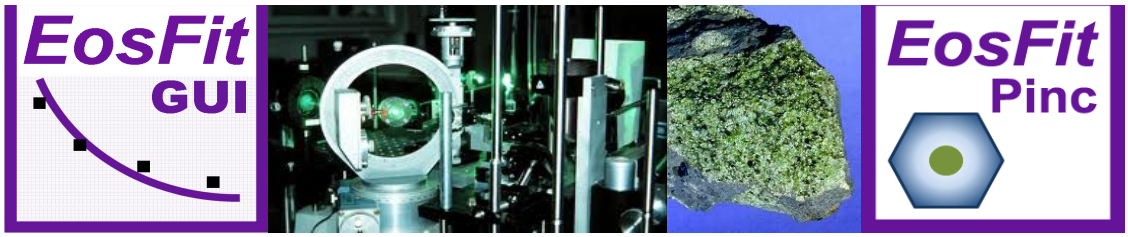


Elasticity and Equations of State of Solids
for Earth and Material Sciences

Course for PhD students, by

Ross J. Angel, MA, PhD

Organized by PhD School of Physics and Geology, Perugia University

6-8 May, 2019

Objectives of the Course

Participants will learn the theory behind Equations of State (EoS) and their relationship to conventional linear elasticity, how to determine the parameters of an EoS of a mineral, and how to perform calculations using EoS of minerals to answer geological questions.

The course will achieve this by a combination of lectures on theory and worked examples using the EosFit software written by the lecturer, which is freely available on-line and widely-used in Earth Sciences and Physics.

The course will be taught in English. No prior knowledge is required of elasticity or EoS, but we will survey the registered students before the course to find out their level of knowledge and interests. A normal level of mathematics for PhD students in sciences will be assumed. Students will install the EosFit software on their laptops before the course and will use the software on their own laptops during the lectures.

Dates

- Monday 6 May – Wednesday 8 May, 2019

Proposed Schedule

- **Day 1, morning**
  - arrival
- **Day 1, afternoon**
  - Introduction to linear elasticity (2 hours)

        - Definition, applications to Earth and Materials Sciences
        - Concept of strain and thermal expansion as a tensor
        - Concept of stress and the elasticity tensors
    - Hydrostatic pressure and experimental methods (2 hours)
        - Definition of hydrostatic pressure as a stress state
        - Concept of compressibility as a tensor
        - Bulk moduli and the elastic tensor

- **Day 2, morning**:
    - Introduction to EoS (2 hours)
        - Introduction to EoS – basic concepts
        - Introduction to EoS parameters
        - Introduction to the EosFit program
    - EoS theory (2 hours)
        - Basis of different types of EoS
        - Finite strain

- **Day 2, afternoon:**
    - Fitting PV datasets (2 hours)
        - EosFit software for fitting EoS
        - Evaluation of results of least-squares
    - Fitting cell parameter variations with pressure (2 hours)
        - How they differ from volume.
        - Using the EosFit software, evaluation of results

- **Day 3 morning:**
    - Students problems, discussion (2 hours)
    - Thermal expansion in EoS (2 hours)
        - Thermal Expansion models
        - PVT EoS theory: isothermal models, thermal pressure models.

- **Day 3, afternoon:**
    - Practical aspects of measuring EoS:
        - Single-crystal diffraction
        - Pressure measurement
    - Final test of skills acquired and quality of the course

Credit

3 **credits** will be awarded for having taken the course by the PhD colleges of the participants.

Logistics

By starting in an afternoon, accommodation costs for the lecturer and the students who come from outside Perugia are minimised, and it gives the students time to absorb the material better than having 8 hours each on 2 days.

The course is free but the admission will be limited to 20 participants, to allow the personal needs of the students to be addressed, especially when working with software.

The students should organise their own accommodation.

Local organisation, registration etc. will be done by **Paola Comodi** (Dipartimento di Fisica e Geologia, Università di Perugia, Italy): paola.comodi@unipg.it

To participate Fill in the registration form below reported and send it before **15th March 2019** to paola.comodi@unipg.it.

Registration form will be evaluated to select 20 participants on the base of criteria which respect variety of scientific interest, provenance of candidate, PhD year.

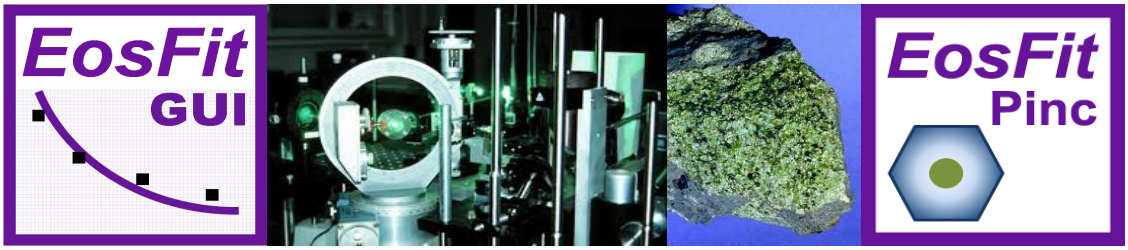
Ross Angel, MA, PhD (Cambridge)

Email: ross.angel@unipv.it
Website: www.rossangel.net

Ross Angel is a native English speaker with over 220 published papers in international scientific journals, and an *h* index of 46. The focus of his research has been 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:

- He has 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 he has developed for diffractometer control and processing of data, including EosFit, is distributed freely from his web site and is in use by many research groups world-wide.
- He is applying elasticity theory to composite materials to develop a method of piezobarometry to determine rock histories independent of chemical methods.
- He has used diffraction methods in combination with Landau theory, symmetry-mode analysis, and his own novel topological forward-modelling technique, to determine the structure-property relationships of framework structures.

A full cv and publications list are available at www.rossangel.net



Registration Form

To sent before 15 March 2019 to paola.comodi@unipg.it

Surname: ……

Name: ……

Institution .....……

Address ……..

Academic Position (e.g. PhD student, post-doc, and year)……

Scientific field (e.g. Geology, Chemistry).....

Why do you want to use EosFit7? (e.g. fit HP diffraction data, or thermodynamic calculations).....
....……

Have you used EosFit-GUI? Y/N

Have you used EosFit7c? Y/N

Tel: ……

e-mail: ……

Date……

Signature ……