

LSC Use Only Proposal No:
LSC Action-Date:

UWUCC Use Only Proposal No: **14-97h**
UWUCC Action-Date: **App-11/11/14** Senate Action Date: **App 12/2/14**

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person(s) Nick Deardorff	Email Address n.deardorff@iup.edu
Proposing Department/Unit Geoscience	Phone 724-357- 2611

Check all appropriate lines and complete all information. Use a separate cover sheet for each course proposal and/or program proposal.

1. Course Proposals (check all that apply)

New Course Course Prefix Change Course Deletion

Course Revision Course Number and/or Title Change Catalog Description Change

Current course prefix, number and full title: **GEOS 363 Volcanology**

Proposed course prefix, number and full title, if changing:

2. Liberal Studies Course Designations, as appropriate

This course is also proposed as a Liberal Studies Course (please mark the appropriate categories below)

Learning Skills Knowledge Area Global and Multicultural Awareness Writing Intensive (include W cover sheet)

Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)

Global Citizenship Information Literacy Oral Communication

Quantitative Reasoning Scientific Literacy Technological Literacy

3. Other Designations, as appropriate

Honors College Course Other: (e.g. Women's Studies, Pan African)

4. Program Proposals

Catalog Description Change Program Revision Program Title Change New Track

New Degree Program New Minor Program Liberal Studies Requirement Changes Other

Current program name:

Proposed program name, if changing:

5. Approvals	Signature	Date
Department Curriculum Committee Chair(s)	<i>Kenneth S. Coles</i>	3/31/2014
Department Chairperson(s)	<i>Sam A. VA</i>	4/20/14
College Curriculum Committee Chair	<i>Chris Korb</i>	10/17/14
College Dean	<i>Diane Surf</i>	10/20/14
Director of Liberal Studies (as needed)		
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	<i>Gail S. Sedquist</i>	Received 11/11/14

Part II. Description of Curricular Change

1. SYLLABUS OF RECORD

I. Catalog Description

GEOS 363 Volcanology

(3c-3l-4cr)

Prerequisite: Grade of C or better in GEOS 301

Introduces volcanoes, volcanic eruption styles, and deposits in subaerial and submarine environments. Students assess risks and hazards associated with living near active volcanoes and discuss the cultural influences of volcanoes around the world throughout human history. Study of different types of volcanic eruptions through historical and pre-historical case studies.

Laboratory exercises focus on rock identification and interpretation, fluid dynamics experiments, and learning laboratory and field skills of volcanologists that allow the determination of eruption dynamics.

II. Course Objectives

At the end of this course, students will be able to:

- 1) Correlate volcanic deposits and rocks with eruption style, intensity, and composition.
- 2) Recognize the devastating, yet constructive, nature of volcanoes and the environmental and climactic effects of volcanic eruptions.
- 3) Evaluate the relationship between rock chemistry, phase relations, and geologic occurrence for igneous samples.
- 4) Interpret igneous rock textures and mineralogy to recreate emplacement history of volcanic deposits and rocks.
- 5) Calculate eruption volume of lava flows and pyroclastic deposits and determine explosivity from grain size analyses and deposit thickness/volume.

III. Course Outline

Lecture Schedule

- | | |
|--|-----------|
| A. <i>Role of volcanoes on Earth and extraterrestrial bodies - why the Earth is hot and the release of heat via volcanoes; volcanoes and their role in plate tectonics</i> | (3 hours) |
| B. <i>Magma generation and ranges of compositions; types of volcanoes</i> | (6 hours) |
| C. <i>Exploring subaerial eruption styles through classic historical examples</i> | (5 hours) |
| D. Exam 1 | (1 hour) |
| E. <i>Magma: volatiles, compositions, and fluid dynamics</i> | (4 hours) |
| F. <i>Lava flows: effect of rheology on styles of emplacement, flow rates, and final length</i> | (4 hours) |
| G. <i>The role of volatiles on volcanic eruptions</i> | (4 hours) |
| H. <i>Pyroclastic eruptions; plume dynamics, deposits, controls on fragmentation, pyroclastic flows, fall deposits</i> | (6 hours) |
| I. Exam 2 | (1 hour) |
| J. <i>Supervolcanoes: Yellowstone, Toba, and the effect of large eruptions on global climate</i> | (4 hours) |

- K. *Submarine eruptions: Mid-ocean ridges, hot spots, and seamount volcanoes; volcanological exploration techniques* (4 hours)
- L. Final exam (2 hours during final exam period)

Lab Schedule

Week 1	Textures of volcanic rocks; hand samples and optical microscopy
Week 2	SEM image analysis: quantifying vesicularity and crystallinity of volcanic rocks
Week 3	Viscosity of lava flows: experimental calculation of analog (wax, syrup, ketchup, etc.) lavas
Week 4	Viscosity 2: calculating the change in viscosity during a Hawaiian eruption due to gradual crystallization
Week 5	Vesicle nucleation experimentation using analog carbonated fluids (coke/mentos)
Week 6	Evaluating lava flow hazards using topographic maps
Week 7	EJECT!- calculating eruption intensity using volcanic ejecta (ballistics)
Week 8	Lab Exam 1
Week 9	Ash fall deposits: calculating eruptive volume from isopach data
Week 10	Calculating eruption dynamics: column height and mass eruption rate
Week 11	Analysis of pyroclastic deposits: grain size, componentry, density, porosity, permeability
Week 12	Ignimbrites: analysis and ranking of welded tuffs
Week 13	Lahars: evaluating runout distances and hazards of Mt Rainier (LaharZ)
Week 14	Lab Exam 2

IV. Evaluation Methods

The final class grade will be determined from the following assessments:

Lecture Exam 1	15 %
Lecture Exam 2	15 %
Final Lecture Exam	20 %
Lecture assignments	10 %
Lab assignments	20 %
Lab Exam 1	10 %
<u>Lab Exam 2</u>	<u>10 %</u>
Total	100 %

V. Example Grading Scale

The final grade will be assigned based on the semester average using the scale: 90-100%=A; 80-89%=B; 70-79%=C; 60-69%=D and below 60%=F.

VI. Attendance Policy

The attendance policy will conform to IUP's undergraduate course attendance policy.

VII. Required Textbook(s), Supplemental Books and Readings.

Francis and Oppenheimer, Volcanoes, 2nd ed. 2004, Oxford

This is the most recent edition.

VIII. Special Resource Requirements.

Students must purchase a 10X hand lens for lab exercises. These typically run \$5-20 depending on quality. Geologic maps of Hawaiian volcanoes will need to be purchased for the lava flow risk assessment lab; available online through the USGS.

IX. Bibliography

The following resources will be used to develop the course curriculum:

Bardintzeff, J.M., McBirney, A. (2000) *Volcanology*. Jones and Bartlett Publishers, Inc.

Fagents, S., Gregg, T., Lopes, R. (2013) *Modeling Volcanic Processes: The Physics and Mathematics of Volcanism*. Cambridge University Press.

Fischer, R.V., Schmincke, H.-U. (1984) *Pyroclastic Rocks*. Springer-Verlag Berlin Heidelberg. 472 pp.

Francis, P., Oppenheimer, C., (2004) *Volcanoes*, 2nd ed., Oxford

Lockwood, J., Hazlett, R. (2010) *Volcanoes: Global Perspectives*. Wiley-Blackwell.

Nesse, William (2011) *Introduction to Mineralogy* (2nd Ed). Oxford University Press, 496 pp.

Oppenheimer, C. (2011) *Eruptions that Shook the World*. Cambridge University Press.

Parfitt, L., Wilson, L. (2008) *Fundamentals of Physical Volcanology*. Blackwell Publishing.

Reid, M. R. (2010) Rethinking how Undergraduate "Hard Rock" Petrology is Taught. AGU Fall Meeting Abstracts, v. 1, p. 0605.

Sigurdsson, H., Houghton, B., McNutt, S., Rymer, H., Stix, J. editors (2000) *Encyclopedia of Volcanoes*. Academic Press. 1417 pp.

Sparks, R., Bursik, M., Carey., Gilbert, J., Glaze, L., Sigurdsson, H., Woods, A. (1997) *Volcanic Plumes*. John Wiley & Sons, Ltd. 574 pp.

Winter, John (2009) *Principles of Igneous and Metamorphic Petrology* (2nd Ed). Prentice-Hall, 720 pp.

Zeilinga de Boer, J., Sanders, D., Ballard, R. (2002) *Volcanoes in Human History: The Far-Reaching Effects of Major Eruptions*. Princeton University Press.

Course Analysis Questionnaire

Section A: Details of the Course

- A1 Volcanology is a new course designed for junior and senior geology majors. It will be a controlled elective option for all Geology (Geology, Environmental, Energy Resources) Tracks.

This is a new course, offered to increase the diversity of upper-level controlled electives. The labs and lectures in this course cover igneous deposits and volcanologic activity on a deeper investigative level than other courses currently offered (GEOS 301: Mineralogy and Petrology) or proposed (i.e. GEOS 345: Igneous and Metamorphic Petrology) in this course revision. By offering a course on volcanology we will allow students interested in igneous rocks and deposits and petrology an additional course elective that will greatly increase their knowledge of igneous activity. Additionally, this course focuses on determining and quantifying the emplacement of volcanic deposits and the overall effect eruptions have on the surrounding landscape, which will build upon other required geology major courses creating an additional capstone experience where students can synthesize and apply skills from prior courses, such as Geomorphology (GEOS 354), Surficial Processes (GEOS 203), and Quantitative methods in the Geosciences (GEOS 202).

Since the last department curriculum reform (2008-2009) faculty analysis of student learning outcomes during our department planning retreats has consistently identified rock and mineral identification and interpretation as a weak area for recent geoscience graduates. Adding Volcanology into our current curriculum reform will provide students with more extensive knowledge of igneous rocks and deposits.

Furthermore, this course has been identified by exit interviews and surveys of recent graduates as an elective they would most have wanted to take, had it been offered during their tenure at IUP. These exit interviews/surveys suggest there is an interest in volcanology beyond those students pursuing a career studying volcanoes and/or igneous deposits.

- A2 Volcanology is a completely new course and will introduce students to concepts and techniques at a much deeper level, not offered in Igneous and Metamorphic Petrology. No changes to existing or proposed courses are required. The catalog number GEOS 363 has not previously been used.
- A3 This course has not previously been offered at IUP.
- A4 This will not be a dual-level course.

A5 This will not be a variable credit course.

A6 Many undergraduate geology programs in the United States offer an upper-level undergraduate course similar to this. There are numerous examples of recent offerings, including:

Oregon State University: GEO 427 Volcanology

University of Alaska, Fairbanks: GEOS F606

University of Bristol: Physical Volcanology and Geological Flow

University at Buffalo, SUNY: GLY 431-531 Volcanology, GLY 477/577 Advanced Volcanology

University of Hawaii: GG 104 Volcanoes in the Sea, GG 300 Volcanology, GG 601

Explosive Volcanism, GG 605 Lava Flow Rheology and Morphology

University of Oregon: GEOL 692 Volcanology

A7 While volcanic eruptions play an important impact on civilizations around the world and present potential hazards, no professional society, accrediting authority, etc. requires the skills proposed in this course.

Section B: Interdisciplinary Implications

B1 This course will not be taught by instructors from more than one department.

B2 There is no relationship between the content of this course and the content of any other course offered at IUP.

B3 This course will not be cross-listed with other departments.

Section C: Implementation

C1 Faculty resources are adequate to teach this class at the current time. The course will be taught on a two-year rotation in the workload of our mineralogist-petrologist, Dr. Nick Deardorff, alternating with another proposed course, GEOS 345: Igneous and Metamorphic Petrology, offered as a requirement for Geology/Geology Track and as a controlled elective course for Geology/Environmental Track and Geology/Resources Track.

C2 The teaching space as well as the existing igneous rock resources we have collected in the department over the past thirty years are sufficient to teach this class. We anticipate modernized teaching labs in the new science building that will assist us to update the lab and incorporate more innovative teaching techniques. We update our teaching collections of rocks and minerals at no additional cost whenever we take our students on a field course to

areas with classic outcrops or unique examples of igneous and metamorphic rocks. Dr. Deardorff's professional research in the Pacific Northwest will also allow him to collect additional igneous samples for use in his volcanology course.

Our optical microscopes are growing old and many are not aligned well enough for students to use them easily. We are implementing a plan to replace six of them at a time using college equipment resources, so that each work table of students in the lab has access to at least one new microscope to examine optical features of the rocks in thin sections. Students supply their own hand lens for hand sample examination and pay for their meals and camping (supplemented by existing departmental foundation resources) for the three-day weekend field trip.

All software intended for use in the Volcanology course is freeware, freely available for download on the internet. This course will require a one-time purchase of a few geologic maps of Hawaiian volcanoes for a risk and hazard assessment lab. A few inexpensive items (Coke, Mentos, honey, ketchup, etc) will need to be purchased each semester the course is taught. Funds for those purchases will be provided by the Geosciences department.

- C3 None of the resources for this course are grant-funded.
- C4 This course will be offered in alternate fall semesters, in tandem with another new course, GEOS 345 Igneous and Metamorphic Petrology, that is being proposed as part of this curriculum package. We offer these upper-level classes in the fall to ensure that students have had a chance to take their pre-requisite, GEOS 301 Mineralogy, in the preceding spring.
- C5 No more than one section of this course will be offered at a time.
- C6 Since this course has an integrated laboratory section, enrollment is limited to 24 students (4 students per work-table / 6 work tables in the lab). This is the standard enrollment limit for our upper-level majors courses. Enrollments in these classes usually range from 15-22 students, although recent rises in our overall enrollment may cause them to fill in the future.
- C7 We are not aware of any parameters or enrollment guidelines for this course.
- C8 This is not a distance education course.

Section D: Other Miscellaneous Information

There is no additional information for this proposal.

Part III. Letters of Support or Acknowledgement

No letters of support from other programs or departments are required for this proposal.