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Personal Details

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SUMMARY

I have been a research crystallographer for my entire scientific career of over 30 years, during which time I have authored or co-authored more than 225 publications in international scientific journals, with an h -index of 47. The focus of my research has been to understand the structure-property relationships of key industrial and geological materials with the aim of providing the basis for rationale materials design and understanding geological processes:

- I have developed and established novel methods for single-crystal diffraction at extreme conditions in order to characterize and understand the fundamental relationship between the atomic-scale structures and properties of materials. The software that I have developed for diffractometer control and processing of data is distributed freely from my web site and is in use by many research groups world-wide.
- I am applying elasticity theory to understand the properties of composite materials so as to develop a method of piezobarometry to determine rock histories independent of chemical methods.
- I have used diffraction methods in combination with Landau theory, symmetry-mode analysis, and a novel topological forward-modelling technique that I have developed, to determine the structure-property relationships of framework structures. These include the most abundant minerals in the Earth and the most important materials for electronics (perovskites) and chemical engineering (zeolites and MOFs).

This research has been recognised by international and national awards, and professorships, and by industry in the form of collaborations with instrument development companies. I have served the scientific community in professional societies, as a journal editor for more than 20 years, and as a member of numerous review panels for national funding agencies and central facilities. I am also very active in teaching crystallography, diffraction methods, elasticity theory, and scientific communication skills, both in regular courses and as workshops and seminars.

RESEARCH PRODUCTIVITY 2012-2018

- 50 publications in ISI journals, 2 in press.
- These papers have 601 citations in 442 articles (not counting self-citations).
- More than 400 citations each year to all of my publications
- H-index = 47
- 15 invited seminars
- 10 conference invited and plenary talks, 22 other first-author conference talks
- 55 contributions to national and international meetings as co-author

SKILLS AND EXPERTISE

- Crystallography, and the relationship between materials structure and properties.
- Development of single-crystal and powder diffraction methods for determining structures of crystalline materials, especially *in-situ* at non-ambient conditions.
- Software development for interactive control of scientific instrumentation for data collection.
- Software development for scientific data analysis.
- Data analysis.
- Teaching of crystallography, mineralogy, mineral physics and physics of the solid state.
- Direction and management of scientific research projects and programs.
- Scientific writing and editing.
- Teaching of scientific communication in English
- Languages: English (native speaker), Italian (basic), German (basic)

APPOINTMENTS, AWARDS AND QUALIFICATIONS

2017: Abilitazione Scientifica Nazionale, Settore 04/A1, Fascia I e Fascia II (to 10/04/2023).
2013: Appointed adjunct Professor in the Department of Geosciences, Virginia Tech.
2012: Guest Professorship, University of Innsbruck, Austria
2011: Cariparo visiting Professorship, University of Padova, Italy
2011: Mercator Professorship of the German Research Foundation, University of Hamburg
2011: Dana Medal of the Mineralogical Society of America.
2005: Appointed adjunct Professor in the Department of Biological Sciences, Virginia Tech.
2001: Appointed Professor of Crystallography, Department of Geosciences, Virginia Tech.
1998: European Mineralogical Union Medal for Research Excellence.
1993: Max Hey Award of the Mineralogical Society of Great Britain.
1991: Phillips Crystallography Award of the British Crystallographic Association.
1991: Elected Fellow of the Mineralogical Society of America.
1990: Mineralogical Society of America Crystallography Research Grant.
1988: Royal Society University Research Fellowship (10 years).
1987: Carnegie Institution of Washington Post-doctoral Fellowship.
1986: Ph.D. from University of Cambridge.
1986: M.A. from University of Cambridge.
1985: NATO Overseas Research Fellowship.
1982: First class honours B.A. in Mineral Sciences from University of Cambridge.
1979: Open scholarship to Clare College, Cambridge.

ACADEMIC RECORD

2017 - present

Research Scientist, Dipartimento di Scienze della Terra e dell'Ambiente, Università degli Studi di Pavia, Italy.

Research: The development of elasticity theory to determine the stress state in the Earth's crust from measurements of stress in mineral inclusions.

2013 - 2017

Research Scientist, Dip. Geoscienze, Università degli Studi di Padova, Italy.

Research: The development of new software for the measurement and reduction of single-crystal diffraction intensity data, and for analysis of equations of state, as part of the INDIMEDEA ERC project developed and led by Prof. F. Nestola. The aim of the project is to determine the formation conditions of natural diamonds from the measurement of included minerals. To achieve this, I am developing a novel method of piezobarometry to determine rock and mineral histories (P-T paths) from the elastic interactions between constrained phases.

I am also teaching classes in elasticity and in scientific communication at the graduate student level, both in Padova and as a guest lecturer at other Universities and Research Institutes.

2013 - present

Adjunct Professor in Department of Geosciences, Virginia Tech

2012 (October)

Guest Professor, Institute of Mineralogy and Petrography, University of Innsbruck, Austria.

An appointment to teach a block course on elasticity to students in Mineralogy and Chemistry.

2011 - 2012

Visiting Professor, Dip. Geoscienze, Università degli Studi di Padova, Italy.

This was primarily a teaching appointment. I taught classes in elasticity and in scientific communication at the graduate student level. Research: The development of a forward-modelling rigid-body approach to explain the elastic properties of framework materials, with a focus on the feldspar group of minerals. I also worked with Prof. Artioli on the development of an elasticity model of composites in general, and cement pastes in particular, funded by the INSTM foundation.

2011

Mercator Professor, Mineralogisch-Petrographisches Institut der Universität Hamburg, Germany.

Research: We developed the ability to measure diffuse scattering from single crystals at high pressures and applied this to determine the detailed atomic-scale mechanisms that underlie the electronic properties of perovskite-structured relaxor ferro-electrics, and their relationship to the development of 2-mode behaviour in single phases in solid solutions. In collaboration with Prof. B. Mihailova and Prof. U. Bismayer.

2001 - 2011

Research Professor in Crystallography, Department of Geosciences,
Director, Virginia Tech Crystallography Laboratory,
Adjunct Professor in Department of Biological Sciences, Virginia Tech from August 2005.

I established and coordinated the activities of the Virginia Tech Crystallography Laboratory as a co-located facility of the Departments of Biological Sciences, Chemistry, and Geosciences with staff, faculty and students from all three departments. The facility performed service crystallography and conducted research programs across mineralogical, protein and small-molecule crystallography. I developed close links between the laboratory and Oxford Diffraction, which brought more than \$2.7 million direct investment into the University, and further investment in the local economy.

After a very successful 10 years at Virginia Tech, I resigned in order to return to Europe for personal reasons.

Research: Development of single-crystal diffraction techniques for in-situ studies of crystalline materials at high pressures to understand the crystal-chemical and quantum-mechanical principles that govern the compression of complex structures, including minerals, molecular compounds, ferroelastic and ferroelectric device materials. In particular, we discovered the principle that the relative compressibility of framework and extra-framework sites governs the elastic behaviour of perovskites, which comprise 50% by volume of the entire Earth. The results provided the key insights in to the complex behaviour and properties of ferro-relaxor perovskites which are used as electronic materials.

1994 - 2000

Staff member of the Bayerisches Geoinstitut responsible for X-ray diffraction.

Research: I led the development of single-crystal diffraction techniques for in-situ studies of minerals at high pressures. I improved the precision with which cell parameters can be determined at high pressure by approximately an order of magnitude. This allowed the detailed determination of the high-pressure behaviour of minerals, including feldspars, pyroxenes, amphiboles, and perovskites, and the characterisation of non-quenchable high-pressure phase transitions, crossovers, and compression mechanism changes in these materials. With my colleagues I also discovered and characterised a number of novel high-pressure phases, including the first and only known crystalline compound to contain silicon in 5-coordination by oxygen.

1988 - 1994

Royal Society "1983 University Research Fellow", jointly at Department of Geological Sciences, University College London and Department of Crystallography, Birkbeck College, University of London.

Research: The determination of feldspar bulk moduli by in-situ high-pressure single-crystal diffraction. The characterisation of the non-quenchable displacive phase transition in anorthites at high pressures and temperatures. The characterisation of the compression behaviour and phase transitions in $(\text{Mg,Fe})\text{SiO}_3$ pyroxenes, including the discovery of a major mantle phase, high-pressure high-clinoenstatite.

1987 - 1988

Post-doctoral Fellow at the Geophysical Laboratory of the Carnegie Institution of Washington.

Research: Single-crystal diffraction of feldspars at ambient conditions to determine the state of Al,Si order and its variation with thermal treatment. High-pressure diffraction studies of feldspars, and the discovery of a new displacive phase transition in anorthite. Structural studies of superconductors, including the first determination of the structure of the 90K "1-2-3" $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ material, and characterisation of several >100K superconductors in the Bi-Ca-Sr-Cu-O and Tl-Ba-Cu-O systems (with LW Finger, CT Prewitt, RM Hazen, and NL Ross).

1985 - 1987

NATO Overseas Research Fellow, first year at State University of New York at Stony Brook, second year at the Geophysical Laboratory, Washington. Supervisor: Dr. C.T. Prewitt

Research: The characterisation of incommensurate structures in insulators by single-crystal X-ray and neutron diffraction.

1982 - 1985

Graduate student in the Department of Earth Sciences, University of Cambridge, England. PhD supervisor: Dr. Andrew Putnis.

Research: The determination of the factors that determine the relative stabilities of pyroxenes and pyroxenoids. Synthesis of chain-silicate minerals at ambient pressures and high temperatures, and piston-cylinder studies. Characterisation by powder diffraction and high-resolution TEM, theoretical and computer modelling.

1979 - 1982

Undergraduate of Clare College in the University of Cambridge, England, studying for the Natural Sciences tripos. Courses in mathematics, physics, chemistry, metallurgy and materials science, crystallography, mineralogy and geochemistry. Degree specialisation: Mineral sciences.

1970-1978

Scholarship at Trinity School of John Whitgift, Croydon, Surrey, England. Passed 9 O-levels (8 grade A), 4 A-levels in mathematics, further mathematics, physics, and chemistry (all grade A), and 2 S-levels in physics and chemistry.

TEACHING 2012-2018

University of Pavia: 48 hour course on ‘Physical Properties of Rocks and Minerals’ for MSc students in Dept. Earth and Environmental Sciences. Autumn semester 2018.

University of Pavia: 16 hour course on ‘Single-crystal Xray Diffraction’ for PhD students in Dept. Earth and Environmental Sciences. Autumn semester 2018.

University of Padova: 20 hour course on ‘Scientific communication in English’ for PhD students in Geosciences, integrated with the annual presentations made by the students to the department. November 2012 and 2013, October 2014, September 2015, June 2016, July 2017.

‘Elasticity and EoS’, taught on-line to students in Pavia, Padova, Hamburg, and Genova. 48 hours of lectures and workshops. October 2016 – February 2017.

International School of Crystallography, 49th course, 27 May-5 June 2016, “High-pressure crystallography: status artis and emerging opportunities”. Gave four invited lectures and three workshops.

Bayerisches Geoinstitut, Universitaet Bayreuth: Course on ‘Elasticity of Minerals and Rocks’ (total of 12 hours) to research students and post-docs. June 2013 and June 2015.

University of Pavia, Italy, 5-7 May 2015: Elasticity short-course (12 hours) for students and post-docs at the Dipartimento di Scienze della Terra e dell'Ambiente, jointly taught with M. Alvaro.

Bressanone, Italy, 2-5 February 2015: A series of three lectures on 'Elasticity and Equations of State' at the GNM school for Italian graduate students "La fisica dei minerali: implicazioni geologiche e applicazioni pratiche".

Ellwangen, Germany: Two lectures as part of the DGK (German Crystallographic Society) Summer School on 'Theory and Practice of Modern Powder Diffraction'. October 2014.

University of Padova: Course on 'Elasticity of Materials' taught to the PhD school of the Department of Geosciences and students from the Engineering faculty and other Italian Universities. 20 hours of lectures plus a workshop. February 2013.

University of Innsbruck: I taught a "block course" of 7 lectures (total of 14 hours) on 'Elasticity and Equations of State' to students and faculty of the University of Innsbruck. Course was hosted by the Institute for Mineralogy and Petrography. October 2012.

University of Padova: Lecture course on 'Structure and Elasticity' taught as part of the Department curriculum in Applied Geology. 48 hours of lectures. Taught (for the very first time in department's history) to a combined class of 13 undergraduate and master's students in geology, joined (at various times) by another 15 students, PhD students, post-doctoral researchers and faculty. October 2011 – January 2012.

Novosibirsk, Russia: I gave eight presentations at a 5 day workshop devoted to advanced crystallographic methods at the University. October 2013.

SERVICE (RECENT)

- Member, Editorial Advisory board, *Zeitschrift für Kristallographie*, 2013-present.
- Member Dana Award Committee, Mineralogical Society of America, 2014-2016.
- Technical Editor for crystal structures, *American Mineralogist*, 2013-present.
- Guest Editor, special issue of *Zeitschrift für Kristallographie*, published 2014.
- Associate Editor, *European Journal of Mineralogy*, 1994-2013.
- Councilor, Mineralogical Society of America 2005-2007.
- Member, Facilities Access Panel, ISIS spallation neutron source, UK (panel reviews applications for beam time) 2004 – 2007.
- Chair, Organising Committee, Virginia Tech Structural Biology Symposium, 2006-2009.
- Organiser, Transactions Symposium, American Crystallographic Association, Annual Meeting, 2009.
- Chair, Program Committee, American Crystallographic Association Annual Meeting, 2010.
- Member, Communications Committee, American Crystallographic Association, 2010-2013.

- Member, High-pressure commission of the International Union of Crystallography 2010-2017. Consultant, 2017- present.
- Proposal reviews for: European Science Foundation, National Science Foundation (USA), Austrian Science Foundation, Helmholtz Foundation (Germany), Natural Environment Research Council (UK), Council for the Central Laboratory of the Research Councils (UK), DFG (German Science Foundation), Polish National Science Foundation, PRIN-MIUR (Italy).

MEETING & WORKSHOP ORGANISATION 2012-2018

- Convenor, workshop on “Solid inclusions in minerals as records of geological processes”, 2nd European Mineralogical Conference, Rimini, Italy, 16 September, 2016.
- Convenor, session S9 “Inclusions in minerals as record of geological processes: new analysis methods and applications”, 2nd European Mineralogical Conference, Rimini, Italy, 11-15 September, 2016.
- Convenor, workshop on “EosFit”, European Crystallography Meeting, Rovinj, Croatia, 28 August, 2015.
- Member, Program Committee, Workshop on “Methods of high-pressure single-crystal diffraction”, European Crystallography Meeting, Bergen, Norway, 4-5 August, 2012.

PROFESSIONAL AFFILIATIONS

- Associazione Italiana Cristallografia
- Deutsches Mineralogische Gesellschaft
- Deutsches Gesellschaft für Kristallographie
- Mineralogical Society of America
- Mineralogical Society of Great Britain and Ireland
- Societa' Italiana di Mineralogia e Petrologia

RESEARCH FUNDING 2001-2011

• NSF: Framework Minerals, 2001-04 (co-PI with NL Ross)	\$241,544
• NSF: Framework Minerals 2004-08 (co-PI with NL Ross)	\$294,767
• NSF: Framework Minerals 2008-10 (co-PI with NL Ross)	\$349,094
• NSF: NATO- Fellowship for Dr. M. Bujak 2004-06	\$46,200
• Advance-VT: Fellowship for Dr. Carine Vanpeteghem, 2004-05	\$30,000
• NSF, Compress: CEAD software project (2006-07)	\$84,486
• NSF: Sulphides project 2006-09 (co-PI with NL Ross)	\$267,820
• NSF: CSEDI Mantle convection (co-PI with SD King)	\$253,720
• NSF: Feldspars NSF EAR-118691 (PI with co-PI NL Ross)	\$398,341
• Total US Federal funding:	\$1,965,972
• Oxford Diffraction:	\$2,750,000

POST-DOCS

At Bayreuth (1994-2000):

- Dr. D.R. Allan (now beamline scientist, Diamond synchrotron, UK)
- Dr. Th. Arlt (now full-time mineral collector and dealer, Switzerland)
- Dr. T. Boffa-Ballaran (now staff member, Bayerisches Geoinstitut)
- Prof. R. Miletich (now Prof. Crystallography, Vienna).

At Virginia Tech (2001-2011):

- Dr. M. Koch (2004-05, now Heidelberg)
- Prof. M. Bujak (2005-06, now on faculty of University of Opole, Poland)
- Dr. J. Zhao (2002-2011, still at VT)
- Dr. N. Vogelaar (2003-2009, still at VT)
- Dr. C. Vanpeteghem (2004-2006, now at University of Ottawa, Canada)
- Dr. F. Nestola (2005-06, now Professor at University of Padova, Italy)
- Dr. J. Yan (2006-08, now at UC Berkeley)
- Dr. J. Engel (2007-08, now working for a commercial instrument company, Frankfurt, Germany)
- Dr. E. Spencer (2007-2011, still at VT)
- Dr. Y. Yu (2008-2010, now University of Colorado)
- Dr. M. Alvaro (2010-2011, now at University of Pavia, Italy)

RECENT TALKS & SEMINARS

Seminars

How do diamonds grow in the deep lithosphere?. Universitaet Wien, Austria, 28 April, 2017.

How do diamonds grow? Insights from crystallography. Universitaet Bern, Switzerland, 20 December, 2016.

How and where do diamonds form? Answers from crystallographic studies. Universitaet Hamburg, Germany, 20 March, 2015.

Where do diamonds grow? A crystallographic approach. Diamond & ISIS, Rutherford-Appleton Laboratory, Didcot, England. 9 December, 2014.

How and where do diamonds form? Insights from the crystallography of inclusions. GeoForschungsZentrum, Postdam, Germany, 21 March, 2014.

Structure and function: why are feldspars so anisotropic? Bayerisches Geoinstitut, Bayreuth, Germany, 27th June, 2013.

Why are feldspars so anisotropic? ETH Zurich, Switzerland, 13th December, 2012.

Why are feldspars so anisotropic? Geokolloquium, University of Innsbruck, Austria, 25th October, 2012.

Equations of state for high pressure. Universidad de La Laguna, Tenerife, 7th September, 2012.

Framework structures: insights from high pressure experiments. Universidad de La Laguna, Tenerife, 5th September, 2012.

Feldspars: Structure and anisotropy. Dip. Scienze della Terra, Università degli Studi di Milano, Italy, 17th July, 2012.

Elasticity of materials II: Non-hydrostatic stress. Bayerisches Geoinstitut, Universität Bayreuth, Germany, 20th March, 2012.

Elasticity of materials I: Elastic tensors. Bayerisches Geoinstitut, Universität Bayreuth, Germany, 19th March, 2012.

Single-crystal diffraction at high-pressure. Agilent Technologies, Wroclaw, Poland, 16th February, 2012.

Structure and Function in Minerals. Lectio Magistralis (public professorial lecture), Dipartimento di Geoscienze, Università di Padova, Italy, 19th January, 2012.

Structure and elasticity of feldspars. Dipartimento di Scienze della Terra, Università di Parma, Italy, 14th December, 2011.

Structure and elasticity of feldspars. Institut fuer Mineralogie und Kristallographie, Universität Wien, Austria, 25th November, 2011

Compression mechanisms of frameworks. Dipartimento di Scienze Mineralogiche e Petrologiche, Università degli Studi di Torino, Italy. 20th October, 2011.

Feldspars. Mineralogisch-Petrographisches Institut der Universität Hamburg, Germany. 22nd July, 2011.

From inter-atomic forces to equilibrium phase diagrams in minerals. Institut fuer Kristallographie, Ludwig-Maximilians Universität Muenchen, Germany. 10th June, 2011.

Structure, elasticity and rheology of feldspars. Institut für Geologie, Mineralogie und Geophysik, Ruhr-Universität, Bochum, Germany. 17th May, 2011.

From inter-atomic forces to equilibrium phase diagrams in minerals. Goettinger Zentrum Goewissenschaften, Georg-August-Universität, Goettingen, Germany. 12th May, 2011.

The fundamental role of tilt modes in perovskite phase transitions. Mineralogisch-Petrographisches Institut der Universität Hamburg, Germany. 12th April, 2011.

Talks at meetings

Angel RJ (2011) Stress and strain in the diamond-anvil cell. 4th Berichtskolloquium of the SPP1236. Hünfeld, Germany, 28th Feb-2nd March, 2011. *Invited keynote lecture.*

Angel RJ, Sochalski-Kolbus LM, Tribaudino M, Walker AM (2011) Of tilts and tetrahedra in feldspars: reviving an old structural analysis to explain thermodynamic properties. European Geophysical Union meeting, Wien, Austria, 4th-8th April, 2011. *Contributed talk.*

Angel RJ (2011) Tilts without tears – Structure and elasticity of feldspars. Goldschmidt meeting, Prague, Czech Republic, 14th -19th August, 2011. *Invited lecture as recipient of the Dana medal.*

Angel RJ, Finger LW (2012) SINGLE: a program to control single-crystal diffractometers for high-precision lattice parameter measurements. DGK Annual meeting, Munich, Germany, 12th-15th March, 2012. *Contributed talk.*

Angel RJ, Mihailova B, Pentcheva R (2012) The control of material properties by polyhedral tilting. DGK Annual meeting, Munich, Germany, 12th-15th March, 2012. *Contributed talk*

Angel RJ (2012) Minerals and materials at high pressures: the challenges of complexity. European Crystallographic Meeting, Bergen, Norway, 9th August, 2012. *Invited keynote lecture.*

Angel RJ, Gonzalez-Platas J (2013) Absorb7 and Absorb-GUI for single-crystal absorption corrections under non-ambient conditions. DGK Annual meeting, Freiberg, Germany, 19th-22nd March, 2013. *Contributed talk.*

Angel RJ, Ross NL, Zhao J, Sochalski-Kolbus L, Krüger H (2013) Modelling frameworks: from polyhedral conformations and distortions to macroscopic strains. DGK Annual meeting, Freiberg, Germany, 19th-22nd March, 2013. *Contributed talk.*

Angel RJ, Milani S, Nimis P, Bruno M, Harris JW, Nestola F (2013) Where do diamonds grow? A crystallographic approach. 3rd International Conference on Crystallogenesi and Mineralogy, Novosibirsk, Russia, 27th September-1st October, 2013. *Keynote lecture*

Angel RJ (2014) Implementation and use of ABSORB in CrysAlisPro. Agilent Technologies X-ray User Group Meeting, Oxford, England, 26-27 February, 2014. *Invited Talk.*

Angel RJ, Milani S, Nimis P, Bruno M, Harris JW, Nestola F (2014) Rock formation processes constrained by host-inclusion crystallography. DGK Annual meeting, Berlin, Germany, 17-20 March, 2014. *Contributed talk.*

Angel RJ, Alvaro M, Mazzucchelli ML, Nimis P, Nestola F (2014) How much differential stress can a rock support? EGU General Assembly, Vienna, Austria, 28 April – 2 May, 2014. *Contributed talk.*

Angel RJ, Gonzalez-Platas J, Alvaro M, Nestola F (2014) EosFit7: A new program for equation of state analysis. Joint AIC-SILS conference, Florence, 15-18 September, 2014. *Contributed talk.*

Angel RJ (2014) In-situ high-pressure X-ray diffraction in materials and mineral science. 5th National Symposium of the Bulgarian Crystallographic Association. Sofia, Bulgaria, *Invited talk.*

Angel RJ (2015) Elastic barometry for diamond-inclusion pairs. International Diamond School "The Nature Of Diamonds And Their Use In Earth's Study", Bressanone, Italy, 27-31 January 2015. *Invited talk.*

Angel RJ, Milani S, Nimis P, Nestola F (2015) Orientations of Inclusions: OrientXplot. International Diamond School "The Nature Of Diamonds And Their Use In Earth's Study", Bressanone, Italy, 27-31 January 2015. *Invited talk.*

Angel RJ (2015) A simple EoS for structural phase transitions. DGK Annual Meeting, Goettingen, Germany, 16-19 March, 2015. *Contributed talk.*

Angel RJ, Milani S, Alvaro M, Pasqual D, Nestola F (2015) OrientXplot – a program to analyse and display relative crystal orientations. European Crystallography Meeting, Rovinj, Croatia, 23-28 August, 2015. *Contributed talk.*

Angel RJ, Nestola F (2015) After a century of Bragg diffraction, how well do we know the structures of inorganic compounds? Italian Crystallographic Association Annual Meeting, Vercelli, Italy, 14-17 September, 2015. *Contributed talk.*

Angel RJ, Milani S, Pasqual D, Nimis P, Nestola F, Miletich-Pawliczek R (2016) High quality structures at high pressure? Insights from diamonds and diamond-anvil cells. DGK Annual Meeting, Stuttgart, Germany, 14-17 March, 2016. *Contributed talk.*

Angel RJ, Alvaro M, Nimis P, Mazzucchelli ML, Nestola F (2016) Single inclusion piezobarometry confirms high-temperature decompression path for Variscan granulites. EGU General Assembly, Vienna, Austria, 17-22 April, 2016. *Contributed talk.*

Angel RJ, Alvaro M, Gonzalez-Platas J, Nestola F (2016) New features in eosfit: fitting elastic moduli and phase transitions. 2nd European Mineralogical Conference, Rimini, Italy, 11-15 September, 2016. *Contributed talk.*

Angel RJ (2016) New trends and recent achievements in high pressure crystallography. 54th European High-Pressure Research Group Meeting, Bayreuth, Germany, 4-9 September 2016. *Conference Plenary Speaker.*

Angel RJ, O'Brien PJ (2016) Host-inclusion crystallography to constrain eclogite exhumation paths. Bayerisches Geoinstitut 30th anniversary meeting, Bayreuth, Germany, 29 September 2016. *Invited talk.*

Angel RJ, Alvaro M, Gonzalez-Platas J, Nestola F (2017) New EoS and new methods in the EosFit7 program suite. DGK Annual Meeting, Karlsruhe, Germany, 27-30 March, 2016. *Contributed talk.*

Angel RJ, Alvaro M, Mazzucchelli ML, Nestola F (2017) Eosfit-Pinc: a GUI program to calculate pressures in host-inclusion systems. EGU General Assembly, Vienna, Austria, 23-28 April, 2016. *Contributed talk.*

Angel RJ, Alvaro M, Gonzalez-Platas J, Nestola F (2017) EosFit: a program suite for Equation of State fitting and calculations. XLVI Annual Meeting of the AIC, Perugia, Italy, 26-29 June 2017. *Contributed talk.*

Angel RJ, Murri M, Mazzucchelli M, Prencipe M, Mihailova B, Alvaro M (2018) Using Raman scattering to measure strains in crystals under non-hydrostatic stress conditions. DGK Annual Meeting, Essen, Germany, 5-8 March, 2018. *Contributed talk*.

Angel RJ, Alvaro M (2018) What are mineral inclusions really telling us about high-pressure rocks? EGU General Assembly, Vienna, Austria, 8-13 April, 2018. *Contributed talk*.

Angel RJ, Alvaro M, Nestola F (2018) Beyond routine refinements in a routine way. SGI-SIMP, Catania, Italy, 12-14 September, 2018. *Contributed talk*.

OTHER RECENT MEETING CONTRIBUTIONS

Milani S, Nestola F, Angel RJ, Pasqual D, Geiger CA (2012) Equation of state of almandine and implications for diamond geobarometry. European Mineralogical Meeting 2012, Frankfurt, September 2012.

Ross NL, Zhao J, Angel RJ (2012) Equations of state and structural evolution of alkali feldspars at high pressure. Geological Society of America Annual Meeting, Charlotte, USA, November 2012.

Mihailova B, Waesermann N, Maier BJ, Angel RJ, Paulmann C, Gospodinov M, Bismayer U (2013) Chemically-induced renormalization phenomena in perovskite-type relaxor ferroelectrics under high pressure. DGK Annual meeting, Freiberg, Germany, 19th-22nd March, 2013.

Pina Binignat FA, Waesermann N, Malcherek T, Paulmann C, Schlüter J, Angel RJ, Mihailova B (2013) Pressure-induced structural changes in metamict zircon. DGK Annual meeting, Freiberg, Germany, 19th-22nd March, 2013.

Nestola F, Milani S, Angel RJ, Pasqual D, Geiger CA (2013) Pressure–volume equation of state for pyrope–almandine solid solutions. EGU General Assembly Wien, Austria, 7th-12th April, 2013.

Milani S, Mazzucchelli M, Nestola F, Alvaro M, Angel RJ, Geiger CA, Domeneghetti C (2013) The P-T conditions of garnet inclusion formation in diamond: thermal expansion of synthetic end-member pyrope. EGU General Assembly, Wien, Austria, 7th-12th April, 2013.

Bartoli O, Cesare B, Poli S, Acosta-Vigil A, Esposito R, Turina A, Bodnar RJ, Angel RJ, Hunter J (2013) Nanogranite inclusions in migmatitic garnet: behavior during piston cylinder re-melting experiments. Ecrofi2013, Antalya, Turkey.

Mihailova B, Angel RJ, Bismayer U (2013) Pressure-induced transformation processes in ferroelastic $Pb_3(P_xAs_{1-x})O_4$, $x = 0$ and 0.8 . 34th International Symposium on Dynamical Properties of Solids, Wien, Austria, September 15-19th, 2013.

Nestola F, Nimis P, Milani S, Angel RJ, Bruno M, Harris JW (2013) Crystallographic relationships between diamond and its olivine inclusions. Goldschmidt Conference, Firenze, Italy, August 25-30th.

Waesermann N, Brown JM, Angel RJ, Ross NL, Kaminsky W (2013) Elastic properties of monoclinic alkali-feldspars. American Geophysical Union Fall Meeting, San Francisco, USA, December 9-13th, 2013

Gonzalez-Platas J, Angel RJ, Alvaro M, Nestola F (2014) EosFit7: A new program for equation of state analyses and calculations. DGK Annual meeting, Berlin, Germany, 17-20 March, 2014.

Alvaro M, Angel RJ, Mazzucchelli ML, Nestola F, Domeneghetti MC (2014) Isomekes: A fundamental tool to determine the formation pressure for diamond-inclusion pairs. EGU General Assembly, Vienna, Austria, 28 April – 2 May, 2014.

Alvaro M, Angel RJ, Mazzucchelli ML, Nestola F, Nimis P (2014) Isomekes: A chemical independent method for geobarometry of UHPM rocks. 90th Annual Congress of SIMP, Milan, 10-12 September, 2014.

Mazzucchelli ML, Angel RJ, Alvaro M, Nestola F, Nimis P (2014) Geobarometry for host-inclusion systems: the role of elastic relaxation. 90th Annual Congress of SIMP, Milan, 10-12 September, 2014.

Nestola F, Alvaro M, Nimis P, Angel RJ, Bruno M, Prencipe M, Harris JW (2014) Diamond-olivine host-inclusion system: crystallography and depth of formation. 90th Annual Congress of SIMP, Milan, 10-12 September, 2014.

Schiazza M, Nestola F, Nimis P, Angel RJ, Reali R, Hutchison M (2014) Ferropericlasite included in diamond: lower or upper mantle origin? 90th Annual Congress of SIMP, Milan, 10-12 September, 2014.

Mihailova B, Angel RJ, Bismayer U (2015) Pressure-induced transformation processes in ferroelastic $\text{Pb}_3(\text{P}_x\text{As}_{1-x})\text{O}_4$, $x = 0$ and 0.8. DGK Annual Meeting, Goettingen, Germany, 16-19 March, 2015.

Nimis P, Nestola F, Angel RJ, Milani S, Alvaro M, Anzolini C, Schiazza M, Bruno M, Prencipe M, Harris JW, Hutchison MT (2014) Crystallographic relationships between diamond and its inclusions. EGU General Assembly, Vienna, Austria, 12-17 April, 2015.

Alvaro M, Angel RJ, Marciano C, Zaffiro G, Scandolo L, Mazzucchelli ML, Milani S, Rustioni G, Domeneghetti CM, Nestola F (2015) Development of a new micro-furnace for "in situ" high-temperature single crystal X-ray diffraction measurements. EGU General Assembly, Vienna, Austria, 12-17 April, 2015.

Mazzucchelli ML, Angel RJ, Alvaro M, Nimis P, Domeneghetti CM, Nestola F (2015) Elastic geobarometry for ultra-high pressure metamorphic (UHPM) rocks. EGU General Assembly, Vienna, Austria, 12-17 April, 2015.

Gonzalez-Platas J, Angel RJ, Alvaro M (2015) Eosfit7-GUI: A new GUI tool for equation of state calculations and analyses. Joint AIRAPT-25 & EHPRG-53 International conference on high pressure science and technology, Madrid, Spain, 30 August – 4 September, 2015.

Alvaro M, Angel RJ, Marciano C, Milani S, Zaffiro G, Scandolo L, Mazzucchelli ML, Rustioni G, Briccola M, Domeneghetti CM, Nestola F (2015) Development of a new micro-furnace for "in situ" high-temperature single crystal X-ray diffraction measurements. European Crystallography Meeting, Rovinj, Croatia, 23-28 August, 2015.

Alvaro M, Angel RJ, Mazzucchelli ML, Domeneghetti MC, Nestola F (2015) Elastic geobarometry for UHPM rocks: A link between mineralogy and petrology. SIMP annual congress, Florence, Italy, 2-4 September, 2015.

Mazzucchelli ML, Angel RJ, Alvaro M, Nimis P, Domeneghetti CM, Nestola F (2015) Host-inclusion geobarometry for ultra-high pressure metamorphic (UHPM) rocks. SIMP annual congress, Florence, Italy, 2-4 September, 2015.

Rustioni G, Angel RJ, Milani S, Mazzucchelli ML, Nimis P, Domeneghetti MC, Marone F, Alvaro M, Harris JW, Nestola F (2015) Elastic geobarometry for host-inclusion systems: Pressure release and the role of brittle failure. SIMP annual congress, Florence, Italy, 2-4 September, 2015.

Zaffiro G, Angel RJ, Alvaro M, Nestola F, Domeneghetti MC, Scandolo L, Mazzucchelli ML, Milani S, Rustioni G, Marciano C (2015) New micro-furnace for “in situ” high-temperature single crystal X-ray diffraction measurements. SIMP annual congress, Florence, Italy, 2-4 September, 2015.

Ferrero S, Ziemann MA, Angel RJ, O’Brien PJ, Wunder B (2015) Significance of kumdykolite, kokchetavite and cristobalite crystallized from melt inclusions in felsic granulites, Orlica-Snieznik dome (Bohemian massif). GSA Annual Meeting, Baltimore, Maryland, USA, 1-4 November, 2015.

Nimis P, Angel RJ, Alvaro M, Nestola F (2015) From mineralogy to petrology: the example of diamond and its inclusions. ‘Geologia delle Alpi’ meeting at l’Accademia Nazionale delle Scienze detta dei XL e l’Istituto Veneto di Scienze Lettere e Arti, Venice, Italy, 20 November, 2015.

Alvaro M, Marciano C, Domeneghetti CM, Nestola F, Angel RJ (2016) A new micro-furnace for “in situ” high-temperature single crystal X-ray diffraction measurements. DGK Annual Meeting, Stuttgart, Germany, 14-17 March, 2016. *Contributed poster*.

Mazzucchelli ML, Angel RJ, Rustioni G, Milani S, Nimis P, Domeneghetti CM, Marone F, Harris JW, Nestola F, Alvaro M (2016) Elastic geobarometry and the role of brittle failure on pressure release. EGU General Assembly, Vienna, Austria, 17-22 April, 2016. *Contributed talk*.

Pina Binvignata FA, Malcherek T, Paulmann C, Schlüter J, Angel RJ, Mihailova B (2016) Pressure-induced structural alteration in metamict zircon. 2nd European Mineralogical Conference, Rimini, Italy, 11-15 September, 2016. *Contributed talk*.

Nestola F, Angel RJ, Nimis P, Alvaro M, Milani S, Harris JW (2016) Crystallographic orientational relationships between diamond and its mg-chromite inclusions. 2nd European Mineralogical Conference, Rimini, Italy, 11-15 September, 2016.

Alvaro M, Angel RJ, Mazzucchelli ML, Nestola F (2016) New constraints on PT evolution of metamorphic rocks from single inclusion piezobarometry. 2nd European Mineralogical Conference, Rimini, Italy, 11-15 September, 2016. *Contributed talk*.

Mazzucchelli ML, Burnley P, Angel RJ, Domeneghetti MC, Nestola F, Alvaro M (2016) Elastic geobarometry: uncertainties arising from the shape of the inclusion. 2nd European Mineralogical Conference, Rimini, Italy, 11-15 September, 2016. *Contributed talk*.

Rustioni G, Angel RJ, Mazzucchelli ML, Milani S, Nimis P, Domeneghetti MC, Marone F, Harris JW, Nestola F, Alvaro M (2016) Pressure release for host – inclusion systems: the interplay between brittle failure and fluid phase. 2nd European Mineralogical Conference, Rimini, Italy, 11-15 September, 2016. *Contributed talk*.

Fischer M, Angel RJ (2017) Accurate structures and energetics of neutral-framework zeotypes from dispersion-corrected DFT calculations. DGK Annual Meeting, Karlsruhe, Germany, 27-30 March, 2016. *Contributed poster*.

Alvaro M, Angel RJ, Nimis P, Milani S, Harris JW, Nestola F (2017) Entrapment mechanism for magnesiochromite inclusions in diamonds. EGU General Assembly, Vienna, Austria, 23-28 April, 2016. *Contributed poster*.

Angel RJ, Alvaro M, Mazzucchelli ML, Nestola F (2017) Eosfit-Pinc: a GUI program to calculate pressures in host-inclusion systems. EGU General Assembly, Vienna, Austria, 23-28 April, 2016. *Contributed talk*.

Mazzucchelli ML, Burnley P, Angel RJ, Domeneghetti CM, Nestola F, Alvaro M (2017) Elastic geobarometry: uncertainties arising from the geometry of the system. EGU General Assembly, Vienna, Austria, 23-28 April, 2016. *Contributed talk*.

Angel RJ, Alvaro M, Nestola F (2017) A critical review and a new parameterisation of Equations of State for mantle olivines and diamond inclusions. XLVI Annual Meeting of the AIC, Perugia, Italy, 26-29 June 2017. *Contributed poster*.

Murri M, Mazzucchi M, Prencipe M, Mihailova B, Scambelluri M, Campomenosi N, Angel RJ, Alvaro M (2017) Ab initio simulation on Quartz (SiO₂) under hydrostatic stress vs isotropic strain. XLVI Annual Meeting of the AIC, Perugia, Italy, 26-29 June 2017. *Contributed poster*.

Angel RJ, Mazzucchelli ML, Alvaro M, Nestola F (2017) Elastic geobarometry: state of the art. 12th International Eclogite Conference, Åre, Sweden, 20-29 August 2017. *Contributed poster*.

Campomenosi N, Scambelluri M, Mihailova B, Alvaro M, Nestola F, Mazzucchi M, Murri M, Angel RJ, Prencipe M (2017) 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, 20-29 August 2017. *Contributed poster*.

Alvaro M, Murri M, Mazzucchi M, Prencipe M, Campomenosi N, Angel RJ (2017) Elastic geobarometry for UHP metamorphic rocks. 12th International Eclogite Conference, Åre, Sweden, 20-29 August 2017. *Contributed poster*.

Ross NL, Zhao J, Angel RJ (2017) Equations of state and high-pressure behavior of alkali feldspars. Presentation number MR31A-0434, American Geophysical Union Fall Meeting, New Orleans, USA, 11-15 December, 2017. *Contributed poster*.

Campomenosi N, Mazzucchelli ML, Mihailova B, Scambelluri M, Angel RJ, Alvaro M (2018) Elastic geobarometry: a comparison between experiments and numerical simulations. EGU General Assembly, Vienna, Austria, 8-13 April, 2018. *Contributed talk*.

Papa S, Pennacchioni G, Angel RJ, Faccenda M (2018) Thermal fragmentation of garnet during deep-seated co-seismic frictional heating. EGU General Assembly, Vienna, Austria, 8-13 April, 2018. *Contributed PICO*.

Zaffiro G, Angel RJ, Alvaro M, Prencipe M, Stangarone C (2018) P-V-T-K^S Equations of State for zircon and rutile. EGU General Assembly, Vienna, Austria, 8-13 April, 2018. *Contributed talk*.

Murri M, Prencipe M, Angel RJ, Mihailova BD, Alvaro M (2018) The role of the phonon Grüneisen tensor in the application of Raman spectroscopy for geobarometry. XIII GeoRaman Conference, Catania, Italy, 10-15 June 2018. *Contributed talk*.

Alvaro M, Campomenosi N, Mazzucchelli ML, Mihailova B, Scambelluri M, Angel RJ (2018) Geothermobarometry of inclusions from Raman spectroscopy: advantages and limitations. Goldschmidt conference, Boston, USA, 12-17 August, 2018. *Contributed talk*.

Campomenosi N, Mazzucchelli ML, Mihailova BD, Korsakov AV, Scambelluri M, Angel RJ, Alvaro M (2018) Relations between induced birefringence haloes and polarized Raman spectra in host cubic crystals. SGI-SIMP, Catania, Italy, 12-14 September, 2018. *Contributed talk*.

Mazzucchelli ML, Angel RJ, Morganti S, Reali A, Alvaro M (2018) Elastic barometry for elastically anisotropic inclusions. SGI-SIMP, Catania, Italy, 12-14 September, 2018. *Contributed talk*.

Murri M, Mazzucchelli ML, Campomenosi N, Korsakov AV, Prencipe M, Mihailova BD, Scambelluri M, Angel RJ, Alvaro M (2018) Raman elastic geobarometry for anisotropic mineral inclusions. SGI-SIMP, Catania, Italy, 12-14 September, 2018. *Contributed talk*.

Zaffiro G, Angel RJ, Prencipe M, Stangarone C, Alvaro M (2018) A novel approach to determine accurate equations of state for zircon and rutile. SGI-SIMP, Catania, Italy, 12-14 September, 2018. *Contributed talk*.

PUBLICATIONS SUMMARY

- More than 225 research publications in ISI journals, and 10 review articles in books.
- More than 7600 total citations (without self-citations), in >5000 articles.
- More than 250 citations per year for the last 15 years, 400/year for the last 8 years.
- *h* index = 47

Five most cited publications:

- [1] Hazen RM, Prewitt CT, Angel RJ, Ross NL, Finger LW, Hadidiacos CG, Veblen DR, Heaney PJ, Hor PH, Meng RL, Sun YY, Wang YQ, Xue YY, Huang ZJ, Gao L, Bechtold J, Chu CW (1988) Superconductivity in the very high T_c Bi-Ca-Sr-Cu-O system: Phase identification. *Physical Review Letters* 60:1174-1177 (539 citations)
- [2] Angel RJ (2000) Equations of state. In RM Hazen and RT Downs (eds.), *High-pressure and high-temperature crystal chemistry*. Reviews in Mineralogy and Geochemistry, 41:35-60 (454 citations)
- [3] Hazen RM, Finger LW, Angel RJ, Prewitt CT, Ross NL, Hadidiacos CG, Heaney PJ, Veblen DR, Sheng ZZ, Elali A, Hermann AM (1988) 100K superconducting phases in the Tl-Ca-Ba-C-O system. *Physical Review Letters* 60:1657-1660 (367 citations)
- [4] Hazen RM, Finger LW, Angel RJ, Prewitt CT, Ross NL, Mao HK, Hadidiacos CG, Hor PH, Meng RL, Chu CW (1987) Crystallographic description of phases in the Y-Ba-Cu-O superconductor. *Physical Review B* 35:7238-7241 (309 citations)
- [5] Angel RJ, Allan DR, Miletich R, Finger LW (1997) The use of quartz as an internal pressure standard in high-pressure crystallography. *Journal of Applied Crystallography* 30:461-466 (303 citations)

A selection of other publications:

- [1] Angel RJ, Bujak M, Zhao J, Gatta GD, Jacobsen SD (2007) Effective hydrostatic limits of pressure media for high-pressure crystallographic studies. *Journal of Applied Crystallography* 40:26-32 (326 citations)
- [2] Angel RJ, Prewitt CT (1986) Crystal structure of mullite - a reexamination of the average structure. *American Mineralogist* 71:1476-1482 (181 citations)
- [3] Angel RJ, Chopelas A, Ross NL (1992) Stability of high-density clinoenstatite at upper-mantle pressures. *Nature* 358:322-324 (168 citations)
- [4] Angel RJ, Gonzalez-Platas J, Alvaro M (2014) EosFit-7c and a Fortran module (library) for equation of state calculations. *Zeitschrift für Kristallographie*, 229, 405-419. (181 citations)
- [5] Angel RJ (2004) Absorption corrections for diamond-anvil pressure cells implemented in a software package Absorb-6.0. *Journal of Applied Crystallography* 37:486-492 (116 citations)
- [6] Angel RJ, Downs RT, Finger LW (2000) High-pressure, high-temperature diffractometry. In RM Hazen and RT Downs (eds.), *High-pressure and high-temperature crystal chemistry*, Reviews in Mineralogy and Geochemistry, vol. 41:559-596. (102 citations)
- [7] Angel RJ, Zhao J, Ross NL (2005) General rules for predicting phase transitions in perovskites due to octahedral tilting. *Physical Review Letters* 95:025503. (88 citations)