



Karst Geology

June 3-9, 2018

GEOG 475, GEOL 475, and GEOS 510

Course Instructor: Dr. Arthur Palmer

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WKU Program Leader: Dr. Leslie A. North

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Course Description: This is a field course that introduces the basics of karst and cave origin, with emphasis on geologic controls, interpretation, and field methods. Treatment of these subjects begins at an introductory level but quickly moves on to the level at which students are able to recognize and interpret karst geology on their own. Detailed topics include karst features and their origin, their geologic setting, hydrologic and chemical processes by which they form, geologic history of the Mammoth Cave region, how to interpret past conditions from karst features, and applications to practical problems. The course consists of classroom presentations and discussions, combined with field trips to surface and underground sites in and around Mammoth Cave National Park. The course is available as a workshop, or for academic credit (either undergraduate or graduate). For those taking the course for academic credit, a two-week field project and written report are required by August 1 following the course. A prior course in geology is recommended but not required. This course is held at the Hamilton Valley Research Facility near Mammoth Cave National Park.

Course Objectives: To introduce students to the full variety of karst and cave features and to the methods by which they can be interpreted. Although field work is focused on Mammoth Cave and vicinity, illustrated discussions will cover caves and karst of different types throughout the world. At the end of the course, students will be familiar with the main concepts of how caves and karst relate to their geologic setting and what they tell us about the regional geologic history. They will also be familiar with field techniques and technical criteria for distinguishing among the various types of cave origin and karst processes.

Required Text:

- Manual of course material, reports, and articles covered in class to be provided by WKU at the start of the course.

Recommended Text: Prior to course, as reference during course, and for assistance with field project after course. Students with limited background in geology should consider reading an introductory book in general geology prior to the course (consult the web for examples).

- Palmer, A.N., 2007, *Cave Geology*: Dayton, Ohio, Cave Books, 454 p. Available for about \$38 at www.cavebooks.com OR www.speleobooks.com.
- Ford, D.C., and P.W. Williams, 2007, *Karst hydrogeology and geomorphology*: Chichester, U.K., John Wiley and Sons, Ltd., 562 p.
- Palmer, A.N., and M.V. Palmer, 2009, *Caves and karst of the USA*: Huntsville, Ala., National Speleological Society, 446 p. (www.caves.org).

Out of print, but available in libraries, or on interlibrary loan:

- Palmer, A.N., 1981, *A geological guide to Mammoth Cave National Park*: Teaneck, N.J., Zephyrus Press, 210 p. (temporarily out of print)
- White, W.B., 1988, *Geomorphology and hydrology of karst terrains*: New York, Oxford University Press, 464 p.
- White, W.B., and E.L. White (eds.), 1989, *Karst hydrology: Concepts from the Mammoth Cave region*: New York, Van Nostrand Reinhold, 346 p.

Equipment and Supply List:

Note, to avoid potential transmission of white-nose syndrome to bats in the cave, the Park Service requires that clothes and equipment used in one part of Mammoth Cave be thoroughly cleaned before being used in another part. Our schedule changes from Mammoth during the first 3 days to Flint Ridge during the last 3 days. A disinfectant will be available to treat helmets and equipment, but for cave clothes it is easier to change to fresh items kept in a separate sealed plastic bag. White-nose syndrome has been identified in Mammoth Cave National Park, but it is still necessary to follow these precautions. WNS, caused by a fungus, is fatal to hibernating bats but does not affect humans. For details, visit www.caves.org and click on WNS.

1. **Helmet** (for caving trips) with non-elastic chin strap, quick-release buckle, and three- or four-point suspension. The helmet should stay on during a fall but be easily released if it should become wedged. The helmet will also be the mounting point for your primary light source, so any accommodation for attaching a headlamp is a plus.
2. **Two (2) lights that can be helmet mounted.** REI or other outdoor outfitters carry suitable lights for caving. Bring extra batteries.
3. **Flashlight** with extra batteries and extra bulb (ex. Mini-Maglite)
4. **Sturdy boots with non-skid soles** (comfortable, hiking, water resistant is good).
5. **Caving coveralls are ideal, but a suitable alternative is rugged clothing** that can withstand outdoor activity. These include comfortable pants or jeans that you can afford to get dirty. To keep you warm in the 56° F, almost 100% humidity, underground environment you'll need to dress in layers. It is strongly advised that you have a thermal layer top (polypro or equivalent) and a bottom. If you are not using coveralls, then a long-sleeve shirt is strongly recommended. You will be underground most days, so be prepared with some clean changes of clothes. There will not be enough time to do laundry each day.

6. **Gloves** (garden type is ok, to protect hands and for gripping)
7. **Knee pads** (These are very helpful in protecting your knees). Basketball or other athletic-type knee pads are good.
8. **Small to moderate size day-pack** to hold batteries, jacket, clothing, supplies. A large backpack will be too bulky for narrow cave passages.
9. **Water Bottle** (fill before going on trips, to keep hydrated)
10. **Snack foods suitable for long underground hiking trips**— such as granola-type bars, small cans of fruit, dried fruit, trail mixes, beef or other jerky – similar to what you would take on a long day hike on the surface.
11. **Rain Gear** (layers of clothing for severe weather, umbrella, rain jacket, etc.)
12. Food if you are staying at Hamilton Valley Facility, which has a fully equipped kitchen, showers and restrooms.
13. Bedding (If staying at Hamilton Valley -sleeping bag or sheet or blanket, pillow). Hamilton Valley has 10 rooms with 4 bunks each.
14. Toiletries and Towels (If staying at HV—Towels, toothbrush, toothpaste, shampoo, etc).

Attendance: Students are expected to participate in all classes and field trips, except under special conditions (e.g., health). Field trips involve easy to moderately challenging caving. In the rare circumstance that students are unable to fulfill the field requirements they will be invited to drop the course. In general the rigor of the trips are adjusted to the abilities of the class. **All participants will receive a Certificate of Participation on the last day of the class for their full participation in the class. This does not constitute the final grade for those taking the course for academic credit.**

Grading: Courses can be taken as non-credit workshops, Undergraduate and Graduate credit, or for Continuing Education Units. For those taking the course for academic credit, a report on a two-week independent field project is required. Students will need to remain in contact with the instructor for guidance. Deadline for written reports is August 1 of year of course. Project grading is based on the insight and quality of work demonstrated, with some accommodation for those with limited background.

Grade Scale (based mainly on project, but weighted according to participation in class):

A = equivalent to the finest work that is expected of a student at this level

B = good work, but with a few flaws in procedure and interpretation

C = average work

D = poor work, sloppy presentation

F = no redeeming features, or failure to turn in project by deadline

Field Trips:

Note, all students are required to sign a waiver for liability purposes related to any and all work involving multiple trips to the field for study and projects. The Karst Field Studies Program provides this form on the KFS website under the Forms tab. A blanket waiver form covering all trips even if they are short in distance or duration will be provided.

1. Surface karst features: a van ride through the Mammoth Cave area to view rock exposures, surface streams, springs, dry valleys, sinkholes, and sinking streams. (4 hrs)
2. Historic tour route of Mammoth Cave, including a side trip to lowest stream level. This will be run after the normal tour hours to avoid interfering with Park Service tours. Goal = introduction to types of cave passages, rock strata, and passage levels (3 hours)
3. Mammoth Cave, Cleaveland Avenue area: Cleaveland Avenue, Boone Avenue, Rose's Pass, Pinson's Pass, Martel Avenue, Cathedral Domes, Emily's Avenue, Pass of El Ghor. These are mainly tour routes (or former tour routes) that require only walking. Emily's Avenue requires scrambling over rocks and a short climb (can be bypassed for those who prefer to). Goal = types of passage intersections, former base levels, solution features. Includes interpretive group projects. (4 hours)
4. Mammoth Cave, Bransford East: Enter New Entrance, follow tour trail for a short distance, then drop into lower levels. Some crawling, minor climbing, mud and shallow water are possible in places. Goal = passage profiles, effects of varying water levels on cave character, effect of rock characteristics on cave character. (4 hours)
5. Great Onyx Cave: A short trip along the main (former) tour route, to view effects of different types of water inputs and their chemistry. Group project with water chemistry of drip water. (2 hours)
6. Crystal Cave, upper levels: Large former tour routes that illustrate the geologic history and characteristics of the oldest levels in the Mammoth Cave System. Group project to interpret passage origin and relation to geologic setting and geologic history. (2 hours)
7. Flint Ridge Cave System via Austin Entrance: A lengthy trip, mainly walking but with some short crawls and scrambling over breakdown. Pohl, Smith, Turner, and Mather Avenues illustrate different levels of passage development and types of mineral deposits. (5 hours)

General Class Conduct and Policies: During class periods, cell phones should be turned off and smoking is not allowed. While in cave, safety and conservation are primary concerns. We will move slowly and carefully to minimize danger and impact on the cave. On the surface, especially in the National Park, it is essential to drive carefully and to obey the speed limit. Beware of snakes, ticks, chiggers, and poison ivy. ** Cell phones should be turned off during class! ** Please treat your colleagues and their desire to learn with appropriate respect.

ADA Statement: Students with disabilities who require accommodations (academic adjustments and/or auxiliary aids or services) for this course must contact the Director of the Karst Field Studies Program, Dr. Leslie North at leslie.north@wku.edu or (270) 745-5982 so proper accommodations can be considered and made as necessary.

Schedule Change Policy: The Department of Geography and Geology strictly adheres to University policies regarding schedule changes. It is the responsibility of the student to meet all admissions deadlines. Only in exceptional cases will a deadline be waived (you will be required to fill out an appeal form). The form requires a written description of the extenuating circumstances involved and the attachment of appropriate documentation. Poor academic performance, general malaise, or undocumented general stress factors are not considered as legitimate circumstances.

Tentative Class Schedule/Agenda

Subject to Change

Sunday, June 3

6:00pm-8:00pm, Meeting to introduce ourselves and to describe the nature of the course

Monday, June 4

8:00am-8:30am, Introduction by WKU staff and by Park Service representatives

8:30am-10:00am, Lecture: Concept of karst, karst types

10:00am-10:15am, Break

10:15am-12:00pm, Lecture: Local geologic setting

12:00pm-1:00pm, Lunch at Hamilton Valley

1:00pm-5:00pm, Field Trip: Surface karst, rock exposures (includes rest breaks)

5:00pm-6:00pm, Dinner at Hamilton Valley

6:30pm-9:30pm, Historic Tour, Mammoth Cave

Tuesday, June 5

8:30am-10:00am, Lecture: Karst processes

10:00am-10:15am, Break

10:15am-12:00pm, Lecture: Interpretation of cave patterns

12:00pm-1:00pm, Lunch at Hamilton Valley

1:00pm-5:00pm, Field Trip: Mammoth Cave, Cleaveland Ave. area (includes rest breaks)

5:00pm-6:00pm, Dinner at Hamilton Valley

6:00pm-8:00pm, Informal presentations

Wednesday, June 6

8:30am-10:00am, Lecture: Karst hydrology and its effects on caves

10:00am-10:15am, Break

10:15am-12:00pm, Lecture: Karst chemistry and its effects on caves

12:00pm-1:00pm, Lunch at Hamilton Valley

1:00pm-5:00pm, Field Trip: Mammoth Cave, Bransford East (includes rest breaks)

5:00pm-6:00pm, Dinner at Hamilton Valley

6:00pm-8:00pm, Informal presentations; free time for laundry, etc.

Thursday, June 7

8:30am-10:00am, Lecture: Varieties of cave origins

10:00am-10:15am, Break

10:15am-12:00pm, Lecture: Field measurements in caves

12:00pm-1:00pm, Lunch at Hamilton Valley

1:00pm-3:00pm, Field Trip: Great Onyx Cave

3:00pm-3:15pm, Break

3:15pm-5:00pm, Field Trip: Crystal Cave

6:00pm-9:00pm, Group meal at HV; optional student presentations of home caving areas

Friday, June 8

8:30am-10:00am, Lecture: Cave minerals and interpretation

10:00am-10:15am, Break

10:15am-12:00pm, Lecture: Geologic history of Mammoth Cave and relation to the development of the surrounding region

12:00pm-1:00pm, Lunch break

1:00pm-6:00pm, Field Trip: Flint Ridge Cave System (includes breaks for rest and food)

6:30pm-7:00pm, Dinner at Hamilton Valley

7:00pm-9:00pm, Summary lecture and course evaluation

Saturday, June 9

Optional field trips and/or discussions