

**CURRICULUM VITAE**  
**FOR**  
**MATTEO ALVARO**  
(Last update July 2019)



• **PERSONAL DETAILS**

**Date of birth:** December 3<sup>rd</sup> 1982 (36 years old)

**City of birth:** Milan (Italy)

**Nationality:** Italian

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**ORCID:** [orcid.org/0000-0002-6975-3241](https://orcid.org/0000-0002-6975-3241)

**Scopus ID:** 24173188200

**ResearcherID:** B-8451-2013

**Google Scholar:** <https://scholar.google.it/citations?hl=en&user=N16v4gAAAAJ>

• **EDUCATION**

- 2006 – 2009 Ph. D. Research: “The  $P2_1/c - C2/c$  phase transition of pigeonite”. Department of Earth Sciences, University of Pavia, Italy. Advisor: M.C. Domeneghetti
- 2004 – 2006 Masters degree in Geology (110/110 with honors): “Investigation on the  $Fe^{2+}$ - Mg exchange reaction kinetics for PCA 82506 ureilitic meteorite. Department of Earth Sciences, University of Pavia, Italy. Advisor: M.C. Domeneghetti
- 2001 – 2004 Bachelor degree – Geology, (110/110 with honors): “Study of chondritic meteorite Trezzano”. Department of Earth Sciences, University of Pavia, Italy. Advisor: M.C. Domeneghetti

• **POSITIONS**

- Jan 2010 – Dec 2011 Postdoctoral fellow, “Framework minerals at non-ambient conditions” at Virginia Tech Polytechnic Institute and State University, USA. NSF - EAR 0738692. Advisors: Ross J. Angel and N. Ross
- Apr 2012 – Apr 2013 Postdoctoral fellow, “Comparison between Martian meteorites and their terrestrial analogues for MARS-XRD experiment” at University G. D’Annunzio Chieti-Pescara, Italy. Italian Space Agency grant (n. I/060/10/0) for the MARS-XRD/ExoMars project. Advisor: L. Marinangeli
- Apr 2013 – Jan 2015 Postdoctoral fellow, “Thermoelastic behavior of mineral inclusions in diamonds” at University of Padua, Italy. ERC – INDIMEDEA (#307322). Advisor: F. Nestola.
- Feb 2015 – Feb 2016 Postdoctoral fellow, “Elastic geobarometry for UHP metamorphic rocks” at University of Pavia, Italy. Excellence research fellowship from University of Pavia.
- Feb 2016 – Oct 2018 Research Scientist, “Elastic geobarometry for UHP metamorphic rocks” at University of Pavia, Italy. SIR-MIUR MILE DEEp, RBSI140351.
- Jun 2017 – Oct 2018 Research Scientist, “Subduction for UHP metamorphic rocks” at University of Pavia, Italy. ERC-StG True Depths, n.714936.
- Jan 2018 – Oct 2018 Research Scientist, “Impact cratering processes” at University of Pavia, Italy. FARE-MIUR IMPACT, n. R164WEJAHH.
- Nov 2018 – present Associate Professor at Department of Earth and Environmental Sciences of the University of Pavia

## • FELLOWSHIPS AND GRANTS

- **Funded research proposals:** 3 funded research proposals as principal investigator and 10 national and international funded research projects as team member.
- 2006 – 2007 PRIN-MIUR: Studi sperimentali su materiali geologici alle alte pressioni e temperature: applicazioni alla comprensione del sistema Terra (PRIN 2006047943 - € 120,000 - PI: PF Zanazzi). Team member.
- 2008 – 2010 PRIN MIUR: Meteoriti marziane (nakhliti): storia termica e contenuto in acqua del pirosseno. Confronto con analoghi terrestri (PRIN 2007H8XWKC – 27,260€ - PI: M. Zema). Team member.
- 2010 – 2012 NSF Earth Science division (EAR): Structure-Based Thermodynamic Properties of Feldspars (EAR-0738692 - PI: N.L. Ross). Post-doctoral fellow.
- 2010 – 2013 Italian Space Agency: MARS-XRD/ExoMars (ASI n.I/060/10/0 - PI: L. Marinangeli). Post-doctoral fellow.
- 2011 – 2012 PRIN-MIUR: Dalle materie prime del Sistema Terra alle applicazioni tecnologiche: studi cristallografici e strutturali (PRIN-2010EARRRZ - € 469,693 - PI: M.F. Brigatti). Team member.
- 2013 – 2018 ERC Starting grant: Inclusion in diamond messenger from the Deep Earth (INDIMEDEA, ERC-StG n.307322 - € 1.423,464 - PI: F. Nestola). Team member
- 2014 – 2016 PRNA-PEA: Meteoriti Antartiche (2013/AZ2.04 - € 88,000 - PI: L. Folco). Team member.
- 2015 – 2018 Italian Space Agency: (TOMOX - PI: L. Marinangeli). Team member.
- 2015 – 2018 SIR-MIUR: Mineral inclusion elasticity for a new deep subduction geobarometer (MILE DEEP, n.RBSI140351 - € 449,900). **Principal Investigator**.
- 2016 – 2018 PRNA-PEA: Meteoriti Antartiche (PRNA16\_00029 - € 87,900 - PI: L. Folco). Team member.
- 2017 – 2022 ERC Starting grant: Determine the true depth of deep subduction from piezobarometry on host – inclusions systems (TRUE DEPTHS, ERC-StG n.714936 - € 1.697,500). **Principal Investigator**.
- 2018 – 2021 FARE-MIUR: StackIng disorder in diaMonds as a marker for the history of Pre-solar Carbon (IMPACt, FARE-MIUR n. R164WEJAHH- € 234.255). **Principal Investigator**.
- 2019 – 2022 PRIN-MIUR: The Dynamic Mass Transfer from Slabs to Arcs (Dynastars, PRIN-MIUR n. 2017ZE49E7 - € 384.084). **Co-PI** responsible for the research unit at University of Pavia.
- **Funded research proposals at large scale facilities:** Principal investigator and co-investigator of 7 funded applications for beamtime at three beamlines.

- 2013: Chromite inclusion in natural diamonds: a picture of deep earth (Diamond Light Source, DLS: I15 experiment number EE7616)
- 2014: Diopsides in diamonds: new geobarometric approaches (Diamond Light Source, DLS: I15 experiment number EE8754)
- 2015: The effect of cracking systems on diamond-inclusion geobarometry (Swiss Light Source, SLS: TOMCAT experiment number e15427)
- 2016: Coesite in Diamond: a unique piezothermometer for geology (Diamond Light Source, DLS: I19, experiment number EE14928)
- 2016: The smaller, the harder: multiphase micro-inclusions in majoritic garnet as signatures of deep Earth mantle conditions (Diamond Light Source, DLS: I15, experiment number EE14855)
- 2017: The smaller, the harder: multiphase micro-inclusions in majoritic garnet as signatures of deep Earth mantle conditions (Diamond Light Source, DLS: I15, experiment number EE14855\_2)
- 2018: Bringing together growth mechanism and oxidation state in the environment of diamond formation (Swiss Light Source, SLS: TOMCAT proposal ID: 20180858)

## • PRIZES AND AWARDS

- 2015 IUCr prize for the best scientific communication at the European Crystallography meeting, Croatia.
- 2016 “Ugo Panichi” prize from the Italian society of Mineralogy and Petrology for significant scientific contributions in the field of mineralogy.
- 2017 Italian Scientific Habilitation (ASN) as associate Professor (“Professore Associato”) in Mineralogy (SSD GEO/06).
- 2018 Mario Nardelli Prize for researchers who contributed significantly to the development of the

2018 Italian crystallography.  
Italian Scientific Habilitation (ASN) as full Professor (“Professore Ordinario”) in Mineralogy (SSD GEO/06).

• **SUPERVISION ACTIVITIES:** Advisor or Co-advisor for over 20 students (BSc, MSc, PhD and post-docs)

• **Postdoctoral researchers**

2017 – 2018 Claudia Stangarone (Ab-initio calculations, crystallography)  
2017 – Mattia Gilio (metamorphic petrology, geochemistry)  
2017 – 2019 Marco Piazzì (solid state physics, magnetism)  
2018 – 2019 Mattia Luca Mazzucchelli (Finite Element Modeling)  
2018 – 2019 Davide Comboni (complex structures at high-P and T)

• **Graduate students (PhD)**

2013 – 2016 *Lorenzo Scandolo*: Thermal expansion of mantle minerals inclusions in diamonds.  
2015 – 2018 *Mattia L. Mazzucchelli*: Finite Element Modelling (FEM) of elastic anisotropy for host inclusion systems.  
2016 – 2019 *Nicola Campomenosi*: Depth of subduction for the UHP units from Dora Maira.  
2016 – 2019 *Mara Murri*: Raman investigation of inclusion under non-hydrostatic deviatoric stress.  
2016 – 2019 *Gabriele Zaffiro*: Elastic properties of UHP metamorphism index minerals.  
2016 – 2019 *Mattia Bonazzi*: Synthesis of host-inclusion systems under known stress-T conditions: Investigation of the validity of single inclusion piezobarometry using experimentally produced UHPM rocks analogous.  
2017 – 2020 *Hugo van Schroyen* *Lantman*: Elastic geobarometry: bringing back together P-T-t paths and deformation history of Lago di Cignana and Western Gneiss Region, Norway.  
2017 – 2020 *Marta Morana*: Geobarometry on inclusions in UHP metamorphic rocks: determining the triple point of Al<sub>2</sub>SiO<sub>5</sub> polymorphs (kyanite andalusite sillimanite).

• **Undergraduate students (M.Sc. and B.Sc.)**

2013: *Davide Comboni* (Now PhD at University of Milan, I): New thermoelastic parameters, thermal expansion behaviour and dehydration of cancrinite (B.Sc. July 2013).  
*Mattia Luca Mazzucchelli*: Diamond inclusions: new thermoelastic parameters for pyrope (B.Sc. July 2013).  
2014: *Mara Murri*: Critical reassessment of the thermoelastic properties for diamond (B.Sc. July 2014).  
*Greta Rustioni*: The role of fractures on the entrapment pressure for diamond-inclusion pair (B.Sc. September 2014).  
2015: *Gabriele Zaffiro*: Development of a new resistance furnace for in situ high temperature single-crystal X-Ray diffraction (B.Sc. January 2015).  
*Matteo Di Prima* (Now at ENI): Almandine garnet at high-temperature: the role of controlled oxygen fugacity (B.Sc. July 2015).  
*Mattia Luca Mazzucchelli*: Pressure of formation determination for host-inclusion system (M.Sc. July 2015)  
2016: *Mara Murri*: Geothermometer calibration for augites. Partially funded by The Barringer award for Impact related research (M.Sc. July 2016).  
*Greta Rustioni* (Now PhD at BGI, Bayreuth, Germany): Brittle deformation in minerals (M.Sc. July 2016)  
*Gabriele Zaffiro*: Characterization of the stress distribution in synthetic host-inclusion pairs (M.Sc. July 2016).  
2017: *Vanessa Fontana*: Rubies from Madagascar and Sri Lanka (M.Sc. July 2017)  
2018: *Pietro Bernocchi*: Raman spectroscopy of zircon inclusions in Dora Maira Garnets (B.Sc. February 2018)  
2018: *Mattia La Fortezza*: Inclusioni multifase in harzburgiti della Cordigliera Betica (Almirez, Spagna): meccanismi di crescita e orientazione di magnetite in olivina (co-supervised with N. Malaspina and M. Campione)  
2018: *Federico Vercesi*: Magnetic properties of inclusions in diamonds (B.Sc. December 2018)

- 2019: *Zeno Geddo*: FEM modeling for multiple inclusions (co-supervised with M.L. Mazzucchelli)  
 2019: *Kira Musyachenko*: Ab initio calculations and Raman measurements of inclusions in garnets  
 2019: *Alice Girani*: Structural refinement for crystalline inclusions trapped in their host (co-supervised with R.J. Angel)  
 2019: *Giulia Mingardi*: Mineral inclusions in garnet megablast from Dora Maira (co-supervised with M.C. Domeneghetti)

#### • TEACHING ACTIVITIES

- 2006 – 2013 Teaching support – Mineralogy and Laboratory (B.Sc, 12 CFU) Geological Sciences, University of Pavia.  
 2015 – 2016 Course taught – Elasticity of crystalline solids (PhD programme in Geology, 3CFU), University of Pavia, Italy.  
 2015 – 2016 Course taught – Analytical methodologies (M.Sc., 3 CFU), University of Pavia, Italy  
 2016 – Course taught – Analytical methodologies applied to geosciences (M.Sc. degree, 6CFU), University of Pavia, Italy  
 2017 – Course taught – Computational mechanics for scientific problems (PhD programme SAFD, 6CFU), University of Pavia, Italy  
 2019 – 2019 Course taught – Pomeriggi all'università “Diamanti il viaggio del carbonio all'interno della Terra” (Piano Lauree Scientifiche), University of Pavia, Italy  
 2019 – 2019 Course taught – PhD Course on scientific approach at University of Milan, Italy (2 CFU)

#### • ORGANIZATION OF SCIENTIFIC MEETINGS: Member of the organizing committee and convener for several national and international workshops and conferences.

- 2015 Organization committee and lecturer for International Diamond School “The nature of diamonds and their use in Earth’s study”. Bressanone-Brixen, 27-31st January 2015.  
 2015 Co-convener for the session “High-pressure and high-temperature mineral physics: a link between petrology, geophysics and geodynamics” (GMPV3.2) at EGU 2015 (European Geoscience Union 2015), Wien.  
 2015 Co-convener for the session “Inclusion-host systems: melt, fluid and solid inclusions and their importance in Earth Sciences” (GMPV4.2) at EGU 2015 (European Geoscience Union Assembly 2015), Wien.  
 2015 Organizer EosFit Workshop at 29th European Crystallographic Meeting (ECM-2015) in Rovinj, Croatia.  
 2016 Sponsorship organization committee for EMC 2016 (European Mineralogical Conference 2016), Rimini.  
 2016 Convener for session “Inclusions in minerals as record of geological processes: new analysis methods and application” (S9) at EMC 2016 (European Mineralogical Conference 2016), Rimini.  
 2016 Organizing committee and lecturer for the workshop “Inclusions in minerals as record of geological processes: New analysis methods and application” at EMC 2016 (European Mineralogical Conference 2016), Rimini.  
 2017 Convener for session “Inclusions in minerals: a record of geological processes” at EGU 2017 (European Geoscience Union Assembly 2017), Wien.  
 2017 Co-convener for the session “Metamorphic and melting processes: from subduction zones to ultra-high temperature terranes” at Goldschmidt 2017, Paris.  
 2017 Convener for the session “An entire rock entrapped inside a mineral grain. What we can learn from it?” at SIMP, Pisa.  
 2018 Organization committee and lecturer for International Diamond School “Diamonds: Geology, Gemology and Exploration”. Bressanone-Brixen, 29<sup>th</sup> January – 2<sup>nd</sup> February 2018.  
 2019 Co-convener for session “At the limits of geoscience: the nanoscale control of the solid Earth” at EGU 2019 (European Geoscience Union Assembly 2017), Wien.  
 2019 Organizing and scientific committee for the Fifth Meeting of the Italian (AIC) and Spanish Crystallographic (GE3C) Associations (MISCA V), Naples.

#### • INSTITUTIONAL RESPONSIBILITIES

- 2016 – Faculty member, Dept. of Earth and Environmental Sciences, University of Pavia, Italy

- 2017 – 2018 Member of the Research Committee, Dept. of Earth and Environmental Sciences, University of Pavia, Italy
- 2017 – Member of the Graduate Student Advisory board (PhD Committee), Dept. of Earth and Environmental Sciences, University of Pavia, Italy
- 2017 – Scientific advisor and panel member for the pre-evaluation of Horizon 2020 proposals (INROAD) at University of Pavia, Italy
- 2018 – Panel member for “valutazione commissari ASN” for the evaluation of the applicants to the committee for the national scientific habilitation (ASN) of the University of Pavia, Italy
- 2018 – Committee member for the “commissione scatti” to evaluate request for career advancement of professors and researchers at University of Pavia, Italy

#### • COMMISSIONS OF TRUST

- 2018 – Reviewer for Nature, Energies, Minerals.
- 2014 – Reviewer for Acta Crystallographica section B; American Mineralogist; Mineralogical Magazine; Physics and Chemistry of Minerals, Science China, Lithos, Journal of Alloys and Compounds, Frontiers in Earth Science, Geophysical Research Letters, Journal of the Geological Society of London.
- 2015 – Editorial board member for Frontiers (Earth and Planetary Material division)
- 2016 – Guest editor for Lithos (for the special issue “The nature of diamonds and their use in Earth’s sciences)
- 2018 – Proposal reviewer for DFG-grant applications

#### • MEMBERSHIPS OF SCIENTIFIC SOCIETIES

- 2011 – Member, of the Italian Society of Mineralogy and Petrology (SIMP)
- 2012 – Member of the Mineralogical Society of America (MSA)
- 2013 – Member of the European Geoscience Union (EGU)
- 2017 – Member of the Italian Association for Crystallography (AIC)

#### • BIBLIOMETRIC RECORD

- 60 Research publications in ISI journals (45 in the past 5 years)
- 170 scientific communications to national and international conferences (105 in the past 5 years)
- 12 invited talks and seminar to national and international institutions
- 1100 citations (1050 in the past 5 years)
- H-index = 16

- **PUBLICATIONS IN PEER-REVIEWED JOURNALS:** 60 publications in high-ranked international peer reviewed journals with more than 950 citations in the past 5 years.

##### 2007.

1. Fioretti A.M., Domeneghetti M.C., Molin G., Cámara F., **Alvaro M.**, Agostini L. (2007) - Reclassification and thermal history of Trezzano chondrite. *Meteoritics & Planetary Science*, 42: 10 (IF:2.371).

##### 2010.

2. **Alvaro M.**, Nestola F., Ballaran T.B., Camara F., Domeneghetti M.C., and Tazzoli V. (2010) High-pressure phase transition of a natural pigeonite. *American Mineralogist*, 95(2-3): 300-311 (IF:2.026).
3. Redhammer G.J., Cámara F., **Alvaro M.**, Nestola F., Tippelt G., Prinz S., Simons J., Roth G. and Amthauer G. (2010) Thermal expansion and high-temperature P2<sub>1</sub>/c–C2/c phase transition in clinopyroxene-type LiFeGe<sub>2</sub>O<sub>6</sub> and comparison to NaFe(Si,Ge)<sub>2</sub>O<sub>6</sub>. *Physics and Chemistry of Minerals*, 37(10): 685-704 (IF: 1.876).

##### 2011.

4. **Alvaro M.**, Nestola F., Cámara F., Domeneghetti M.C., And Tazzoli V. (2011) High-pressure displacive phase transition of a natural Mg-rich pigeonite. *Physics and Chemistry of Minerals*, 38(5): 379-385 (IF: 1.730).

5. **Alvaro M.**, Cámara F., Domeneghetti M.C., Nestola F., And Tazzoli V. (2011) HT P2<sub>1</sub>/c to C2/c phase transition and kinetics of Fe<sup>2+</sup>-Mg order-disorder of an Fe-poor pigeonite: implications for cooling history of ureilites. *Contributions to Mineralogy and Petrology*, 163(3): 599-613. (IF: 3.441)
  6. Gatta G.D., Angel R.J., Zhao J., **Alvaro M.**, Rotiroti N., Carpenter M.A. (2011) Phase-stability, elastic behavior and pressure-induced structural evolution of kalsilite: a ceramic material and high-T/high-P mineral. *American Mineralogist*, 96(8-9): 1363-1372 (IF:2.169).
- 2012.**
7. Gatta G.D., **Alvaro M.**, Bromiley G. (2012) A low temperature X-ray single-crystal diffraction and polarised infra-red study of epidote. *Physics and Chemistry of Minerals*, 39(1), 1-15 (IF: 1.304).
  8. Periotto B., Nestola F., Balić-Zunic T., Pasqual D., **Alvaro M.**, Ohashi H. (2012) High-pressure systematic of NaMe<sup>3+</sup>Si<sub>2</sub>O<sub>6</sub> silicates. *Solid State Communication*, 152(2): 132-137 (IF: 1.534).
  9. **Alvaro M.**, Angel R.J., Cámara F. (2012) High-pressure behaviour of zoisite. *American Mineralogist*, 97: 1165-1176 (IF:2.204).
- 2013.**
10. Periotto B., Angel R., Nestola F., Balić-Žunić T., Fontana C., Pasqual D., **Alvaro M.**, Redhammer G. (2013). High-pressure X-ray study of LiCrSi<sub>2</sub>O<sub>6</sub> clinopyroxene and the general compressibility trends for Li-clinopyroxenes. *Physics and Chemistry of Minerals*, 40: 378-399 (IF: 1.403).
  11. Dobson D. P., Miyajima N., Nestola F., **Alvaro M.**, Casati N., Liebske C., Wood I.G. and Walker A.M. (2013) Inherited textures during the perovskite to post-perovskite transition and seismic anisotropy in D". *Nature Geosciences*, 6: 575-578 (IF: 11.668).
  12. Domeneghetti M.C., Fioretti A.M., Cámara F., McCammon C., **Alvaro M.** (2013) Thermal history of nakhilites: a comparison between MIL-03346 and its terrestrial analogue Theo's flow. *Geochimica and Cosmochimica acta*, 121: 571-581 (IF: 4.250).
  13. Guastoni A., Nestola F., Gentile P., Zorzi F., **Alvaro M.**, Lanza A., Peruzzo L, Schiazza M., and Casati N. (2013) Deveroite-(Ce) : a new REE-oxalate from Mount Cervandone, Devero Valley, Western-Central Alps, Italy. *Mineralogical Magazine*, 77(7): 3019-3026 (IMA 2013-003. CNMNC Newsletter No. X, Month 2013, page X). (IF: 1.898)
  14. R. Arletti, G. Vezzalini, S. Quartieri, F. Cámara, **M. Alvaro** (2013) A new framework topology in the dehydrated form of zeolite levyne. *American Mineralogist*, 98: 2063-2074 (IF: 2.059)
- 2014.**
15. Ferrari S., Nestola F., Massironi M., Maturilli A., Helbert J., **Alvaro M.**, Domeneghetti M.C., Zorzi F. (2014) In-situ high-temperature emissivity spectra and thermal expansion of C2/c pyroxenes. *American Mineralogist*, 99(4): 786-792 (DOI: 10.2138/am.2014.4698, IF:1.964)
  16. Gatta G.D., Comboni D., **Alvaro M.**, Lotti P., Cámara F., Domeneghetti M.C. (2014) Thermoelastic behavior and dehydration process of cancrinite. *Physics and Chemistry of Minerals*, 41(5): 373-386 (DOI: 10.1007/s00269-014-0656-2, IF: 1.538).
  17. **Alvaro M.**, Nestola F., Ross N.L., Domeneghetti M.C. and Reznitsky L. (2014) High pressure behavior of thiospinel CuCr<sub>2</sub>S<sub>4</sub>. *American Mineralogist* 99(5): 908-913 (DOI: 10.2138/am.2014.4689, IF: 1.964).
  18. Angel R.J., Gonzalez-Platas J., **Alvaro M.** (2014) EosFit-7 and a Fortran module (library) for equation of state calculations. *Zeitschrift fuer Kristallographie*, 229(5): 405-419 (DOI: 10.1515/zkri-2013-1711, IF: 1.310)
  19. 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 (DOI: 10.2138/am-2014-5047, IF: 1.964).
  20. Dobson D., Lindsay-Scott A., Wood I.G., Nestola F., **Alvaro M.**, Casati N., Liebske C., Knight K.S. (2014) Time-of-flight neutron powder diffraction with milligram samples: the crystal structures of NaCoF<sub>3</sub> and NaNiF<sub>3</sub> post-perovskites. *Journal of Applied Crystallography* 47: 1-9 (doi:10.1107/S1600576714021803, IF: 3.984).
- 2015.**
21. Pandolfo F., Cámara F., Domeneghetti M.C., **Alvaro M.**, Nestola F., Karato S., Amulele G. (2015) Volume

- thermal expansion along the jadeite–diopside join. *Physics and Chemistry of Minerals*, 42(1): 1-14 (DOI: 10.1007/s00269-014-0694-9, IF: 1.585)
22. 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*, 56: 225-234. (IF: 2.019)
  23. **Alvaro M.**, Domeneghetti M.C., Marinangeli, L. (2015) A new calibration to determine the closure temperatures of Fe-Mg ordering in augite from nakhlites. *Meteoritics and Planetary Science*, 50(3): 499-507 (IF: 2.819).
  24. Malaspina N., **Alvaro M.**, Campione M., Wilhelm W., Nestola F. (2015) Dynamics of mineral crystallization from precipitated slab-derived fluid phase: first in-situ synchrotron x-ray measurements. *Contributions to Mineralogy and Petrology*, 169: 26: 1-12. (IF: 3.218)
  25. Scandolo L., Mazzucchelli M.L., **Alvaro M.**, Domeneghetti M.C., Nestola F. (2015) Thermal expansion behavior of orthopyroxenes: the role of the Fe-Mn substitution. *Mineralogical Magazine*, 79(1): 71-87. (IF: 2.212)
  26. Milani S., Nestola F., **Alvaro M.**, Mazzucchelli M.L., Domeneghetti M.C., Geiger C.A. (2015) Diamond-garnet geobarometry: The role of garnet compressibility and expansivity. *Lithos*, 227: 140-147. (IF: 3.723)
  27. 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 (8): 801-813 (doi: 10.1111/jmg.12138, IF: 3.673).
  28. Periotto B., Anzolini C., Andreozzi G., Woodland A., Lenaz D., **Alvaro M.**, Princivalle F. (2015) Equation of state of hercynite spinel, FeAl<sub>2</sub>O<sub>4</sub>, and high-pressure systematics of Mg-Fe-Cr-Al spinels. *Mineralogical Magazine*, 72(2): 285-294. (IF: 2.212)
  29. **M. Alvaro**, R.J. Angel, C. Marciano, S. Milani, G. Zaffiro, L. Scandolo, M.L. Mazzucchelli, G. Rustioni, M.C. Domeneghetti, F. Nestola (2015) A new micro-furnace for “in situ” high-temperature single crystal X-ray diffraction measurements. *Journal of Applied Crystallography*, 48 (4): 1192-1200. (IF: 2.570)
  30. Angel R.J., Milani S., **Alvaro M.**, Nimis P., Nestola F. (2015) OrientXplot: A software for processing host inclusion orientation data. *Journal of Applied Crystallography*, 48 (4): 1330-1334. (IF: 2.570)
- 2016.**
31. Nestola, F., Burnham, A.D., Peruzzo, L., Tauro, L., **Alvaro, M.**, Walter, M.J., Gunter, M., Kohn, S.C. (2016): Tetragonal Almandine-Pyrope Phase, TAPP: finally a name for it, the new mineral jeffbenite. *Mineralogical Magazine*, 79(7):1219-1232.
  32. P. Nimis, **M. Alvaro**, F. Nestola, R.J. Angel, K. Marquardt, G. Rustioni, J. Harris (2016) First evidence of hydrous silicic fluid films around solid inclusions in gem-quality diamonds. *Lithos*, 260: 384-389. (RBSI140351: MILE DEEp)
  33. J. Gonzalez-Platas, **M. Alvaro**, F. Nestola and R.J. Angel (2016) EosFit7-GUI: A new GUI tool for equation of state calculations, analyses, and teaching. *Journal of Applied Crystallography*, 49: 1377-1382 (10.1107/S1600576716008050). (RBSI140351: MILE DEEp)
  34. Nestola F., **Alvaro M.**, Casati M.N., Wilhelm H., Kleppe A., Jephcoat A.J., Domeneghetti M.C., Harris J.W. (2016) Source assemblage types for cratonic diamonds from X-ray synchrotron diffraction. *Lithos*, 265: 334-338. (RBSI140351: MILE DEEp)
  35. M. Murri, L. Scandolo, A. Fioretti, M.C. Domeneghetti and **M. Alvaro** (2016). Fe-Mg equilibrium behaviour in augite: implications for the thermal history of terrestrial and extraterrestrial rocks. *American mineralogist* 101 (12), 2747-2750. (RBSI140351: MILE DEEp)
  36. Angel R.J., Milani S., **Alvaro M.**, Nestola F. (2016) High quality structures at high pressure? Insights from inclusions in diamonds. *Zeitschrift für Kristallographie*, 231(8): 467-473.
  37. Nestola F., **Alvaro M.**, Pearson D.G., Shirey S.B. (2016) “The nature of diamonds and their use in Earth's study”, Special issue preface. *Lithos*, 265: 1-3. (RBSI140351: MILE DEEp)
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  6. DMG-Short Course “Doktorandenkurs”: “High-Pressure Experimental Techniques and Applications to the Earth’s Interior”. Feb. 19 – 24<sup>th</sup> 2007. Bayreuth, D
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  10. **Alvaro M.**, Nestola F., Boffa Ballaran T., Cámara F., Domeneghetti M. C., Tazzoli V. HP – phase transition of a natural P21/c pigeonite: spontaneous strain and structure evolution. **EGU 2008**, Apr. 11 – 18<sup>th</sup> 2008. Wien, A
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  18. “Software fayre: going from raw data to hkl file”. **ECM26 2010 Workshop**, Aug 29<sup>th</sup> – Sept 5<sup>th</sup> 2010 Darmstad, D. *Invited talk*
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21. Gatta, G.D., **Alvaro M.**, Bromiley G. The effects of temperature on the crystal structure of a natural epidote. **Geoitalia 2011**, Sept 19<sup>th</sup> – 23<sup>rd</sup> 2011. Turin, I
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57. G. Zaffiro, R.J. Angel, **M. Alvaro**, F. Nestola, M.C. Domeneghetti, L. Scandolo, M.L. Mazzucchelli, S. Milani, G. Rustioni, C. Marciano. New micro-furnace for “in situ” high-temperature single crystal X-ray diffraction measurements. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 2<sup>nd</sup> - 4<sup>th</sup> 2015. Florence, I
58. **M. Alvaro**, R.J. Angel, M.L. Mazzucchelli, M.C. Domeneghetti, F. Nestola. Elastic geobarometry for UHPM rocks: A link between mineralogy and petrology. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 2<sup>nd</sup> - 4<sup>th</sup> 2015. Florence, I
59. Murri M., Scandolo L., **Alvaro M.**, Domeneghetti M.C., Fioretti A.M. Clinopyroxene Fe-Mg exchange reaction applied to Martian nakhlites. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 2<sup>nd</sup> - 4<sup>th</sup> 2015. Florence, I
60. G. Rustioni, R.J. Angel, S. Milani, M.L. Mazzucchelli, P. Nimis, M.C. Domeneghetti, F. Marone, **M. Alvaro**, J.W. Harris, F. Nestola. Elastic geobarometry for host-inclusion systems: Pressure release and the role of brittle failure. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 2<sup>nd</sup> - 4<sup>th</sup> 2015. Florence, I
61. S. Milani, L. Scandolo, G. Zaffiro, M. Di Prima, M.L. Mazzucchelli, **M. Alvaro**, M.C. Domeneghetti, F. Nestola. On the determination of the entrapment pressure for garnet inclusions in diamond. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 2<sup>nd</sup> - 4<sup>th</sup> 2015. Florence, I

62. M.L. Mazzucchelli, R.J. Angel, **M. Alvaro**, P. Nimis, M.C. Domeneghetti, F. Nestola. Host-inclusion geobarometry for ultra-high pressure metamorphic (UHPM) rocks. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 2<sup>nd</sup> - 4<sup>th</sup> 2015. Florence, I
63. S. Ferrari, **M. Alvaro**, F. Nestola, A. Maturilli, J. Helbert, M. C. Domeneghetti, M. Massironi and F. Zorzi. Thermal Expansion of C2/c Pyroxenes: Implications for the Thermal Infrared Spectroscopy of Solar System Bodies. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 2<sup>nd</sup> - 4<sup>th</sup> 2015. Florence, I
64. Chiara Anzolini, Fabrizio Nestola, Antony D. Burnham, Luca Peruzzo, Leonardo Tauro, **Matteo Alvaro**, Michael J. Walter, Mickey Gunther and Simon C. Kohn Diffraction and spectroscopic characterization of jeffbenite: a high-pressure marker in diamonds. **ECMS 2015**. September 9-11<sup>th</sup> 2015. Rome, I
65. Niccolò Menegoni, Fabrizio Nestola, **Matteo Alvaro** and Sula Milani. A combined micro-Raman spectroscopy and single-crystal X-ray diffraction approach: an example on natural and synthetic garnets. **ECMS 2015**. September 9-11<sup>th</sup> 2015. Rome, I
66. S. Milani, F. Nestola, **M. Alvaro** and V. Stagno. Diamond-eclogitic garnet pair: A test case to elastic geobarometry. **Goldschmidt 2015**.
67. Jones Adrian, Fabrizio Nestola, **Matteo Alvaro**, David Price. High-pressure shock behavior of diamond, laboratory experiments, synchrotron characterization and application to natural systems: examples and discussion. **CECAM** (Carbon at extreme conditions). October 26<sup>th</sup> - 30<sup>th</sup> 2015. Lugano, Swiss.
68. Nimis, P., Angel, R.J., Alvaro, M., Nestola, F. From mineralogy to petrology: The example of diamond and its inclusions. **Geologia delle Alpi**, Venezia November 20<sup>th</sup> 2015. Rendiconti Online Societa Geologica Italiana, 37, 47-49.
- 2016.**
69. **M. Alvaro**, R.J. Angel, C. Marciano, G. Zaffiro, L. Scandolo, M.L. Mazzucchelli, S. Milani, G. Rustioni, C.M. Domeneghetti, and F. Nestola. Development of a new micro-furnace for "in situ" high-temperature single crystal X-ray diffraction measurements. **24<sup>th</sup> Annual Meeting of the German Crystallographic Society (DGK)**, March 14<sup>th</sup> – 17<sup>th</sup> 2016, Universität Stuttgart, D.
70. R.J. Angel, **M. Alvaro**, P. Nimis, M.L. Mazzucchelli, F. Nestola. Single Inclusion Piezobarometry Reveals High-temperature decompression path for Variscan Granulites. **EGU 2016**, April 17<sup>th</sup> 22<sup>nd</sup> 2016. Wien, A
71. M.L. Mazzucchelli, R.J. Angel, G. Rustioni, S. Milani, P. Nimis, M.C. Domeneghetti, F. Marone, J.W. Harris, F. Nestola, **M. Alvaro**. Elastic geobarometry and the role of brittle failure on pressure release. **EGU 2016**, April 17<sup>th</sup> 22<sup>nd</sup> 2016. Wien, A
72. P. Nimis, **M. Alvaro**, F. Nestola, R.J. Angel, K. Marquardt, G. Rustioni, J.W. Harris. Hydrous Silicic Fluid Films around Solid Inclusions in Gem-Quality Diamonds. **IGC 2016**, 35<sup>th</sup> International Geological Congress, 27 August - 4 September 2016, Cape Town, South Africa.
73. M. Murri, L. Scandolo, A.M. Fioretti, M.C. Domeneghetti, **M. Alvaro**. Fe-Mg exchange reaction in clinopyroxene and its application to the thermal history of planetary bodies. **Lunar and Planetary Science Conference 21<sup>st</sup> -25<sup>th</sup> March**, Houston, Texas (USA).
74. Angel R.J., **M. Alvaro**, Gonzalez-Platas J. & Nestola F. New features in EosFit: fitting elastic moduli and phase transitions. European Mineralogical Conference – **EMC 2016**, 11<sup>th</sup>-15<sup>th</sup> September, Rimini, Italy.
75. Nimis P., **Alvaro M.**, Nestola F., Angel R.J., Marquardt K., Rustioni G. & Harris J.W. Hydrous silicic fluid films around solid inclusions in gem-quality diamonds. European Mineralogical Conference – **EMC 2016**, 11<sup>th</sup>-15<sup>th</sup> September, Rimini, Italy.
76. Nestola F., Angel R.J., Nimis P., **Alvaro M.**, Milani S., Harris J.W. The crystallographic orientations between diamond and its Mg-chromite inclusions. European Mineralogical Conference – **EMC 2016**, 11<sup>th</sup>-15<sup>th</sup> September, Rimini, Italy.
77. G. Rustioni, R.J. Angel, M.L. Mazzucchelli, S. Milani, P. Nimis, M.C. Domeneghetti, F. Marone, J.W. Harris, F. Nestola & **M. Alvaro**. Pressure release for host – inclusion systems: the interplay between brittle failure and fluid phase. European Mineralogical Conference – **EMC 2016**, 11<sup>th</sup>-15<sup>th</sup> September, Rimini, Italy.
78. **Alvaro M.**, Angel R.J., Mazzucchelli M.L., Nestola F. New constraints on PT evolution of metamorphic rocks from single inclusion piezobarometry. European Mineralogical Conference – **EMC 2016**, 11<sup>th</sup>-15<sup>th</sup> September, Rimini, Italy.

79. M. Murri, L. Scandolo, A.M. Fioretti, M.C., F. Nestola, Domeneghetti & **M. Alvaro**. new insights on Theo's flow lava using intracrystalline thermometry on augites. European Mineralogical Conference – **EMC 2016**, 11<sup>th</sup>-15<sup>th</sup> September, Rimini, Italy.
80. 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. European Mineralogical Conference – **EMC 2016**, 11<sup>th</sup>-15<sup>th</sup> September, Rimini, Italy.
81. **Alvaro M.** Solid state host-inclusion systems: a powerful tool to unravel geological and technological processes. Dept. of Chemistry, University of Frankfurt (December 2016). *Invited Seminar*.
82. **Alvaro M.** Mineral inclusions: a powerful tool for research in Earth Science. University College of London (December 2016). *Invited seminar*.
- 2017.**
83. Angel R.J., **M. Alvaro**, M.L. Mazzucchelli & Nestola F. EoSFit-Pinc: a GUI program to calculate pressures in host-inclusion systems. **EGU 2017**, April 17th 22nd 2017. Wien, A
84. Mazzucchelli M.L., Burnley P., Angel R.J., Domeneghetti M.C., Nestola F., **Alvaro M.** Elastic geobarometry: uncertainties arising from the geometry of the system. **EGU 2017**, April 17th 22nd 2017. Wien, A
85. **M. Alvaro**, Angel R.J., P. Nimis, S. Milani, J.W Harris & Nestola F. Orientation relationship between diamond and magnesiochromite inclusions. **EGU 2017**, April 17th 22nd 2017. Wien, A
86. AP Jones, **M Alvaro**, P McMillan, GD Price, J Milledge. "Lonsdaleite" signatures and shock remnants in mantle diamond? **EGU 2017**, April 17th 22nd 2017. Wien, A
87. Lucia Marinangeli, Loredana Pompilio, Anna Chiara Tangari, Antonio Baliva, **Matteo Alvaro**, Maria Chiara Domeneghetti, Franco Frau, Maria Teresa Melis, Giovanni Bonanno, Maria Consolata Rapisarda, Paolo Petrinca, Oliva Menozzi, Vasco Lasalvia, and Simone Pirrotta TOMOX : An X-rays tomographer for planetary exploration. **EGU 2017**, April 17th 22nd 2017. Wien, A
88. Angel, R.J., Mazzucchelli, M.L., Nestola, F., Alvaro, M. Elastic geobarometry: state of the art. **12th International Eclogite Conference**, August 20-29, 2017, Åre, Sweden.
89. Alvaro, M., Murri, M., Mazzucchelli, M.L., Prencipe, M., Campomenosi, M., Angel, R.J. Elastic geobarometry for UHP metamorphic rocks. **12th International Eclogite Conference**, August 20-29, 2017, Åre, Sweden.
90. Campomenosi, N., Scambelluri, M., Mihailova, B., Alvaro, M., Nestola, F., Mazzucchelli, M.L., Murri, M., Angel, R. J., 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**, August 20-29, 2017, Åre, Sweden.
91. Murri M., Mazzucchelli M.L., Prencipe M., Mihailova B., Scambelluri M., Campomenosi N., Angel R.J., Alvaro M. Ab initio simulation on quartz (SiO<sub>2</sub>) under hydrostatic stress vs isotropic strain. Associazione Italiana di Cristallografia **AIC2017**, 26-29 June 2017, Perugia
92. Murri M., Jones A.P., McMillan P.F., Salzmann C.G., **Alvaro M.**, Domeneghetti M.C., Nestola F., Prencipe M., Dobson D., Hazael R., Moore M. Structure characterization of impact natural diamond from Popigai crater. **Meteoritical Society Meeting 2017**, 24-28 July 2017 Santa Fe, New Mexico, USA.
93. Lucia Marinangeli, Loredana Pompilio, Anna Chiara Tangari, Antonio Baliva, **Matteo Alvaro**, Maria Chiara Domeneghetti, Franco Frau, Vasco La Salvia, Maria Teresa Melis, oliva Menozzi, Giovanni Bonanno, Maria Consolata Rapisarda, Paolo Petrinca, Simone Pirrotta and Angela Volpe TOMOX : An X-rays tomographer for lunar planetary exploration. **European Planetary Science conference (EPSC)**, Riga.
94. **Alvaro M.**, Jones A.P., McMillan P.F., Salzmann C.G., Murri M., Domeneghetti M.G., Nestola F., Prencipe M., Dobson D., Hazael R., Moore M., Vishnevsky S., Logvinova A.M. & Sobolev N.K. : Structure characterization of impact natural diamond from Popigai crater. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 3<sup>rd</sup> - 6<sup>th</sup> 2017. Pisa, I.
95. Bonazzi M., Tumiatì S., Poli S. & **Alvaro M.**: Synthesis of host-inclusion systems: Preliminary Data. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 3<sup>rd</sup> - 6<sup>th</sup> 2017. Pisa, I

96. Campomenosi N., Scambelluri M., Mihailova B., **Alvaro M.**, Nestola F., Mazzucchelli M.L., Murri M., Angel R.J. & Prencipe M.: Geometry and size effects on Raman shifts in natural host-inclusion systems: an experimental validation. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 3<sup>rd</sup> - 6<sup>th</sup> 2017. Pisa, I
97. Jones A.P., **Alvaro M.** & Collins G.S.: A new framework for shock transformation of terrestrial minerals in the lithosphere during bolide impacts. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 3<sup>rd</sup> - 6<sup>th</sup> 2017. Pisa, I
98. 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-AIV-SoGeI-SGI**. September 3<sup>rd</sup> - 6<sup>th</sup> 2017. Pisa, I [714936: TRUE DEPTHS]
99. Murri M., Cámara F., Adam J., Domeneghetti M.C. & **Alvaro M.**: Intracrystalline “geothermometry” assessed on clino- orthopyroxenes bearing synthetic rocks. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 3<sup>rd</sup> - 6<sup>th</sup> 2017. Pisa, I [714936: TRUE DEPTHS]
100. Zaffiro G., Angel R.J., Mazzucchelli M.L. & **Alvaro M.**: Towards a reliable equation of state for zircon. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 3<sup>rd</sup> - 6<sup>th</sup> 2017. Pisa, I [714936: TRUE DEPTHS]
101. Murri M., Mazzucchelli M.L., Prencipe M., Mihailova B., Scambelluri M., Campomenosi N., Angel R.J. & **Alvaro M.**: How does quartz respond to deviatoric stresses? Ab initio calculations on SiO<sub>2</sub> tectosilicate. **Congresso congiunto SIMP-AIV-SoGeI-SGI**. September 3<sup>rd</sup> - 6<sup>th</sup> 2017. Pisa, I [714936: TRUE DEPTHS]
102. **Alvaro M.**: An entire rock entrapped in a mineral grain: what can we learn from it? *Colloquia Doctoralia* at University of Perugia. 1<sup>st</sup> December 2017. *Invited seminar* [714936: TRUE DEPTHS]

## 2018.

103. Murri M., Jones A.P., McMillan P.F., Salzmann C.G., **Alvaro M.**, Domeneghetti M.C., Nestola F., Prencipe M., Dobson D., Hazael R., Moore M., Vishnevsky S., Logvinova A.M., Sobolev N.V. Crystal structure characterization of impact diamonds. International Diamond School “Diamonds: Geology, Gemology and Exploration”. 29th January -2nd February 2018, Brixen, Italy.
104. Murri M., Jones A.P., McMillan P.F., Salzmann C.G., **Alvaro M.**, Domeneghetti M.C., Nestola F., Prencipe M., Dobson D., Hazael R., Moore M., Vishnevsky S., Logvinova A.M., Sobolev N.V. XRD structure characterization of impact diamonds from Popigai crater. **XIV National Congress of Planetary Sciences** 5th -9th February 2018, Bormio, Italy.
105. Morana M., Murri M., Nestola F., Fioretti A.M., **Alvaro M.**, Domeneghetti M.C., Goodrich C., Shaddad M.H. Diamonds in the Almahata Sitta meteorite. **XIV National Congress of Planetary Sciences** 5th -9th February 2018, Bormio, Italy.
106. 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.
107. **Alvaro M.** News and views on inclusion barometry. Pierre et Marie Curie University, Paris. March 19th 2018. *Invited seminar* [714936: TRUE DEPTHS]
108. Gabriele Zaffiro, Ross John Angel, **Matteo Alvaro**, Mauro Prencipe, and Claudia Stangarone: P-V-T-K<sup>S</sup> Equations of State for zircon and rutile. **EGU 2018**, Wien, A. [714936: TRUE DEPTHS]
109. Nicola Campomenosi, Mattia Luca Mazzucchelli, Boriana Mihailova, Marco Scambelluri, Ross John Angel, and **Matteo Alvaro**: Elastic geobarometry: a comparison between experiments and numerical simulations. **EGU 2018**, Wien, A. [RBS1140351: MILE DEEP, 714936: TRUE DEPTHS]
110. Ross Angel and **Matteo Alvaro**: What Are Mineral Inclusions Really Telling Us about High-pressure Rocks? **EGU 2018**, Wien, A. [714936: TRUE DEPTHS]
111. **Alvaro M.** News and views on inclusion barometry and the possible role of overpressure. University of Milano Bicocca, Milano, Italy. May 3<sup>rd</sup> 2018. *Invited seminar* [714936: TRUE DEPTHS]
112. Németh, P., Tóth, S., Koós, M., Jones, A.P., McMillan, P.F., Miller, T., McGilvery, C., Salzmann, C.G., **Alvaro, M.**, Murri, M., Nestola, F., and Garvie, L.A.J. (Year) of Conference Peculiar graphite-diamond grains in the impact-produced Popigai sample. **Annual meeting of the Hungarian Society for Microscopy**, May 24th-26th 2018. Siófok - Lake Balaton, Hungary

113. Campomenosi N., Mazzucchelli M.L., Mihailova B., Scambelluri M., Stangarone C., Angel R.J., **Alvaro M.**: Raman spectroscopy as a tool to determine elastic strain in natural host-inclusion systems. **GeoRaman 2018**, Catania, I [714936: TRUE DEPTHS]
114. Mara Murri, Mauro Prencipe, Ross J. Angel, Boriana Mihailova and **Matteo Alvaro**: The role of the phonon Grüneisen tensor in the application of Raman spectroscopy for geobarometry. **GeoRaman 2018**, Catania, I
115. C. Stangarone, M. Prencipe, R. Angel, B. Mihailova, **M. Alvaro**: New insights into zircon-reidite phase transition: an ab initio study. **GeoRaman 2018**, Catania, I [R164WEJAHH: IMPACT, 714936: TRUE DEPTHS]
116. Mazzucchelli M.L., Angel R.J., Nestola F., **Alvaro M.**: Pressure estimates from fluid and solid inclusions in minerals. EGU - Galileo Conference, Liebnitz, A (24<sup>th</sup> 29<sup>th</sup> June 2018) [714936: TRUE DEPTHS]
117. Murri, M., Cámara, F., Adam, J., Domeneghetti, M.C., and **Alvaro, M.** (2018) Intracrystalline geothermometers validated on synthetic clino and orthopyroxenes and applied to a terrestrial analogue. **EPSC 2018** - European Planetary Congress, Berlin. [R164WEJAHH: IMPACT]
118. **Alvaro M**, Campomenosi N, Mazzucchelli ML, Mihailova BD, Scambelluri M & Angel RJ: Geothermobarometry of Inclusions from Raman Spectroscopy: Advantages and Limitations. **Goldschmidt Abstracts**, 2018 [RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]
119. Morana M., Murri M., Nestola F., Fioretti A.M., **Alvaro M.**, Domeneghetti M.C., Goodrich C., Shaddad M.H. X-ray diffraction study of diamonds from the Almahata Sitta meteorite. **XLVII Annual Meeting of the AIC**, 25th-28th June 2017, Roma, Italy.
120. **Alvaro M.** Using Crystal physics to unravel geological puzzles (Premio Nardelli talk) **XLVII Annual Meeting of the AIC**, 25th-28th June 2017, Roma, Italy.
121. 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. **Congresso congiunto SIMP-SGI**. September 12<sup>th</sup> – 14<sup>th</sup> 2018. Catania, I [RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]
122. Gilio M., Campomenosi N., Scambelluri M. & **Alvaro M.**: Raman vs. classic geothermobarometry: a comparative study. **Congresso congiunto SIMP-SGI**. September 12<sup>th</sup> – 14<sup>th</sup> 2018. Catania, I [RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]
123. Mazzucchelli M.L., Angel R.J., Morganti S., Reali A. & **Alvaro M.**: Elastic geobarometry for elastically anisotropic inclusions. **Congresso congiunto SIMP-SGI**. September 12<sup>th</sup> – 14<sup>th</sup> 2018. Catania, I [RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]
124. Murri M., Mazzucchelli M.L., Campomenosi N., Korsakov A.V., Prencipe M., Mihailova B.D., Scambelluri M., Ange R.J. & **Alvaro M.**: Raman elastic geobarometry for anisotropic mineral inclusions. **Congresso congiunto SIMP-SGI**. September 12<sup>th</sup> – 14<sup>th</sup> 2018. Catania, I [RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]
125. Van Schroyen Lantman H.W., Wallis D., Scambelluri M. & **Alvaro M.**: Applying elastic geobarometry on the Lago di Cignana UHPM unit: preliminary results. **Congresso congiunto SIMP-SGI**. September 12<sup>th</sup> – 14<sup>th</sup> 2018. Catania, I [RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]
126. Bonazzi M., Tumiati S., Thomas J. & **Alvaro M.**: Raman approach to evaluate the strain state of synthetic host-inclusion pair. **Congresso congiunto SIMP-SGI**. September 12<sup>th</sup> – 14<sup>th</sup> 2018. Catania, I [RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]
127. Piazzì M., Morana M. & **Alvaro M.**: Fingerprinting diamonds growth conditions through the time and temperature dependence of the properties of magnetic inclusions. **Congresso congiunto SIMP-SGI**. September 12<sup>th</sup> – 14<sup>th</sup> 2018. Catania, I [RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]
128. Zaffiro G., Angel R.J., Prencipe M., Stangarone C. & **Alvaro M.**: A novel approach to determine accurate Equations of State for zircon and rutile. **Congresso congiunto SIMP-SGI**. September 12<sup>th</sup> – 14<sup>th</sup> 2018. Catania, I [RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]
129. Angel R.J., **Alvaro M.** & Nestola F.: Beyond routine refinements in a routine way. **Congresso congiunto SIMP-SGI**. September 12<sup>th</sup> – 14<sup>th</sup> 2018. Catania, I [RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]



130. Marinangeli L., Pompilio L., Baliva A., **Alvaro M.**, Bonanno G., Domeneghetti M.C., Frau F., La Salvia V., Melis M.T., Menozzi O., Tangari A.C., Rapisarda M., Petrinca P. & Pirrotta S. : An X-Rays tomographer (Tomox ) for in situ planetary exploration. **Congresso congiunto SIMP-SGI**. September 12<sup>th</sup> – 14<sup>th</sup> 2018. Catania, I [R164WEJAHH: IMPACT, RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]
131. Morana M., Murri M., Nestola F., Barbaro A., Fioretti A.M., **Alvaro M.**, Domeneghetti M.C., Goodrich C. & Shaddad M.H. : Diamond formation in ureilites: a shock origin inferred from diamond in Almahata Sitta ureilites. **Congresso congiunto SIMP-SGI**. September 12<sup>th</sup> – 14<sup>th</sup> 2018. Catania, I [R164WEJAHH: IMPACT, RBSI140351: MILE DEEP, 714936: TRUE DEPTHS]
132. Alvaro M. Mineral inclusion – host systems as natural high-pressure cells. Universidad La Laguna, Tenerife, Spain. October 9<sup>th</sup> - 12<sup>th</sup> 2018. *Invited seminar* [714936: TRUE DEPTHS]

## 2019.

133. Piazzzi, M., Morana, M., Coisson, M., Ferrara, E., Basso, V., Jones, A.P., and **Alvaro, M.** Experimental study and physical interpretation of hysteresis of magnetic inclusions in Earth diamonds. **Magnet** 19, 2019/1/31. Messina, Italy [R164WEJAHH: IMPACT]
134. Barbaro, A., Domeneghetti, M.C., Meneghetti, M., Litti, L., Fioretti, A.M., Goodrich, C., Shaddad, M.H., **Alvaro, M.**, and Nestola, F. Graphite-based geothermometry of Almahata Sitta meteorite. **XV National Congress of Planetary Sciences**, 2019/2/04-08. Florence [R164WEJAHH: IMPACT]
135. Murri, M., Cámara, F., Adam, J., Domeneghetti, M.C., and **Alvaro, M.** Intracrystalline geothermometry applied to a Martian analogue. **XV National Congress of Planetary Sciences**, 2019/2/04-08. Firenze, Italy. [R164WEJAHH: IMPACT]
136. Stangarone, C., Angel, R.J., Prencipe, M., Mihailova, B.D., and **Alvaro, M.** New insights into the zirconoidite phase transition as an indicator of impact structures. **LPSC 2019** - Lunar and Planetary Science Conference, 2019/4/18-22. Huston, TX, USA [R164WEJAHH: IMPACT, 714936: TRUE DEPTHS]
137. Mihailova, B., Stangarone, C., Waesermann, N., Angel, R.J., Prencipe, M., and **Alvaro, M.** A new high-pressure polymorph of ZrSiO<sub>4</sub> revealed by DFT modelling and Raman spectroscopy. **DGK**, 2019/3/25-28. Leipzig, Germany [714936: TRUE DEPTHS]
138. Angel, R.J., Zaffiro, G., Stangarone, C., Mihailova, B., Murri, M., and **Alvaro, M.** The Limitations on Quasi-harmonic Thermal-Pressure Equations of State from Anisotropic Thermal Pressure. **DGK**, 2019/3/25-28. Leipzig, Germany [714936: TRUE DEPTHS]
139. **Alvaro, M.**, Gilio, M., Angel, R., and Scambelluri, M. Elastic geothermobarometry on multiple inclusions in a single host. **EGU General Assembly 2019**, 2019/4/8-12. Vienna, A [714936: TRUE DEPTHS]
140. Angel, R., Zaffiro, G., Stangarone, C., Mihailova, B., Murri, M., and **Alvaro, M.** The Limitations on Quasi-harmonic Thermal-Pressure Equations of State from Anisotropic Thermal Pressure. **EGU General Assembly 2019**, 2019/4/08-12. Vienna, A [714936: TRUE DEPTHS]
141. Lantman, H.v.S., Wallis, D., Scambelluri, M., and Alvaro, M. Garnetite formation along fluid pathways in subducting oceanic sediments from Lago di Cignana, Western Alps. **EGU General Assembly 2019**, 2019/04/8-12. Vienna, A [714936: TRUE DEPTHS]
142. Campomenosi, N., Mazzucchelli, M.L., Mihailova, B.D., Angel, R.J., Scambelluri, M., and **Alvaro, M.** Analysis of induced birefringence in host-inclusion mineral systems: a Raman spectroscopy approach. **EGU General Assembly 2019**, 2019/04/8-12. Vienna, A [714936: TRUE DEPTHS]
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## • RESEARCH INTERESTS AND TRACK RECORD

The overall goal of my research is the determination of the chemical, physical and mechanical properties of minerals that represent the deep regions of the Earth because these properties govern planet-scale geological processes such as convection, plate tectonics and subduction. In detail, my research activity is focused on the *in situ* determination of the thermo-elastic properties of minerals by means of X-ray diffraction (XRD) techniques applied under extreme conditions of pressure and temperature. Furthermore, I have dedicated a large part of my research to shed light on geological processes occurring on planetary bodies by investigating minerals from meteorites.

Since the start of my bachelor and masters degrees at the University of Pavia I have focused all of my efforts on the investigation of crystal-chemical properties (*i.e.* cation substitution and order-disorder phenomena) of mineral phases relevant for the Earth and planetary sciences (*e.g.* publication number 19). During my Ph.D. I directed my interests towards the investigation of the elastic properties of mantle minerals under extreme conditions of temperature and pressure. My PhD project was entirely devoted to the application and development of high-pressure and high-temperature (*in situ* and *ex situ*) methods mostly in combination with single-crystal X-ray diffraction (SC-XRD). That research (3 years) allowed me to author several papers (*e.g.* 2,5,7) focused on the high-pressure and high-temperature phase transformations of pyroxenes with compositions typical of the Earth's upper mantle and of a class of meteorites called ureilites. The aim of this work was to (i) understand the effects of common chemical substitutions on mineral elastic behavior (*i.e.* phase transitions at high temperatures and pressures as possible cause for seismic discontinuities) and (ii) determine the equilibrium exchange reaction on the same phases to understand and interpret host meteorites cooling history.

After completion of my PhD in 2010, I obtained a position as a post-doctoral fellow (funded by NSF grant EAR 0738692 to N.L. Ross and R.J. Angel) at Virginia Polytechnic Institute and State University in Blacksburg (Virginia, USA). My research at Virginia Tech was focused on the high-pressure and low-temperature behavior of hydrous mantle minerals with framework structures (*i.e.* zoisite, kalsilite, epidote etc.) relevant for subduction

processes in the Earth. The papers published during the period at Virginia Tech (*e.g.* 11,13) show the relevance of accuracy and precision in the determination of the elastic properties of mineral phases.

Immediately after the post-doc at Virginia Tech I moved back to Italy to collaborate as a team member to the MARS-XRD project (P.I. Lucia Marinangeli) for EXO-MARS mission (2018 ESA) developing calibrations of exchange reaction equilibria for pyroxenes contained in meteorites and their terrestrial analogues. This research allowed me to publish some papers (*e.g.* 18, 14,12) and develop many new ideas for research to be carried out in the field of planetary science (*e.g.* 20).

The experience gained during my PhD and two post-doctoral positions (in United States and Italy) allowed me to obtain a position as a post-doctoral research fellow at University of Padua funded by the European Research Council (ERC grant #307322, acronym **INDIMEDEA**, PI F. Nestola). The INDIMEDEA project was devoted to determining the processes and depth of formation of cratonic diamonds using the information retrieved from the orientation and elastic behavior of mineral phases trapped in natural diamonds as inclusions.

The first two years of work within the framework of the INDIMEDEA project allowed me to start revisiting general elasticity theory (*e.g.* see publications 1,3,6,8,10,15) to prepare the ground for re-writing a newly developed elasticity formalism. Development of these ideas allowed me to obtain some funds from the Italian Ministry of Research and University for a project named **MILE DEEP** (project code: RBS1140351). This funding allowed me to recruit 4 PhD students to expand my research group and to start developing the mineral physics laboratory at the University of Pavia. The project is mainly aimed to develop the isotropic elastic method and perform the first in situ measurements on isotropic host-inclusion pairs. Early development of the MILE DEEP project revealed that in order to generalize the method and extend it to any type of rock, further development beyond the case of simple non-linear elastic isotropy was necessary. Furthermore, testing the general results is also mandatory. Therefore, I developed a complementary project "**TRUE DEPTHS**" (project code: 714936), funded by the European Research Council (ERC) in the framework of the ERC starting grant call in 2016, aimed to further generalize elasticity theory by incorporating anisotropic elasticity and geometrical effects. The main goal of the ERC-funded project is to explore the use of elastic anisotropy of hosts and their inclusions to provide a quantitative estimate of the stresses acting on the host inclusion pair and obtain a quantitative estimate of both the full stress field and T for an entire outcrop that can be then linked with time. This will enable the first quantitative stress-depth-time evaluation to be performed extensively across some of the most crucial ultra-deep subduction zones in Europe. The interest for the effect of oriented stresses on common minerals led me to develop another research project "**IMPACT**" (project code: R164WEJAHH) funded by the Italian Ministry for Research and University (MIUR) to investigate the effect of uniaxial compression on planetary materials and applied to extraterrestrial micro-diamonds.

The entire development of my research is supported by experimental and theoretical interests that includes the following main topics:

- **High pressure** study of crystalline material by means of single-crystal X-ray diffraction using DAC (Diamond Anvil Cell) apparatus mounted on point detector and area detector diffractometers (*i.e.* Rigaku, Bruker and Huber systems). In particular, these experiments have a wide variety of applications from the elastic response of mineral from the Earth's mantle (*e.g.* publications 2, 4, 9, 11 etc..) to industrial/commercial development and applications (*i.e.* ceramic industry, gemstone industry etc... see publications 6, 8, 10, 17).
- **High temperature** study of crystalline material *in situ* by single-crystal X-ray diffraction using micro-furnace mounted on conventional diffractometer (*i.e.* Philips, Huber, Bruker and Rigaku systems). These experiments have a wide variety of applications ranging from the elastic response of minerals from the Earth's mantle (*e.g.* publication 3, 21), the spectral analysis of planetary bodies (*e.g.* publication 15) to industrial/commercial development and application (*i.e.* ceramic industry, gemstone industry etc...see publications 3, 14, 16). To this aim I developed a new high-temperature device (publication 29) with considerably improved performances with respect to its predecessors. It allows determining lattice thermal expansion on single-crystals by means of X-ray diffraction up to 1200K with much higher precision and accuracy than before, using the same methods adopted for high-pressure measurements (*e.g.* 8-position centring).

- Kinetic and equilibrium study of crystalline material at high temperature conditions *ex situ* by single-crystal X-ray diffraction (i.e. Rigaku and Bruker area detector systems) using ovens for the annealing experiments. These experiments are relevant to study Earth and planetary processes such as cooling rate and history of terrestrial and extraterrestrial rocks (e.g. publications 1, 5, 12, 23, 35, 46).
- Low temperature study of crystalline material *in situ* by single crystal X-ray diffraction (i.e. using cryojet systems mounted on area detector diffractometer). These studies are devoted to the investigation of crystalline materials with ferroelectric and magneto-electric properties (e.g. publication 7). Few more applications recently on development regards the analysis of spectroscopic data at low temperature in order to apply the results to the shadow zones on planetary bodies (e.g. 15).
- Elasticity: All the experimental methods above mentioned are fundamental experimental tools for the characterization of crystalline material under non-ambient conditions. Analysis of these experimental results requires knowledge of linear and non-linear elasticity. To this aim most of my latest research had been devoted to further extend and simplify elasticity theories to be applied to crystalline material (e.g. publications 18, 21). The recently developed EoSFit7c program allows users with basic knowledge on elasticity to expand their capabilities for data analysis including linear and non-linear elasticity in a simple manner.
- Host-inclusion systems: Expanding the limits for linear and non-linear elasticity intrinsically means dealing with more complex system such as “host-inclusion systems” where the elastic response of the single-phase components needs to be combined to allow the evaluation of the elastic response of the multicomponent system (e.g. publication 19, 22, 26, 27). Such multicomponent systems are among the most common cases on several disciplines going from earth sciences to material sciences (i.e. from mantle minerals to cements). Within the framework of the recently developed EoSFit7c program (publication 18) the “isomeke tool” has been developed and is still currently under development. Such tools will allow the retrieval of the entrapment pressures by means of linear and non-linear elasticity of two isotropic spherical components (host-inclusion) system also accounting for elastic relaxation effects. Furthermore, current developments are aimed to expanding the program capabilities to handle anisotropic and non-spherical inclusion-host systems.
- Diamonds are of fundamental carrier of information from the deep Earth and from the outer space. The investigation of mineral inclusions in diamonds can provide a wealth of information on the Earth mantle state and processes (e.g. publications 33, 34). I started to carry out research on such topic while member of the INDIMEDEA project funded by the European community to F. Nestola (#307322). At the same time, diamond itself can be used to retrieve insight into large scale planetary processes such as impact cratering as well as to shed light on the origin of primordial carbon in the early solar system. Currently this part of my research is sustained by one research grant funded by the Italian Ministry for Research and University (MIUR, project code: R164WEJAHH) titled IMPACT (StackIng disorder in diaMonds as a tool for investigating imPACT CraTers). One of my PhD student (Mara Murri) has been supported during her master degree by a small research grant (5.000\$) awarded by the Barringer Family (Barringer award for impact cratering research) to carry out part of the project.

Matteo Alvaro

