Quadrangle-scale Mapping in Support of 3-D Modelling of Quaternary Deposits in Northeastern Illinois

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Abstract

Detailed geological mapping at 1:24,000 scale has been initiated in a six-quadrangle area of Lake and McHenry counties in northeastern Illinois as part of the Central Great Lakes Geologic Mapping Coalition. These two counties are the most rapidly developing areas in Illinois, and conflicts over land usage and development are becoming more common. Legislation instituted by state and local governments attempt to control development, frequently in areas where the surface environment is sensitive to disturbance, but often where geological information is deficient. From these discussions, public planning agencies have now requested more complex geological databases that are in a form that is easily manipulated by their clients, yet flexible to incorporate new data.

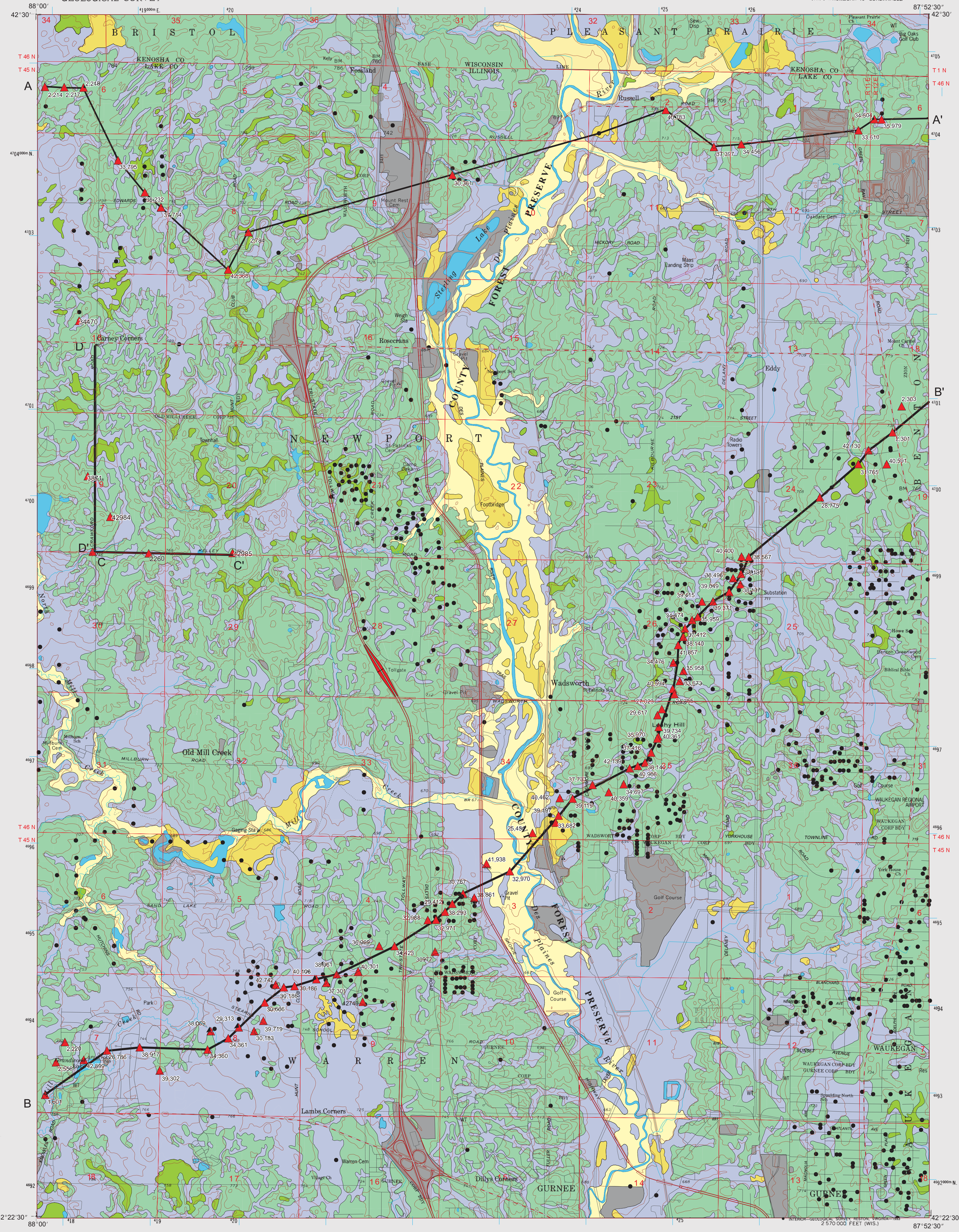
Concurrent, coordinated studies in three quadrangles (Fox Lake, Antioch and Wadsworth quadrangles), involving the retrieval and compilation of existing geological data, and completion of new subsurface drilling and geophysical fieldwork are developing three-dimensional models that will provide a framework for future mapping. These studies indicate that sediments of the Wadsworth Formation have considerable textural variability, comprised of a silty clay diamicton (till) that is interbedded with finer-grained sediments deposited in ephemeral lakes or by mudflows, and discontinuous, irregular lenses of sand and gravel of various origins. In the region, the Wadsworth sediments overlie at least two other diamictons (tills), but the thicknesses and spatial continuity of the diamictons are not well known. In the Wadsworth quadrangle (the northeastern-most quadrangle) the Wadsworth sediments compose most of the 150–250 feet of glacial drift that overlie bedrock. Along the western boundary of the quadrangle, proglacial sediments (sands and gravels) contact the lower boundary of the Wadsworth sediments. The sands and gravels become thicker in the subsurface westward over the Antioch quadrangle where they constitute a major aquifer supplying potable water to municipal and private wells.

Intensive mapping at the quadrangle-scale will provide a detailed database for modeling the complex geology and allow more extensive modeling of aquifers in this region of high population growth. As additional quadrangles are mapped, a more comprehensive model should emerge to assist in dealing with land-use management and other important issues.

SURFICIAL GEOLOGY MAP

WADSWORTH QUADRANGLE
ILLINOIS–WISCONSIN
7.5 MINUTE SERIES (TOPOGRAPHIC)

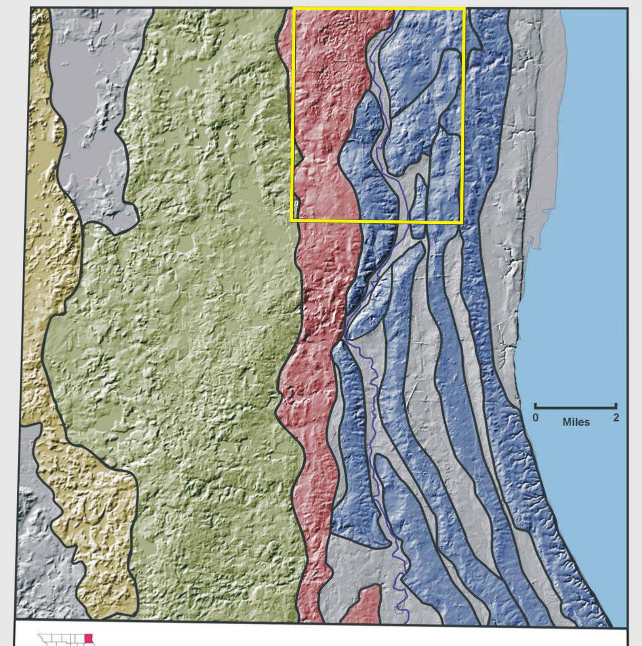
UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY



Map compilation Pamella Carrillo

MATERIAL	LITHOSTRATIGRAPHIC UNIT	INTERPRETATION
	Hudson Episode (postglacial)	
Clay, silt, sand, gravel; texture is variable; compact	Disturbed Land (Human modified)	Land disturbed by human activities; includes fill for transportation network and excavations such as gravel pits
Silt and clay; occasional sand lenses; brown to yellowbrown; may be mottled and gleyed; some bedding; organic-rich in places; loose to compact	Cahokia Formation	**Alluvial Deposits:** postglacial river and stream sediment (alluvium) found in active floodplains; derived mainly from eroded loess and diamictons; may overlie outwash sand and gravel, lacustrine silt and clay, and/or till; may be overlain by or interfingered with silty slope wash deposits in foot slope locations; thickness ranges from less than 5 feet to more than 20 feet
Peat and muck; may be interbedded with silt, clay, and some fine sand; black to dark brown; snail shells common; soft to firm	Grayslake Peat	**Organic Deposits:** decomposing organic-rich sediments accumulated in low depressions, drainages, and on floodplains; may be intertongued with modern alluvium, silty slope wash, or lake sediment overlying diamicton.
	Hudson and Wisconsin Episodes	
Silt and clay; very fine and fine sand may occur along bedding planes; dark gray to light gray; occasional light gray and white silt inclusions and lenses; very few pebbles; massive to bedded; generally abrupt upper and lower contacts; soft to hard; compact	Equality Formation	**Proglacial Deposits (Lacustrine):** postglacial and glacial lake deposits; found at or near land surface along major floodplains and around modern lakes; in the subsurface may be interfingered with diamicton; may be overlain by silty slope wash deposits at the base of slopes
	Wisconsin Episode	
Sand and/or gravel; sand is fine to coarse, very well to poorly sorted; gravel is very fine to coarse, very well to very poorly sorted; variable color, generally light brown; minor variable color, generally light brown; minor amounts of silt and clay; bedded; loose	Henry Formation	**Proglacial Deposits (Fluvial):** glacial meltwater sediment found along the margin of major floodplains and on stream terraces; along Des Plaines River their thickness ranges from 20 to 40 feet; may occur as tongue of sand and gravel beneath Haeger and Tiskilwa tills
Diamicton; silty clay loam to silty clay; pebbly with occasional cobbles and boulders; silt and sand inclusions; sand and/or gravel lenses common; may contain pebble-free, silty and clayey zones with strongly expressed laminations interbedded with diamicton; gray to dark brown; compact; lenses of saturated silt and very fine sand are loose and runny Lowermost part (above bedrock), up to 25 feet of sediment consisting of bedrock rubble, gravel, and compacted diamicton of variable texture	Wadsworth Formation	**Till:** subglacial till, subglacial channel, and lake deposits, and sediment that melted out on top of the glacier or along the ice margin and was reworked by slope processes and water; subglacial sand and gravel; laminated sequences may be more than 40 feet thick Basal zone consists of glacially reworked bedrock and older drift
Diamicton; sandy loam to silt loam; cobbly; compact Lowermost part (above bedrock), up to 25 feet of sediment consisting of bedrock rubble, gravel, and compacted diamicton of variable texture	Haeger Member, Lemont Formation	**Till:** subglacial and ice marginal deposits; commonly underlain by outwash sand and gravel of a tongue of the Henry Formation; found in subsurface only in northwest part of Wadsworth Quadrangle; described from sample sets and drillers' logs for water wells; generally more than 60 feet below land surface on this quadrangle Basal zone consists of glacially reworked bedrock and older drift
Diamicton; clay loam to loam; reddish brown to reddish gray; compact Lowermost part (above bedrock), up to 25 feet of sediment consisting of bedrock rubble, gravel, and compacted diamicton of variable texture	Tiskilwa Formation	**Till:** subglacial and ice marginal deposits; subglacial sand and gravel; commonly underlain by outwash sand and gravel of a tongue of the Henry Formation; describedfrom sample sets and drillers' logs for water wells; identified in subsurface only on the Wadsworth Quadrangle, mainly in the northwestern part of the map. Basal zone consists of glacially reworked bedrock and older drift
	Paleozoic Bedrock	
Dolomite with chert lenses; may be shale in places	S Silurian dolomite and Ordovician shale	Silurian (dolomite) and Ordovician (shale); buried beneath 200 to 300 feet of Quaternary sediments on quadrangle; described from selected sample sets and drillers'logs

Water
A–A′ Cross section line
2556* Borehole number (* - offset of survey line)
Borehole on cross section
Other verified borehole (including water wells, engineering boreholes)
More reliable contact
Less reliable contact



LOCATION OF WADSWORTH QUADRANGLE AND END MORAINES OF LAKE COUNTY

Fox Lake Moraine
Valparaiso Morainic System
Tinley Moraine
Lake Border Morainic System

Overview of Glacial History

The Quaternary geology of the Wadsworth Quadrangle is predominantly the result of continental glaciers and glacial meltwaters of the last (Wisconsin Episode) glaciation. The Quaternary deposits, which are from about 150 to 250 feet thick, represent at least three major glacial events that occurred between about 25,000 and 14,000 radiocarbon years before present. Lithologically distinct till units of the Tiskilwa, Lemont (Haeger Member), and Wadsworth Formations were deposited by the Lake Michigan lobe during the three events. Locally, glacial meltwater and lake deposits are present between the tills of the three events and are classified as tongues of the Henry and Equality Formations, respectively.

Only the uppermost till (Wadsworth Formation) is present at the surface in the Wadsworth Quadrangle. The Wadsworth till is predominantly a dark grayish brown, silty clay to silty clay loam diamicton (a massive to poorly sorted mixture of clay, silt, sand, and gravel), but it also contains lenses and beds of sorted sediment, especially silty clay, silt, and fine sand. Locally, the Wadsworth till has a coarser texture and contains a higher proportion of sand, gravel, and pebbles east of the Des Plaines River. The more uniform diamicton likely was deposited subglacially, whereas the more variable (bedded and coarser) diamicton may represent material that melted out near the ice margin or on top of the glacier and was reworked by slope processes and water.

As the Wadsworth ice was generally melting back toward the Lake Michigan basin, several moraines formed at ice margin positions. Locally along the western margin of the quadrangle, segments of the Valparaiso Morainic System are present. This moraine forms a hummocky, upland surface west of the Wadsworth Quadrangle. Immediately to the east of the Valparaiso Morainic System lies the Tinley Moraine. Based on the presence of proglacial sorted sediment (outwash sand and gravel, and lake silt and clay) regionally found between the Wadsworth till of the Tinley Moraine and Wadsworth till in the subsurface, the Tinley Moraine represents a re-advance of the ice margin. North-south-trending ridges of the Lake Border Morainic System are present in the central and eastern half of the quadrangle. These moraines likely formed during short-lived readvances or still stands of the retreating glacier. In the central part of the quadrangle, the Lake Border moraines are bisected by the Des Plaines River and its tributaries, which carried glacial meltwater southward between the Tinley and Valparaiso moraines west of Chicago. Outwash sand and gravel (Henry Formation) and modern river and stream sediment (Cahokia Formation) are present as terraces and floodplain deposits along the Des Plaines River and its tributaries.

The Wadsworth Formation ranges from about 100 to 200 feet thick and is overlain by outwash and modern stream sediment and, locally, by fine-grained lake sediment (Equality Formation) and muck or peat (Grayslake Peat). In the western part of the quadrangle, the Wadsworth Formation is (from the top down) underlain by grayish brown, sandy loam to silt loam diamicton of the Haeger Member (Lemont Formation), and/or sand and gravel of the Henry Formation, and/or reddish brown diamicton of the Tiskilwa Formation, and/or sand and gravel of the Henry Formation, and/or bedrock rubble over bedrock.

Mapping Methods

The surficial geology map is based largely on a digitized version (courtesy of the Lake County) of the individual soil maps from the *Soil Survey of Lake County, Illinois* (Paschke and Alexander 1970) and the hard copy of the *Soil Survey of Kenosha and Racine Counties, Wisconsin* (Link and Demo 1970). Polygons of individual soil series were grouped by parent material following *Soils of Illinois* (Fehrenbacher et al. 1984), profile descriptions in the survey reports, and published soil series descriptions available from the U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS). Regrouping of selected soils into different parent material classes was accomplished following fieldwork during which an AMS PowerProbe drill rig was used to sample continuous cores to a depth ranging from 10 to 40 feet in selected soil series on a variety of geomorphic positions. These cores (23 total), along with an additional 50 boreholes drilled on the Wadsworth and adjacent Antioch and Fox Lake Quadrangles to depths of 120 feet, were used to determine the parent material groups (geologic material classes). In addition, parent material data gathered by the USDA-NRCS soil scientists along transects during the fieldwork phase for the new (in-progress) digital soil survey for Lake County were obtained for 27 locations (135 total boreholes). These transects are used by the USDA-NRCS to assess soil mapping accuracy. We used them to verify the characteristics of our surficial mapping unit materials. The parent material (geologic material) classes were generalized for the surficial geology map because the soil-based data layer created a very complex map with polygons that were too small for incorporation into cross sections. The thickness of each surficial unit was assumed to be at least 6 to 10 feet or more based upon the depth to which soil mappers sample during their mapping. The thickness of specific units were adjusted where our drilling, field observations, or records suggested otherwise. The Explanation of Mapping Units table provides additional discussion on the variability of sediments in the different mapping units.

Geologic information for subsurface units depicted on the cross sections (A–A′, B–B′, C–C′, D–D′) was obtained from core descriptions for the above-mentioned boreholes, several dozen sample sets obtained from water wells and engineering boreholes, and the drillers' logs for more than 1000 location-verified water wells, which are available in databases at the Illinois State Geological Survey. Additional information on subsurface materials was obtained from two geophysical transects, a 2 mile long north-south line and an intersecting 1 mile long east-west line, using shallow reflection seismic techniques (cross sections C–C′ and D–D′). Four engineering boreholes, 50 to 100 feet in depth, were drilled along these two transects to provide information on geologic materials to support seismic data interpretation. Forty additional water wells have been logged using downhole natural gamma techniques. Information from these various sources was interpreted and correlated to establish the geologic mapping units.

Acknowledgments

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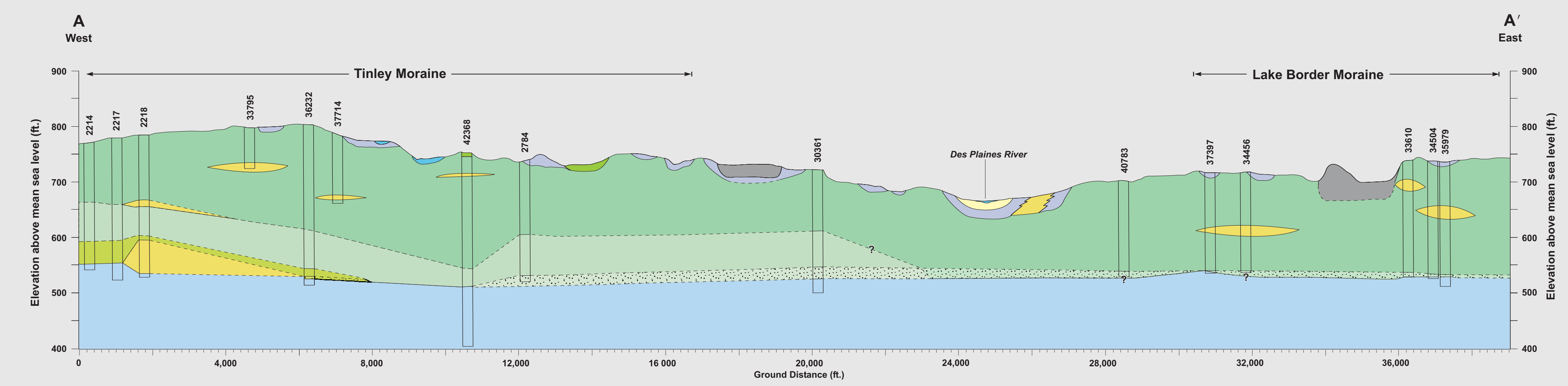
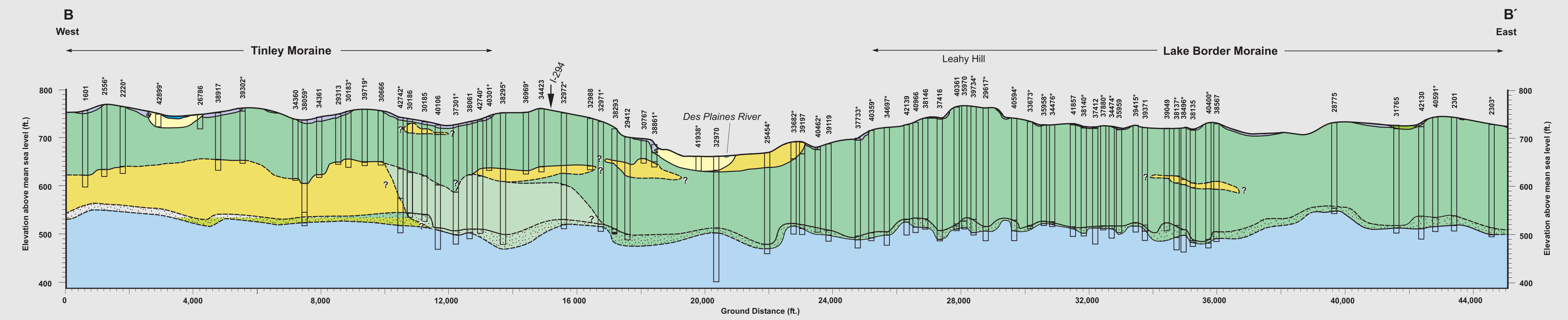
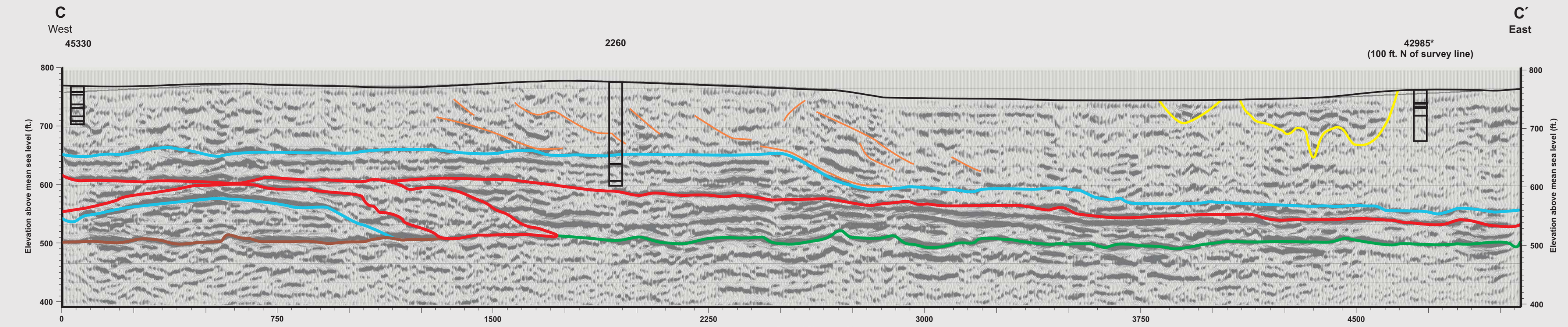
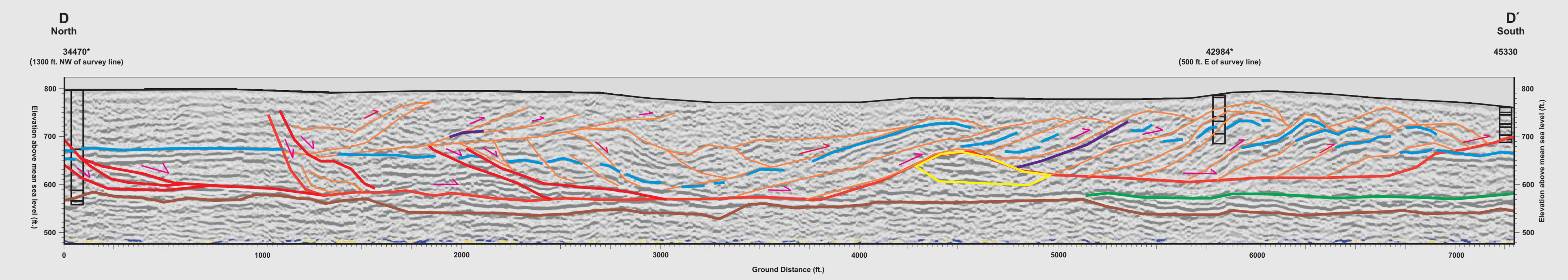
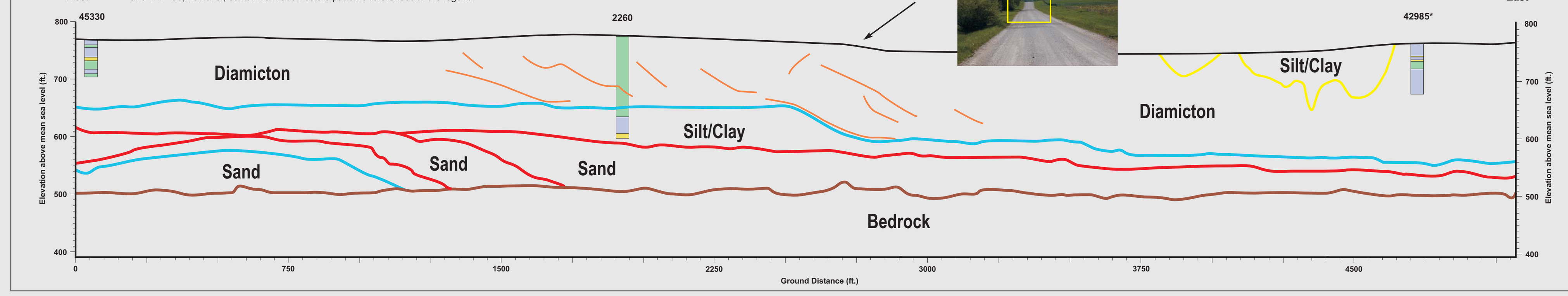








NOTE: Horizontal scale of geophysical transects C-C′ and D-D′ is not the same as A-A′ and B-B′. Geophysical transects and interpretations courtesy of Andre Pugin and Tim Larson, Illinois State Geological Survey. Interpretations are preliminary and may be modified based on future research. Colored lines on these transects are for visualization purposes and are not correlated to the colors used in transects A-A′ and B-B′. The colored cylinders representing boreholes on transects C-C′ and D-D′ do, however, contain formation colors/patterns referenced in the legend.



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