**Course Description:**

**GEO 303** introduces current perspectives on the origins and evolution of the Turkana Basin, Kenya. Students will learn how to apply fundamental geological concepts to sediments and rock units to provide a foundation for the chronology and context for events in human evolution. Emphasis is given to sedimentation, stratigraphy, volcanism, and tectonics, as they apply to local geology, including training in field methods. Modern terrestrial processes and landscape evolution are examined using features present in the Turkana Basin. Consideration is also given to broader geologic events spanning the Cretaceous to the present. Geologic concepts are linked to modern and ancient environments, archaeology, and paleoanthropology in northern Kenya. It is a field-based course involving visits to important geological and fossil sites. Graded work includes fieldwork assignments, quizzes, and a final exam.

**2014 Course Content and Chronology**

3 Feb AM: **Introduction** Initial Assessment; Bush sense and safety; Field Notes; Sketch Maps

PM: Mapping Discussion, Introduction to GPS

**Geology Walk** Nachukui Formation strata West of Camp

4 Feb AM: Mapping I Spatial concepts; compass basics; pacing; map components; scaled maps. Exercise 1: Camp Map of TBI Turkwell

PM: Sedimentology I Sediment, processes and products; weathering, transport and deposition

5 Feb AM: Mapping II GPS setup and use; waypoints and tracks; topography, contours; Brunton pocket transit, attitude, geological mapping

PM: Sedimentology II Sedimentary rocks, depositional environments, post-depositional modification. Orienteering Contest

6 Feb AM: Modern Sedimentary Processes I – Turkwell River Fluid flow, sedimentary structures, sequences. Exercise 2: Fluvial Processes of the Turkwell River

PM: Stratigraphy I Stratigraphic principles, physical stratigraphy, unconformities; stratigraphic cross-sections and geological history

7 Feb AM: Modern Sedimentary Processes II – Aiyangiyang Depression Aeolian processes, closed depressions, soil formation; taphonomy and fossil preservation

PM: Turkana Basin Geologic History I Cenozoic record; rift development, Omo and Turkana Group sequences

8 Feb Kabua Gorge Trip Travel to Kalakol River. Investigate Holocene Lake beds, volcanics and border fault.

9 Feb BREAK

10 Feb AM: Tectonics and Volcanism Fundamentals of structure and faulting; evolution of East African Rift System; rift volcanism and tephra

PM: Stratigraphy II Stratigraphic approaches; practical aspects of stratigraphic sections, measurement, Munsell colors, contacts

11 Feb AM: Stratigraphic Sections Exercise 3: Description and measurement of sedimentary strata at Epim

PM: Geochronology and Tephrostratigraphy Chronostratigraphy, isotopic dating, magnetic polarity stratigraphy; tephra and geochemical fingerprinting

12 Feb AM Climate and Environments Local, regional and global patterns; temporal development; forcing arguments

PM: Lothagam Introduction to research history, geology and significance of Lothagam.

13-14 Feb Lothagam Field Trip: Fly-camp overnight at Lothagam Hill. Depart early AM, transit to Lothagam, establish camp. Overview of Miocene, Plio-Pleistocene and Holocene stratigraphic components. Observation and field description of strata.

15 Feb Final Exam

Assignments

Sketch Map – initial spatial analysis and diagrammatic graphical representation of features in and around camp.

Camp Map – reprise of initial spatial analysis of camp, introducing quantitative tools for distance and angle measurements. Report/publication quality standards of scaled graphical representation.

Slope Profile – field exercise introducing quantification of topography with Jacob’s staff and Brunton compass.

Minerals and Rocks Quiz – identification of local materials and their components

Orienteering Exercise – practical field test integrating compass and GPS operation in traversing complex terrain.

Orienteering GPX – Download, integration and presentation of GPS files from exercise.

Turkwel Map – map compositing to establish drainage basin context for ensuing field exercise.

Turkwel River Exercise – three-component field exercise to describe and measure fluvial dynamics in the Turkwel River, relate modern sedimentary structures to bedforms, and to interpret Modern, Holocene, and Pliocene fluvial strata.

Stratigraphic Section Exercise – a field exercise to measure and describe, in both written and graphic formats, the Holocene sedimentary sequence at Epim.

Localities Quiz – partial test for placement of prominent Turkana Basin localities.

Climate Quiz – lecture based queries on orbital controls, climate dynamics, and Earth-Life System interactions.

Final Exam – the final will consist of three components, a Field Component based on performance on the Lothagam Field Trip, a Written Component of questions based on lectures, experiences and observations during the course, and an ID & Practical Component demonstrating ability to identify and relate significance of hand specimens of minerals, rocks and fossils, as well as ability to use basic field equipment.

Grading

Sketch Map 5 pts

Localities Quiz 5 pts

Camp Map 10 pts

Slope Profile 5 pts

Minerals and Rocks Quiz 5 pts

Orienteering Exercise 10 pts

Orienteering GPX 5 pts

Turkwel Map 5 pts

Turkwel River Exercise 15 pts

Stratigraphic Section Exercise 15 pts

Climate Quiz 5 pts

Final Exam

Field Component 15 pts

Written 50 pts

ID & Practical 35 pts

**Reading List**

**Historical Background**

Lewin, R. 1987. Bones of contention. Simon and Schuster, New York. 348 pp.

Chapters 9 & 10

**Geology of Kenya**

National Museums of Kenya. 1984. Kenya’s place in geology. NMK, Nairobi. 39 pp.

**Turkana Basin Geology**

Feibel, C. S. 2011. A geological history of the Turkana Basin. *Evolutionary Anthropology* 20(6): 206-216.

**Field Notes**

Behrensmeyer, A. K. 2012. Linking researchers across generations. In: Canfield, M. R. (ed.) *Field Notes on Science & Nature*. Harvard University Press, Cambridge. pp. 89-108.

**South Turkwel**

Ward, C.V., Leakey, M. G., Brown, B., Brown, F., Harris, J. and Walker, A. 1999. South Turkwel: A new Pliocene hominid site in Kenya. Journal of Human Evolution 36: 69-95.

**Mapping**

Compton, R. R. 1985. Geology in the field. J. Wiley & Sons, New York. 398 pp.

Chapters 1, 2 & 5

**Sedimentology**

Feibel, C. S. 2001. Archaeological sediments in lake margin environments. In: Stein, J. K. and Farrand, W. R. (eds.) *Sediments in Archaeological Context.* University of Utah Press, Salt Lake City. pp. 127-148.

Feibel, C. S. 2013. Facies and Pliocene paleoecology. In: Sponheimer, M. Lee-Thorp, J. Reed, K. Ungar, P. (eds.) *Early Hominin Paleoecology*. University of Colorado Press. pp. 35-58.

**Stratigraphy**

Brown, F. H. and Feibel, C. S. 1986. Revision of lithostratigraphic nomenclature in the Koobi Fora region, Kenya. Journal of the Geological Society, London 143: 297-310.

**Tectonics and Volcanism**

Haileab, B., Brown, F. H., McDougall, I. and Gathogo, P. N. 2004. Gombe Group basalts and initiation of Pliocene deposition in the Turkana depression, northern Kenya and southern Ethiopia. Geological Magazine 141: 41-53.

**Geochronology and Tephrostratigraphy**

Feibel, C. S. 1999b. Tephrostratigraphy and geological context in paleoanthropology. *Evolutionary Anthropology* 8: 87-100.

**Climate and Environments**

Feibel, C. S. 1999c. Basin evolution, sedimentary dynamics and hominid habitats in East Africa: an ecosystem approach. In: Bromage, T. and Schrenk, F. (eds.) *African Biogeography, Climate Change, and Human Evolution*. Oxford University Press, Oxford. pp. 276-281.

Potts, R. 2012. Environmental and behavioral evidence pertaining to the evolution of Early *Homo*. Current Anthropology 53: S299-S317.

**Lothagam**

Feibel, C. S. 2003. Stratigraphy and depositional history of the Lothagam sequence. In: Leakey, M. G. and Harris, J. M. (eds.) *Lothagam: The Dawn of Humanity in Eastern Africa*. Columbia University Press, New York. pp. 17-29.