



GEOL 789P

IGNEOUS AND METAMORPHIC PETROLOGY

Dr. Sarah Penniston-Dorland

Spring, 2008

**Monday, 10:00 a.m.-12:50 p.m.,
EDU 2101 (Benjamin Building)/GEOL 2117**

Assessment: Course project (30%), Seminar presentation (30%), lab/class assignments (e.g. answer assigned questions about reading, exercises in calculating P,T, etc., 30%), class participation (10%)

Course project

Your course project should complement your research. It should not be something you have already done for your research, but it should be something that you would like to do for your research or that is tangentially related to your research that hopefully will help lead you to a better understanding of your research project. It should be something that gets you actively involved – not a passive summary of the literature, although that is important – but doing microprobe analyses, or stable isotope analyses or petrographic analysis, or using a computer to quantitatively model igneous or metamorphic processes and then interpreting your results.

Some possible project ideas:

Determination of P/T on thin sections, determination of X_{CO_2} on appropriate thin sections, quantitative modeling of fluid-rock interactions, thermal modeling of contact aureole or more complicated tectonic setting, modeling of crystallization of magma, crystal size distribution analysis of rocks

Seminar presentation

Students will work alone or in groups of 2-3 to prepare a seminar on a topic that is relevant to igneous and/or metamorphic petrology. The seminar should focus on a subject that is or has recently been actively debated in the literature. It will involve a summary of the literature on that topic, discussion of topics that are debated, presentation of different points of view and the pros and cons for each side.

Office Hours: Fridays, 10-11 am, CHEM 1221B.

Optional fieldtrip

One-day trip on Saturday, March 1 or Saturday March 8 (rain date) to look at igneous and metamorphic rocks in the area.

Class topics – first few class meetings

Background information:

Important Minerals

Metamorphic facies, P-T diagrams, mineral assemblages, regional metamorphism, hi-P, low-T metamorphism, contact metamorphism

Metamorphism of different bulk compositions

Classification of igneous rocks

Tectonic environments and igneous and metamorphic rocks

Chemographics and phase relations – phase rule, phase diagrams, Schreinemakers' analysis

Other Possible Lecture/Discussion Topics

Igneous and metamorphic petrology

P-T estimates: petrogenetic grid, thermobarometry, pseudosections, isotope thermometry, solvus thermometry

Subduction zones – from the top (volcanic rocks) and bottom (eclogites, blueschists)

Dimensionless numbers and their uses (e.g. Reynolds number, Rayleigh number, Peclet number)

Mineral textures – Crystal size distributions, reaction textures, cumulus textures, crystal zoning

Metamorphic Petrology

Fluids during metamorphism-evidence, estimating fluid composition (T-X)

Models of fluid-rock reaction – disequilibrium flow, flow along P-, T-gradient, stable isotope alteration

Kinetics

Mapping isotherms, isobars, isograds and bathograds

Thermal models – subduction zones, contact aureoles, orogenesis

P-T-t paths

Types of mineral reactions (continuous, discontinuous, net transfer), reaction progress

Igneous petrology

Fractional crystallization, differentiation, partial assimilation, solidification fronts

Layered ultramafic intrusions – Bushveld, Skaergaard

MORBs, OIBs, learning about the mantle from igneous rocks

Iceland

Exotic igneous rocks – kimberlites, komatiites, carbonatites, etc.

REE plots and spider diagrams

Additional topics of interest to students enrolled in the class

Useful resources:

Best, Myron G., 2003, Igneous and metamorphic petrology, 729 pp.
QE461 .B53 2003

Philpotts, Anthony R., 1990, Principles of Igneous and Metamorphic Petrology, 498 pp.

Spear, Frank S., 1993, Metamorphic Phase Equilibria and Pressure-Temperature-Time Paths,
Mineralogical Society of America Monograph, 799 p.

Winter, John D., 2001, An Introduction to Igneous and Metamorphic Petrology, 699 p.
QE461.W735 2001

Code of Academic Integrity: The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit <http://www.studenthonorcouncil.umd.edu/code.html> .