F. M., Duarte, J. C., Almeida, P., Schellart, W., **Riel, N**, & Terrinha, P. (2017). Analogue modelling of thrust systems: Passive vs. active hanging wall strain accommodation and sharp vs. smooth fault-ramp geometries. *Journal of Structural Geology*, *99*, 45–69.

Lamarque, G., Bascou, J., Maurice, C., Cottin, J.-Y., **Riel Nicolas**, & Ménot, R.-P. (2016). Microstructures, deformation mechanisms and seismic properties of a palaeoproterozoic shear zone: The mertz shear zone, east-antarctica. *Tectonophysics*, *680*, 174–191.

Salerno, V. M., Capitanio, F. A., Farrington, R. J., & **Riel, Nicolas**. (2016). The role of long-term rifting history on modes of continental lithosphere extension. *Journal of Geophysical Research: Solid Earth*, *121*(12), 8917–8940.

Riel Nicolas, Mercier, J., & Weinberg, R. (2016). Convection in a partially molten metasedimentary crust? insights from the el oro complex (ecuador). *Geology*, *44*(1), 31–34.

Capitanio, F., Replumaz, A., & **Riel**, N. (2015). Reconciling subduction dynamics during tethys closure with large-scale asian tectonics: Insights from numerical modeling. *Geochemistry, Geophysics, Geosystems*, *16*(3), 962–982.

Riel Nicolas & Lanari, P. (2015). Techniques, méthodes et outils pour la quantification du métamorphisme. *Géochronique*, *136*, 53–60.

Riel Nicolas, Martelat, J.-E., Guillot, S., Jaillard, E., Monie, P., Yuquilema, J., Duclaux, G., & Mercier, J. (2014). Forearc tectonothermal evolution of the el oro metamorphic province (ecuador) during the mesozoic. *Tectonics*, *33*(10), 1989–2012.

Lanari, P., **Riel**, N., Guillot, S., Vidal, O., Schwartz, S., Pêcher, A., & Hattori, K. H. (2013). Deciphering high-pressure metamorphism in collisional context using microprobe mapping methods: Application to the stak eclogitic massif (northwest himalaya). *Geology*, *41*(2), 111–114.

Riel Nicolas, Guillot, S., Jaillard, E., Martelat, J., Paquette, J., Schwartz, S., Goncalvez, P., Duclaux, G., Thiebaud, N., Lanari, P., et al. (2013). Implications for high-temperature metamorphism in a forearc zone: A metamorphic and geochronogical study of the triassic el oro metamorphic complex in ecuador. *Lithos*, *156*, 41–68.

Lanari, P., Guillot, S., Schwartz, S., Vidal, O., Tricart, P., **Riel**, N., & Beyssac, O. (2012). Diachronous evolution of the alpine continental subduction wedge: Evidence from p–t estimates in the briançonnais zone houillère (france–western alps). *Journal of Geodynamics*, *56*, 39–54.