GSA 2020 CONNECTS ONLINE
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Session # 230: T145.From Hudson Bay to the Coastal Plain: Comparisons of Pre-LGM (Last Glacial Maximum) Quaternary Records in Glaciated and Unglaciated North America II
Abstract 230-5

Correlation of terrace tread surfaces using PyOSP: an example from the Licking River, Kentucky

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Kentucky Geological Survey

1 Introduction & Regional Setting

- Kentucky is on the margin of Pleistocene glaciation

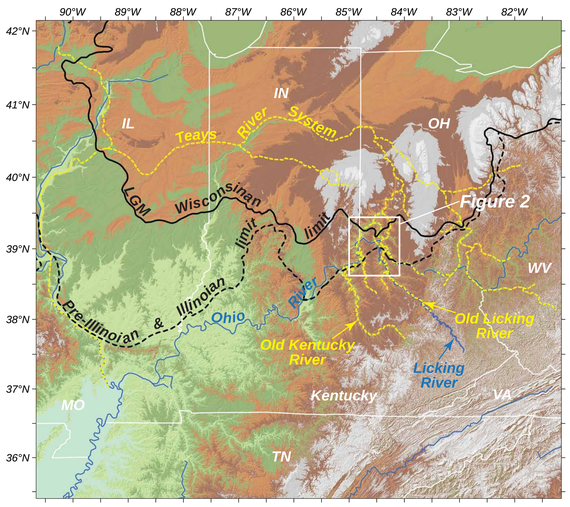


Figure 1. Digital elevation model of Midwestern USA showing approximate trace of pre-glacial Teays River system (yellow dashed line), glacial limits of Pre-Illinoian and Illinoian (dashed black line) and Wisconsinan (solid black line) glaciations, and seelcted modern rivers (blue lines). Northern Kentucky includes pre-glacial drainage networks, all three glaciattions, and Holocene transition into modern landscape. State bounaries in white.

- Northern Kentucky provides a look at the pre-glacial landscape, glacial overprinting, and transition into modern landscape

- This study is focused on incision history of the Licking River and includes field mapping, geochronology, and preliminary results of terace correlation using a new swath analysis tool (PyOSP)

2 Northern Kentucky Surficial Geology

- Regional mapping has captured...
  - pre-glacial Teays deposits & paleochannels in uplands (840 ft)
  - Pre-Illinoian drift, till, & outwash in uplands (830-700 ft)
  - Lacustrine deposit in Old Licking River paleochannel (700 ft)
  - Illinoian drift and outwash along Ohio River valley (600-560 ft)
  - Late Pleistocene Wisconsinan outwash along Ohio River valley (570-450 ft)

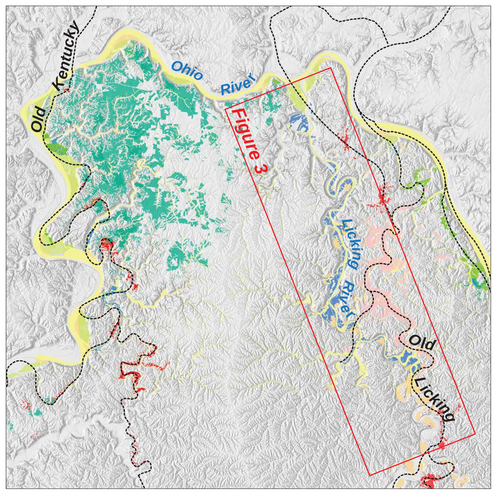
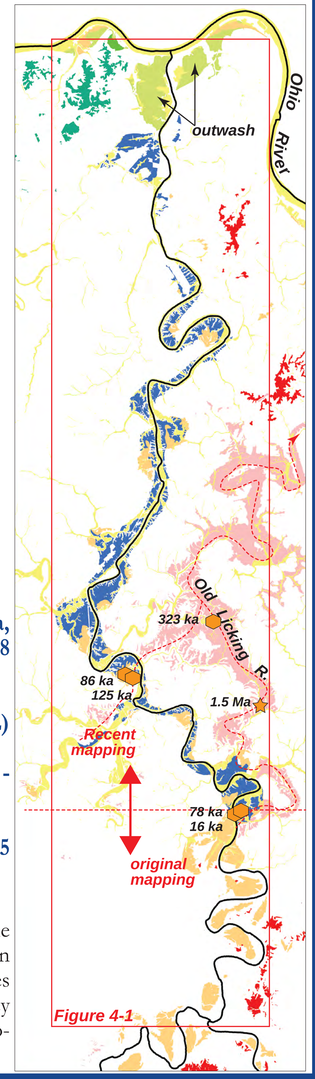


Figure 2. Fluvial, lacustrine, and glacial geology of northern Kentucky overlain on hillshade image; location shown by red box in figure 1. Red rectangle shows focus area of this study and extent of figure 3 in Licking River.

3 Licking River Geology & Geochronology

- Detailed mapping has captured multiple paired terrace flights along the lower reach of the modern Licking River...
  - Qat1 alluvial terrace (501 ft)
  - Qat2 local alluvial terrace (520 ft)
  - Qlt1 lacustrine terrace (529 ft)
  - Qat3 alluvial terrace (557 ft)
  - Qat4 alluvial terrace (573 ft)
- Additional map relationships...
  - Subsurface data shows max. incision >50 ft below current
  - Outwash deposit at mouth same elevation as Qlt1 (528 ft)
- Geochronology constraints...
  - Licking River terraces - 16.0 ± 0.7 ka, 78.2 ± 4 ka, 86.2 ± 7.8 ka, 124.7 ± 14.8 ka (OSL)
  - "Illinoian drift" - 93.2 ± 9.9 ka (OSL)
  - Old Licking River lacustrine deposit - 323.5 ± 15.5 ka (OSL)
  - Old Licking River fluvial deposit - 1.5 Ma (Be-Al)

Figure 3. Geology of the lower reach of the Licking River and surrounding area (location shown in figure 2). Multiple paired terraces recently mapped in Licking River valley (north of red dash line). Geochronology locations marked and labeled with ages.



4 Terrace Correlation with PyOSP

- Objective classification of landforms & reproducibility
- Post-processing & data filtering for more robust statistics
- Longitudinal swath, cross swath, histogram, scatter swath plots, and more...

PYTHON PyOSP OBJECT-ORIENTED SWATH PROFILE

https://github.com/PyOSP-devs/PyOSP

https://pyosp.readthedocs.io/en/latest/

- Licking River terrace correlation using PyOSP...
  - **Input parameters:** DEM.tif, baseline.shp, TPI threshold = 20; baseline step size = 100; max. profile width=12,000; profile step size = 5
  - Post-processing slope < 5°
  - Correlation of terrace tread surfaces based on point clusters

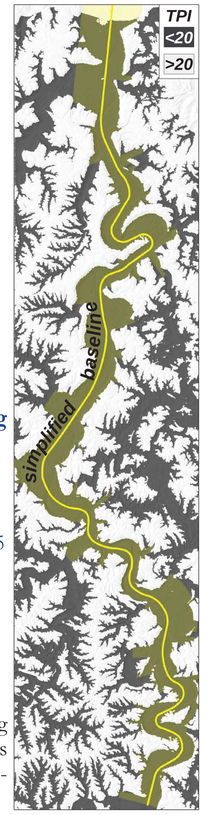


Figure 4-1. TPI classification of Licking River valley. Simplified baseline minimizes sinuosity. Transparent yellow polygon represents area of data capture.

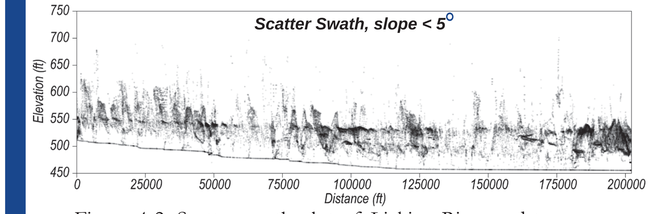
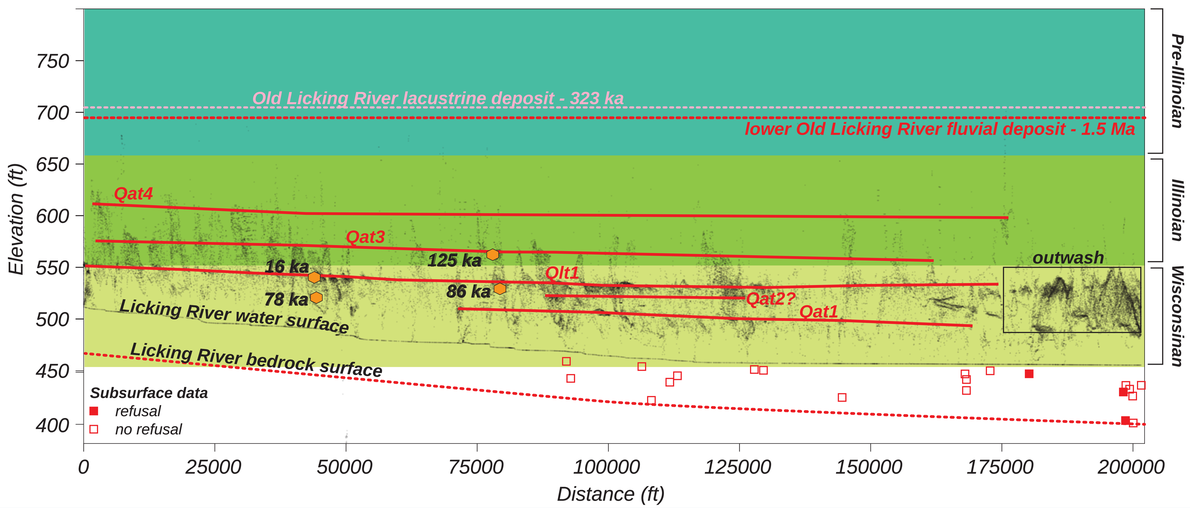


Figure 4-2. Scatter swath plot of Licking River and terrace correlation models (red dashed lines).

5 Summary & Conclusions

- Terrace correlation model provides context for data integration & interpretation...
  - Elevation ranges of regional glacial deposits (colored rectangles)
  - Terrace correlation model from swath, corroborated by detailed field mapping (red lines)
  - Depth to bedrock constrained by well data (small red squares)
  - Relevant geochronology along Licking River (orange dots) & Old Licking River paleochannel (dashed lines)



1. Pliocene(?) - Early Pleistocene, Teays River system fluvial deposition, Old Licking River

2. Early Pleistocene, Pre-Illinoian glaciation, ice in Northern Kentucky

3. Middle Pleistocene(?), impoundment of Old Licking River paleochannel, lacustrine deposition
   - Why? Late phase of Pre-Illinoian? Geochronology problem?

4. Major baselevel drop, avulsion of Old Licking River into modern channel

5. Middle-Late Pleistocene, Illinoian glaciation, outwash along Ohio River, Qat3 deposition along Licking River

6. Late Pleistocene, impoundment of Licking River Qlt1
   - Outwash dam assumed Wisconsinan. Early phase? Illinoian?

7. Lat Pleistocene - Holocene, baselevel drop and incsion along Licking River, Qat2 and Qat1 deposition