

TRIAL COURSE OR NEW COURSE PROPOSAL
(Attach copy of syllabus)

SUBMITTED BY:

Department	Geosciences	College/School	Natural Science & Mathematics (CNSM)
Prepared by	Jochen Mezger	Phone	474-7809
Email Contact	jemezger@alaska.edu	Faculty Contact	Jochen Mezger

1. ACTION DESIRED
(CHECK ONE): Trial Course ☒ X New Course ☐

2. COURSE IDENTIFICATION: Dept **GEOS** Course # **F694** No. of Credits **3**

Justify upper/lower division status & number of credits:

N/A

3. PROPOSED COURSE TITLE: **Deformation and Metamorphism of Crystalline Rocks**

4. To be CROSS LISTED? YES/NO ☐ No If yes, Dept: ☐ Course # ☐

NOTE: Cross-listing requires approval of both departments and deans involved. Add lines at end of form for additional required signatures.

5. To be STACKED?* YES/NO ☐ No If yes, Dept. ☐ Course # ☐

How will the two course levels differ from each other? How will each be taught at the appropriate level?:

* Use only one Format 1 form for the stacked course (not one for each level of the course!) and attach syllabi. Stacked course applications are reviewed by the (Undergraduate) Curricular Review Committee and by the Graduate Academic and Advising Committee. Creating two different syllabi (undergraduate and graduate versions) will help emphasize the different qualities of what are supposed to be two different courses. The committees will determine: 1) whether the two versions are sufficiently different (i.e. is there undergraduate and graduate level content being offered); 2) are undergraduates being overtaxed?; 3) are graduate students being undertaxed? In this context, the committees are looking out for the interests of the students taking the course. Typically, if either committee has qualms, they both do. More info online - see URL at top of this page.

6. FREQUENCY OF OFFERING: **Spring (every)**
Fall, Spring, Summer (Every, or Even-numbered Years, or Odd-numbered Years) - or As Demand Warrants

7. SEMESTER & YEAR OF FIRST OFFERING
(Effective AY2015-16 if approved by 3/31/2015; otherwise AY2016-17)

Spring 2015

8. COURSE FORMAT:

NOTE: Course hours may not be compressed into fewer than three days per credit. Any course compressed into fewer than six weeks must be approved by the college or school's curriculum council. Furthermore, any core course compressed to less than six weeks must be approved by the Core Review Committee.

COURSE FORMAT: (check all that apply) ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☒ 6 weeks to full semester

OTHER FORMAT (specify)

Mode of delivery (specify lecture, field trips, labs, etc)

Lecture, labs

RECEIVED

SEP 12 2014

Dean's Office
College of Natural Science & Mathematics

Governance
9/23/14 *Tap*

9. CONTACT HOURS PER WEEK:

LECTURE hours/weeks LAB hours /week PRACTICUM hours /week

Note: # of credits are based on contact hours. 800 minutes of lecture=1 credit. 2400 minutes of lab in a science course=1 credit. 1600 minutes in non-science lab=1 credit. 2400-4800 minutes of practicum=1 credit. 2400-8000 minutes of internship=1 credit. This must match with the syllabus. See <http://www.uaf.edu/uafgov/faculty-senate/curriculum/course-degree-procedures-/guidelines-for-computing-/> for more information on number of credits.

OTHER HOURS (specify type)

10. COMPLETE CATALOG DESCRIPTION including dept., number, title, credits, credit distribution, cross-listings and/or stacking (50 words or less if possible):

Example of a complete description:

FISH F487 W, O Fisheries Management
3 Credits Offered Spring
Theory and practice of fisheries management, with an emphasis on strategies utilized for the management of freshwater and marine fisheries. Prerequisites: COMM F131X or COMM F141X; ENGL F111X; ENGL F211X or ENGL F213X; ENGL F414; FISH F425; or permission of instructor. Cross-listed with NRM F487. (3+0)

GEOS F694 Deformation and Metamorphism of Crystalline Rocks
3 Credits Offered Spring
Identification, description and interpretation of metamorphic and/or microstructural fabrics of crystalline rocks. The class provides theoretical and practical tools to understand the interaction of metamorphism and deformation that most metamorphic and plutonic rocks experience; crucial for the development of tectonic models. Laboratory exercises include studies of rock thin sections with optical microscope and hand specimen. Students are encouraged to bring samples from their own thesis. Prerequisites: Graduate standing; OR permission of instructor. (2 + 3)

11. COURSE CLASSIFICATIONS: Undergraduate courses only. Consult with CLA Curriculum Council to apply S or H classification appropriately; otherwise leave fields blank.

H = Humanities S = Social Sciences

Will this course be used to fulfill a requirement for the baccalaureate core? If YES, attach form.

YES: NO:

IF YES, check which core requirements it could be used to fulfill:

O = Oral Intensive, Format 6 W = Writing Intensive, Format 7 X = Baccalaureate Core

11.A Is course content related to northern, arctic or circumpolar studies? If yes, a "snowflake" symbol will be added in the printed Catalog, and flagged in Banner.

YES

NO

12. COURSE REPEATABILITY:

Is this course repeatable for credit?

YES

NO

Justification: Indicate why the course can be repeated (for example, the course follows a different theme each time).

How many times may the course be repeated for credit?

TIMES

If the course can be repeated for credit, what is the maximum number of credit hours that may be earned for this course?

CREDITS

If the course can be repeated with variable credit, what is the maximum number of credit hours that may be earned for this course?

CREDITS

13. GRADING SYSTEM: Specify only one. Note: Changing the grading system for a course later on constitutes a Major Course Change - Format 2 form.

LETTER: PASS/FAIL:

RESTRICTIONS ON ENROLLMENT (if any)

14. **PREREQUISITES** Graduate standing; OR permission from instructor

These will be required before the student is allowed to enroll in the course.

15. **SPECIAL RESTRICTIONS, CONDITIONS**

N/A

16. **PROPOSED COURSE FEES** \$ N/A

Has a memo been submitted through your dean to the Provost for fee approval?
Yes/No

N/A

17. **PREVIOUS HISTORY**

Has the course been offered as special topics or trial course previously?

Yes/No

No

If yes, give semester, year, course #, etc.:

18. **ESTIMATED IMPACT**

WHAT IMPACT, IF ANY, WILL THIS HAVE ON BUDGET, FACILITIES/SPACE, FACULTY, ETC.

This course will have no adverse impacts on budget, facilities or faculty.

19. **LIBRARY COLLECTIONS**

Have you contacted the library collection development officer (kljensen@alaska.edu, 474-6695) with regard to the adequacy of library/media collections, equipment, and services available for the proposed course? If so, give date of contact and resolution. If not, explain why not.

No

Yes

X

The text book is available as an e-book; supplementary readings are available as hard copies. Mrs. Jensen has been contacted and confirmed on 9/10/2014.

20. **IMPACTS ON PROGRAMS/DEPTS**

What programs/departments will be affected by this proposed action?

Include information on the Programs/Departments contacted (e.g., email, memo)

MS Geoscience, PhD Geoscience, MS Mining Engineering (the Chair of the Mining and Geological Engineering Department has been informed by email.)

21. **POSITIVE AND NEGATIVE IMPACTS**

Please specify **positive and negative** impacts on other courses, programs and departments resulting from the proposed action.

The course will benefit students working in crystalline terrains, not only from the Geoscience Department, but also the Department of Mining and Geological Engineering. Courses that could benefit from it include Advanced Economic Geology (GEOS F635), Rock Mechanics (MIN F370), Advanced Rock Mechanics (MIN F673), as well as Thesis (GEOS F699). There will be no negative impacts on existing courses and programs.

JUSTIFICATION FOR ACTION REQUESTED

The purpose of the department and campus-wide curriculum committees is to scrutinize course change and new course applications to make sure that the quality of UAF education is not lowered as a result of the proposed change. Please address this in your response. This section needs to be self-explanatory. Use as much space as needed to fully justify the proposed course.

Crystalline rocks form the backbone of mountain belts and underlie sediments on the continental crust as the so-called basement. They are also hosts to many ore deposits. The geological history of crystalline rocks is commonly complicated, and may reflect more than one orogenic cycle, i.e. mountain building phase. Throughout their history, these rocks were exposed to changes in temperature and pressure (metamorphism), and experienced deformation, plastic and brittle. The current courses at the UAF that cover crystalline rocks focus on one aspect, e.g. Structural geology (GEOS F314), Petrology (GEOS F214) and Advanced Petrology (GEOS F621). This course integrates their content and provides additional theoretical and practical tools that will allow students to better understand the interaction of deformation and metamorphism, and enable them to develop more accurate geological models of metamorphic and plutonic terranes. In this course students can draw on a comprehensive collection of thin sections and hand samples to study different rock types and fabrics. They are also encouraged to

use samples from their own thesis project. Students learn how to retrieve a substantial amount of information without major expenses for analytical data. Furthermore, they will gain experience and confidence in addressing crystalline rocks in the field and under the microscope, crucial for any field-related task in their own research, or the mining and exploration industry.

APPROVALS: Add additional signature lines as needed.

	Date	
Signature, Chair, Program/Department of:		
	Date	
Signature, Chair, College/School Curriculum Council for:		
	Date	
Signature, Dean, College/School of:		

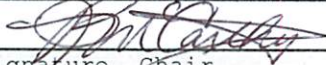

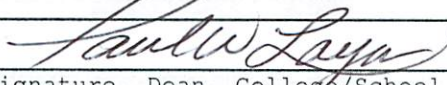
Offerings above the level of approved programs must be approved in advance by the Provost.

	Date	
Signature of Provost (if above level of approved programs)		

ALL SIGNATURES MUST BE OBTAINED PRIOR TO SUBMISSION TO THE GOVERNANCE OFFICE

	Date	
Signature, Chair		
Faculty Senate Review Committee: ___Curriculum Review ___GAAC		
___Core Review ___SADAC		

ADDITIONAL SIGNATURES: (As needed for cross-listing and/or stacking)

	Date	9-18-14
Signature, Chair, Program/Department of:	GEOSCIENCES.	
	Date	9/18/14
Signature, Chair, College/School Curriculum Council for:	CNSM	
	Date	9/18/14
Signature, Dean, College/School of:	CNSM	

Deformation and Metamorphism of Crystalline Rocks (GEOS F694)

3 Credits

Prerequisites: Graduate standing; OR permission of instructor.

Location: 237 Reichardt

Meeting Time: TBA

Instructor: Dr. Jochen Mezger

Office: 308a Reichardt

Office Hours: Monday 10-12 am; Wednesday 2-4 pm

Telephone: 474-7809

Email: jemezger@alaska.edu

Required textbook:

- Passchier & Trouw (2005): Microtectonics (2nd edition, Springer) - available as download from Springer through UAF Rasmuson Library. (P&T)

Required supplementary reading:

- Vernon (2004): A practical guide to Rock Microstructure (Cambridge University Press). Hard copy available at UAF Rasmuson Library in UAF - Level 5 (V)
- Vernon & Clarke (2008): Principles of Metamorphic Petrology (Cambridge University Press). Hard copy available at the GI-IARC Library. (V&C)

Recommended supplementary reading:

- Yardley, MacKenzie & Guilford (1990): Atlas of metamorphic rocks and their textures (Longman). Hard copy available at the GI-IARC Library.

Course Description

A variety of crystalline rocks, schists, ortho- and paragneisses, igneous rocks, are studied in thin sections and hand samples, with respect to their metamorphism and deformation. Different microstructures, fabrics of rocks and individual minerals, are observed and described, their development explained, and their bearing on the history of a particular sample revealed. The relative timing of metamorphic and deformational events can be reconstructed to develop a reasonable tectonic model by just looking at thin sections. The general understanding of crystalline rocks in the field will increase by knowing what to look for. Successful participation requires some basic knowledge of optical petrography, mineralogy/petrology (e.g. GEOS F214) and structural geology (e.g. GEOS F314).

From the course catalog

GEOS F694 Deformation and Metamorphism of Crystalline Rocks

3 Credits Offered Spring

Identification, description and interpretation of metamorphic and/or microstructural fabrics of crystalline rocks. The class provides theoretical and practical tools to understand the interaction of metamorphism and deformation that most metamorphic and

plutonic rocks experience; crucial for the development of tectonic models. Laboratory exercises include studies of rock thin sections with optical microscopes and hand specimen. Students are encouraged to bring samples from their own thesis. *Prerequisites: Graduate standing; OR permission of instructor. (2 + 3)*

Course Goals

This course is about as much, if not more, getting practical experience using the optical microscope and examining rock samples, as it is gaining theoretical knowledge. The more time you invest studying thin sections, the more you will be able to discover and interpret microstructures, and connect the terminology of the lectures with real images. You will eventually get a sharp eye for tell-tale fabrics of rock deformation and metamorphism. During this course you will:

- learn about the way rocks and individual minerals react under plastic deformation,
- *and* recognize the resulting microstructures in thin sections and hand samples;
- observe how rock composition determines how a rock is deformed and what metamorphic minerals can grow;
- find out how metamorphic reactions change the shape of minerals and which minerals are formed at the expense of others,
- *and* be able to identify them under the optical microscope;
- hone your drawing skills by sketching key microstructures;
- combine metamorphic and deformation microstructures to establish the relative history of a given piece of hard rock;
- be astonished to find out how much information you can get out of a thin section of a schist or a gneiss by thorough microscope studies, without spending a huge amount of money on fancy analyses.

Student Learning Outcomes

After completing this course, you should be able to:

- recognize the main microstructures in thin sections and hand samples;
- determine if observed metamorphic fabrics indicate a prograde or retrograde path;
- present the crucial microstructures by drawing and sketching, allowing you better understand and demonstrating them;
- approximate the metamorphic P-T conditions;
- integrate deformation and metamorphism to develop a tectonometamorphic model of a certain geologic region;
- decide which analytical methods (e.g. geochemistry, geochronology) will provide additional quantitative data (protolith provenance, age, etc.);
- develop a sampling strategy for your own research project;
- be confident in addressing rocks and get an answer from them. After all, it should be exciting and a lot of fun!

Instructional Methods

The course is designed in such a way that the laboratory sections are commonly the practical application of the theory covered in the lectures. The lectures may include some experiments and presentations with a microscope. Questions are welcome at all time. Ask if you don't understand. The labs predominantly feature working with optical microscopes. Most of the study material (thin sections, hand samples) is from my own collection, however, students are welcome and encouraged to bring their own thin sections/samples along to every lab. The more we see (including myself), the more we learn. There is no such thing as a geologist who knows it all! Throughout the lab you are encouraged to discuss what you see with fellow students. You will use sketches of rocks and thin sections to concentrate on the crucial microstructures that tell the story of that sample. Case studies discussed in lectures and labs will give you an idea how integrated deformation-metamorphism studies are used to solve problems in tectonics, plate reconstruction and orogeny. There will be weekly assignments that are arranged in such a way that they can be completed during the lab period, and commonly include description – written and sketched – of one or more thin sections with a metamorphic and structural interpretation.

Course Calendar (tentative)

See attached sheets.

Course Policies

Your success in the course depends largely on your active presence, looking at rocks. You gain experience with every hour spent at the microscope. Presence during lab period is therefore **CRUCIAL**. Let me know ahead of time if you know you will miss a lab or not be able to finish an assignment. In principle, I can only accept conference attendances (as a presenter) or documented medical appointments as excuses. I will then try to accommodate missed labs by arranging make-up time or extend an assignment deadline.

While I encourage open discussion among students, it is in your very own interest that you do your assignment yourself. Plagiarism will **NOT** be tolerated. Since thin sections or hand samples used for the assignments are unique, there is no point in copying the work of fellow students or the WWW. However, should I find that you have copied a significant portion of material, e.g. duplicate a thin section sketch or copied several sentences word-by-word, you will receive 0 points for that assignment. A second act of plagiarism will automatically have you failed the course. In addition, the **Student Code of Conduct** (in Academics and Regulations chapter of the UAF Catalog) outlines your rights and responsibilities, as well as prohibited forms of conduct. Please be aware of the contents of the code.

Evaluation

There is no written exam since it is a hands-on class. All you learn will be reflected in the quality of the weekly assignments and a final project. The final project, which will be assigned several weeks ahead, includes, but is not restricted to, microscopic analyses and a geological interpretation. Sample material from your own research project can be used.

- Weekly assignments (70%), due at the beginning of the next lab

- 10-15 min oral presentation of final project (10%) given in the last lab session
- Written presentation of final project (20%), due at the scheduled time of final exam.

The final grade will be based on the percentage of the total points from the weekly assignments and the final project (written and presentation) according to the following scale:

100-99% = A+	87-82% = B	71-70% = C-
98-92% = A	81-80% = B-	69-68% = D+
91-90% = A-,	79-78% = C+	67-62% = D
89-88% = B+	77-72% = C	61-60% = D-, <60% = F.

Support Services

Optical microscopes are set up and available in the Petrography Lab (REIC 311) for use outside the regular lab hours. Time permitting, I am available for consultation of thin sections and rock samples.

Disabilities Services

The Office of Disability Services implements the Americans with Disabilities Act (ADA) and ensures that UAF students have equal access to the campus and course materials. I will work with the Office of Disability Services (208 Whitaker Bldg., 474-5655) to provide reasonable accommodation to students with disabilities. Please let me know at the beginning of the course if accommodations should be provided.

Week	Lecture	Lab	Reading
1	Refresher: - Types of metamorphism, metamorphic facies - Types of deformation; flow and deformation	Introduction to using an optical microscope; Review of rock forming minerals: quartz, feldspars, micas	V&C 1.1, 1.8 P&T 2
2	Formation and characteristics of major metamorphic minerals	Petrography of aluminosilicates, garnet, staurolite, cordierite and other common metamorphic phases	
3	Deformation Mechanisms	Microstructures of intracrystalline deformation, recrystallization, deformation of rock forming minerals	P&T 3 V 5.3 V&C 6.2, 6.3
4	Foliations: cleavage and schistosity, influence of rock composition	Foliations of different metamorphic grade and rock types	P&T 4 V 5.8
5	Nucleation and growth of metamorphic minerals; grain size and shape; porphyroblasts	Different size and shapes of important metamorphic minerals: garnet, staurolite, andalusite, sillimanite, cordierite, micas	V&C 3.1-3.3 V 4.1-4.5
6	Growth sequence of metamorphic minerals: petrogenetic grids, textural relationships, metamorphic parageneses, monometamorphism vs. polymetamorphism	Decoding the growth sequence of metamorphic minerals in various metasedimentary rocks, recognition of metamorphic parageneses	V&C 2.1-2.3, 3.4
7	Inclusions in porphyroblasts, porphyroblast-matrix relations, relative sequence of deformation events,	Inclusion trails in garnets, staurolite, andalusite, microstructures in porphyroblasts and matrix; sequence of structures with respect to mineral growth	P&T 7.3-7.6 V&C 3.5, 3.6 V 4.13
8	Deformation partitioning, influence of compositional layering on deformation and metamorphism, metamorphism during deformation	Observe how compositional layering causes inhomogeneous deformation and controls nucleation of metamorphic minerals	V 5.5-5.7
9	Shear zones, mylonites, shear sense indicators	Shear bands, rotated porphyroblasts, deflected foliation	P&T 5
10	Deformation of high-grade metamorphic rocks, migmatites, igneous rocks	Microstructures of migmatites and metagranites	V 5.11
11	Tectonometamorphic models in a complexes with different rock types; sampling strategies	Develop a model for the tectonic and metamorphic history of an exemplary metamorphic region using rocks of various composition and stuctures	
12	Pressure-temperature conditions, thermobarometry	Calculating P-T conditions using simple geothermometers and geobarometers with a given set of mineral analyses (computer lab)	V&C 2.4
13	Auxiliary methods: - Special technics to study deformation fabrics (e.g. EBSD, Quartz C-axes) - Dating deformation and metamorphic events	Recap of various microstructures in thin section and hand samples; students show and tell, BYO sample or thin section	P&T 11
14	Case Studies	Student presentations of Final Project	N/A
Final exam	Discussion on course and student feedback		