GEOS 624 Syllabus

International Volcanological Field School
Investigating the White River Ash eruption and magma storage from Mt Churchill, Alaska

Course information: GEOS 624 - 3 credits
Prerequisites: Acceptance into the course is contingent upon: 1) a completed application, 2) a reference letter, and 3) permission of instructor
Location: UAF campus, field trip locations in Alaska and Canada
Meeting times: Daily from 8:00 am to 5:00 pm
Course type: in person, field, classroom and laboratory

Instructor
Jessica Larsen – Professor, Volcanology, Geophysical Institute and Dept. of Geosciences, University of Alaska, Fairbanks AK; email: jflarsen@alaska.edu; cell phone 1-907-388-2680

Dates: July 15-31, 2024
Estimated costs: $800* plus UAF tuition and fees plus roundtrip airfare to Fairbanks, AK

Course description:
This course will deliver a hands-on experience to students who wish to learn how to investigate where magmas are stored in the crust. The course will include lectures about magmas and volcanic plumbing systems, different eruption styles, how to use petrology and experiments to constrain the conditions of magma storage in the crust, and background information about the Wrangell Volcanic Field and Mt Churchill – the source of the north and east lobes of the White River ash deposits. The field trip will take place over 7 days in Alaska and Canada. We will visit outcrops of the White River ash, north and east lobes, learn how to log a stratigraphic section from tephra deposits, sampling, and a tephra isopach exercise. After returning from the field, students will learn how to conduct high pressure-temperature experiments and will use the outcomes to help construct a phase diagram for the WRA-E eruption from Mt Churchill.

Restrictions
Valid passport to enter Canada is required. This trip does not require a high level of physical fitness, but students should be in generally good health and willing to travel in remote places in Alaska and Canada by van. Students should be prepared to camp in developed campgrounds and follow safety instructions in the camp and at the outcrops, many of which will be along the highway. Please bring your own camping gear or the instructor can help arrange for local rentals. If this requirement is a barrier to your participation, the instructor will be able to loan camping gear to a few students who may not have their own. Summer in Alaska is beautiful but not without annoyances, such as mosquitos and other biting bugs, rain and cold, damp weather, and possibly bears. While we will be traveling along the road system, there will be places along the road with no towns or cell service so be prepared with all essentials you need

for the trip. Students must be willing to follow a high level of safety protocols and standards in the lab and pass a lab safety test before starting experiments.

*Pending approval of fee justification. Includes shared dormitory room at UAF for the duration of the course. If students wish to find their own housing or are local, the course fees can be reduced

Objectives

- GEOS 424 will be a hybrid field and lab course experience, suitable for undergraduates who would like to learn more about Alaska volcanism, basic field methods, and combine those with hands on learning about high pressure and temperature magma experiments.
- GEOS 624 is an excellent course for students new to their graduate career as an introduction to explosive volcanism, Alaska volcanoes, and experimental petrology as possible future topics for their research careers.

Key concepts addressed

- Explosive volcanism
- Volcanism and tectonics in the Wrangell Volcanic Field
- Using field observations to constrain eruption VEI
- Magma processes and advanced petrology
- Experimental petrology methods to determine magma storage

Student learning outcomes

GEOS 624:

- For students with minimal camping experience, learn how to camp in Alaska at developed campgrounds
- Learn how to recognize volcanic ash deposits in the field
- Learn how to describe tephra by grain size and mineral components using a hand lens in the field
- Practice taking detailed, neatly written field notes
- Gain hands-on experience constructing an isopach map from the outcrop measurements
- Learn how to operate safely in an experimental petrology lab
- Apply your learning to create an experimental run
- Learn how to work effectively in a group environment
- Help create a phase diagram for constraining magma storage
- Gain mentorship skills by working in graduate - undergraduate student cohorts
- Apply your field data to advanced models constraining eruption volume and VEI
- Learn how to use the Rhyolite MELTS model to compare quantitatively with an experimental phase diagram
- Establish collegial relationships with other graduate students from other universities.

Instructional methods

This course will use a combination of instructional methods: traditional in-class lectures, hands on learning of volcanology and tephrochronology field work methods, field note taking practice, hands-on laboratory methods training, field and laboratory safety training.

Tentative course schedule (*note – this schedule is subject to change, but should give you a general idea of what to expect*)

Day 1: July 14th or earlier: Arrive in Fairbanks. Please arrange for travel to UAF. Be prepared to arrange for your first night of lodging and transportation to and from UAF.

July 15th : Introductory lectures and prepare for the field trip (9 hours total time, includes breaks and lunch)
Location: Reichardt building at UAF

-Lecture 1 – Alaska tectonics, Wrangell Volcanic Field
-Lecture 2 – Mt Churchill and the White River Ash eruption; Physical volcanology 1 – Conduit dynamics, plume dynamics
-Lecture 3 – Plinian style eruptions, isopach mapping, VEI determination.
-Field preparation – we will go over the field gear and make sure everyone is all set! We will sort through and pack up the field food.

July 16: We will meet at 8:00am in the back of the Reichardt building to load up the vans and start our trip. We will drive first south to Delta Junction and then east toward Tok, AK. We will stop in Tok for lunch, but then continue to the West fork campground or Chicken on the Taylor highway, making one or two field stops on the way.

July 17: We will depart camp around 8:00 am and drive towards Dawson on the Taylor highway and visit another 2 or 3 outcrops of WRA N along the way. Camp near Dawson YT.

July 18th: Pack up camp and depart around 8:00 am. We will drive halfway between Dawson and Whitehorse, YT on this day visiting as many outcrops along the road system as we can.

July 19th: Drive the rest of the way to Whitehorse, visiting outcrops along the way. Camp near Whitehorse

July 20th: Drive to Lake Creek Campground and visit a few outcrops in the area. Camp there for the night

July 21 – Continue down the road to Tok visiting outcrops in the WRA E lobe and North lobe along the way. Camp near Tok.

July 22 – Return to Fairbanks (about a 4-hour drive) by mid-day. Unpack the vans, check into the dorms, and rest and relax.

July 23: Introduction to experimental petrology. Location Reichardt building UAF

-Lecture 4 – using petrology to estimate magma storage conditions, tour EPMA lab
-Lecture 5 – Experimental petrology and phase equilibria, tour ex pet lab.
- First day – all hands safety, SOP, and protocols lecture and demonstration of methods.

Safety Quiz – students must pass the safety quiz to be able to participate in the experiments

July 24: The class will split into two groups. Instructor will demonstrate how to load and solder capsules to all. While one group is working on their capsules (with TA supervision), the other group will get a semi-hands-on tour of the electron microprobe.

July 25: The class will split into two groups. Instructor will demonstrate first how to quench an experiment (4 pre-loaded before class starts), and then how to load an experiment, using one of the successful capsules to each group at a time. Instructor will demonstrate and then students will load their runs. Students not actively loading runs will (work on tabletop isopach exercise, microscope work with grain mounts, work with EPMA data, learn how to do phase proportions, work on presentation, etc) – end of day – four runs in furnaces.

July 26: Pressure check demonstration to start off the day. Instructor demonstrates how to make a polished thick section from the prior quenched runs (have 5 samples on hand so that each group of two students can learn how to polish thick sections). Students work on polished thick sections.

July 27 (6 to 8 hours): Pressure check start of day. Rest of day – students finish up their thick sections. We will look at each under petrographic microscope first. Students write notes, draw sketches of all phases they see in each thick section. Students compile isopach data and calculate VEI.

July 28: (4 to 6 hours): Students work in shifts to use BSE imaging on the microprobe to verify phases and collect EDS spectra for semi-quant analyses. Start assembling phase diagram. Introduction to MELTS modeling for graduate students.

July 29 (8 hours): Experiment quench day! In the morning students will quench their runs under close supervision in groups of 2 to 3. They will extract capsules and make thick sections and do petrography identification and work on MELTS modeling (graduate students) for the rest of the day.

July 30th (4 to 6 hours): Students will continue to work on petrography identification of phases in their runs and then using the BSE and EDS quant. Spend remainder of day finishing up any unfinished work (isopach VEI, MELTS modeling, etc) and work on presentations

July 31 (6 to 8 hours): Group phase diagram assembly session in the morning, presentations in the afternoon.

July 31 evening: Farewell dinner! Students may depart this evening or the following morning

Policies

Students are expected to participate in all class activities and graded assignments. All participants must be willing to listen to and abide by important safety information and safety-related instructions given by instructor both in the field and in the lab. Students should conduct themselves in a manner that is inclusive and respectful of others. No drugs, alcohol, or firearms will be allowed during the field trip. Students will record their field observations in a notebook according to the examples given on the first day before the field trip begins. Students will also keep a laboratory notebook to record experimental parameters for their runs. The 400 level students will participate in the presentations with a graduate student team member. The 600 level students will be expected to help mentor the undergraduates in their experiments and presentation work.

Equipment

Students should bring their own camping gear. However, if this is a barrier to participation, please contact the instructor who can provide you with loaned gear:

-Tent
-Rain jacket and pants
-Bug net and/or bug spray
-A variety of layers for chilly or wet nights as well as warm sunny days
-Rain jacket and pants
-Long sleeve warm fleece jacket
-Hat for sun or rain
-Sturdy shoes or lightweight hiking boots
-Rain boots if you prefer (like Xtra Tuff brand)
-Sunglasses
-Sunscreen
-Sleeping bag
-Sleeping pad
-1 L water bottle(s) for personal use
-Personal eating gear (bowl, cup, spoon)
-Field notebook and pencils
-Hand lens
-Handheld GPS - optional
-Any necessary medications or other personal items you can’t live without
-Small personal first aid kit
-Laptop for class and lab sessions

We will provide campground cooking gear and related utensils, water jugs, and other communal camp items. Instructor will have a first aid kit, satellite phone, and inReach device for emergencies.

Geos 624 graded assignments
Field notebook
Safety exam – must pass to be allowed to do experiments
Isopach assignment – advanced modeling
Make a capsule
Help load and quench one run
Help make thick section
Lab notebook
Rhyolite MELTS modeling assignment
Mentorship reflection assignment
Final presentation

Notebooks: 20% total, 10% each
Final presentation: 25%
Safety Exam: 10%
Isopach assignment: 10%
Capsule, plus load and quench run, and make thick section (participation): 10%
Rhyolite MELTS: 10%
Mentorship reflection: 15%

Grading
Letter grades for the course will be given according to the following percentage scale according to the assignment percentages listed above: A+ (100–97), A (96–93), A- (92–90), B+ (89–87), B (86–83), B- (82–80), C+ (79–77), C (76–73), C- (72–70), D+ (69–67), D (66–63), D- (62–60), F (59–0).

Required reading (will be provided to you)

Cas and Wright Volcanic Successions (out of print) Chapter 5.1-5.3 and pages 129-133.

Daggitt, M. L., Mather, T. A., Pyle, D. M., & Page, S. (2014). AshCalc–a new tool for the comparison of the exponential, power-law and Weibull models of tephra deposition. *Journal of Applied Volcanology*, *3*, 1-8.

Kristensen, T. J., Beaudoin, A. B., & Ives, J. W. (2020). Environmental and hunter-gatherer responses to the white river ash east volcanic eruption in the late Holocene Canadian subarctic. *Arctic*, *73*(2), 153-186.

Larsen, J. F. (2006). Rhyodacite magma storage conditions prior to the 3430 yBP caldera-forming eruption of Aniakchak volcano, Alaska. *Contributions to Mineralogy and Petrology*, *152*(4), 523-540.

Lockwood and Hazlett Chapter 5

Richter, D. H., Preece, S. J., McGimsey, R. G., & Westgate, J. A. (1995). Mount Churchill, Alaska: source of the late Holocene White River Ash. *Canadian Journal of Earth Sciences*, *32*(6), 741-748.

Preece, S. J., McGimsey, R. G., Westgate, J. A., Pearce, N. J. G., Hart, W. K., & Perkins, W. T. (2014). Chemical complexity and source of the White River Ash, Alaska and Yukon. *Geosphere*, *10*(5), 1020-1042.

Pyle, D. M. (2016). Field observations of tephra fallout deposits. In *Volcanic ash* (pp. 25-37). Elsevier.

Pyle, D. M. (2015). Sizes of volcanic eruptions. In *The encyclopedia of volcanoes* (pp. 257-264). Academic Press.

Recommended reading (will be provided to you)

Bonadonna, C., Costa, A., Folch, A., & Koyaguchi, T. (2015). Tephra dispersal and sedimentation. In *The encyclopedia of volcanoes* (pp. 587-597). Academic Press.

Carey, S., & Bursik, M. (2015). Volcanic plumes. In *The encyclopedia of volcanoes* (pp. 571-585). Academic Press.

Reuther, J., Potter, B., Coffman, S., Smith, H., & Bigelow, N. (2020). Revisiting the timing of the northern lobe of the White River Ash volcanic event in Eastern Alaska and Western Yukon. *Radiocarbon*, *62*(1), 169-188.

Pyle, D. M. (1989). The thickness, volume and grainsize of tephra fall deposits. *Bulletin of Volcanology*, *51*, 1-15.

Student code of conduct

Students are subject to the UAF Student Code of Conduct. University of Alaska is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: www.alaska.edu/nondiscrimination.

Protections and services statement

Every qualified student is welcome in our classroom. As needed, we are happy to work with you, disability services, veterans' services, rural student services, etc. to find reasonable accommodations. Students at this university are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. As required, if we notice or are informed of certain types of misconduct, then we are required to report it to the appropriate authorities. For more information on your rights as a student and the resources available to you to resolve problems, please go the following site: www.uaf.edu/handbook/

UAF Non-Discrimination Statement

The University of Alaska is an affirmative action/equal opportunity employer and educational institution. The University of Alaska does not discriminate on the basis of race, religion, color, national origin, citizenship, age, sex, physical or mental disability, status as a protected veteran, marital status, changes in marital status, pregnancy, childbirth or related medical conditions, parenthood, sexual orientation, gender identity, political affiliation or belief, genetic information, or other legally protected status. The University's commitment to nondiscrimination, including against sex discrimination, applies to students, employees, and applicants for admission and employment. Contact information, applicable laws, and complaint procedures are included on UA's statement of nondiscrimination available at www.alaska.edu/nondiscrimination. For more information, contact:

UAF Department of Equity and Compliance
1760 Tanana Loop, 355 Duckering Building, Fairbanks, AK 99775
907-474-7300
uaf-deo@alaska.edu

Disability Services

I will work with the Office of Disability Services to provide reasonable accommodation to students with disabilities. 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 Disabilities Services (208 Whitaker, 907-474-5655) to provide reasonable accommodation to students with disabilities uaf.edu/disability/https://www.uaf.edu/disabilityservices/

COVID-19 Statement

Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19. Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply. In the event of a change in UAF's COVID-19 policy, the instructor will inform students in the course promptly and adjustments will be made as needed.