

CURRICULUM VITAE ET STUDIORUM

Mattia Luca Mazzucchelli

Last update: August 2018

I. Personal details and contacts

Date of birth: February 1st 1989
City of birth: Milan (Italy)
E-mail: mattialuca.mazzucchelli01@universitadipavia.it
Current position: Ph.D. student (XXXI cycle), Department of Earth and Environmental Sciences - University of Pavia, Italy.
Present address: Via Cairoli, 12, Vigevano (PV), 27029, Italy
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I am currently a Ph.D. student at the Department of Earth and Environmental Sciences (University of Pavia, Italy). I make use of crystallography and mineral physics to understand the complex elasticity of mineral inclusions entrapped in Ultra High Pressure (UHP) metamorphic rocks. The aim of my project is to provide an alternative and complementary new method for accurate elastic geobarometry for UHP metamorphic rocks that is independent from chemistry and chemical equilibria.

II. Academic records and career

2017-2018 (*Tutor for mineralogy and laboratory*)

Place: Department of Earth and Environmental Sciences - University of Pavia, Via Adolfo Ferrata n.4, Pavia, Italy

January 2016 - April 2016 (*Visiting Scholar - University of Nevada, Las Vegas*)

Research topic: Extension of the classical host-inclusion elastic geobarometry analysis beyond the isotropic assumptions by using Finite Elements Modelling (FEM).

Grant: sponsored by the University of Pavia and the MILE DEEP project (SIR-MIUR grant, RBSI140351)

Place: University of Nevada, Las Vegas, Nevada (UNLV)

2015-2016 (*Tutor for mineralogy and laboratory*)

Place: Department of Earth and Environmental Sciences - University of Pavia, Via Adolfo Ferrata n.4, Pavia, Italy

October 2015 - present (*Ph.D. Student*)

Research topic: Development of geobarometry for UHPM rocks based on host-inclusion elasticity: quantification of the effects of elastic anisotropy and inclusion shape.

Place: Department of Earth and Environmental Sciences - University of Pavia, Via Adolfo Ferrata n.4, Pavia, Italy.

Advisors: Dr Matteo Alvaro, Dr Ross J. Angel, Prof. M.C. Domeneghetti

2015 (*Master degree – Geology, 110/110 cum laude and with Honours*)

Dissertation: Non-linear elastic geobarometry: methods and applications

Place: Department of Earth and Environmental Sciences - University of Pavia, Via Adolfo Ferrata n.4, Pavia, Italy.

Advisor: Prof. M.C. Domeneghetti, Dr Matteo Alvaro, Dr Ross J. Angel

2014 -2015 (*Tutor for petrography*)

Place: Department of Earth and Environmental Sciences - University of Pavia, Via Adolfo Ferrata n.4, Pavia, Italy

2014-2015 (*Tutor for mineralogy and laboratory*)

Place: Department of Earth and Environmental Sciences - University of Pavia, Via Adolfo Ferrata n.4, Pavia, Italy

2013-2014 (*Tutor for mineralogy and laboratory*)

Place: Department of Earth and Environmental Sciences - University of Pavia, Via Adolfo Ferrata n.4, Pavia, Italy

2013 (*Bachelor degree – Geology, 110/110 cum laude*)

Dissertation: Inclusions in diamonds: new thermoelastic parameters for pyrope

Place: Department of Earth and Environmental Sciences - University of Pavia, Via Adolfo Ferrata n.4, Pavia, Italy.

Advisor: Prof. M.C. Domeneghetti

2008 (*High school degree, 100/100*)

Place: Liceo Classico “B. Cairoli”- Vigevano (PV), Italy

III. Scientific activity

- A. **Current Research:** Conventional thermobarometry is severely challenged in ultra-high-pressure metamorphic (UHPM) rocks, but these are the only rocks that can provide insights into the detailed processes of subduction, especially deep and ultra-deep subduction. To break the “chemical dependency” of petrology and petrologists, I am developing methods to interpret the residual stress in mineral inclusions trapped in host minerals contained in UHPM rocks, to provide an alternative and complementary method to conventional thermobarometry. Elastic geobarometry does not rely on the detailed chemistry of the rock, nor on whether chemical equilibrium has been attained. As part of my M.Sc. Thesis research I helped to incorporate non-linear elasticity into the classic host-inclusion elasticity solutions. During my Ph.D. research I am calculating the effects of anisotropic elasticity and inclusion shape, with the aim of being able to recover accurate entrapment pressures for real mineral inclusions in UHPM rocks.

B. Main research skills:

1. **NUMERICAL MODELING (FINITE ELEMENT METHOD):** extension of the classical host-inclusion elastic geobarometry analysis beyond the isotropic assumptions by using Finite Elements Modelling (FEM).
2. **HIGH-TEMPERATURE RESEARCH:** Investigation of crystalline materials at high temperature conditions *in situ* by single-crystal X-ray diffraction using micro-furnace mounted on conventional diffractometer (i.e. Philips, Bruker and Huber systems).
3. **HIGH-PRESSURE RESEARCH:** Investigation of crystalline materials at high pressure conditions by means of single-crystal X-ray diffraction using DAC (Diamond Anvil Cell) apparatus.

C. Main collaborations:

- Matteo Alvaro (Research Scientist, University of Pavia, Italy)
- Ross J. Angel (Research Scientist, University of Pavia, Italy)
- Pamela Burnley (Associate Research Professor, University of Nevada, Las Vegas, USA)
- Boriana Mihailova (Full Professor, University of Hamburg, Germany)
- Fabrizio Nestola (Full Professor, University of Padua, Italy)
- Alessandro Reali (Full Professor, University of Pavia, Italy)
- Marco Scambelluri (Associate Professor, University of Genova, Italy)

D. Grants and Awards

- 2018 – Travel Grant for the EGU Galileo conferences: Exploring new frontiers in fluids processes in subduction zones (Leibnitz, Austria) - SIMP
- 2016 – PhD Student Award – International Mineralogical Association (IMA)
- 2016 – Travel Award – Minerals international journal
- 2016 – Travel Grant for the International School of Crystallography – NATO Advanced Study Institute

E. Seminars & Courses attended:

Jan 29th – Feb 2nd 2018 Fourth international Diamond School
Brixen (Italy)

Sept 18th -22nd 2017 Short course:
Bayreuth (Germany) DMG PhD short course „Mineralogy, Mineral Physics and Seismology of Earth’s Mantle“

March – June 2017 Course: “Nonlinear computational mechanics” (Held by: Prof.
Pavia (Italy) Alessandro Reali – University of Pavia, Italy)

March 20th – March 24th 2017 Short course: “Raman and IR spectroscopy of solids” (Held by: Prof. B.
Hamburg (Germany) Mihailova - University of Hamburg, Germany)

Jan 23rd – Feb 3rd 2017 Short course: “Metodologie di calcolo ab initio di grandezze
Torino (Italy) termodinamiche, e di proprietà strutturali, elastiche e vibrazionali di minerali” (Held by: Prof. M. Prencipe - University of Torino, Italy)

Nov 2016 – Feb 2017 Course: “Mineral elasticity” (Held by Dr. Ross J. Angel -University of
Pavia (Italy) Padova, Italy)

Oct 25th – Oct 27th 2016 Short course: “M²F² : Mechanical Modelling of Faulting and Fractures”
Pavia (Italy) (Held by: Prof. Michele Cooke - University of Massachusetts, USA)

May 27th – June 5th 2016 International school of crystallography
Erice (Italy) “High-pressure crystallography: status artis and emerging opportunities”

Jan 27th – Jan 31st 2015 International Diamond School,
Brixen (Italy) “The Nature of Diamonds and Their Use in Earth’s Study”

Aug 28th – Sep 6th 2014 1st European Crystallography School
Pavia (Italy)

Feb 24th – Feb 28th 2014 Short course:
Bayreuth (Germany) High-pressure experimental techniques and applications to the Earth's interior

F. Invited Lectures:

1. December 2017 – PhD short course “Computational Mechanics for Scientific Problems” – Department of Mathematics, University of Pavia, Italy.
2. May 2017 – “Elastic geobarometry: where do we stand, where are we heading to?” - Institute for Mineralogy and Crystallography, University of Wien, Austria
3. September 2016 - Workshop “Inclusions in minerals as record of geological processes: New analysis methods and application” at EMC 2016 (European Mineralogical Conference 2016), Rimini.

4. Scientific record:

Peer reviewed papers:

1. Campomenosi N., **Mazzucchelli M.L.**, Mihailova B., Scambelluri M., Angel R.J., Nestola F., Alvaro M. (2018). How geometry and anisotropy affect residual strain in host inclusion system: coupling experimental and numerical approaches. *American Mineralogist* (in press)
2. M. Murri, **M. L. Mazzucchelli**, N. Campomenosi, A. V. Korsakov, M. Prencipe, B. D. Mihailova, M. Scambelluri, and R. J. Angel, M. Alvaro (2018). Raman Elastic Geobarometry For Anisotropic Mineral Inclusions. *American Mineralogist* (in press)
3. **M.L. Mazzucchelli**, P. Burnley, R.J. Angel, S. Morganti, M.C. Domeneghetti, F. Nestola, M. Alvaro (2018). Elastic geothermobarometry: Corrections for the geometry of the host-inclusion system. *Geology*; 46 (3): 231–234. doi: <https://doi.org/10.1130/G39807.1>
4. Angel, R., **Mazzucchelli, M.**, Alvaro, M., et al. (2017). EosFit-Pinc: A simple GUI for host-inclusion elastic thermobarometry. *American Mineralogist*, 102(9), pp. 1957-1960. doi:10.2138/am-2017-6190
5. S. Milani, R.J. Angel, L. Scandolo, **M.L. Mazzucchelli**, T. Boffa Ballaran, S. Klemme, M.C. Domeneghetti, R. Miletich, K. S. Scheidl, M. Derzsi, K. Tokár, M. Prencipe, M. Alvaro, F. Nestola, (2016). Thermo-elastic behaviour of grossular garnets at high pressures and temperatures. *American Mineralogist* 102 (4), 851-859

6. Angel R.J., Alvaro M., Nestola F., **Mazzucchelli M.L.** (2015) Diamond thermoelastic properties and implications for determining the pressure of formation of diamond inclusion systems. *Russian Geology and Geophysics Journal*, 56, 225-234.
7. Scandolo, L., **Mazzucchelli, M.**, Alvaro, M., Nestola, F., Pandolfo, F., Domeneghetti, M. (2015). Thermal expansion behaviour of orthopyroxenes: the role of the Fe-Mn substitution. *Mineralogical Magazine* 79, 71-87.
8. Milani, S., Nestola, F., Alvaro, M., Pasqual, D., **Mazzucchelli, M.L.**, Domeneghetti, M.C., Geiger, C.A., (2015). Diamond–garnet geobarometry: The role of garnet compressibility and expansivity. *Lithos* 227, 140-147.
9. Angel, R.J., Nimis, P., **Mazzucchelli, M.L.**, Alvaro, M., and Nestola, F. (2015) How large are departures from lithostatic pressure? Constraints from host–inclusion elasticity. *Journal of Metamorphic Geology*, 33, 801–813.
10. Alvaro, M., Angel, R. J., Marciano, C., Milani, S., Scandolo, L., **Mazzucchelli, M. L.**, ... Nestola, F. (2015). A new micro-furnace for in situ high-temperature single-crystal X-ray diffraction measurements. *Journal of Applied Crystallography*, 48(4), 1192–1200. <https://doi.org/10.1107/S1600576715011371>
11. Angel R.J., **Mazzucchelli M.L.**, Alvaro M., Nimis P., and Nestola F. (2014) Geobarometry from host-inclusion systems: the role of elastic relaxation. *American Mineralogist*, 99 (10), 2146-2149

Meetings, conferences, seminars and workshop:

2018

1. **Mazzucchelli M.L.**, Angel R.J., Morganti S., Reali A. & Alvaro M. : Elastic geobarometry for elastically anisotropic inclusions. *SIMP-SGI*, Catania, Italy. Contributed talk
2. Campomenosi N., **Mazzucchelli M.L.**, Mihailova B.D., Korsakov A.V., Scambelluri M., Angel R.J. & Alvaro M. : Relations between induced birefringence haloes and polarized raman spectra in host cubic crystals. *SIMP-SGI*, Catania, Italy. Contributed talk
3. Murri M., **Mazzucchelli M.L.**, Campomenosi N., Korsakov A.V., Prencipe M., Mihailova B.D., Scambelluri M., Ange R.J.I. & Alvaro M. : Raman elastic geobarometry for anisotropic mineral inclusions. *SIMP-SGI*, Catania, Italy. Contributed talk
4. **Mazzucchelli M.L.**, Ange R.J., Nestola F. & Alvaro M.: Pressure estimates from fluid and solid inclusions in minerals from UHPM rocks. *EGU Galileo conferences, Exploring new frontiers in fluids processes in subduction zones*, Leibnitz, Austria, 24-29 June 2018. Contributed poster.
5. Angel R.J., Murri M., **Mazzucchelli M.L.**, Prencipe M., Mihailova B., Alvaro M. Using Raman scattering to measure strains in crystals under non-hydrostatic stress conditions. *26th Annual Meeting of the German Crystallographic Society: DGK2018* 5th-8th March 2018, Essen, Germany. Contributed talk
6. Campomenosi N., **Mazzucchelli M.L.**, Mihailova B., Scambelluri M., Angel R.J., and Alvaro M. Elastic geobarometry: a comparison between experiments and numerical simulations. *EGU General Assembly 2018*, Vienna, Austria. Contributed talk.

2017

7. **Mazzucchelli M.L.**, Burnley P., Angel R.J., Domeneghetti M.C., Nestola F., Alvaro M. Elastic geobarometry: the strain and the stress distribution in the host-inclusion system revealed by Finite Element Modeling (FEM). *Congresso congiunto SIMP-SGI-SOGEI-AIV*, Pisa, Italy. Contribute talk.

8. Alvaro M, Murri M, **Mazzucchelli M**, Prencipe M, Campomenosi N, Angel RJ. Elastic geobarometry for UHP metamorphic rocks. *12th International Eclogite Conference*, Åre, Sweden. Contributed poster.
9. Angel RJ, **Mazzucchelli ML**, Alvaro M, Nestola F. Elastic geobarometry: state of the art. *12th International Eclogite Conference*, Åre, Sweden. Contributed poster.
10. Campomenosi N, Scambelluri M, Mihailova B, Alvaro M, Nestola F, **Mazzucchelli M**, Murri M, Angel RJ, Prencipe M. Experimental evidence on natural host-inclusion mineral systems to characterize the role of geometry and size of the inclusions for Raman elastic geobarometry. *12th International Eclogite Conference*, Åre, Sweden. Contributed poster.
11. Murri M, **Mazzucchelli M**, Prencipe M, Mihailova B, Scambelluri M, Campomenosi N, Angel RJ, Alvaro M. Ab initio simulation on Quartz (SiO₂) under hydrostatic stress vs isotropic strain. *XLVI Annual Meeting of the AIC*, Perugia, Italy. Contributed poster.
12. **M.L. Mazzucchelli**. Elastic geobarometry: where do we stand, where are we heading to. May 2017. **Invited seminar**. PhD programme of the “Fakultät für Geowissenschaften, Geographie und Astronomie” University of Wien, Austria.
13. Angel RJ, Alvaro M, **Mazzucchelli ML**, Nestola F. Eosfit-Pinc: a GUI program to calculate pressures in host-inclusion systems. *EGU General Assembly 2017*, Vienna, Austria. Contributed talk.
14. **Mazzucchelli M.L.**, Burnley P., Angel R.J., Domeneghetti M.C., Nestola F., Alvaro M. Elastic geobarometry: uncertainties arising from the geometry of the host-inclusion system. *EGU General Assembly 2017*, Vienna, Austria. Contributed talk.

2016

15. **Mazzucchelli M.L.**, Burnley P., Angel R.J., Domeneghetti M.C., Nestola F., Alvaro M.. Elastic geobarometry: uncertainties arising from the shape of the inclusion. *EMC 2016*, Rimini, Italy. Contributed talk.
16. Alvaro M., Angel R.J., **Mazzucchelli M.L.**, Nestola F. New Constraints on PT evolution of metamorphic rocks from single inclusion piezobarometry. *EMC 2016*, Rimini, Italy. Contributed talk.
17. Rustioni G., Angel R.J, **Mazzucchelli M.L.**, Milani S., Nimis P., Domeneghetti M.C., Marone F., Harris J.W., Nestola F. & Alvaro M. Pressure release for host – inclusion systems: the interplay between brittle failure and fluid phase. *EMC 2016*, Rimini, Italy. Contributed talk.
18. Scandolo L., Milani S., **Mazzucchelli M.L.**, Alvaro M., Di Prima M., Domeneghetti M.C., Nestola F., Geiger C.A., Stagno V. Thermoelastic properties of silicate garnets and their use in the study of diamond formation. *EMC 2016*, Rimini, Italy. Contributed poster.
19. **M. L. Mazzucchelli**, R. J. Angel, P. Burnley, C. M. Domeneghetti, F. Nestola, M. Alvaro. Elastic geobarometry: principles and practice *International School of Crystallography, 2016*, Erice, Italy. Contributed poster.
20. **M.L. Mazzucchelli**, R. J. Angel, G. Rustioni, S. Milani, P. Nimis, M.C. Domeneghetti, F. Marone, J. W. Harris, F. Nestola, and M. Alvaro. Elastic geobarometry and the role of brittle failure on pressure release. *EGU General Assembly 2016*, Vienna, Austria. Contributed talk.
21. R. Angel, M. Alvaro, **M. Mazzucchelli**, P. Nimis, and F. Nestola. Single inclusion piezobarometry confirms high-temperature decompression path for Variscan granulites. *EGU General Assembly 2016*, Vienna, Austria. Contributed talk.

2015

22. **Mazzucchelli M.L**, Angel R.J., Alvaro M., Nimis P., Domeneghetti M.C. & Nestola F. Host-inclusion geobarometry for ultra high pressure metamorphic (UHPM) rocks. *SIMP-SGI-So.Ge.I-AIV meeting 2015*, Firenze, Italy. Contributed talk.
23. Zaffiro G., Angel R.J., Alvaro M., Nestola F., Domeneghetti M.C., Scandolo L., **Mazzucchelli M.L.**, Milani S., Rustioni G. & Marciano C. New micro-furnace for “in situ” high-temperature single crystal X-ray diffraction measurements. *SIMP-SGI-So.Ge.I-AIV meeting 2015*, Firenze, Italy. Contributed poster.
24. Rustioni G., Angel R.J., Milani S., **Mazzucchelli M.L.**, Nimis P., Domeneghetti M.C., Marone F., Alvaro M., Harris J.W. & Nestola F. Elastic geobarometry for host-inclusion systems:

Pressure release and the role of brittle failure. *SIMP-SGI-So.Ge.I-AIV meeting 2015*, Firenze, Italy. Contributed poster.

25. Milani S., Scandolo L., Zaffiro G., Di Prima M., **Mazzucchelli M.L.**, Alvaro M., Domeneghetti M.C. & Nestola F. On the determination of the entrapment pressure for garnet inclusions in diamonds. *SIMP-SGI-So.Ge.I-AIV meeting 2015*, Firenze, Italy. Contributed talk.
26. Alvaro M., Angel R.J, **Mazzucchelli M.L.**, Domeneghetti M.C & Nestola F. Elastic geobarometry for UHPM rocks: A link between mineralogy and petrology. *SIMP-SGI-So.Ge.I-AIV meeting 2015*, Firenze, Italy. Contributed talk.
27. **Mattia L. Mazzucchelli**, Ross Angel, Matteo Alvaro, Paolo Nimis, Chiara Maria Domeneghetti and Fabrizio Nestola. Elastic geobarometry for ultra high pressure metamorphic (UHPM) rocks. *EGU General Assembly 2015*, Vienna, Austria. Contributed talk.
28. Matteo Alvaro, Ross Angel, **Mattia L. Mazzucchelli**, Paolo Nimis, and Fabrizio Nestola. Development of a new micro-furnace for "in situ" high-temperature single crystal X-ray diffraction measurements. *EGU General Assembly 2015*, Vienna, Austria. Contributed talk.

2014

29. Alvaro M., Angel R.J., **Mazzucchelli M.L.**, Nestola F. & Nimis P.: A chemically-independent method for geobarometry of UHPM rocks. *SIG-SIMP meeting 2014*, Milano, Italy. Contributed talk.
30. **Mazzucchelli M.L.**, Angel R.J., Alvaro M., Nestola F. & Nimis P. Geobarometry for host-inclusion systems: the role of elastic relaxation. *SIG-SIMP meeting 2014*, Milano, Italy. Contributed poster.
31. Scandolo L., **Mazzucchelli M.L.**, Domeneghetti M.C., Alvaro M., Nestola F. & Pandolfo F. Thermal expansion behavior of orthopyroxenes: the role of the Fe-Mn substitution. *SIG-SIMP meeting 2014*, Milano, Italy. Contributed poster.
32. **M.L. Mazzucchelli**. High-temperature behaviour of pyrope, Mg₃Al₂Si₃O₁₂: implications for the depth of diamond formation. *1st European Crystallography School*, Pavia, 2014. Contributed poster.
33. Ross Angel, Matteo Alvaro, **Mattia L. Mazzucchelli**, Paolo Nimis, and Fabrizio Nestola. How much differential stress can a rock support? *EGU General Assembly 2014*, Vienna, Austria. Contributed talk.
34. M. Alvaro, R.J. Angel, **M. L. Mazzucchelli**, F. Nestola, M.C. Domeneghetti. Isomekes: A fundamental tool to determine the formation pressure for diamond-inclusion pairs. *EGU General Assembly 2014*, Vienna, Austria. Contributed talk.

2013

35. Sula Milani, **Mattia Mazzucchelli**, Fabrizio Nestola, Matteo Alvaro, Ross J. Angel, Charles A. Geiger, and Chiara Domeneghetti. The P-T conditions of garnet inclusion formation in diamond: thermal expansion of synthetic end-member pyrope *EGU General Assembly 2014*, Vienna, Austria. Contributed poster.

5. **Editorial activity:**

Reviewer for: Lithos

6. **Teaching Activities:**

1. Tutoring for Mineralogy and Laboratory course for students of first and second year of the degree in Geological Sciences at the University of Pavia (a.y. 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018)

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2. Lecturer for the PhD short course “Computational Mechanics for Scientific Problems”, 11th -15th December 2017, Department of Mathematics, University of Pavia, Italy.