

Petrochronology Course

Kathryn Cutts

Synopsis:

The purpose of this course will be to teach students the methods of petrochronology (petrology and geochronology) in the context of scientific research. The objective is not just to teach the students the methods of petrochronology but how these can be used to interrogate scientific problems, and in particular how they can be applied in the students own research. By the end of the course, the students should be able to select samples suitable for petrochronology, know what methods would yield results, and be able to interpret the geological significance of these results and present this as a scientific paper. The class is composed of a lecture of 1.5 hours per week plus a homework assignment (taking 2-3 hours on average).

Class plan:

10 classes of 2 hours (plus one homework exercise per class)

1. An introduction to petrochronology, what it is, what it can be used for (homework exercise could be to find a paper where petrochronology is used, and write a brief-half page summary of what petrochronology methods are used and how these contributed to the findings of the paper).
2. Petrology, what is a good petrological description? How to identify a sample useful for petrochronology (homework exercise – given some images of thinsections and asked to make petrological descriptions for these).
3. Geochron 1 – an introduction to geochronology, how it fits in with petrochronology and some different minerals/isotopic systems (homework exercise - for three weeks – choose a mineral and explain how it can dated, including details about the isotopic system and give an example from the literature explaining why they chose this mineral and the significance of the ages with explanation, 2-3 pages).
4. Geochron 2 – detailed description of Zircon geochronology – U-Pb and Lu-Hf, zircon textures and significance of ages.
5. Geochron 3 – detailed description of garnet and monazite geochronology (continuation of last class).
6. Geochronology and geochemistry – the role of major and trace elements in rocks and minerals (microprobe/sem analyses) – what these can add to the story, how they can aid in interpretation of ages (homework – students should choose a paper from a list and describe how trace elements contributed to the interpretations/conclusions of the work).
7. Geochron 3 – thermochronology – the advantages of dating more than one mineral in a sample (mon and zirc), how these are related by trace elements, will also talk more about the lower T side (Ttn, rutile, apatite, Bt, mus). Homework – find a paper where two geochron methods are used together and describe how this provided more detail on the rock history.
8. An introduction to P-T modelling. What it is, what it can tell us, how to choose a good sample and a bit of background on the programs. Homework – I will provide a petrological description and thin section images along with a phase diagram and the students will make an interpretation (half a page).
9. More P-T modelling. How to use Theriak Domino. Homework (TD exercise).

10. Petrochronology – how everything we have learned so far fits together – an introduction to XMapTools. Homework – read paper by Lanari (bingo antidote) and write how you could apply this to your studies (1 paragraph).

Bonus classes (1 hour each)

11. Data interpretation and making models – setting up research problems and evaluating the literature (homework – write half a page about the scientific problem you are addressing in your project – what methods are you using and what you expect these to tell you).
12. How to write a scientific paper – what goes in each section, how to choose a journal, common mistakes, how to respond to review (and handle reviewer comments), and what you should do as a reviewer (homework – I will give you a paper to review).
- 13-15. Discussion – depending on the size of the group we might split and do half this week and half the following week. Each student will present their research (15 minute talk) – I want to hear about the problem they are investigating and methods and any preliminary results they have. The other students can provide feedback.

Bibliography:

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Kohn, M., Engi, M., & Lanari, P. (Eds). 2017. *Petrochronology: Methods and Applications*. *Reviews in Mineralogy and Geochemistry* vol. 83.

Lanari, P., Vidal, O., De Andrade, V., Dubacq, B., Lewin, E., Grosch, E., Schwartz, S. (2014) XMapTools: a MATLAB©-based program for electron microprobe X-ray image processing and geothermobarometry. *Computers and Geosciences*. 62, 227-240.

Lanari, P., Vho, A., Bovay, T., Airaghi, L., Centrella, S., (2019). Quantitative compositional mapping of mineral phases by electron probe micro-analyser. *Geological Society of London, Special Publications*, 478, 39-63.