

**Department of Geography
University of Western Ontario,
Geography 3000y Section 3: Kentucky Field Camp
Course Outline and Briefing**

1. Objective

Field Camp is intended to provide an intensive, multiday experience directed to reading and interpreting the environment in a geographical context. The Kentucky field camp provides a novel experience involving a “karst” landscape where both physical and human geographies are underpinned by ubiquitous underground drainage.

2. Personnel

Leader: Dr Chris Smart, SSC 1402 (csmart@uwo.ca, 519 661 2111 x 85007)

Assistant: TBA

3. Background: Karst Landscapes

Karst is a noun and adjective applied to landscapes developed on soluble rocks like limestone where the majority of runoff travels through underground cave streams. Cracks in the rock are opened up over time, increasing the permeability of the bedrock. As a result, there is little surface water; rainfall and rivers disappear underground, where they join up into river systems and finally emerge as springs.

Much of our familiar landscape is “fluvial” with river networks nestling in integrated valley systems. In karst, rivers occupy cave networks and the surface landscape is much less coherent, featuring closed depressions and often the dry remnants of former valley systems. In conventional landscapes, rivers and surface runoff progressively denude the landscape removing most of the evidence of its former condition. In karst, as the cave stream drops to new levels, the old conduits are left as abandoned (“dry”) passageways that can be explored. The result can be a complex network accumulating over millions of years.

Karst can be challenging for its resident people. Water may be hard to obtain, floods (paradoxically) can be all too frequent and pollution is extremely difficult to control as contaminants can travel rapidly underground into water supplies.

Mammoth Cave National Park is a UNESCO World Heritage Site in Central Kentucky containing the longest single cave system in the world. It highlights many aspects of the karst landscape and allows us to travel both above and below ground to understand how the system evolves and operates.

Dissolution of limestone is driven by dissolved carbon dioxide creating a weak acid. Rain water and stream water are mildly acidic because they hold only small amount of carbon dioxide. However, when rain water soaks through soil it picks up considerably more carbon dioxide and is much more acidic.

The way in which karst develops depends on the way in which rain and rivers contact the limestone. Non karst surface streams deliver a lot of (possibly dirty) water to a particular point or line of attack on the limestone. They often develop gorges and sink points where they go underground. Stream sinks typically lead into caves that join with other caves before emerging at a spring (or more briefly a karst “window”). Rain falling directly on limestone may erode pits and runnels, but does little more. In contrast, rain infiltrating into the soil becomes much more acidic, and aggressively erodes the underlying rock. Rain water is widely dispersed over the landscape and so opens up numerous small fractures that coalesce into closed depressions. Dissolution decreases with depth, so karst often has a characteristic highly eroded “epikarst” zone near the surface, but becomes integrated into fewer, smaller channels at depth. Like Cinderella, soil water loses its magic dissolution capability if it encounters a normal atmosphere. It may then deposit extensive “speleothems” better known as stalactites and stalagmites.

Understanding karst requires a basic understanding of geology, particularly, the distribution of soluble (limestone) and insoluble (sandstone, shale) rocks. The Mammoth Cave karst starts from the insoluble Glasgow uplands in the south. Rivers gather in this area and flow north to where they meet limestone and sink (disappear underground) into caves that run beneath area of limestone that has been heavily eroded by soil water dissolution (and collapse of underlying caves) to form the Sinkhole Plain. Further north the limestone lies under a protective layer of sandstone to form the Chester Uplands. Most of Mammoth Cave national Park lies in this area as the sandstone caprock has preserved caves for millions of years. Cave streams run through the lowest levels of the cave to finally emerge at numerous springs along the deeply incised green River.

The first problem for those living in karst is obtaining reliable water supply. Initially settlements focused on springs or karst windows and avoided the dry areas around. Occasionally wells could be dug, but often proved unreliable. This constraint was reduced when boreholes were developed allowing drilling wherever anyone wanted. Again, however, it was surprising how a very productive well could be near those yielding very little water. The secret of course, was that the productive wells had been lucky enough to hit an underground river in a cave. The advantage of good supply was often more than offset by the attendant risks of pollution. A cave river is very similar to a surface river in its levels of bacteria, nutrients and artificial chemicals. (A similar problem was responsible for the Walkerton tragedy.) In general, conventional water distribution networks are now replacing many of the wells.

Closed depressions are characteristic of karst, but they vary in origin. Some are collapses into underlying caves. Others are caused by concentrated infiltration eroding the bedrock. Others are the remnants of former stream networks. It is often difficult to tell them apart because of the typically rich red residual soil that mantles the underlying bedrock. This soil can plug up the epikarst drains, especially if disturbed by construction or farming so that depressions have a tendency to fill. When these overflow into adjacent depressions the problem is exacerbated resulting in much deeper and more frequent floods than anticipated. Similarly, the land cover over caves and epikarst may be weak or unstable, so that it can collapse quite spontaneously undermining highways and foundations. It has also been recognised, somewhat belatedly that karst environments host particularly unusual and vulnerable ecosystems. Conservation measures often prove difficult to devise even when the problem is recognised. For example, Mammoth Cave National Park was deliberately (and forcefully) acquired to encompass the known cave at the time. Since then it has been recognised that most of the streams hosting cave life originate in the polluted Sinkhole Plain outside any jurisdiction of the Park.

Solutions to these problems have been slow to develop as the problems are not obvious locally and the underground flow routes can be complex. Pioneering work in the region has resulted in significant headway in mapping underground flow routes using cave maps, dye tracing and groundwater monitoring. We will be studying and using these maps in our own studies of the region.



Central Kentucky Karst: key landscape units and Hamilton Valley, the base of operations

4. Itinerary

The group will travel by van ~960km to Mammoth Cave National Park, KY. We will be staying at the Cave Research Foundation base at Hamilton Valley, immediately east of MCNP.

Accommodation will be in comfortable bunkhouses. Catering will be largely self-organised (see below). From Hamilton Valley, day trips will run out to the surrounding region. See the itinerary below. (Note final scheduling is still being worked out due to limited availability of some local hosts.)

Day: 2011	Itinerary	Objective	Notes:
1. Sat. 24	London-Mammoth Cave	Travel	Depart SSC Loading Bay 8:30 am. Arr.: Hamilton Valley, KY. ~17:30 CST
2. Sun 25	Sinkhole Plain-Mammoth Cave NP	Surface hydrology & geomorphology	<i>Geology, landscape & landforms, evolution, hydrology.</i>
3. Mon 26	Mammoth Cave NP	Caves: forms, origin, development & function	<i>Cave evolution, cave forms, cave sediments, cave hydrology.</i>
4. Tues 27	Mammoth cave Bowling Green, KY	Cave management and urban karst	<i>Urban contamination, drainage, foundations (Evening in Bowling Green)</i>
5. Wed 28	Sinkhole Plain, Horse Cave	Cave mapping and groundwater pollution	<i>Water contamination: cause, impact, diagnosis, remediation, biology</i>
6. Thu 29	Hamilton Valley	Cave project:	Project Briefings Project Debriefings (group)
7. Fri 30	Mammoth Cave-London	Travel	Depart HV. 8:30ish Arrive London, 7:30pm very approximate

***HIDDEN RIVER CAVE TOUR CONSIDERATIONS:** This tour should be considered very strenuous and includes bending and crawling. This tour is not recommended for anyone that has claustrophobia, breathing or walking difficulties, heart conditions or other physical impairments. Restrooms are not available inside the cave.

5. Resources

Students are expected to have developed a basic comprehension of karst and the region based on the assigned reading prior to the trip. Most students will find that they need to work hard to learn to comprehend the landscape forms and processes and to navigate the rolling country and its towns. The Sunday day surface tour provides a foundation that is developed in each subsequent day. Readings are posted on Web CT or can be emailed on request. Additional background information is available in the library and on-line in. An accessible starting point is to look up the chapter on karst that can be found in most geomorphology text books. There are a number of more specialised text books on karst and Mammoth cave in particular. Some of these will be brought on the trip.

Web resources are superabundant. *Read and understand selected materials rather than accumulating reams of unread pages.*

6. Preparation

A logistical orientation meeting will be held in SSC2333E 5:30pm Wednesday 14 September. A second meeting will be held same time and place Wednesday 21 to explore preparatory reading and build a foundation for the field programme.

Students are expected to prepare logistically (passport, insurance, clothing, headlight etc see below).

They are also required to review the above summary and to read the preparatory readings provided on Web CT. Preparedness will be assessed and assisted in the second organisational meeting and through the field week.

Readings

1. Cobb and Currens. Karst the stealthy hazard. *Geotimes*
<http://www.agiweb.org/geotimes/may01/feature2>.

2. Palmer, A,N, 1990. A Geological guide to mammoth Cave National Park. [html](#) You can read the entire book all, not worrying too much about detail. Alternatively, a more tactical priority might be...

a) Initial reading:

Ch3, Exploration history

Part of Ch5, (59-67) Rock formations at Mammoth Cave

Ch7 Cave Science

Ch 11 Underground sculpture, decoration and deposits.

b) Follow up reading:

Ch2. The cave and its surroundings

Ch4. The regional picture

Ch8 Underground water and how it moves

Ch10 The cave as a drainage system (108-114)

Ch 14

Historic tour 152-164.

Half day tour 170-179

7. Assessment and Deliverables

a). Preparation: 20% based on evidence for prior reading, informed questions and self briefing.

b) Participation: 40% based on daily summary, behaviour, timeliness, preparation, contributions (academic and domestic) and overall engagement and responsibility in the trip.

The daily summary is a one page plus figures synopsis prepared on a daily basis of the ideas explored and exemplified each day. This is handed in every morning and will be based on a consolidation of field notes, materials provided and discussion and question sessions. It is not a diary of activities.

c) Term paper 40%. Each student is required to submit an original (five pages double spaced text) written paper on karst, normally on a topic of their choice particularly drawing on information and examples culled during the field trip. The paper is due (in electronic Word format) Monday 14 November 2011.

Possible term paper topics:

1, Karst and regional geology, 2, Karst landscape & landforms, 3, Karst hydrology., 4, Cave evolution, 5, Cave forms., 6, Cave sediments., 7, Cave hydrology., 8, Cave ecology., 9, Water contamination: cause & impact., 10, Water contamination: diagnosis & remediation., 11, Urban contamination., 12, Urban Drainage & Foundations., 13, Urban Planning. etc.

7. Health, Safety and Department

a) *Behaviour*

It is important to be considerate of the functioning of the group with an emphasis on timeliness, attentiveness and responsibility. Students not ready on time may be left for the day at the base. As we are self catering, all participants must contribute to domestic duties.

The academic goal of this field trip is to develop skill in reading the environment, interpreting the observations and integrating them with existing knowledge. Students are expected to show appropriate preparation, constructive contribution and to ask salient questions. How much we do and learn will rest on students' contributions and reliability.

(Note 40% of the mark for the trip is assessed against “participation” which includes general behaviour and contribution as well as academic engagement.)

b) International travel

As guests of the United States, the State of Kentucky and various institutions and municipalities, it is understood that we will behave with courtesy and respect in following civilised protocol and applicable law. This translates into good manners and common sense. Kentucky is culturally somewhat different from Ontario; with stronger emphasis on religion and independence than we might be accustomed to. Many counties in Kentucky are “dry”; “wet” counties have a legal drinking age of 21 years. . Alcohol will not be part of this trip.

You are required to have a current Canadian Passport or appropriate visa to cross the US border. Those lacking the appropriate documentation will remain in Canada with little prospect of a refund.

c) General Safety

Effectiveness in the field requires the ability to be aware of and respond appropriately to hazards while concentrating on the work in hand. Definition and compliance with safety requirements is a start. However, an awareness of hazards and making an appropriate response requires that you stay alert and flexible despite competing demands. Group field work requires group awareness and shared responsibility become a priority. Lack of attention, fatigue and disrespect for the group amplify many hazards.

On this trip, field work will include working in underground caves (see below), near rivers and in forest. A reasonable level of fitness and agility is assumed. Familiar hazards include traffic, steep slopes, tripping etc. In addition, loose rock, sudden drops and low ceilings can all pose hazards {wear a helmet and gloves, look where you are going}. In Kentucky, poison ivy is common and rampant {recognise the leaf and climbing forms <http://www.omafra.gov.on.ca/english/crops/facts/99-015.htm>}; venomous snakes may be encountered occasionally {watch the ground around cave entrances}, ticks and chiggers can be irritating {keep out of long grass, strip and check your clothing on return}. In addition to personal fitness, attentiveness and group awareness are the key to safe practice. It is everyone’s responsibility to look out for the group, anticipate hazards, work out responses and to prevent separation. If a hazard exists, then the group must be made aware of it. If you consider yourself or anyone else to be outside their personal capabilities, then ensure that this is addressed by the group leaders.

No one should wander off alone. Endeavour to keep together to avoid separation. Fast movers have to ensure their followers are keeping up. Groups working independently should make their plans and precautions in advance and make them explicitly known to the leaders.

Minor hazards encountered should initially be communicated as additions to one’s personal awareness “portfolio”. Major hazards such as dangerous traffic, drops or deep water should always be pointed out. Do not assume that someone else will point out all risks, but remain aware of and communicate perceived hazards.

In the event of a minor accident or injury (minor scrapes, bumps and abrasions are common in caves and field work), make sure the group is aware of this and remains cohesive while things are resolved. There will normally be a first aid kit with every group.

In the event of a more serious accident, then remain calm and engaged in working as a team to ensure the following:

- (i) Undertake a rapid assessment of the situation particularly if leadership is compromised.
- (ii) Determine if others are at risk and if possible ensure their safety.
- (iii) If appropriate reduce or remove the risk.
- (iv) Provide first aid assistance to anyone injured. Note do not move a person with possible spinal or head injuries unless it is imperative for their survival and comfort.

- (v) Assess the situation and call for emergency assistance. If underground, designate exit and resident teams. Ensure the exit team knows the way out and can inform the emergency response unit of the situation and location. (Kentucky emergency response (including cave rescue) 1-800-255-2587.or (502) 564-7815)
- (vi) The resident team maintain surveillance of the injured party. Be prepared for strain and hypothermia (chilling).

d) The nearest hospitals:

Mammoth Cave: Caverna Memorial Hospital 1501 S. Dixie Hwy (31W) Horse (270) 786-2191 Located on the Cave City-Horse Cave Road. 4km from Cave City. 2.5 km from Horse Cave.

Bowling Green: Greenview regional Hospital Scottsville Road (ky 231) Bowling green. 3.7 km North of I65 junction 22. Telephone: (270) 793-1000

e) *Caving: practice and impact*

Working in a cave is like learning to ride a bike, until you get coordinated things get in your way a lot. Doing is the best way of learning. However, some advice can be provided.

- (i) The ground is not guaranteed smooth, flat, and firm. It can be rough, loose and slippery. Wear robust shoes and gloves.
- (ii) The ceiling is not always >2 m above the floor. Watch your head and don't move without your helmet securely attached.
- (iii) The only light comes from your headlight. Make sure it works, and carry spare light and batteries. Direct vision is poor, peripheral vision negligible. So you have to point your head (light) where relevant. Operationally, this is the floor immediately in front of you. But the walls, ceiling and distant vistas are much more interesting. Stop if you want to look at the latter. Apparently black bits of floor are usually holes or pools of water. Avoid shining your light into people's eyes.
- (iv) "Dry" caves can be quite wet (I nearly drowned in one once.) Wet caves have streams in them and so add water hazards to the mix.
- (v) Keep together, have a spare light and some food. Progress at the rate of the slowest member of the team. Do not wander off either individually or as a group.
- (vi) Caves can be challenging to navigate (complicated by the darkness). It should not be an issue on this trip, but try to spot and note junctions. Make a habit of looking back as you go because a passage looks completely different on return.
- (vii) Try to understand the geography of the cave route by studying cave maps and understanding the progress of a trip, so you know where you are at any time.

f) *Conservation*

Caves are particularly vulnerable environments as our unnatural presence poses an exceptional threat to the normally stable climate, geology, hydrology and biology. Beware of causing physical damage to rocks, sediments and speleothems (do not touch stalactites etc.) that may be millions of years in age. Consider that someone may drink the water you encounter. Finally, cave life is tenuous, vulnerable and extremely limited in its capacity to respond to our presence. Cave softly: watch your step, leave nothing behind and take nothing out (other than someone else's garbage).

g) *Contact Information at Hamilton Valley*

For Emergency Contact Only: Cave Research Foundation 270-773-8955

Equipment list Kentucky field trip

Individual equipment

It is likely to be quite warm (25-30 C and can be humid). Caves are cooler, but comfortable. You will get muddy, possibly wet and smelly crawling through caves.

1. Passport.
2. Health: personal medication, notification of allergies, sensitivities, out of province health insurance, contact information.
3. Cash: for occasional lunches, souvenirs, meals on the road (~us\$100). Credit card.
4. Academic tools: Camera, field notebook, paper, writing tools, handout information.
5. Cave clothing: head light (batteries), small flashlight, coveralls (TSC possible source. or equivalent rough clothing e.g. jeans and jean jacket), rubberised gardening gloves, side pack, camera protection, tee shirt, shorts, underwear/swim suit, towel. (We will provide a departmental helmet and large garbage bags for dirty gear and for seat covers). Headlights are available from Novaks or Canadian Tire or Mountain Equipment Coop.
6. Field and travel clothing. shorts, walking boots/heavy running shoes), water proofs.
7. Personal toiletries, sun screen, basic first aid kit.
8. Sleeping bag, pillow or equivalents.

Reading Sources: posted on WebCT.

1. Palmer, A.N. 1990 A geological guide to Mammoth Cave National park . Zephyrus Press
2. Palmer, A.N., 2007. Cave Geology. Cave Books. (Book will be deposited in the Map Library.)
3. Quinlan, J.M., and Ewers, R.O. 1986. Groundwater flow in the Mammoth Cave Area Kentucky with emphasis on principles, contamination dispersal, instrumentation for monitoring water quality and other methods of study. Field trip guide. Environmental Problems in Karst Terranes and their solutions.
4. Crawford, N.C, 1986. Karst hydrologic problems associated with urban development: groundwater contamination, hazardous fumes, sinkhole flooding, and sinkhole collapse in the Bowling Green Area, Kentucky. Field trip guide. Environmental Problems in Karst Terranes and their solutions.

Maps and figures are also posted on Web CT.

Accommodation for medical Illnesses

For UWO Policy on Accommodation for Medical Illness and a downloadable SMC see:

http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf

Downloadable Student Medical Certificate (SMC): <https://studentservices.uwo.ca> under the Medical Documentation heading

Students seeking academic accommodation on medical grounds for any missed tests, exams, participation components and/or assignments worth 10% or more of their final grade must apply to the Academic Counselling office of their home Faculty and provide documentation. Academic accommodation cannot be granted by the instructor or department.

Notes from the registrar.

“Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

<http://www.uwo.ca/univsec/board/code.pdf>

“Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.”

Support Services

Registrarial Services: <http://www3.registrar.uwo.ca/index.cfm>

Student Development Services: <http://www.sdc.uwo.ca/>