The Compass: Earth Science Journal of Sigma Gamma Epsilon

Volume 85 | Issue 1 Article 3

7-30-2013

The Coffee Sands: A Cretaceous Beach Deposit in the Mississippi Embayment of Western Tennessee

Jennifer Martin
Murray State University, jlambert1@murraystate.edu

Lara Homsey
Murray State University, lhomsey@murraystate.edu

ON THE OUTCROP

The Coffee Sands: a Cretaceous beach deposit in the Mississippi Embayment of western Tennessee

Jennifer Martin[1, 2] and **Lara Homsey**[2]
[1]Office of Undergraduate Research and Scholarly Activity,
2011-2012 Research Scholar Fellow,
Murray State University
Murray, KY, 42071 USA
Jlambert1@murraystate.edu

[2]Department of Geosciences
Murray State University
Murray, KY 42071
lhomsey@murraystate.edu

LOCATION

Just off of Co. Hwy 140 near Buchanan, TN, in Henry County, a noteworthy example of the Coffee Sands Formation outcrops. Travelling from Murray, Kentucky, the site can be located by driving south on U.S. Hwy 641 towards Paris, TN (becomes TN-54 immediately south of Hazel, TN). In Puryear, TN, turn east onto Co. Hwy 140 and drive approximately 15 km (9.5 miles). The outcrop is located on the north side of the road-cut approximately three km (2 miles) before reaching the intersection of U.S. Hwy 79 (Fig. 1). You cannot miss the approximately 10 meter high exposure of brightly colored yellowish-red, strongly cross-bedded sands (Fig. 2).

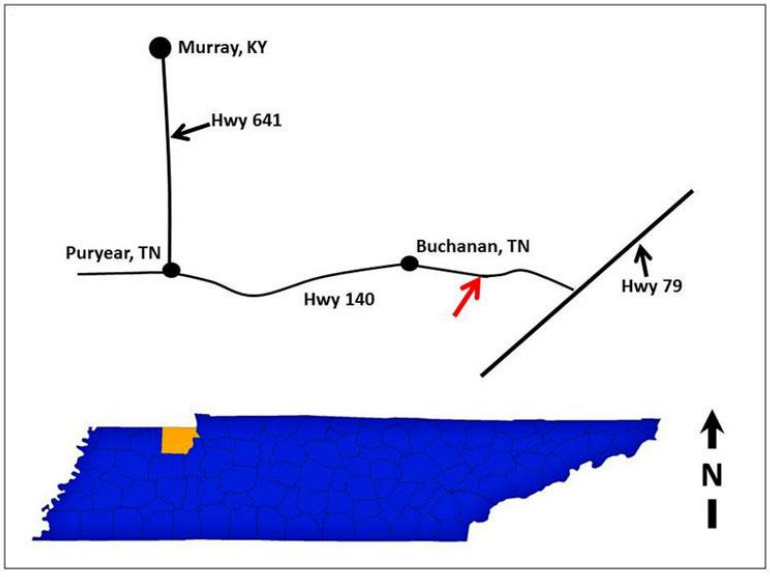


Figure 1. Map showing location of the Buchanan outcrop in Henry County, western Tennessee. Red arrow points to the approximate location of the outcrop.

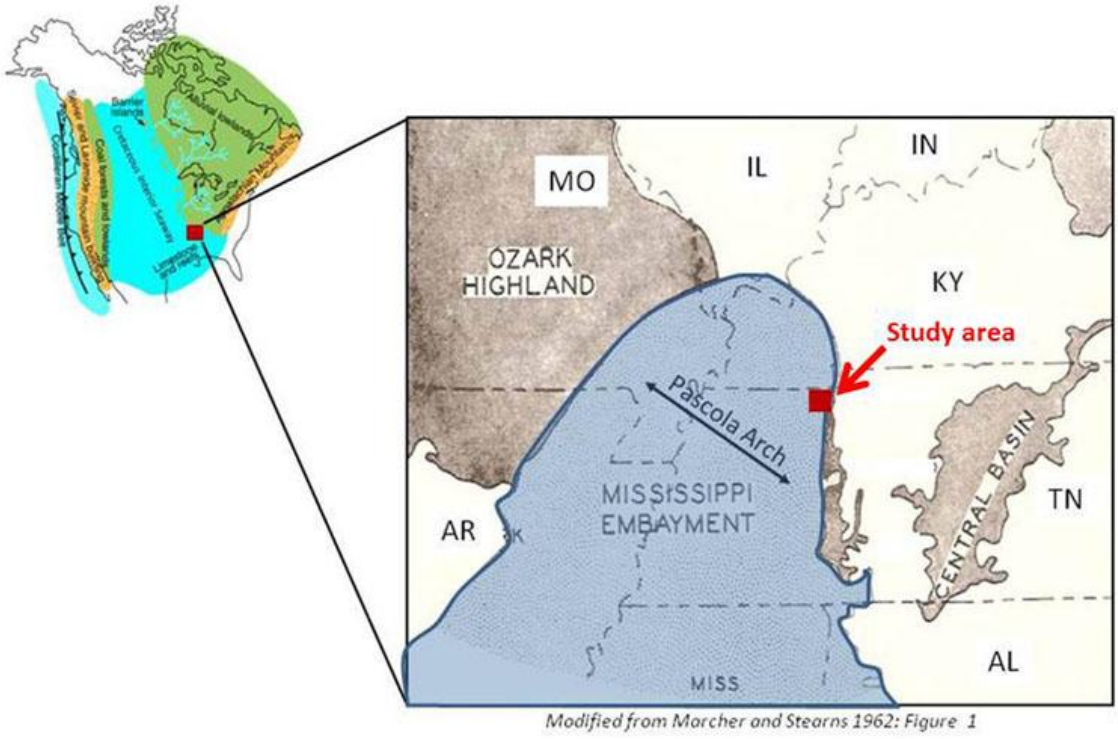
Figure 2. Google Earth imagery (dtd 10 September 2012) and north-facing exposure of the Buchanan outcrop along the north side of Co. Hwy 140 just west of Buchanan, TN. The dashed line demarcates the channel cut.

SIGNIFICANCE OF SITE

During the Cretaceous geologic period, the Cretaceous Interior Seaway (CIS) stretched from the Gulf of Mexico to the Arctic Sea (Fig. 3). In the Mississippi Embayment physiographic province of western Tennessee, a vast network of rivers drained the highlands of the Pascola Arch to the west. Marcher (1962) describes these deposits as the Coffee Sands and Tuscaloosa Gravel Formations. Today, the Coffee Sands and Tuscaloosa Gravels occur only as ephemeral, discontinuous deposits capping ridges within the Western Highland Rim in western Tennessee and Kentucky (Marcher 1962). Due to their limited geographic distribution and minimal economic use (other than as sand) the Coffee Sands have traditionally received minimal attention from geologists. One of the few to note and describe these sediments is Marcher (1962), who visually described the sands and interpreted them as having a fluvial origin. However, Marcher provides no quantitative or statistical data to support his interpretations, focusing instead on the more

economically viable Mississippian and Buchannan outcrop therefore offers an opportunity to refine Marcher's fluvial interpretation and, in so doing, helps fill in a Devonian rocks of the region. The gap in our knowledge of the Cretaceous paleogeography of the Mississippi Embayment.

Figure 3. Location of the Cretaceous Interior Seaway (CIS) and close-up view of the Mississippi Embayment illustrating locations of the CIS and Pascola Arch with respect to modern state boundaries. The study area is shown in red.



Modified from Marcher and Stearns 1962: Figure 1

SITE DESCRIPTION

The Coffee Sands Formation and General Stratigraphy

The Coffee Sands Formation was first described by early researchers (Drake, 1914; Roberts, 1927a, b; Safford, 1901) as a thick deposit of Cretaceous-aged sands capping many of the ridges in the Western Highland Rim in western Tennessee and Kentucky. Marcher (1962) and Marcher and Stearns (1967) further named this sandy strata the Coffee Sands Formation, overlying the Cretaceous-age Tuscaloosa Formation and underlying the Tertiary-age Lafayette Gravels (of former usage) (Fig. 4).

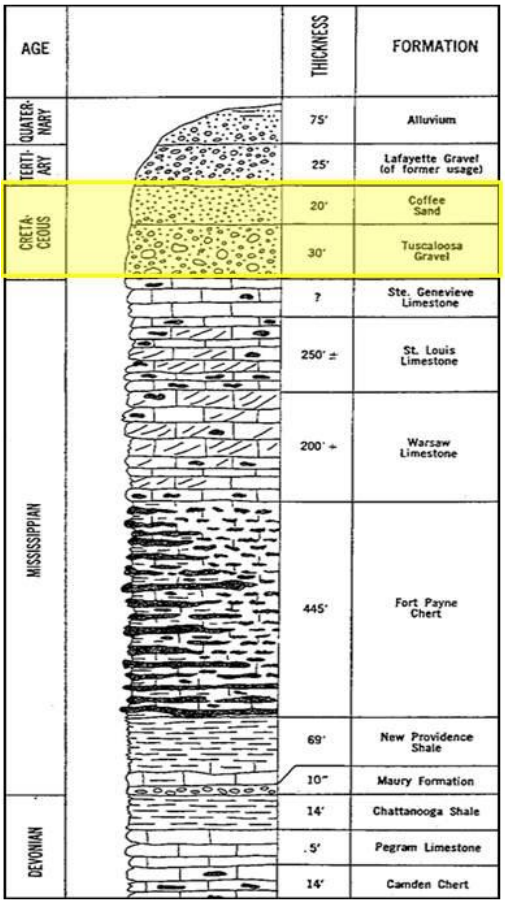


Figure 4. Generalized stratigraphy for the Mississippi Embayment physiographic province in western Tennessee. Figure adapted from Marcher (1962).

The Outcrop

The Buchannan outcrop of the Coffee Sands averages 5-8 m (16-26 ft) thick and is incised by a gravel channel exhibiting graded bedding (Figure 5a, b). The Coffee Sands are largely unconsolidated sediments (though they are locally indurated) consisting of moderately well-sorted fine to medium-grained rounded to sub-rounded sands (Fig. 5d). The dominant mineralogy is quartz, many grains of which are coated with iron and magnesium oxide films giving the outcrop its characteristic reddish appearance. Trace amounts of mica are also visible. Small, localized lenses of white clay also occur, as do large (>15cm) tubular and lenticular concretions of specular hematite (in the locally indurated zones) (Fig. 5e). The entire outcrop exhibits significant trough cross-bedding (Fig. 5f).

The channel consists of moderately to poorly-sorted gravels and sands; the gravels are dominated by rounded chert gravels (fossil inclusions in which indicate that they are weathered out of the underlying Ste. Genevieve, St. Louis, and Camden Formations (not exposed at this location) and quartz pebbles (Fig/ 5c). The channel sands consist of medium to coarse-grained rounded to sub-rounded quartz grains.

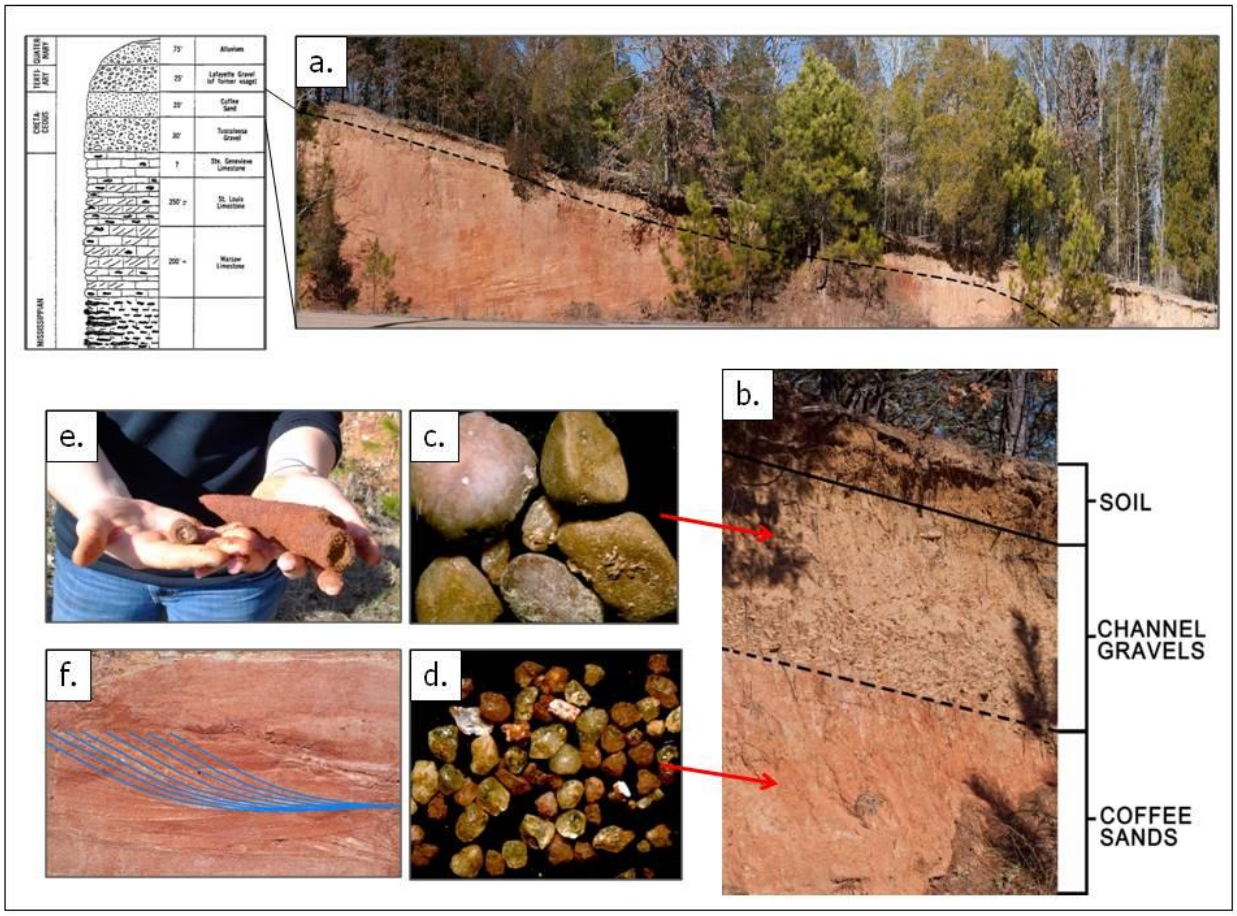


Figure 5. North-facing view of the Buchanan outcrop with reference to generalized stratigraphy (a); close up of the Coffee Sands Formation and overlying Tuscaloosa Gravel Formation and modern soil (b); rounded quartz and chert sand grains characteristic of the Tuscaloosa Gravels (c); rounded to sub-rounded quartz sand grains characteristic of the Coffee Sands (d); tubular hematite concretions typical of the Coffee Sands (e); and east-trending trough cross-beds of the Coffee Sands (f).

Particle size analysis of the Coffee Sands confirms a unimodal grain size distribution with a modal grain size of 0.25 mm (medium sand) (Fig. 6a). Using the graphic method, a standard deviation of 0.67 was calculated (Fig. 6b), a value reflecting the moderately-well to well-sorted deposits consistent with a beach or fluvial depositional environment. Plotting standard deviation against skewness on a grain-size bivariate plot (following Friedman 1967: Figure 5) (Fig. 6c) suggests a beach environment with strong fluvial input.

In contrast, the overlying channel gravel deposit exhibits a polymodal grain size distribution with modes at >4.75 mm, 1-2 mm and 0.25 mm, the latter which corresponds to the modal grain size of the Coffee Sands. A comparison of these channel gravels to Marcher's (1962) particle

size analysis of the Tuscaloosa Formation (a composite of various locales), illustrates a nearly identical distribution (see Fig. 6a). While the accepted stratigraphy for the region (based on Marcher 1962) defines the Coffee Sands and Tuscaloosa Gravels as separate formations, based on the similar polymodal distribution of the channel and Tuscaloosa Formation, coupled with the identical mineralogy of the sand fraction of the Tuscaloosa and Coffee Sands Formations, our analysis rather suggests that the Coffee Sands more likely reflects a sandy member of the Tuscaloosa Formation, rather than a distinct formation. Further study is needed to verify this revision of the regional stratigraphy; unfortunately, outcrops are becoming increasingly few as erosion and modern sand extraction preferentially obscure the Cretaceous record in the Embayment.

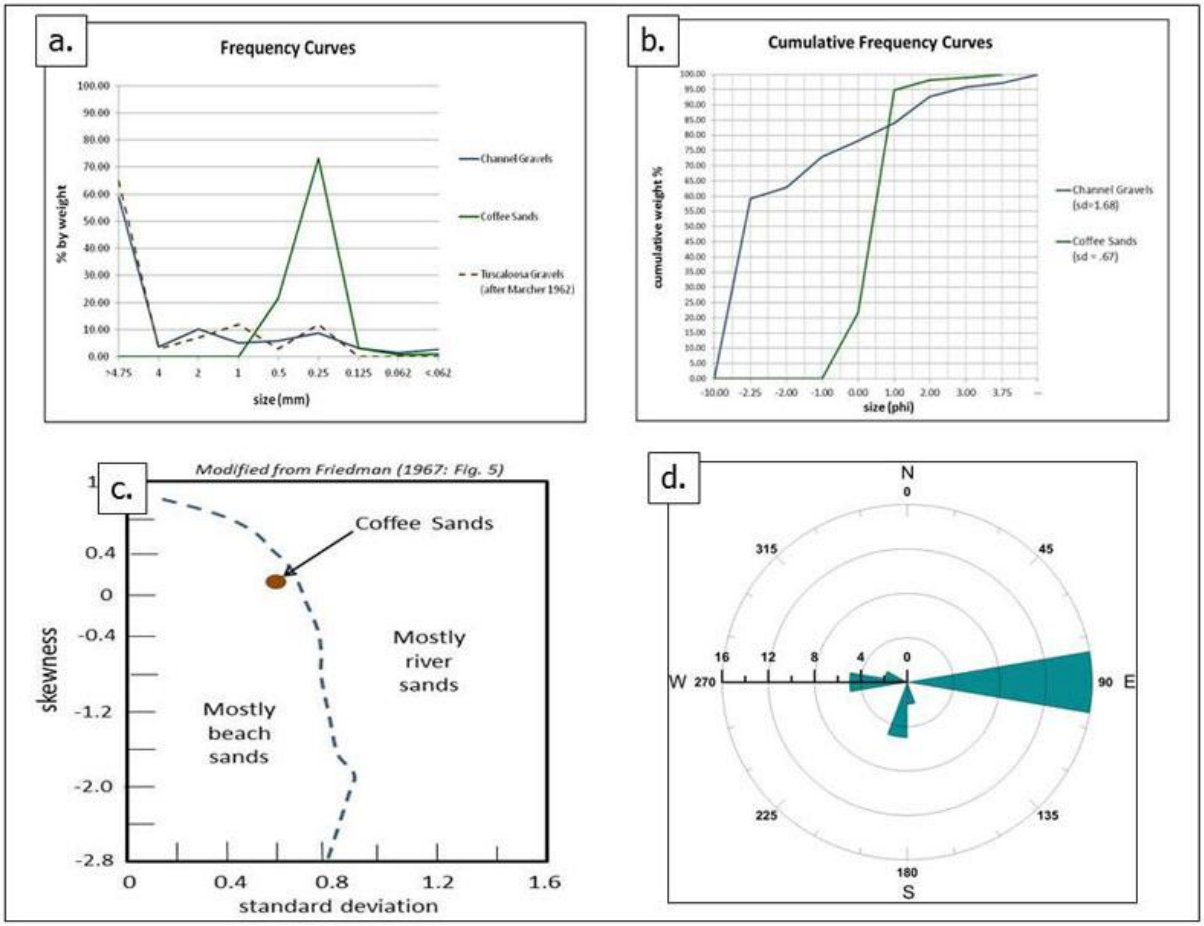


Figure 6. Descriptive statistics for the Coffee Sands, Channel Gravel, and Tuscaloosa Formation: frequency curves showing modal grain sizes (a); cumulative frequency curves indicating degree of sorting (b); grain-size bivariate plot indicating depositional environment (c); and rose diagrams illustrating dominant cross-bed direction within the Coffee Sands (d).

Paleogeography

The Coffee Sands formation shows significant trough cross-bedding. Using a Brunton compass, the bedding direction was measured for 30 cross-beds and plotted on a Rose diagram (Fig. 6d). The resulting plot indicates a dominant easterly current direction, suggesting that the origin for the Coffee Sands lies to the west, most likely from the Pascola Arch, which existed as a ridge within the Interior Seaway during the Cretaceous period (Marcher and Stearns 1962).

Preliminary investigation at the Buchannan outcrop has opened the door for further research into the paleogeography of the Mississippi Embayment region of western Tennessee and Kentucky (Martin and Homsey 2012). Often overlooked in favor of more "geologically interesting" or economically viable deposits, the Coffee Sands and Tuscaloosa Gravel Formations preserve the region's geologic history as the coastline of a vast Interior Seaway spanning the Cretaceous through early Tertiary periods. This outcrop offers an ideal field trip for introductory and mid-level geology students. The site is extremely sandy and students frequently untie their shoes to empty them of sand, inevitably remarking facetiously that it feels like the beach. Indeed, that is exactly the point of the field trip—the Buchanan outcrop helps them visualize western Tennessee as it would have existed 65-145 million years ago—standing on a Cretaceous-age beach with the highlands of the Pascola Arch to the west and an epeiric seaway to the east. After visualizing this, it is hard to view the region as anything but geologically intriguing, despite being ignored by geologists for decades.

REFERENCES CITED

Drake, N.F., 1914. Economic geology of the Waynesboro quadrangle. *Tennessee Geologic Survey, Resources of Tennessee*. v. 4(3), p. 99-120.

Friedman, G.M., 1967. Dynamic Processes and Statistical Parameters Compared for Size Frequency Distribution of River and Beach Sands. *Journal of Sedimentary Petrology*, v. 37(2), p. 327-354.

Marcher, M. V., 1962. *Geology of the Dover Area, Stewart County, Tennessee*. Report of Investigations No. 16, Tennessee Department of Conservation and Commerce, Nashville.

Marcher, M. and Stearns, R, 1962. *Tuscaloosa Formation in Tennessee.* Report of Investigations No. 17, Tennessee Department of Conservation and Commerce, Nashville.

Martin, J. and Homsey, L., 2012. *Reconstructing the Paleogeography of the Coffee Sands*. MSU-UT-Martin *Sigma Xi* Symposium. Murray State University, February 25, 2012.

Roberts, J.K., 1927a. The Tuscaloosa Formation in Kentucky. *American Journal of Science*, v. 14(5), p. 465-472.

Roberts, J.K., 1927b. The Cretaceous deposits of Trigg, Lyon, and Livingston Counties, Kentucky. *Kentucky Geologic Survey*, v. 31(6), p. 281-326.

Safford, J.M., 1901. Classification of the Geological Formations of Tennessee. *Geologic Society of American Bulletin*, v. 13, p. 10-14.