

## Elias Morgan Bloch

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Maître Assistant  
University of Lausanne  
Institut des Sciences la Terre (ISTE)  
Géopolis Mouline, CH 1015 Lausanne, Switzerland  
+41 79 296 08 64  
Elias.Bloch@unil.ch  
www.diffusionkreep.com  
Google Scholar ID: KoBH978AAAAJ

RESEARCH INTERESTS	Igneous and metamorphic processes, high-temperature thermochronology, diffusion kinetics, crustal generation and recycling, cosmochemistry, tectonics	
EMPLOYMENT	<b>2017-present</b> Maître Assistant (senior researcher) <b>2015-2017</b> Postdoctoral Researcher <b>2013-2015</b> Postdoctoral Researcher	University of Lausanne (ISTE) University of Lausanne (ISTE) University of Oregon (DES )
EDUCATION	<b>2008-2013</b> Ph.D. The University of Arizona, AZ, USA ( <i>advisor: Jibamitra Ganguly</i> ) <b>2005-2008</b> B.Sc. The University of Washington, WA, USA ( <i>advisor: Stewart McCallum</i> )	
FUNDING	<b>2017-2022</b> Ambizione Fellowship SNF: <i>Diffusion kinetics of U, Th, Pb, Hf and REEs in baddeleyite, and development of local electrode atom probe tomography as a means to analyze experimentally induced diffusion profiles in crystalline materials</i>	
STUDENTS	<b>Current</b> <ul style="list-style-type: none"><li>• Thomas Grocolas (Ph.D. student, 2021-, co-advisor w/ Othmar Müntener)</li></ul> <b>Alumni</b> <ul style="list-style-type: none"><li>• Arnaud Devoir (Ph.D. student, 2016-2020; postdoc, 2020-2021, co-advisor w/ Othmar Müntener)</li><li>• Michelle Foley (Ph.D. student, 2018-, co-advisor w/ Benita Putlitz)</li></ul> <b>External Committees</b> <ul style="list-style-type: none"><li>• Daniil Popov (Ph.D. student, defended 2020, University of Geneva)</li><li>• Tommaso Tachetto (Ph.D. student, defending 2023, Curtin University)</li></ul>	
TEACHING	<b>Classes Currently Offered</b> <ul style="list-style-type: none"><li>• <i>Physics and Structure of Minerals</i>. Master's course co-taught with Othmar Müntener at the University of Lausanne</li><li>• <i>Introduction to Atom Probe Tomography with Highlights in Geoscience Applications</i>. Doctoral course co-taught with Stephan Gerstl, Benita Putlitz and Michelle Foley.</li></ul> <b>Past/Sporadically offered Classes</b> <ul style="list-style-type: none"><li>• <i>Ion-Beam Methods</i>. Doctoral short courses &amp; SIMS workshops</li><li>• <i>Diffusion in Earth Science: Theory and Applications</i>. Doctoral course</li></ul>	

## EXTERNAL REVEIWS **Peer-Reviewed Journals**

- Geochimica et Cosmochimica Acta
- Geology
- Chemical Geology
- Contributions to Mineralogy and Petrology
- Journal of Petrology
- America Mineralogist
- Journal of Metamorphic Geology
- Brazilian Journal of Geology

### **Research Grant Proposals**

- German Research Foundation (*Germany*)
- National Science Foundation (*USA*)

## AFFILIATIONS

### **Professional Societies**

- American Geophysical Union
- European Association of Geochemistry
- European Geophysical Union
- Geological Society of America
- GEODES (Geosciences Diversity and Equality Switzerland)

### **Research Groups**

- Center for Advanced Surface Analysis (UNIL/EPFL joint platform)
- Magmatic Petrology Group (UNIL)
- SwissSIMS (Ion probe national facility in Switzerland)

## CONFERENCE ORGANIZATION

- Thermodynamics and diffusion kinetics within the core and mantle: A session in honor of Jibamitra Ganguly and Surendra Saxena, *Goldschmidt International Conference on Geochemistry*, Paris 2017.
- Diffusion and Reaction in Minerals and Melts: Small Scale Processes with Large Scale Implications, *Goldschmidt International Conference on Geochemistry*, Boston 2018.
- It's about time: Determinations, applications and complications of diffusion in minerals and melts, *European Geosciences Union General Assembly*, Vienna 2019.
- Mineral reaction rates and phase equilibria in magmatic and metamorphic processes: Implications for thermobarometry and time scales of high temperature processes, *Goldschmidt International Conference on Geochemistry*, Honolulu 2022.

## PUBLICATIONS

### **Under review/In preparation:**

Zeiman, L., Ibañez-Mejia, M., Tissot, F., Tompkins, H.G.D., **Bloch, E.** The zirconium stable isotope systematics of continental crust formation in an active continental arc. *\*In preparation*

Cheng, H., **Bloch, E.**, Moulas, E., Wen-Liang, X., Vervoort, J., Dragovic, B., Ibañez-Mejia, M. The 1.1 Ga discrepant Lu-Hf and Sm-Nd dates of crustal xenoliths witness the stability of a craton in the period of Boring Billion. *\*In preparation*.

**Bloch, E.** Constraints on U, Th, Ti and Na diffusion in baddeleyite. *\*In preparation*

Ibañez-Mejia, M., **Bloch, E.**, Murray, K. Multiple magmatic pulses and complex exhumation processes in the Northern Andean Arc documented by U-Pb and U-Th/He thermochronology in zircon and titanite. *\*In preparation*.

*\*by labeling a study as "in preparation", I am stating that all experiments, field work, data collection and modeling are complete, and that the only remaining task prior to submission is completion of the manuscript. Ongoing projects not at this stage are not listed here.*

**Printed/In press:**

Zieman, L., Ibañez-Mejia, M., Rooney, A., **Bloch, E.**, Pardo, N., Schoene, B., Szymanowski, D. (2023) To sink or not to sink: The thermal and density structure of the modern northern Andean arc constrained by xenolith petrology. *In Press at Geology*.

Thompkins, H.G.D., Ibañez-Mejia, M., Tissot, F.L.H., **Bloch, E.**, Wang, Y., Trail, D. (2023) Zircon-growth experiments reveal limited equilibrium Zr isotope fractionation in magmas. *In press at Geochemical Perspective Letters*.

Jollands, M., **Bloch, E.**, Van Orman, J., O'Neill, H., Hermann, J. (2022) Scandium diffusion in forsterite: Concentration dependence, inter-site reactions and the effect of trivalent cations on Fe diffusion. *Physics of the Earth and Planetary Interiors* 334, 106954.

**Bloch, E.**, Jollands, M., Tollan, P., Hervig, R., Müntener, O., Bouvier, A.-S., Plane, F., Berry, A., Escrig, S., Meibom, A., Alleon, J., Ibañez-Mejia, M., Baumgartner, L., Zaubitzer, C., Marin-Carbonne, J., Newville, M. (2022) Diffusion anisotropy of Ti in zircon and implications for Ti-in-zircon thermometry. *Earth Planet. Sci. Lett.* 578, 117317.

Devoir, A., **Bloch, E.**, Müntener, O. (2021) Residence time of igneous garnet in Si-rich magmatic systems: Insights from diffusion modeling of major and trace elements. *Earth Planet. Sci. Lett.* 560, 116771.

**Bloch, E.**, Jollands, M., Devoir, A., Bouvier, A.-S., Ibañez-Mejia, M., Baumgartner, L. (2020) Multi-species diffusion of yttrium, rare earth elements and hafnium in garnet. *Journal of Petrology* v. 61(7), ega055.

Jollands, M., **Bloch, E.**, Müntener, O. (2020) New Ti-in-quartz diffusivities reconcile natural Ti zoning with time scales and temperatures of upper crustal magma reservoirs: REPLY. *Geology* v. 48(12), e514.

Pistone, M., Baumgartner, L. P., Begué, F., Jarvis, P. A., **Bloch, E.**, Robyr, M., Müntener, O., Sisson, T. W., Blundy, J. D. (2020) Felsic melt and gas mobilization during magma solidification: An experimental study at 1.1 kbar. *Frontiers in Earth Science* 8.

Jollands, M., **Bloch, E.**, Müntener, O. (2020) New Ti-in-quartz diffusivities reconcile natural Ti zoning with time scales and temperatures of upper crustal magma reservoirs. *Geology* v. 48(7), 654-657.

Cheng, H., **Bloch, E.**, Moulas, E., Vervoort, J. (2020) Reconciliation of discrepant U-Pb, Lu-Hf, Sm-Nd, Ar-Ar and U-Th/He dates in an amphibolite from the Cathaysia block in Southern China *Contributions to Mineralogy and Petrology* 175: 4.

**Bloch, E.**, Jollands, M., Gerstl, S., Bouvier, A.-S., Baumgartner, L. (2019) Diffusion of calcium in forsterite and ultra-high resolution of experimental diffusion profiles in minerals using local electrode atom probe tomography. *Geochim. Cosmochim. Acta* 265: 85-95.

Ibañez-Mejia, M., **Bloch, E.**, Vervoort, J. (2018) Timescales of collisional metamorphism from combined Sm-Nd, Lu-Hf and U-Pb thermochronology: A case study from the Proterozoic Putumayo Orogen.

Geochim. Cosmochim. Acta 235: 103-126.

- Bloch, E.,** Watkins, J., Ganguly, J. (2018) Comment on “Reconciliation of the excess  $^{176}\text{Hf}$  conundrum in meteorites: Recent disturbances of the Lu-Hf and Sm-Nd isotope systematics” [Geochimica et Cosmochimica Acta 212 (2017) 303-323]. Geochim. Cosmochim. Acta 230: 190-192.
- Bloch, E.,** Ibañez-Mejía, M., Murray, K., Vervoort, J., Müntener, O. (2017) Recent crustal foundering in the Northern Volcanic Zone of the Andean Arc: Petrological insights from the roots of a modern subduction zone. Earth Planet. Sci. Lett. 476: 47-58.
- Bloch, E.,** Watkins, J., Ganguly, J. (2017) Diffusion kinetics of lutetium in diopside and the effect of thermal metamorphism on Lu-Hf systematics in clinopyroxene. Geochim. Cosmochim. Acta 204: 32-51.
- Bloch, E.,** Ganguly, J. (2015)  $^{176}\text{Lu}$ - $^{176}\text{Hf}$  geochronology of garnet II. Numerical simulations of the development of garnet-whole rock  $^{176}\text{Lu}$ - $^{176}\text{Hf}$  isochrons and a new method for constraining the thermal history of metamorphic rocks. Contrib. Mineral. Petrol. 169: 14.
- Bloch, E.,** Ganguly, J., Hervig, R., Cheng, W. (2015)  $^{176}\text{Lu}$ - $^{176}\text{Hf}$  geochronology of garnet I. Experimental determination of the diffusion kinetics of  $\text{Lu}^{3+}$  and  $\text{Hf}^{4+}$  in garnet, Diffusion mechanisms, closure temperatures and geochronological implications. Contrib. Mineral. Petrol. 169: 12.
- Bloch, E.,** Ganguly, J. (2014)  $^{176}\text{Lu}$ - $^{176}\text{Hf}$  and  $^{147}\text{Sm}$ - $^{143}\text{Nd}$  ages of the Martian shergottites: Evaluation of the shock-resetting hypothesis through diffusion kinetic experiments and modeling, and petrological observations. Earth Planet. Sci. Lett. 395: 173-183.
- Yang, H., Jenkins, R., Downs, R., Evans, H., **Bloch, E.** (2013) Rongibbsite,  $\text{Pb}_2(\text{Si}_4\text{Al})\text{O}_{11}(\text{OH})$ , a new zeolitic aluminosilicate mineral with an interrupted Framework from Maricopa County, Arizona, USA. Amer. Mineral. 98: 236-241.
- Yang, H., Jenkins, R., Thompson, R., Downs, R., Evans, H., **Bloch, E.** (2012) Markascherite,  $\text{Cu}_3(\text{MO}_4)(\text{OH})_4$ , a new mineral species polymorphic with szenicsite, from Copper Creek, Pinal County, Arizona, USA. Amer. Mineral. 97: 197-202.