

A. Title Page

**Teaching Geomorphology in the 21st Century Workshop
Final Report**

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B. Restatement of Professional Enhancement Opportunity

The National Association of Geoscience Teachers (NAGT) and the Digital Library for Earth System Education (DLESE) sponsor *On the Cutting Edge*, a workshop series that helps geosciences faculty stay up-to-date with both geosciences research and teaching methods. *Teaching Geomorphology in the 21st Century* is one of the *On the Cutting Edge* workshops underwritten by the National Science Foundation (NSF). The workshop involved general discussions of general issues in teaching geomorphology to students, activities in development of assignments and activities in geomorphology, activities in development of experimental approaches to teaching geomorphology, development of a resource collection, and participation in field trips. The purpose of the grant was to send Dr. Baker to participate in the workshop (July 28 – August 1, 2008 at Colorado State University) in order to strengthen and improve her background in aspects of geomorphology for teaching landscape geology at Arkansas Tech University.

C. Brief Review of Professional Enhancement Opportunity

The *Teaching Geomorphology in the 21st Century* workshop involved joint discussions between the 42 participants of the workshop and smaller “focus” sessions (the 42 participants represented approximately 10% of the faculty teaching geomorphology in geology programs in the United States). Discussions and activities included:

- visualizing important concepts in geomorphology
- integrating concepts into courses, including experimentation and modeling into understanding geomorphic processes
- development of innovative tools
- development of strategies to deal effectively with teaching
- demonstration of activities designed to examine experimental approaches
- creation of activities/assignments and innovative lab or field experiences.
- creation of a teaching materials collection
- participation in a critical review of a geomorphology textbook that will incorporate web-based supplemental articles and activities
- participation in field trip to the Poudre River Canyon area west of Fort Collins – planning field exercises for stream surveying and slope failure processes
- participation in a field trip to the Colorado State University Engineering Research Facility – stream modeling lab
- creation and participation in a List Serve to promote discussion among participants after the workshop

D. Summary of Experience

The Workshop produced a number of teaching materials, projects, exercises, activities, and articles which have been made available online to geosciences teachers:

- Activities/projects: <http://serc.carleton.edu/NAGTWorkshops/geomorph/index.html>
- "Vignettes" which are short articles:
<http://serc.carleton.edu/NAGTWorkshops/geomorph/vignettes.html>
- List Serve: <http://serc.carleton.edu/mailman/listinfo/geomorph>

Articles/activities which I authored that were published as part of the workshop are available online:

1. Recognition of Recent Meander Cutoff in the Arkansas River Alluvial Plain in West Central Arkansas and Implications for Land Use (a copy of is attached to the report).

<http://serc.carleton.edu/NAGTWorkshops/geomorph/vignettes/25482.html>

2. Geomorphic Landscape Analysis Project

<http://serc.carleton.edu/NAGTWorkshops/geomorph/activities/23482.html>

3. Topographic Map Review

<http://serc.carleton.edu/NAGTWorkshops/geomorph/activities/23480.html>

E. Conclusions and Recommendations

The workshop was extremely helpful in providing connections to others teaching and researching geomorphological processes; providing experience in innovative ways to teach landscape geology; providing examples of field activity planning and development; obtaining an extensive teaching materials collection of exercises and activities; and receiving feed-back on projects, activities, and approaches being used in teaching geomorphology in the geology program at Arkansas Tech University. I would strongly recommend other *On the Cutting Edge* workshops to geology faculty at Arkansas Tech University and would consider other workshops in areas in which I teach in the future.

Cathy Baker

Teaching Geomorphology in the 21st Century

Topical Resources

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Recognition of Recent Meander Cutoff in the Arkansas River Alluvial Plain in West Central Arkansas and Implications for Land Use

Cathy Baker
Arkansas Tech University

Description

River floodplains have traditionally served many purposes. Settlements have built up worldwide along rivers because avenues of transportation and abundant water were available and because rich fertile lands could be cultivated. Large population centers today are concentrated on many floodplain areas of the United States, and land use issues in addition the threat of flooding exist.

Floodplains are comprised of materials deposited by both channel and "overbank" processes. The deposits range from highly porous and permeable sands and gravels to low permeability muds and clays. Highly permeable zones within floodplains can provide vast groundwater reserves in addition to the surface water resources; however, the very permeability of those materials can aid in the spread of contaminants. Very slowly permeable zones act to restrict the migration of pollutants and can serve in the limiting of contamination. The distribution of gravels, sands, silts, and clays in floodplain deposits is a consequence of river processes. Predicting the nature and distribution of materials in a floodplain, therefore, involves recognition of the landforms created by the action of the river.

Rivers which create well-developed floodplains (also known as "alluvial plains") most commonly possess a sinuous meandering pattern. The winding pattern develops in response to the interplay of erosion, transportation, and deposition by the river. Lateral erosion by swift currents on stream "outside" banks results in steep cut-banks while deposition by corresponding slower currents on "inside" banks results in the formation of sandbars known as "point bars". The thickest and aerially most extensive deposits of sands on floodplains are in the areas of most recently migrating point bars. Lateral erosion can eventually cut through meanders creating cutoffs. Cutoff meanders are eventually abandoned completely forming oxbow lakes and depressions. During flood stage rivers surge onto floodplains leaving deposits of muds comprised primarily of silt and clay. Thick overbank muds can accumulate on the most distant sections of floodplains. Areas of most recently migrating point bars, therefore, are typically the most vulnerable areas for groundwater contamination, whereas, more distant areas from the active channel usually are less vulnerable to groundwater contamination.

The Arkansas River is a generally southeasterly trending waterway that originates in the Rocky Mountains of western Colorado and joins the Mississippi River in southeastern Arkansas. The Arkansas River in the area of the Holla Bend National Wildlife Refuge exhibits well developed landforms commonly created by a meandering river (Figure 1). Landforms are clearly discernable using a number of sources: surface reconnaissance, aerial and satellite imagery, and topographic

Location

Continent: North America
Country: United States
State: Arkansas
City: Russellville/Dardanelle
UTM coordinates and datum: 15H VB
94812 11442

Setting

Climate Setting: Humid
Tectonic setting: Passive Margin
Type: Process

Click the images for a full-sized view.



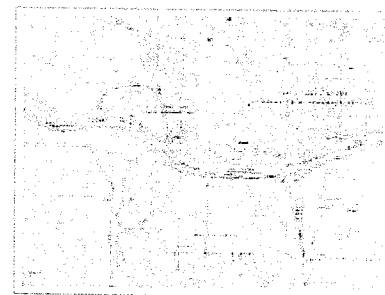
depressions (Figure 2). In field-scale reconnaissance, ridges and swells appear as a gently rolling landscape (Figure 3). Swales in field-scale view are commonly water-filled after flood events or during wet cycles (Figure 4). Ridges at the Holla Bend National Wildlife Refuge have been utilized to plant windbreaks for soil erosion reduction. Curved lines of southern pine trees mark the crests of many ridges throughout the refuge (Figure 4). and cutoffs is imperative when evaluating floodplains for land use practices that subject the area to potentially harmful contaminants. Although most states regulate the location of landfills, sewage waste treatment facilities, and environmentally harmful manufacturing facilities on floodplains, many potentially environmentally harmful facilities including animal confinement operations may still be sited on vulnerable materials.

Point bars of the Arkansas alluvial plain at Holla Bend are readily discernable in satellite and aerial views due to differences in coloration patterns related to different forage crops and woodlands in the area (Figure 1). As point bars migrate, slight depressions develop between sand bar crests creating alternating crests and troughs known as "ridges and swales" or a "ridge-and-swale topography". In topographic maps, the ridges are discernable as long low narrow ridges and swales are distinguishable as narrow

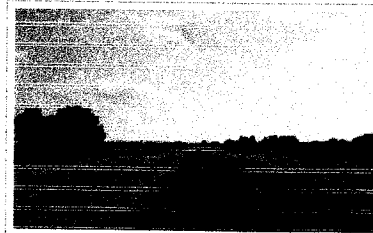
Associated References:

- Easterbrook, D. J. 1999 Development Center, Geotechnical and Structures Laboratory. ERDC/GSL TR-04-XX. 33p. . Surface Processes and Landforms. Prentice-Hall Inc. p. 128.
- Kline, S. W., Horn, N. R., Baker, C., and Horn, J. D. 2003. A model for groundwater flow in the alluvial aquifer of the Arkansas River at Dardanelle, Arkansas. Arkansas Geological Commission. Water Resources Circular #18. 35 p.
- Leigh, D. S. (2006). Terminal Pleistocene braided to meandering transition in rivers of the Southeastern USA. *Catena*, 66 (1-2), pp. 155-160.
- Smith, L. M. and Breland, P. L. 2004. Geomorphic reconnaissance of the McClellan-Kerr Arkansas River Navigation System Dardanelle, Lock and Dam to the Mississippi River. United States Army Corps of Engineers, Engineering Research and

Supporting URLs



In this image the "ridge and swale" topography can be recognized from a 7.5 minute topographic quadrangle map by the presence of long narrow low ridges and shallow curved water-filled depressions and wetlands south of the current Arkansas River channel. United States Geological Survey [Details](#)



Ridge and swale topography in the region of the previous map is expressed in profile views across floodplain as a broad faintly rolling landscape. Cathy Baker [Details](#)

